Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan

Lower Fox River and Green Bay Site

Revision 3

P.H. Glatfelter Company
Charlotte, North Carolina

Georgia-Pacific Corporation
Atlanta, Georgia

September 2021

Project I.D.: LFR LTM and COMMP

Solving our clients' toughest science and engineering challenges.

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September 21, 2021

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Remedial Project Manager
Superfund Division/SR-6J
77 West Jackson Blvd.
Chicago IL 60604-3507

Ms. Beth Olson
Project Coordinator
Wisconsin Department of Natural Resources
2984 Shawano Ave.
Green Bay WI 54313

Dear Mr. Saric & Ms. Olson:

RE: Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan – Revision 3, Lower Fox River and Green Bay Site

Enclosed please find the *Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan – Revision 3, Lower Fox River and Green Bay Site*. This document has been prepared as an addendum to both the December 2009 Long-Term Monitoring Plan, included as Appendix I of the *Lower Fox River Remedial Design 100 Percent Design Report* (Anchor QEA, et al., 2009a) and the June 2011 Lower Fox River Operable Unit 1 – Long-term Monitoring Plan, included as Appendix F of *Lower Fox River Operable Unit 1 – Integrated Final Design and Remedial Action Work Plan for Post-2009 Response Work* (Foth and CH2M HILL, Inc., 2011).

The revisions in this document combine details from both of the above referenced plans, as well as capture recommended changes documented in the *2014 Long-Term Monitoring Summary Report – Lower Fox River Operable Units 2-3* (Foth, 2016) and lessons learned through adaptive management working co-operatively with the Agencies Oversight Team since commencing the long-term monitoring work.

Please do not hesitate to contact us if you should have any questions or would like additional information.

Sincerely,

Foth Infrastructure & Environment, LLC

Sharon Kozicki

Sharon Kozicki, P.G., P.M.P.
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Lake Winnebago and OU1-5 Long-Term Monitoring

Sampling and Analysis Plan – Revision 3

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Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan – Revision 3

Project ID: LFR LTM and COMMP

Prepared for

Glatfelter Corporation & Georgia-Pacific Corporation

Prepared by

Foth Infrastructure & Environment, LLC

Revision 3

September 2021

Lake Winnebago and OU1-5 Long-Term Monitoring

Sampling and Analysis Plan - Revision 3

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List of Abbreviations, Acronyms, and Symbols

2018 CIA	*2018 Cap Integrity Assessment - Lower Fox River Operable Units 1, 3, and 4*
°C	degrees Celsius
CCU	cap certification unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIL	chemical isolation layer
COC	chain of custody
Collectors Permit	Scientific Collectors Permit or Research License Application and Authorized; Form 94000-397 (R6/05)
COMMP REV3	*OU2-5 Cap Operations, Maintenance, and Monitoring Plan – Revision 3*
CMMP	*Lower Fox River Operable Unit 1 - Cap Monitoring and Maintenance Plan*
CMU	cap management unit
DGPS	differential global positioning system
EDL	Estimated Detection Limit
Foth	Foth Infrastructure & Environment, LLC
FR-LTMP	*Fox River Long-Term Monitoring Plan*
Glatfelter	Glatfelter Corporation
GP	Georgia-Pacific Corporation
GPS	global positioning system
kHZ	kilohertz
LFR	Lower Fox River
LIMS	Laboratory Information Management System
LLC	LFR Remediation LLC
LTM	long-term monitoring
LW	Lake Winnebago
LWB	Lake Winnebago Background
mg/kg	milligrams per kilogram
MGP	manufactured gas plant
MDL	method detection limit
MNR	monitored natural recovery
NAD83	North American Datum 1983
NAVD88	North American Vertical Datum of 1988
NFA	North Focus Area
NOAA	National Oceanic and Atmospheric Administration
OU	operable unit
OU1-LTMP	*Operable Unit 1 Long-Term Monitoring Plan*
OU2-5 QAPP-REV2	*Quality Assurance Project Plan – Revision 2* for Remedial Action of Operable Units 2, 3, 4, and 5
PCB	polychlorinated biphenyls

Plant	Sediment Desanding and Dewatering Plant
PM	project manager
QAM	Quality Assurance Manager
QC	quality control
RA	remedial action
RAO	remedial action objective
Response Agencies	Collectively, the U.S. Environmental Protection Agency and Wisconsin Department of Natural Resources
RI/FS	Remedial Investigation/Feasibility Study
RM	river mile
ROD	*Record of Decision*
RTK-GPS	real time kinematic-global positioning system
SAP	*Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan - Revision 3*
SBES	single beam echo sounder
SOP	Standard Operating Procedure
SRA	Special Remediation Area
TOC	total organic carbon
UAS	unmanned aircraft system
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources
UWGB	University of Wisconsin Green Bay
WPS	Wisconsin Public Service Corporation
WTM27	Wisconsin Transverse Mercator NAD27
WTM8391	Wisconsin Transverse Mercator NAD83
YOY	young of year

1 1 Introduction

Glatfelter Corporation (Glatfelter) and Georgia-Pacific Corporation (GP) are performing long-term monitoring (LTM) activities in Lake Winnebago, and Operable Units (OU) 1, OU2, and OU3, as well as OU4 and OU5 beginning with the 2021 LTM event. The current LTM schedule prepared by the U.S. Environmental Protection Agency (USEPA)/Wisconsin Department of Natural Resources (WDNR), dated April 2020, is provided as Appendix A. Glatfelter and GP retained Foth Infrastructure & Environment, LLC (Foth) to prepare this *Lake Winnebago and OU1-5 Long-Term Monitoring Sampling and Analysis Plan - Revision 3* (*SAP*) to present the sampling strategies for monitoring the post-remediation recovery of surface water and biota in OU1, OU2, OU3, OU4, and OU5 of the Lower Fox River (LFR), shown on Figure 1-1. The *SAP* is termed *Revision 3* as it has been modified from the previous version (*OU1-3 Long-Term Monitoring Sampling and Analysis Plan – Revision 2* [Foth, 2018]), which detailed LTM sampling and analysis procedures for only OU1, OU2, and OU3.

The *SAP* addresses surface water and fish tissue sampling in Lake Winnebago (background reference, also referred to as “LW” or “LWB”), OU1, OU2, OU3, OU4, and OU5. In addition, the methodologies and procedures for evaluating monitored natural recovery (MNR) of sediments in OU2 and OU5 and chemical isolation layer (CIL) confirmation in “Type B” cap areas in OU3 and OU4 are addressed. Monitoring will be performed to assess progress toward achieving the remedial action objectives (RAO) specified in two *Records of Decision* (*ROD*) (USEPA, 2002 and 2003) issued in December 2002 and June 2003, for OUs 1-2 and OUs 3-5, respectively; and two *ROD Amendments* (USEPA, 2007 and 2008) issued in June 2007 and June 2008, for OUs 2-5 and OU1, respectively, by the USEPA and the WDNR (collectively, the "Response Agencies") under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended.

Post-remediation monitoring on the Fox River and Green Bay system in LW and OU1 is guided by the *Lower Fox River Operable Unit 1 – Integrated Final Design and Remedial Action Work Plan for Post-2009 Response Work*, Appendix F, *Lower Fox River Operable Unit 1 – Long-term Monitoring Plan* (*OU1-LTMP*) (Foth and CH2M HILL, Inc., 2011a), and OU2-5 is guided by the *Lower Fox River Remedial Design 100 Percent Design Report* – Appendix I, *Long-Term Monitoring Plan* (Anchor QEA, et al., 2009a), generally referred to as the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*). This *SAP* combines elements of both LTM plans, providing additional guidance regarding monitoring in LW, OU1, OU2, OU3, OU4, and OU5 and should be considered an addendum to those plans.

1.1 Purpose

The purpose of this *SAP* is to describe the sampling strategies and methods to be employed during respective surface water, fish tissue, sediment, and cap monitoring events, including sample quantities, monitoring locations, sampling schedules, sample labeling and field and laboratory procedures. These sampling strategies may be adjusted or modified through adaptive management and the CERCLA 5-year review process. For example, environmental media or fish species may be added, reduced, or discontinued based on an ongoing evaluation of progress toward risk reduction goals.

This *SAP* addresses:

- Surface water quality sampling in LW, OU1, OU2, OU3, OU4, and OU5;
- Fish tissue sampling in LW, OU1, OU2, OU3, OU4, and OU5;
- Sediment sampling in MNR areas of OU2 and OU5;
- Cap CIL confirmation sampling in representative areas with “Type B” caps in OU3 and OU4;
- Sample handling and custody requirements; and
- Laboratory analytical methods.

Note that in 2021 this *SAP* will only apply to OU4 and OU5, and then beginning in 2022 this *SAP* will apply for all OUs.

1.2 Scope of Work

The scope of work is the sampling and analysis necessary to provide data to evaluate the post-remediation recovery of surface water and biota in OU1, OU2, OU3, OU4, and OU5 of the LFR. This includes surface water and fish tissue in LW, OU1, OU2, OU3, OU4, and OU5, and sediment sampling in OU2 and OU5. It also includes CIL cap testing at selected “Type B” cap areas in OU3 and OU4 to confirm design assumptions. Descriptions and methodologies for the required sampling are discussed in detail in Section 3.

2 Project Background

2.1 Site History

The LFR extends 39 miles from the outlet of Lake Winnebago over a series of locks and dams to the mouth of the river where it discharges into Green Bay. It is the most industrialized river in Wisconsin. Since the early 1900s, water quality has been degraded by expanding industries and communities discharging sewage and industrial wastes into the river. Polychlorinated biphenyls (PCB) were discovered in the LFR in the 1970s.

The LFR is divided into five OUs as shown on Figure 1-1:

- OU1 is also known as Little Lake Butte des Morts. The Neenah and Menasha Dams control the pool elevation of Lake Winnebago and discharge to the upstream end of OU1 at river mile (RM) 39.
- OU2 extends from the Appleton Locks at RM 31.9 to the Little Rapids Dam at RM 13.1. This unit contains the majority of locks and dams in the LFR system and the greatest elevation drop and gradient. Sediments have a very patchy distribution in this reach with extensive intervening bedrock exposures.
- OU3 extends from the Little Rapids Dam to the De Pere Dam at RM 7.1. Soft sediment covers most of this unit.
- OU4 extends from the De Pere Dam to the river mouth at Green Bay. The area around OU4 is highly urbanized, including the city of Green Bay metropolitan area.
- OU5 begins at the river mouth and includes the entirety of Green Bay.

Remedial action (RA) construction was completed in OU1 in 2009, OU2 in 2009, OU3 in 2011, and OU4 and OU5 in 2020. LTM in OU1 began in 2010. Implementation of the *FR-LTMP* was delayed for OU2 in order to be concurrent with OU3 and required initiating LTM for both OUs in 2012. LTM will be initiated in OU4 and OU5 in 2021. LTM for all OUs will begin to coincide in 2022.

LTM data is being collected to evaluate progress toward achieving the RAOs of reduced risk to humans and the environment. The data collection effort is focused on water, fish tissue, and sediment, these being critical components of all major bioaccumulation risk pathways. Water and sediment are media of concern through which many aquatic organisms, including benthic and pelagic fish, may be exposed to PCBs at the Site. Water and sediment are also the media through which contaminants in the LFR are entrained and transported out into Green Bay. Fish are the medium of exposure for bioaccumulation risk in higher-level organisms, including humans, mammals, and birds, as well as the fish themselves.

Progress toward achieving the RAOs is evaluated, in part, through statistical comparison of monitoring data with baseline data obtained in 2006-2007, as presented in the *Baseline*

Monitoring Data Report 2006-2007 (Anchor QEA et al., 2009b). To facilitate the statistical comparison, several aspects of this *SAP* (for example, water quality sampling locations and fish species) are pre-determined by choices made during baseline data collection.

2.2 Chemicals of Concern

Due to their persistence in the environment, PCBs are the chemicals of concern and are the focus of current remediation efforts in the river.

3 Field Sampling Plan

The following sections present the descriptions and methodologies for the required field sampling at LW, OU1, OU2, OU3, OU4, and OU5. Surface water, fish tissue, and sediment sampling, as well as CIL cap design confirmation sampling are discussed. The respective sample locations, quantities, labeling, field procedures, and schedules are described for each media to be sampled or tested.

3.1 Water Quality Sampling

3.1.1 Sampling Locations

Representative transects and associated water monitoring stations in LW, OU1, OU2, OU3, OU4, and OU5 will be sampled in general accordance with U.S. Geological Survey (USGS) "quarter point" sampling methods. Water quality sampling transects are located to the extent possible in areas assumed to be characterized by relatively uniform and well mixed flow. In a uniform, well-mixed cross-section, an area-weighted sampling design provides a reasonable approximation of a flow-weighted design.

There is one water monitoring transect sited in LW, one transect in OU1, three transects in OU2, one transect in OU3, one transect in OU4, and three transects in OU5.

- Lake Winnebago
  - Near the northwest shoreline of Lake Winnebago where it flows into the Fox River (Figure 3-1)

- OU1
  - Reach between Lake Winnebago and Upper Appleton Dam, downstream of all completed RA areas in OU1 (Figure 3-2)

- OU2
  - OU2A − Reach between Upper Appleton Dam and Upper Kaukauna Dam (Figure 3-3)
  - OU2B − Reach between Upper Kaukauna Dam and Rapide Croche Dam (Figure 3-4)
  - OU2C – Reach between Rapide Croche Dam and Little Rapids Dam (Figure 3-5)

- OU3
  - Reach between Little Rapids Dam and De Pere Dam (Figure 3-6)

- OU4
  - Reach between De Pere Dam and mouth of Green Bay (Figure 3-7)

- OU5
  - OU5A – Mouth of Green Bay covering southern end of Green Bay (Figure 3-8)
  - OU5B – Middle Green bay (Figure 3-9)
  - OU5C – Northern end of Green Bay (Figure 3-10)

The coordinates for the LW, OU1, OU2, OU3, OU4, and OU5 water quality sampling stations along each sampling transect are presented in Table 3-1. Note that Table 3-1 provides the station locations in three coordinates systems: North American Datum 1983 (NAD83) Wisconsin State Plane Central (WSPC), Wisconsin Transverse Mercator NAD27 (WTM27) and Wisconsin Transverse Mercator NAD83 (WTM8391). The NAD83 WSPC coordinate system is used in the field and for presentation purposes; however, the coordinates may be converted to the WTM27 and/or WTM8391 coordinate systems at the specific request of the Response Agencies.

3.1.2 Sampling Frequency, Completeness, and Schedule

Monthly water samples will be collected at all LW, OU1, OU2, OU3, OU4, and OU5 monitoring stations during the eight warm-weather months (April through November). In general, the *FR-LTMP* states that the "completeness" objective for the water quality sampling program will be a minimum of seven out of eight possible sampling events at each station.

Sampling will be "systematic" in design, to provide representative and unbiased coverage. Specific runoff events will not be targeted but a random and representative range of flows is expected to be captured during the course of the monitoring program. Water sampling will be scheduled during the first two weeks of each month. The river water samples will be collected in order from upstream to downstream monitoring stations then north to south in Green Bay (i.e., LW, OU1, OU2A, OU2B, OU2C, OU3, OU5C, OU5B, OU5A, and OU4) over as short a period of time as practical, typically six to eight days. Table 3-2 presents water sampling details.

3.1.3 Sample Identification

Water quality samples will be identified (or coded) using a scheme designed to sort alphabetically in time and space. Table 3-2 illustrates the water sampling identification scheme for the LW, OU1, OU2, OU3, OU4, and OU5 sampling locations.

3.1.3.1 Laboratory Composite

The water quality sample analyzed by the laboratory will be a composite of aliquots from different distances and depths along each channel transect. The aliquots will be submitted separately to the analytical laboratory for compositing. A composite sample will be identified as follows:

AAAA-YY-MMDD

where "AAAA" is a 3 to 4 letter code that identifies the OU (OU2) or subunit (OU2A); "YY" is the two-digit year (e.g., -18 for 2018); and "MMDD" is the month and day of the sample collection. For example, "OU2A-18-1008" is a (composite) water sample from the OU2A station collected on October 8, 2018.

3.1.3.2 Field Aliquots

Each of six separate field aliquots collected from different distances and depths along a sampling transect will be field labeled with a consecutive letter (A, B, C, D, E, and F) progressing from top to bottom and west to east in the following format:

AAAA-YY-MMDD-B

where the “B” suffix letter identifies the aliquot sample point and depth along a transect. For example, "OU2A-18-1008-A" is a water sample aliquot from the top of the west sample point along the OU2A transect collected on October 8, 2018. The aliquots will be submitted separately to the analytical laboratory for compositing.

3.1.3.3 Replicates and Rinsates

Replicates will be coded with a “D” in the initial letter string (e.g., OU2BD or OU3D) such that the time stamp at the end of the name is preserved. For example, "OU2AD-18-1008" is a replicate (composite) water sample from the OU2A station collected on October 8, 2018.

The code for field rinsate blanks will replace the OU designation.at the beginning of the sample identification code and will retain the time stamp. For peristaltic pump rinsate blanks the code is:

RBP-YY-MMDD (for peristaltic pump)

Replicates and field rinsate blanks are discussed further in Section 3.1.5.

3.1.4 Sample Collection Procedure

Samples will be collected using the procedures described below. Additional details are provided in the *OU1-LTMP and FR-LTMP*.

3.1.4.1 Location Control

Water quality monitoring stations will be located to within a target accuracy of two (2) meters using a differential global positioning system (DGPS) calibrated to known shoreline benchmarks before and after each sampling transect. Water depths will be determined using either a lead line or a calibrated echo sounder recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *Sample Vessel Location Control Using Handheld Differential Global Positioning System* Standard Operating Procedure (SOP) located in Appendix B-1a.

3.1.4.2 Quarter Point Sampling Method

The LW, OU1, OU2, OU3, OU4, and OU5 transects will be sampled in general accordance with USGS "quarter point" sampling procedures as described in the *OU1-LTMP* and *FR-LTMP*. The channel cross-sections are divided into three equal areas based on bathymetric data. Water sampling stations (designated W, M, and E for west, middle, and east, respectively) are positioned at the midpoint of each of the three flow areas; the coordinates of these stations are listed in Table 3-1. In the LFR, discrete water samples will be collected at 0.2 and 0.8 times the depth of the water column. Sampling procedures are described in the *Trace PCB Sampling of Surface Water* SOP located in Appendix B-2, the *Water Quality Meter Use* SOP located in Appendix B-3, and the *Field Log Book* SOP located in Appendix B-4.

3.1.4.3 Sample Compositing

The compositing strategy is described in the remainder of this subsection. Based on previous work, a thermocline is not expected to be encountered in LW, OU1, OU2, OU3, OU4, OU5A, and OU5B.

A thermocline was encountered in OU5C during the baseline monitoring program; however, it was determined at the time of baseline that there was no statistical significance in PCB concentrations between the shallow and deep water layers, above and below the thermocline. Therefore, samples collected in OU5C will be composited the same as the other transects.

Discrete water subsamples (or aliquots) will be collected at each of the six "quarter point" locations and depths (i.e., 2 depths x 3 stations = 6 subsamples) for each transect, and then shipped to the analytical laboratory where the compositing will be performed under clean laboratory conditions. A 2-liter bottle will be collected at each of the six subsampling locations/depths (six bottles total) and a second, redundant set of bottles will be collected and held in refrigerated storage near the sampling site until it has been determined that the original bottle set arrived safely at the analytical laboratory.

3.1.4.4 Field Equipment

Samples will be collected using a peristaltic pump with one set of dedicated tubing for each transect used for that transect throughout the sampling field season.

3.1.4.5 Field Parameters

The following field parameters will be measured at each of the "quarter-point" locations on each sampling transect:

- Temperature
- Turbidity

These field parameters will be monitored from water surface to river bed at nominal 3-foot intervals to assess water column stratification and spatial heterogeneity in each cross section of the river at the time of sampling.

3.1.5 Field Replicates and Rinsates

3.1.5.1 Field Replicates

To provide an overall assessment of the field and analytical precision associated with PCB congener analysis, one field replicate sample will be collected during each sampling event, from a different OU each time. All six sampling points on a transect (A through F) will be sampled for the primary sample. For replicates, a second sample aliquot will be collected immediately after the primary sample at each location.

The sample ID scheme for replicates is discussed in Section 3.1.3.

3.1.5.2 Field Rinsates

To provide an assessment of ambient field contamination caused by low but ubiquitous levels of PCBs in the regional background of the Site, field rinsate blanks will be collected. A rinsate blank will be collected each month from a clean unused section of Teflon™ tubing to assess field contamination associated with water sampling. The laboratory will provide ultra-pure water to the field crew for use in preparing rinsate blanks for high-resolution congener analysis.

The sample ID scheme for rinsate blanks is discussed in Section 3.1.3.

3.2 Fish Tissue Sampling

3.2.1 Sampling Locations

Fish tissue sampling will occur in LW, OU1, OU2, OU3, OU4, and OU5 locations as shown on Figures 3-11 through 3-18. These locations are generally described as follows:

- Lake Winnebago
  - Several locations along the west side of Lake Winnebago. (Historic LTM fishing results indicate bountiful fish populations in the northwest portion of Lake Winnebago, near the water sampling transect and outlet to Little Lake Butte des Morts. This will be the primary initial focus of fishing efforts in this location.) (Figure 3-11)

- OU1
  - Reach between Lake Winnebago and Upper Appleton Dam (Figure 3-12)

- OU2
  - OU2A − Reach between Upper Appleton Dam and Upper Kaukauna Dam (Figure 3-13)
  - OU2B − Reach between Upper Kaukauna Dam and Rapide Croche Dam (Figure 3-14)
  - OU2C – Reach between Rapide Croche Dam and Little Rapids Dam (Figure 3-15)

- OU3
  - Reach between Little Rapids Dam and De Pere Dam (Figure 3-16)

- OU4
  - Reach between De Pere Dam and mouth of Green Bay (Figure 3-17)

- OU5
  - OU5A – Mouth of Green Bay covering southern end of Green Bay (Figure 3-18)
  - OU5B – Middle Green bay (Figure 3-18)

The (recommended) fish collection sites shown on Figures 3-11 through 3-18 are based on the catches obtained during the baseline monitoring data collection with preference near the surface water transects in each OU. However, fishing locations may be adjusted as needed in the field based on species availability, habitat, river conditions, seasonal migration patterns, or other field conditions. Because of these variables and habitat preferences, it is assumed that different species will be collected from different parts of the OUs. However, fish have free access within the entire OU or subunit that they represent; therefore, they should be representative of the general environmental conditions in the OU or subunit.

3.2.2 Sample Quantity and Completeness

Table 3-3 summarizes the completeness goal range for LW, OU1, OU2, OU3, OU4, and OU5. Table 3-4 illustrates the optimum number of fish samples per OU or subunit. The completeness goal is described below:

Optimum Completeness Goal. The following number of primary fish samples will be targeted at each OU or subunit:

- Walleye (human health index species): 15 individual fish.
- Carp (ecological index species) (LW, OU1, OU2A, OU2B, OU2C, OU3, and OU4): 35 individual fish, to be composited into 7 groups of 5 fish each. Maximum number of alternate (22 to 24 inches) carp retained for possible analysis will be capped at 14.
- Drum (ecological index species) (OU4, OU5A and OU5B): 35 individual fish, to be composited into 7 groups of 5 fish each.
- Gizzard shad (young-of-year [YOY] forage fish): 175 individual fish, to be composited into 7 groups of 25 fish each.

Minimum Completeness Goal. Reasonable efforts will be made to obtain the optimum numbers of target species. However, if the optimum numbers of fish cannot be collected at certain OUs or subunits, after consideration of alternate fish sizes and other contingency actions to improve the harvest, the following minimum numbers of fish will be collected to satisfy project completeness goals, while still providing a reasonable level of statistical power:

- Walleye: Minimum of 8 individual fish.
- Carp (LW, OU1, OU2A, OU2B, OU2C, OU3, and OU4): Minimum of 14 individual fish, to be composited into 7 groups of 2 fish each.
- Drum (OU4, OU5A, and OU5B): Minimum of 14 individual fish, to be composited into 7 groups of 2 fish each.
- Gizzard shad: Minimum of 25 individual fish, to be composited into 5 groups of 5 fish each.

3.2.3 Target Fish Species and Size Classes

Target fish species and size classes for LW, OU1, OU2, OU3, OU4, and OU5 are summarized in Table 3-5. Three fish species will be analyzed during the LTM program, including a human health index species, an ecological index species, and a YOY forage fish species. The YOY forage fish species is intended to provide an early indication of recovery in the river because these fish best represent current conditions unburdened by legacy contaminants. The three primary species that will be targeted during the LTM program at LW, OU1, OU2, OU3, OU4, and OU5 are:

- Walleye (human health index)
- Carp (ecological index for LW, OU1, OU2, OU3, and OU4)
- Drum (ecological index for OU4 and OU5)
- Gizzard shad (YOY forage fish)

The following secondary species may be considered if the corresponding primary species are difficult to obtain or unavailable during a particular monitoring event:

- Smallmouth bass (human health index)
- Drum (ecological index for LW, OU1, OU2, and OU3)
- Carp (ecological index for OU5)

Secondary species will be retained and archived during field collection activities until the entire catch is evaluated and it can be determined that the completeness objectives for the primary species are fulfilled.

In addition, substitute human health species may be selected for monitoring after walleye have achieved their monitoring goals, to better support the evaluation of fish consumption advisories.

The WDNR collects fish from the various OUs frequently to assess PCB tissue levels as it pertains to health advisories. From time to time WDNR may have excess fish available to help meet completeness goals for the OU1-OU5 LTM work.

3.2.4 Sampling Schedule

Fish will be collected in late summer/early fall, between August 15 and September 15. Every fish sampling event will target this same seasonal sampling window to control for seasonal variability in the monitoring data. Due to past experience with difficulties in achieving minimum and optimum completeness goals during this time frame, the following will be employed, in collaboration with the Agencies, in order to mitigate potential optimum completeness goal challenges:

- Add days of fishing (minimum of two) between August 15 and September 15 in each OU/subunit that has not reached optimum completeness.
- Supplemental sampling during surface water sample collection (August through October).

- Use of sport fisherman (rod and reel), incidental catches, research vessels, etc. (see Section 3.2.6.3 Supplemental Fish Collection Methods) during other times of the year.
- Additional trained individuals performing rod and reel.
- WDNR shared efforts.
- Extension of the sampling period an additional month (from September 15 through October 15), as a last option.

Fish tissue collection starts in Lake Winnebago and proceeds through OU5B, OU5A, OU1, OU2A, OU2B, OU2C, OU3, and OU4. Two contiguous days of fishing are performed in each OU starting with Lake Winnebago. If some stations still lack the optimum complement of target species and sizes, then a field contingency strategy will be implemented, as described in the *Quality Assurance Project Plan – Revision 2* for Remedial Action of Operable Units 2, 3, 4, and 5 (*OU2-5 QAPP-REV2*) (Tetra Tech, et al., 2016) to optimize follow-up sampling efforts.

3.2.5 Sample Identification

With the exception of gizzard shad, each individual fish will be given a unique sample ID, as follows:

LLLL-YY-SP-NN

where [LLLL] is the location code describing the OU or subunit (LW, OU1, OU2A, OU2B, OU2C, OU3, OU4, OU5A, OU5B), [YY] is the two-digit year (i.e., 18 is 2018), [SP] is the species identification code (WA = walleye, SB = smallmouth bass, CA = carp, and DR = drum), and [NN] is a sequential number assigned to each individual fish in a given OU. For example, OU2A-18-WA-11 is the 11th walleye collected at the OU2A subunit during a monitoring event in 2018. Gizzard shad from a particular sampling location will be bagged in groups of 25 fish or less and each bag of fish will be assigned a sample number in accordance with this convention (with the species code GS = gizzard shad). For alternate sizes collected (those outside the target size class), the unique sample IDs will remain as described above with a sequential number assigned beginning with 50. For any WDNR-collected sample, the sequential numbering will begin with 100.

Composite sample IDs will follow a similar convention as the IDs assigned to individual fish, except the last two characters will be changed to identify a composite sample:

LLLL-YY-SP-C#

where C# represents composite samples Cl, C2, C3, etc. These IDs will be assigned in the laboratory where the compositing will be performed at the direction of the Respondent Project Manager (PM), or his/her designee, in consultation with the Response Agencies.

3.2.6 Fish Sampling and Preparation

3.2.6.1 Location Control

The beginning, end, and turning points of fishing transects will be located to within a target accuracy of 10 meters using a DGPS as well as references to shoreline landmarks. Project-specific location control requirements for fish sampling activities are described in the *Sample Vessel Location Control Using Handheld Differential Global Positioning System* SOP located in Appendix B-1a. Because fish migrate freely within an OU or subunit, location control requirements are less stringent for fish collection.

3.2.6.2 Fish Sampling Methods

Primary and secondary target fish species are listed in Section 3.2.3 and are included in Table 3-5. Retained secondary species will be archived during field collection activities until the entire catch is evaluated and it can be determined that the completeness objectives for the primary species are fulfilled. Fish will be collected using the following methods based on the experience gained during the baseline monitoring data collection (see Table 3-6):

- Electrofishing (all species)
- Fyke nets (all species)
- Trawls (all species)
- Seine nets (gizzard shad)
- Rod and reel (bass and potentially other species)

Electroshock fishing has been the primary collection method for all of the LFR OUs for the baseline monitoring and the LTM to date. It has been successful in LW, OU1, OU2, OU3, and OU4. It was moderately successful for the target fish species in OU5.

During the targeted fishing schedule months (August 15 through September 15 with a possible extension from September 15 through October 15), extra on water efforts will be leveraged to increase primary and secondary targeted completeness goals. These may include:

- Supplemental fish sampling by above methods during surface water sample collection with guide (August through September with possible extension to October).
- Use of other sport fisherman (rod and reel), incidental catches, research vessels, etc.
- Additionally trained individuals performing rod and reel.
- WDNR shared efforts.
- University of Wisconsin Green Bay (UWGB) shared efforts.
- Extension of the sampling period an additional month (through October 15) as a last option.

Methods may be modified as needed based on field conditions at the time of sampling. Fish collection, handling and preservation techniques are provided in the *Fish Collection* SOP located in Appendix B-5.

The date, coordinates, time, and water depth of the starting point, ending point, and turning points of each fishing run will be recorded in field logs. The coordinates, water depth, and time of deployment and recovery will be logged for stationary equipment, if used, such as set lines, fixed nets, etc.

The following data will be recorded for each individual fish (with the exception of gizzard shad):

- Unique individual sample ID
- Time of collection
- Length
- Weight
- Abnormalities (i.e., tumors, lesions)

Because of their small size and large numbers, YOY gizzard shad will not be logged individually. All gizzard shad fingerlings from a particular fishing location will be combined in groups of 25 or less and forwarded to the analytical lab for compositing.

3.2.6.3 Supplemental Fish Collection Methods

Based on experience gained during the baseline monitoring and LTM data collection, the sampling methods described in the *FR-LTMP* and above in Section 3.2.6.2 are expected to supply the majority of fish to be tested and will be given priority for analysis. Various challenges to meeting fish optimum collection completeness goals have been observed during OU4 and OU5 baseline monitoring, as well as LTM in LFR OU1, OU2, and OU3. In order to mitigate potential optimum completeness goal challenges, supplemental collection methods are recommended to be used, as needed, particularly in OU5. These procedures are designed to provide additional opportunities to supplement the fish catch to meet optimum completeness goals and are not meant to replace the standard methods identified in the in the *FR-LTMP* and above in Section 3.2.6.2. Potential fish sampling methods include:

- Rod and reel using public and professional guides (walleye, bass and drum and potentially carp).
- Supplemental fish sampling during surface water sample collection with guide (August through September with possible extension to October).
- Utilizing commercial fishing incidental catches (potentially all species).
- Baiting (carp and potentially other species).
- Bongo tows (gizzard shad).
- Light trapping (gizzard shad).
- Gill netting (all species).
- Bow hunting (carp).
- Sharing samples with other research and regulatory entities including but not limited to WDNR, US Fish and Wildlife and UWGB.
- Extension of the sampling period an additional month (from September 15 through October 15) as a last option.

3.2.6.3.1 Collectors Permit

Before any fish tissue sample is collected, a ***Scientific Collectors Permit or Research License Application and Authorized***; ***Form 94000-397 (R6/05)*** (Collectors Permit) will be applied for through WDNR. The Collectors Permit for the 2021 season is provided in Appendix C. Included on the Collectors Permit, Agents Section, is a list of names of all agents of the permittee/license holder that are authorized to act under the Collectors Permit. Each person listed on the permit is responsible for actions of agents under the Collectors Permit. Each agent shall comply with all terms and conditions of the permit. Each agent will be trained in proper length measurement, weight and identification requirements for handling and care of the fish tissue. This includes providing coordinates of fish collection location to verify operating unit in which it was collected. If any of the above cannot be met, the fish tissue will not be accepted. All fish will be frozen and stored until the selection process.

3.2.6.3.2 Public and Professional Guides

The "public" is considered to be people who fish recreationally on OU5 waters. This could include key surface water and fish collection members on the LTM team who participate recreationally in fishing OU5 waters. Utilizing public catches could be an efficient source of targeted fish samples.

Professional guides are people who are in the business of catching fish for their clients on OU5 waters. Professional guides are being considered for their vast experience in tracking and catching targeted human health fish species and incidental catches of ecological indicator species, along with their generally large, quick and seaworthy watercraft. This may provide dual opportunities to collect fish and surface water samples during a single LTM outing, particularly in OU5 where the large open water surface water collection procedures will enlist the use of a charter vessel that is operated by a professional fishing guide.

Only fish samples collected by public and professional guides listed on the Collectors Permit or accompanied by someone listed on the collectors permit and individuals having completed an LTM training session performed by Foth, will be accepted to supplement the LTM catch. The training session will focus on procedures for accurately collecting and documenting the required field data, including date, time, water depth, length, weight, and global positioning system (GPS) coordinates of fish caught to comply with Section 3.2.6.2. The training will include Foth distributing sampling equipment and supplies to individuals completing the training session. Participants will also be trained on proper care of the samples and sample handling including labeling, preservation, storage and chain of custodies (COC) of procedures.

In all previous baseline and LTM events, a biologist has identified abnormalities in the field (i.e., tumors, lesions) as per Section 3.2.6.2. However, this may be an unreasonable expectation for professional guides and the public. Therefore, a qualified person will make this assessment prior to fish processing and storage.

3.2.6.3.3 Commercial Fishing

Commercial fishing uses many different methods to effectively catch a large variety of species, including trawling with large nets, gill nets, and entangling nets. Commercial fishing gear is specifically designed and updated to avoid catching species that are unwanted or endangered. Although this equipment is species-preferred, it is not species-selective as other fish may be caught.

Trawling is an option listed in this document. The equipment for trawling is generally not readily available; however, trawling is a method that commercial fishers implement. These trawling techniques can be completed throughout the water column. Commercial fishers also set nets along shoreline or in and over deeper water. Exercising these various methods, commercial fishers may collect incidental catches of the targeted primary and secondary species for the LTM. These unutilized fish may be used to supplement the catch numbers. Foth will consider collaboration with local commercial fishers and would do so by participating in their harvest to retrieve any unwanted primary or secondary target species. Authorization from the commercial fishers would be obtained prior to collecting any fish samples in this manner.

3.2.6.3.4 Baiting

Applying bait is an option that can be deployed for using such methods as a Fyke net or using a rod to catch carp. The bait is used as an attractant in both cases. The bait can be indiscriminate in the species that are attracted.

3.2.6.3.5 Bongo Tows (Gizzard Shad)

A bongo tow is named because the net setup looks like bongo drums. The commercially-made nets are two conical nets with weights added to submerge the nets into the water column so the nets are level in the water and can be towed at a desired depth alongside a watercraft. The nets are mounted off the side of the watercraft and towed obliquely through the water while the watercraft is underway, effectively sampling the targeted layer of water. Tows are usually conducted at a speed of between 2 and 3 knots for one minute or longer duration. Bongo tows are typically conducted shortly after sunset for gizzard shad. Samples are collected in open water and obstruction-free areas.

3.2.6.3.6 Light Trapping (Gizzard Shad)

Young of the year gizzard shad are attracted to light. These gizzard shad could be collected in various types of light traps. For example, Quatrefoil light traps with waterproof LED flashlights and light diffusers could be used to passively collect small young of the year gizzard shad. Light traps are distributed across a sampling area in both nearshore and offshore locations. Light traps are generally deployed at dusk singularly, fished overnight, and retrieved early the following morning.

3.2.6.3.7 Gill Nets

The use of gill nets is an option that is indiscriminate on the fish species collected, and generally kill species that are caught. If Foth would implement gill netting, nets would be check frequently to minimize the killing of non-targeted species.

3.2.6.3.8 Bow Hunting Fisherman

The use of bow hunters for carp is another option to supplement the completeness goal requirements. Any fish collected using this method would be subject to the requirements in Section 3.2.6.3.1.

3.2.6.3.9 Shared Samples

Sharing target species with research or regulatory entities, such as the WDNR fisheries provides an additional opportunity to supplement the catch collected by Foth. The option to share catches has been discussed by the team in the past and has been implemented.

Additionally, other agencies could be contacted prior to the season, (e.g., U.S. Fish and Wildlife Services and local research universities) regarding the possibility of sharing catches for both their target species and the LTM target species.

3.2.6.4 Compositing

The Respondent PM, or his/her designee, in consultation with the Response Agencies, will select the fish to be used for composite samples and will direct the laboratory in their preparation. Details on the laboratory methods of preparing composite samples are provided in the Pace Analytical Services, Lower Fox River Remediation LLC's (LLC) *Biological Tissue and Plant Preparation* SOP, located in Appendix B-6.

Carp and drum (ecological index species), and gizzard shad (YOY forage fish species) will be analyzed as composite samples. Carp composites (optimum) will consist of 7 composites with 5 individuals in each composite (i.e., 35 fish total), drum composites (optimum, if prepared) will consist of 5 composites with 2 individuals in each composite (i.e., 10 fish total), and gizzard shad composites will consist of 7 composites with 25 individuals in each composite (i.e., 175 fish total). To the extent possible, fish will be collected that are representative of the size classes listed in Table 3-5. Ideally, composites would be prepared for each of the 2-inch classes in the target length window. However, some compositing classes may be represented by two or more samples, whereas other classes may contain no samples, depending on the catch.

The individual fish will be archived (frozen) until the fishing season is completed, and the entire catch may be evaluated. The fish will then be assigned to compositing groups. Similarly sized individuals (within 2-inch size classes, if possible) will be grouped together for compositing. To the extent possible, gizzard shad composites will be prepared using fish obtained from a single fishing site. Carp and drum composites, on the other hand, may be combined from multiple fishing sites; the primary consideration for these larger and older fish is preparing composites based on a relatively narrow range of fish lengths. In no case will fish be composited across OUs or across subunits in OU2 and OU5.

3.2.6.5 Fish Tissue Preparation

Walleye (and bass, if analyzed) will be prepared as skin-on fillets. These human health species will be analyzed on an individual basis to be consistent with methods used in the State Fish Consumption Advisory Program. Carp and drum (ecological species) and gizzard shad will be analyzed as composite samples of whole fish.

3.2.6.6 Tissue Archiving

For human health species (i.e., walleye or bass), a single skin-on fillet will be analyzed and the other will be archived. For ecological species (i.e., carp and drum), each fish will be individually homogenized, then equal masses of tissue will be drawn from the individual samples to prepare the composite sample. For gizzard shad, groups of 25 individual fish are homogenized and an aliquot of the homogenate will be analyzed.

Aliquots of all homogenized fish tissue samples (including both individual and composited samples) will be set aside and archived (frozen) for possible future analysis. Homogenized fish tissue samples will be archived for a minimum of one CERCLA 5-year review cycle. The status of the homogenized samples will be considered during the 5-year review process, at which time the samples may be designated for continued archiving over another review cycle, or else discarded.

3.3 OU2 and OU5 MNR Sediment Sampling

MNR sediment sampling will be completed in OU2 and OU5 during LTM sampling activities. A summary of the OU2 and OU5 sediment sampling program is presented in Table 3-7.

3.3.1 Sediment Sampling Locations

Ten sediment sampling stations in OU2 and 21 sediment sampling stations in OU5 will be monitored, focusing on those areas that were reported in the Remedial Investigation/Feasibility Study (RI/FS) as containing surface sediment PCB concentrations (total Aroclors) above 1 milligram per kilogram (mg/kg), and that were selected for MNR. The rationale for the OU2 sample locations was discussed in the September 21, 2012 memorandum, “Fox River OU2 MNR Sediment Sampling Objectives” (Foth, 2012), and the rationale for the OU5 sample locations was discussed in the March 2021 technical memorandum, “Lower Fox River OU4-5 Long-Term Monitoring Proposed MNR and CIL Locations” (Foth, 2021), included in Appendix F. The sediment sampling locations are shown in Table 3-8. To the extent possible, sediment MNR sampling locations are co-located with surface water and fish monitoring stations. The sediment sampling locations in OU2 are shown on Figures 3-19 through 3-21 and in OU5 are shown on Figures 3-22 and 3-23. Note that the 2014 sampling locations in OU2 were adjusted based on 2012 sediment sampling, as no soft sediment was present at two locations (ID 2X3.1 in OU2B and ID DD2.1 in OU2C) (Foth, 2012). The purpose of these samples is to assess if surface PCB concentrations are decreasing over time in OU2 and OU5, where MNR is the primary remedy, as approved in the *ROD*.

3.3.2 Sampling Frequency, Completeness, and Schedule

Ten composite surficial sediment samples from OU2 and 21 composite surficial sediment sampling stations in OU5 will be collected once during one of the eight months of the LTM period each year. For consistency with LTM work that commenced in 2012, the fall months (September and October) will be targeted. Sediment samples will be collected using a ponar grab sampler.

3.3.3 Sample Identification

The sediment samples analyzed by the laboratory will be a composite of five grab samples each at different distances from the original sediment sampling location. The grab samples will be composited and submitted to the analytical laboratory for testing. The composite sample will be identified as follows:

AAAA-YY- MMDD-location ID

where "AAAA" is a 3 to 4 letter code that identifies the OU (OU2) or subunit (OU2B); "YY" is the two-digit year (e.g., -18 for 2018) and "MMDD" is the month and day of the sample collection; and “location ID” identifies the location within the OU or subunit where the sample was collected. For example, "OU2A-18-1008-2003-04A" is a (composite) sediment sample from location 2003-04A collected on October 8, 2018 from subunit OU2A.

3.3.3.1 Replicates and Rinsates

To provide an overall assessment of the field and analytical precision associated with PCB aroclor analysis, four replicate samples will be collected during the sediment sampling activities, one in OU2 and three in OU5. Replicates will be coded with a “(2)” after the location ID (e.g., A(2)). For example, "OU2A-18-1008-2003-04A(2)" is a replicate (composite) sediment sample from location 2003-04A collected on October 8, 2018 from subunit OU2A.

One rinsate blank will be collected from the ponar grab sampler per day of sampling to ensure non-dedicated equipment is being sufficiently decontaminated. A rinsate blank will be collected from a cleaned ponar and any additional cleaned non-disposable equipment to assess field decontamination procedures. The rinsate blank will be collected by pouring deionized water over a cleaned ponar sampler and collecting the rinsate water in a pail. Deionized water will also be poured over any additional cleaned non-disposable equipment and collected in a pail to assess field decontamination procedures. The code for field rinsate blanks will replace the OU designation.at the beginning of the sample identification code and will retain the time stamp. For ponar grab sampler rinsate blanks, the code is:

RBP-YY-MMDD (for ponar grab sampler).

The S*ediment Sampling Equipment Cleaning and Decontamination* SOP is provided in Appendix B-7.

3.3.4 Sample Collection Procedure

3.3.4.1 Location Control

Sediment sampling locations will be located to within a target accuracy of 1 meter using a DGPS calibrated to known shoreline benchmarks before and after each sampling transect. Water depths will be determined using either a pole fitted with a 6-inch diameter disc or a lead line and recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *Sample Vessel Location Control Using Handheld Differential Global Positioning System* SOP, which is provided as Appendix B-1a.

3.3.4.2 Sampling Method

At each sampling station, a ponar sampler will be used to collect five surface samples from the top 6 inches (15 centimeters) of sediment to track reductions in average PCB concentrations over time. The *Sediment Sampling – Ponar Dredge* SOP is provided as Appendix B-8.

3.3.4.3 Sample Compositing

A total of five samples will be collected from each of the 31 sediment sample locations. These locations will be offset from each other by approximately 5 feet.

Each sample will be transferred from the ponar bucket to a 5-gallon plastic bucket as described in the *Sediment Sampling – Ponar Dredge* SOP, which is provided as Appendix B-8. Each 5-gallon bucket may be lined with a single use plastic bag to prevent cross-contamination. The samples will be homogenized using decontaminated or disposable one-time use utensils for mixing. After homogenization is complete, a composite sample will be prepared for laboratory analysis by taking equal aliquots from each of the five sample buckets from the location and placing them into a double Ziploc® bag or sample jars provided by the lab to form one composite sample in accordance with the sample containers, holding times, and preservation requirements as described in Section 4. The sample container will be labeled with the sample identification, kept on ice or refrigerated at 4°C and submitted to the analytical laboratory for PCB analysis. Field replicates shall be collected in a similar manner. Unused sediment may be returned to the river at the completion of sample collection compositing at each location.

Investigative waste material, including any residual sediment, plastic bucket liners, disposable utensils and gloves, etc., will be transported to the OU2-5 Sediment Desanding and Dewatering Plant (Plant) and disposed of with the dewatered sediment and other investigative waste generated at the Plant. When the Plant is no longer in operation, the investigative waste material will be disposed of appropriately at an alternate location.

3.3.4.4 Sample Archiving

Sediment samples will be archived (in frozen storage) in case additional or repeat analyses are called for during data review and evaluation. Samples will be archived for a minimum of one CERCLA 5-year review cycle. The status of the samples will be considered during the 5-year review process, at which time the samples may be designated for continued archiving over another review cycle, or else discarded.

3.4 OU3 and OU4 Chemical Isolation Layer Sampling

CIL monitoring will be performed in representative areas with "Type B" caps to confirm basic cap design assumptions (i.e., proper installation of the cap and resistance to chemical diffusion through from underlying contaminated sediments). Given the short timeframe since installation of the caps, this sampling is more focused to address proper installation of the cap as diffusion is less likely to occur within this short timeframe. "Type B" caps contain a basal layer of mixed cap material and sediment overlain by a clean CIL and a final armor layer; these types of caps are typically installed over mid-range sediment PCB concentrations (between 10 and 49.99 mg/kg). Figure 3-24 provides a detail of the “Type B” cap design.

An OU3 and OU4 CIL sampling summary is presented in Table 3-9.

3.4.1 Chemical Isolation Layer Sampling Locations

The *FR-LTMP* specifies collecting CIL samples at approximately 15 to 20 representative locations in OUs 2-5. Three CIL “Type B” cap locations will be sampled in OU3, as shown on Figures 3-25 through 3-27, and 15 CIL “Type B” cap locations will be collected from eleven caps in OU4, as shown on Figures 3-28 and 3-29. CIL sample locations were selected using the following rationale:

- Co-located with previous CIL sample locations collected immediately after placement of the caps, providing a basis of comparison for future sampling events.
- Caps containing little to no deposition, as to minimize the amount of sediment requiring removal prior to a sampling event.
- Outside of turning basins and navigation channels, which are typically depositional areas with greater water depths that are logistically difficult to obtain and have more potential hazards that may interfere with the safety of the divers.
- With consideration for the representative range of sediment PCB concentrations below the caps.

Note that sample locations were not selected in modified Type B caps, which have additional armoring.

To reduce the potential for sampling in previously disturbed areas of the CIL (the exact previously sampled location), a minimum offset of 3 feet, but no greater than 5 feet, from the previously sampled coordinates will be maintained. (Note: The CIL sampling location F 12-3-CB5-1-1-C3 was moved approximately 14 feet in 2012 to collect a more representative Cap B CIL sample. The modified location serves as the basis for future CIL sampling.)

3.4.2 Sampling Frequency, Completeness, and Schedule

Three CIL samples in OU3 and 15 CIL samples in OU4 will be collected from “Type B” caps once during the fall. CIL samples will be collected using a vibrocore or vacuum push core sampler. Table 3-10 provides a summary of CIL sampling locations.

3.4.3 Sample Identification

The CIL samples analyzed by the laboratory will be discrete samples. The samples will be processed and submitted to the analytical laboratory for testing. The sample will be identified as follows:

FYY-OU#- cap area-CCU-CMU-sample location-sample interval

Foth (F) is the contractor who collected the sample; "YY" is the two-digit year (e.g., -18 for 2018); "OU#" is operating unit in which the sample is located; then the ID includes the cap area, cap certification unit (CCU), and cap management unit (CMU); this is followed by the sample location and finally the sample interval. For example, "F18-3-CB3B-1-1-C3(2-4)" is a (discrete) CIL sample from cap CB3B, CCU 1, CMU 1, location C3, from 2 to 4 inches collected by Foth in 2018 from OU3.

3.4.3.1 Replicates and Rinsates

To provide an overall assessment of the field and analytical precision associated with PCB Aroclor analysis, two replicate samples will be collected during the CIL sampling activities, one in OU3 and one in OU4.

Replicates will be coded with a "REP" after the location ID (e.g., A). For example, "F18-3-CB3B-1-1-C3(2-4)REP" is a replicate (discrete) sediment sample from cap location CB3B-1-1-C3.

One rinsate blank will be collected from the CIL sampler per day of sampling to ensure non-dedicated equipment is being sufficiently decontaminated. The code for field rinsate blanks will replace the OU designation at the beginning of the sample identification code and will retain the time stamp.

3.4.4 Sample Collection Procedure

3.4.4.1 Location Control

CIL sampling locations will be located to within a target accuracy of 1 meter using a real-time kinematic GPS (RTK-GPS) calibrated to known shoreline benchmarks before and after each sampling transect. As stated in Section 3.4.1, the actual locations of CIL LTM sample collection are intended to be between 3 and 5 feet from any previously collected CIL sample. Water depths will be determined using either a pole fitted with a 6-inch diameter disc or a lead line and recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *RTK-Global Positioning System for Sample Location Accuracy and Surface Elevation Calculations* SOP, which is provided in Appendix B-1b.

3.4.4.2 Sampling Method

It is proposed that divers will first clear an area of armor stone, exposing the sand CIL. Divers will inspect the armor stone surface to ensure the surface has not been disturbed and is, therefore, representative of typical cap Type B design. The divers will then guide the barrel of a vibrocore or vacuum push core sampler to the cleared area and set the barrel on top of the sand layer. As stated in the *Chemical Isolation Layer Sampling – Cap B* SOP (Appendix B-9), the target push depth of the CIL core samples will be 24 inches from the top of the CIL sand surface with the intent of acquiring the full sand CIL layer, plus a minimum of 6 inches of underlying sediment. Following removal of the armor layer of the cap by divers, CIL samples will be collected using vibrocore or vacuum push core sampling techniques. The *Vibrocore Sampling* SOP is provided in Appendix B-10. The *Vacuum Push Core Sampling* SOP is provided in Appendix B-11. Once the core sample has been collected, the diver will replace the armor stone over the core location to the extent practicable.

4 Sample Handling and Laboratory Analytical Methods

The following sections describe the procedures for sample handling, preservation, transportation, and storage (see *Shipping and Packaging of Non-Hazardous Samples* SOP provided in Appendix B-13). Sample COC procedures are also described in the *Sample Chain of Custody* SOP provided in Appendix B-14.

4.1 Sample Handling, Preservation, Transportation, and Storage

Table 4-1 lists the required sample containers, preservation requirements, and holding times for the specified analytical methods and sample matrices. Sample bottles will be provided by the laboratory and prepared in accordance with the *Samplers Guide: Contract Laboratory Program Guidance for Field Samplers* (USEPA, 2014). Sample containers will be provided by the laboratory pre-cleaned to requirements of the USEPA Office of Solid Waste and Emergency Response Directive 9240.05A. Sample containers will be kept closed and in a cooler until used.

Vendor certificates of cleanliness for sampling supplies will be accepted and on file at the analytical laboratories.

4.1.1 Sample Packaging

Sample packaging and shipping procedures are designed to ensure that the samples and their accompanying COC will arrive at the laboratory intact. A temperature blank is required in all coolers. Packaging, marking, labeling, and shipping of samples will comply with the regulations of the U.S. Department of Transportation in 49 Code of Federal Regulations (CFR) 171-177. The *Shipping and Packaging of Non-Hazardous Samples* SOP is provided in Appendix B-13.

4.1.2 Shipping Airbills

If samples are shipped, airbills will be retained to provide a record of sample shipment to the laboratory. Completed airbills will accompany shipped samples to the laboratory and will be forwarded along with data packages. Airbills will be kept as part of the data packages in the project files. Core samples will be maintained in a vertical orientation and transported to a local processing facility (Foth's office laboratory De Pere, Wisconsin).

Sealing, handling, transporting, opening, segmenting, and sampling of material from the core is addressed in the SOPs located in Appendix B (see B-13 and B-14).

4.1.3 Chain of Custody

Proper sample and data custody procedures will be followed during the LTM program. Custody is addressed during field sample collection, during data analyses in the laboratory, and through proper handling of project files. Persons will have custody of samples when samples are in their physical possession, in their view after being in their possession, or in their possession and secured to prevent tampering. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Field personnel designated as responsible for sample custody will fill out COC forms at each sampling site, at a group of sampling sites, or at the end of each day of sampling. Original COC forms will accompany samples to the laboratory. Copies will be forwarded to the project files.

4.1.4 Field Custody Procedures

A COC form will be required for all samples. The sample processing team will record the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. Original COC forms, signed by the field team, will accompany the samples to the laboratory. A copy of relinquished COC forms will be retained with the field documentation. COC forms will remain with the samples at all times. Samples and signed COC forms will remain in the possession of the field team until samples are delivered to the express carrier (e.g., Federal Express), hand delivered to the laboratory, or placed in secure storage. Refer to the *Sample Chain of Custody* SOP, which is provided in Appendix B-14.

4.1.5 Laboratory Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify package seals, open the packages, check temperature blanks (and record temperatures), verify sample integrity, and inspect contents against COC forms. Note that samples requiring preservation at 4 degrees Celsius (°C) may be recorded as "received on ice" if solid ice is present in the cooler at the time the samples are received, in lieu of temperature measurements, per Wisconsin Administrative Code NR 149.11(4). The laboratory PM will be contacted to resolve any discrepancies between sample containers and COCs. After confirming the shipment and COC are in agreement, the sample custodian will initiate an internal COC as well as supply the laboratory Quality Assurance Manager (QAM) with a sample acknowledgement letter. If the sample temperatures are outside the required range, the laboratory will contact the laboratory QAM to determine the proper course of action.

Samples will be logged into the Laboratory Information Management System (LIMS), which assigns a unique laboratory number to each sample. LIMS will be used by all laboratory personnel handling samples to ensure all sample information is tracked and recorded.

After the laboratory labels the samples, they will be moved to secured refrigerators where they will be maintained at 4°C or frozen, as appropriate. Access to refrigerators and freezers will be limited to authorized laboratory personnel.

4.2 Laboratory Analytical Methods

4.2.1 Order of Analysis

To minimize cross-contamination within a sample batch, the analytical laboratory will be directed to analyze the water samples in order from the least to the most contaminated, the anticipated order is provided below. This order will be reviewed after the first monitoring event for compliance with the procedure:

- LW (analyze first)
- OU5C
- OU5B
- OU5A
- OU1
- OU2A
- OU2B
- OU2C
- OU3
- OU4 (analyze last)

The data validation process will verify that the designated analysis order was followed, and if it is not, the potential effect on the data of the out-of-order analysis will be assessed.

4.2.2 Water Analysis

Water column samples (once a month from April through November) will be collected at the LW, OU1, OU2, OU3, OU4, and OU5 monitoring stations, plus the specified number of quality control (QC) samples for each sampling round and monitoring event.

4.2.2.1 Analytical Parameters

All water column samples will be analyzed for the following:

- PCB Congeners (209 total) by USEPA Method 1668A (HRGC/MS)
- TSS by USEPA Method SM2540D
- Total Organic Carbon (TOC) by USEPA Method SM5310C

Water sampling analytical parameters are summarized in Tables 3-2 and 4-2.

4.2.2.2 Methods and Reporting Limits

Analytical methods and reporting limits for water analyses are summarized in Table 4-2. Estimated detection limits (EDL) and reporting limits for PCB congeners by Method 1668A are listed in Table 4-3. Two-liter samples will be analyzed to improve reporting limits.

4.2.3 Fish Tissue Analysis

Fish will be collected from the locations shown on Figures 3-11 through 3-18 between August 15 and September 15 as described in Section 3.2.

4.2.3.1 Analytical Parameters

Fish tissue samples will be analyzed using the following methods:

- Tissue Extraction (USEPA Method 3541)
- PCB Aroclors (USEPA Method 8082A)
- Lipid Content (USEPA 2000)

Fish tissue sampling analytical parameters are summarized in Tables 3-4 and 4-2.

4.2.3.2 Methods and Reporting Limits

Analytical methods and reporting limits for fish tissue analysis are summarized in Table 4-2.

Detected values above the method detection limit (MDL) but below the reporting limit (also known as the limit of quantitation) will be reported by the laboratory as estimated values with a J flag qualifier to indicate that the reported value is less accurate in this region of measurement. Matrix effects should be considered in assessing the laboratory's compliance with MDLs and reporting limits. The laboratory will provide a discussion of all failures to meet sensitivity specifications in the data package narrative. If a sample dilution results in non-detected values for analytes that had been detected in the original analysis, the results of the original run and the dilution will be reported with the appropriate notations in the case narrative.

4.2.4 MNR Sediment Analysis

MNR sediment samples will be collected from ten locations shown on Figures 3-19 through 3-21 in OU2 and the 21 locations shown on Figures 3-22 and 3-23 in OU5 as described in Section 3.3.

4.2.4.1 Analytical Parameters, Methods, and Reporting Limits

MNR sediment samples will be analyzed using the following methods:

- PCB Aroclors (Fox River Method)

Sediment sampling analytical parameters are summarized in Tables 4-1 and 4-2.

4.2.5 Chemical Isolation Layer Analysis

CIL testing will be completed at three Type B caps in OU3 and 15 Type B caps in OU4 shown on Figures 3-25 through 3-29 as described in Section 3.4.

4.2.5.1 Analytical Parameters, Methods, and Reporting Limits

CIL samples will be analyzed using the following methods:

- PCB Aroclors (Fox River Method)
- TOC – Sediment (USEPA 9060A)
- Grain Size (ASTM D422)

In the event that PCB concentration is detected in the CIL and it becomes necessary to assess correlation of PCB concentration to particle size distribution and TOC levels in the CIL samples, grain size and TOC analyses will be performed on the CIL and underlying sediment samples. CIL sampling analytical parameters are summarized in Tables 4-1 and 4-2.

5 CMMP and COMMP Monitoring Requirements

This section supplements requirements identified in the *Lower Fox River Operable Unit 1 - Cap Monitoring and Maintenance Plan* (*CMMP)* (Foth and CH2M HILL, Inc., 2011b) and the OU2-5 *Cap Operations, Maintenance, and Monitoring Plan – Revision 3* (*COMMP REV3)* (Anchor QEA, LLC and Tetra Tech EC, Inc.; Draft Final approved June 2021) for monitoring and maintenance of engineered caps, including aggregate caps, bulkhead wall caps at the RGL Slip and C. Reiss Terminal, Special Remediation Area (SRA) cap, and the manufactured gas plant (MGP) North Focus Area (NFA) armored cap.

Aggregate caps are engineered caps consisting of a sand layer and overlying armor layer(s), as described in Section 2.1 of the *COMMP REV3*.

Bulkhead wall caps were constructed at the RGL Slip and C. Reiss Terminal bulkheads during the RA to provide structural integrity of the shoreline to facilitate dredging of sediments adjacent to the bulkheads to the maximum extent practicable. These bulkhead wall caps were also designed to prevent the release of contaminated sediment remaining between the new and old bulkhead walls that could not be practicably removed. Bulkhead wall caps are described further in Section 2.2 of the *COMMP REV3*.

SRA caps have been constructed in areas requiring site-specific designs including over utility crossings intended to provide chemical isolation and armoring where it would be unsafe to dredge closer to the utility. Due to location-specific constraints, such as resistance to vessel propeller wash forces, SRA caps cannot achieve all cap design or performance criteria and are appropriately categorized as exceptional areas as identified in the *Record of Decision* and *Record of Decision Amendment*. SRA caps are described further in Section 2.3 of the *COMMP REV3*.

The MGP NFA armored cap was constructed in the NFA adjacent to the Georgia-Pacific Day Street Mill, downstream of a former MGP owned by Wisconsin Public Service Corporation (WPS). The MGP NFA armored cap includes a chemical isolation layer amended with organoclay and GAC overlain by a geotextile filter layer and a grouted mattress armor layer for stability and erosion protection and is described further in Section 2.4 of the *COMMP REV3*.

Long-term monitoring and maintenance of these caps includes routine monitoring in all capped areas using bathymetric surveys and other techniques (e.g., geophysical surveys, poling, probing, inspections and sub-bottom profiling), as appropriate, and event-based monitoring in “sentinel” cap and bulkhead wall caps areas using bathymetric surveys, instrumentation, and other techniques, as appropriate, which are discussed further in the sections below.

5.1 Routine Monitoring of Aggregate and SRA Caps

The *CMMP* and *COMMP REV3* require that routine monitoring of all cap areas be conducted using geophysical methods (including sub-bottom profiling and/or hydrographic survey), and states that the first routine monitoring event (Year 0) of engineered caps shall be conducted at the end of the year when cap construction is completed, to establish baseline conditions and provide a point of comparison for future *COMMP* events. Furthermore, the *CMMP* requires that routine monitoring of cap areas will be conducted in 2010, 2012, and every 5 years thereafter or until otherwise determined as part of the 5-year EPA review cycle, and the *COMMP REV3* requires that routine monitoring of cap areas will be conducted during Years 2, 6, and every 5 years thereafter for groups of CCUs completed within the same year of construction. To supplement the *CMMP* and *COMMP REV3* and to more efficiently sync the routine monitoring events, the USEPA and WDNR prepared the Long-Term Chemical and Cap Monitoring Schedules, dated April 13, 2020. These schedules, which are provided in Appendix B, identify the specific years that routine monitoring is expected to be performed for each OU for the next 30 years, or as otherwise deemed necessary based on results to date. This "sync'd" schedule varies from that originally envisioned in the *CMMP and previous versions of the COMMP REV3*.

Baseline cap elevations were established by completing hydrographic surveys of caps placed following completion of construction, approximately 115 acres in OU1, 27 acres in OU3, 52 acres in OU4 placed in 2013 through 2014, 57 acres in OU4 placed in 2015 through 2017, and 18 acres in OU4 placed in 2018 through 2020. The hydrographic surveys documenting the baseline conditions has been termed the "Year 0" surveys. Figure 5-1 is a timeline of the Year 0 and subsequent routine monitoring events for each OU and subunit. The locations of all capped areas placed through 2020 are illustrated on Figure 5-2 for OU1, Figures 5-3 and 5-4 for OU3, and Figures 5-5, 5-6, 5-7, and 5-8 for OU4.

To supplement the hydrographic surveys and determine if erosion of the armor layer over more than 5% of a CCU has occurred (a requirement of the *CMMP* and *COMMP REV3*), the cap areas are assessed using a poling/probing survey each time a routine (or river flow event-triggered) hydrographic survey is completed. The main objectives of the poling/probing survey is to determine if the armor stone layer is intact (i.e., present) and how much, if any, cap settlement and/or sediment deposition has occurred since placement of the caps. If the engineered cap's top of cap bathymetric elevation has lowered since its original installation but physical poling/probing confirms the armor stone remains present, it will be concluded that the sediment underlying the cap has consolidated causing the surface of the cap to subside rather than that the cap has eroded. Poling/probing will be discussed in further detail in Section 5.2.

5.1.1 Methods

During routine monitoring, multi-beam hydrographic surveys (survey using a multi-beam echo sounder [MBES] with 400 kilohertz [kHZ] transducers) are completed over all of the engineered caps in OUs 1, 3, and 4 with water depths of 3 feet or greater. The MBES surveys provide a high degree of accuracy and coverage in these areas. In cap areas with water depths less than 3 feet, a single beam hydrographic survey (using a single beam echo sounder [SBES], with 200 kHZ transducer) is completed. For cap areas along the shoreline that protruded from the water, an unmanned aircraft system (UAS, or drone) survey is completed.

The survey work is conducted by a subcontractor proficient with hydrographic survey and audited by Foth. Hydrographic survey audit forms are prepared for each day and type of survey. The form is provided in Appendix C. The survey work is carried out in compliance with the project specifications, as provided in Appendix G of the *100 Percent Design Report for 2010 and*

Beyond Remedial Actions (Tetra Tech EC, Inc. et al., 2012), and SOPs, as provided in Attachment 2 of the *OU2-5 QAPP-REV2*.

Following the survey, Foth obtains raw survey files and gridded survey files (2 feet x 2 feet) from the survey subcontractor. They are processed and plotted for visual review of the engineered cap's bathymetric surface and to identify any irregularities indicating potential failing or damaged cap areas. Additionally, the bathymetric elevations of the current year are compared to the previous routine monitoring event for each respective OU and an elevation difference (isopach) drawing is created, again to visually identify any failing or damaged cap areas. Where irregularities are observed or it is difficult to make an evaluation, a cross-section is cut through the area.

SRA cap integrity is evaluated similarly to aggregate caps in that routine monitoring will be based on initial post-construction bathymetric surveys compared to subsequent bathymetric surveys. If bathymetric surveys show evidence of erosion of the top of the cap in excess of specified amounts for a contiguous area greater than 5 percent of the individual SRA cap footprint, the need for additional assessment will be evaluated in collaboration with the Response Agencies. The trigger for discussions on addition evaluations is based on the thresholds presented in the *COMMP REV3*.

5.1.2 Reporting

Results of the evaluation of the integrity of the caps is provided in a cap integrity assessment report to be submitted to the Response Agencies for review and approval. Included in the report is a set of figures for visual review to identify failing or damaged cap areas. Each figure set includes an "A" figure, which depicts the previously evaluated year's[1] bathymetric elevations, a "B" figure which depicts the current year's bathymetric elevations, and a "C" figure which depicts the differences in elevations (isopachs) between the surveys. For some cap areas, "D" series figures are added to offer cross sections to better depict areas of interest. Additionally, an accounting of evaluations and recommendations made during each post-cap monitoring event for each cap area in each OU. Finally, in order to further quantify the observed differences between the current survey elevations with the previous survey elevations, statistical boxplots are generated for datasets of elevation differences. The boxplots illustrate differences between survey elevations based on datasets defined along a 5-foot by 5-foot grid. The analysis is completed for each CCU within each OU. Positive values in the boxplots reflect elevations which are higher in the current survey than those which were observed in the previous survey, while negative values reflect elevations which are lower in the current survey.

5.2 Sediment Deposition Measurements

Comparing the surface elevation of the capped areas between routine monitoring events and the baseline year (year 0) is a component of the integrity assessment required by the *CMMP* for OU1 and the *COMMP-REV3* for OU3 and OU4. To better compare elevation changes in the capped surface over time, it is necessary to measure sediment deposition (via poling/probing methods,

[1] The current year's elevation is always compared to the baseline year (year 0) elevation and also to the next most recent cap elevation.

see Section 5.2.4.2) that may have occurred between the routine monitoring events (e.g., Year Zero and Year 2). When sediment deposition thickness is measured, the presence of the armor layer is also verified by poling through the sediment and "feeling" the armor layer with the poling rod.

The findings of the poling/probing work will be incorporated into the routine monitoring technical memorandum documenting cap integrity.

5.2.1 Sediment Deposition Poling/Probing Locations

5.2.1.1 Base Grid Development

The appropriate number of poling/probing locations was determined using statistical confidence limits with a lower 95% confidence limit targeted as described below.

A total of 60 poling/probing locations (55 locations for OU1) were initially selected for evaluating cap integrity during a given routine monitoring event. (Refer to the "Lower Fox River OU1 Cap Monitoring Maintenance Plan – 5-Year Flow Hydrographic Survey Comparison" memorandum [Foth, 2013] for further details.) Assuming that the armor layer is observed at all 60 locations, this number of monitoring points provides 95% statistical confidence that a minimum 95% proportion of the cap has maintained integrity (as measured by the armoring layer of the cap being present). Specifically, when all 60 locations (100% proportion) indicate armor integrity, a lower statistical confidence limit (exact binomial) can be calculated on this proportion (Conover, 1999) as follows:

> The lower 95% confidence limit on the observed 100% proportion is found by selecting the largest proportion (p_1) such that:
>
> $$P(Y \geq y | p = p_1) = \alpha = \sum_{i=60}^{60} \binom{60}{60} p_1^{60} (1 - p_1)^{60-60} = p_1^{60} \leq 0.05.$$
>
> Solving the above (for p_1) results in a lower confidence limit of $0.951 \approx 0.95$. This implies there is 95% confidence that a minimum 95% proportion of the cap area has maintained integrity.

In addition to the poling/probing providing confidence that the armored cap is present, the sediment thickness measurements at each of the 60 locations will be used to determine the thickness of sediment across the capped areas and factored into isopach drawings depicting the change in cap elevation over time.

Using the base number of 60 poling locations, a suitable grid spacing was selected and subsequently used to identify the specific poling/probing locations within cap areas for each region (i.e., OU3, OU4 caps placed in 2013-2014, OU4 caps placed in 2015-2017, and OU4 caps placed in 2018 through 2020). Based on previous experience and review comments by the Response Agencies, the base grid was then supplemented with additional poling locations, primarily in smaller cap areas, as necessary to provide additional coverage. If determined to be necessary, select poling locations were then adjusted from the initial base grid coordinates to fall within a minimum 10-foot buffer inside the CCU areas. Location additions and slight adjustments were also made to provide coverage of areas with discernible increases (i.e., deposition) or decreases in elevation (i.e., depressions, gullies, etc.). The specific poling/probing locations are identified as follows:

- OU1 – 55 locations shown on Figures 5-9 through 5-11.
- OU3 – 90 locations shown on Figures 5-12 through 5-18.
- OU4 (caps placed 2013-2014) – 143 locations shown on Figures 5-19 through 5-31.
- OU4 (caps placed 2015-2017) – 101 locations shown on Figure 24 and Figures 5-29 through 5-36.

Poling/probing has not yet been completed for caps placed during 2018 through 2020 in OU4. The same process as described above will be used to determine poling/probing locations. These locations will be submitted for approval prior to poling/probing being completed (anticipated in Fall 2022).

For additional details regarding selection of these locations, refer to *Lower Fox River OU1-4 COMMP Sediment Deposition Poling/Probing Plan* (Foth, 2019b) and the *2018 CIA*.

5.2.2 Monitoring Frequency, Completeness, and Schedule

Poling/probing for the purpose of evaluating sediment deposition will be performed during routine monitoring events. For OU1, OU3, and OU4, routine cap monitoring will be performed in Fall 2022 and every 5 years thereafter, or until otherwise determined as part of the 5-year review process.

5.2.3 Poling/Probing Location Identification

The poling/probing locations will be identified as follows:

OU#(year range of cap placement)-poling/probing location

"OU#" is the operating unit; followed by the “year of cap placement” identifies the region evaluated within the OU (if it applies); and then the poling/probing location. Some examples include: "OU1-P1", "OU3-P1", “OU4(2013-2014)-P1”, “OU4(2015-2017)-P1”, and “OU4(2018-2020)-P1”..

5.2.4 Poling/Probing Measurement Procedure

5.2.4.1 Location Control

Poling/probing locations will be located to within a target accuracy of 1 meter using an RTK-GPS calibrated to known shoreline benchmarks before and after each sampling transect. Water depths will be determined using a pole fitted with a 6-inch diameter disc and recorded to the nearest 0.1 foot. Project-specific location control requirements, calibration protocols, and quality indicators are described in the *RTK-Global Positioning System for Sample Location Accuracy and Surface Elevation Calculations* SOP, located in Appendix B-1b.

5.2.4.2 Poling/Probing Measurement Method

At each of the poling/probing locations, while hovering with the sampling vessel, top of sediment elevation is determined with a graduated pole fitted with a 6-inch diameter disc. At the same locations, a probing rod with 1-inch diameter probing tip is advanced (two-hand push) until armor stone is encountered; and the elevation of the top of armor stone is determined. This information is then used to calculate the thickness of sediment deposition above the caps for each location. Field observations are logged and entered into a summary table that includes the following information: location ID, proposed easting, proposed northing, actual easting, actual northing, deck elevation, time, date, water depth, total push, sediment thickness, and presence of soft sediment. (Note that sediment thicknesses, as presented in the table, are based on measurements collected in the field. However, the irregular surface representing the top of the armor stone (e.g., for C caps and modified B caps) should be considered in that the top of sediment elevation is measured using a 6-inch diameter disc, which sits on top of the surface, whereas the sediment thickness is measured using 1-inch diameter poling rod, which can fit within cracks and spaces in the rocky surface. Multi-beam bathymetry is the primary tool used in the cap integrity assessment. Any areas of concern identified by reviewing the bathymetry from the multi-beam survey may warrant field investigation. During that investigation, areas with the larger armor layer (C caps and modified B caps) would be further evaluated with poling/probing. To account for the irregular surface of the larger armoring, each poling/probing location would consist of the average of three readings taken at the sampling location. The summary table will identify locations in which the presence of soft sediment deposition was obvious (i.e., soft over gravel or soft over rock).

5.3 Routine Monitoring of Bulkhead Wall Caps

Routine monitoring of the RGL Slip and C. Reiss Terminal bulkhead wall caps will include topographic surveying of monitoring points on the walls to measure deflection, topographic surveying of select upland areas to identify potential subsidence behind the walls, and visual monitoring for significant deflection, damage and/or movement as detailed in *COMMP REV3* and the Bulkhead Wall Cap Monitoring Program Outline provided in Appendix B of the *COMMP REV3*.

5.4 Routine Monitoring of the MGP NFA Cap

The extent of the MGP NFA is identified on Figure 5-8. The initial installation of the NFA armored cap was verified through surveys (Year 0 survey), and the design bathymetry was confirmed by the LLC. The next scheduled survey of the NFA armored cap will occur in 2022, as the Year 2 survey for caps completed in OU4 between 2018 and 2020. This survey will be performed over the entire cap footprint including the buttress and sand portions of the cap. The survey will include a follow-up investigation of anomalies that are encountered and warrant further review; the scope of these investigations will be developed in consultation with the WDNR and USEPA.

If the final remedy for the MGP site has not been determined prior to 2022, the NFA armored cap will be included with the monitoring of all other caps addressed in the *COMMP REV3* beyond the Year 2 survey planned for 2022 and reported in the USEPA 5-year review, until such time as a final remedy for the MGP site is determined and the cap monitoring and maintenance responsibility has been legally transferred to WPS by the Response Agencies, through the formal CERCLA RI/FS, *ROD* process/mechanism.

5.5 Event-Based Monitoring of Aggregate Caps

The *CMMP* and the *COMMP REV3* require that, in addition to routine monitoring, event-based monitoring (i.e., supplemental bathymetric surveys) will be performed following major river-flow events, periods of extended low water (OUs 3-4 only), or construction activities (OUs 3-4 only) that may have a significant impact on river hydrodynamics, and therefore the engineered cap.

5.5.1 High Flow Event-Based Monitoring

Event-based monitoring in OU1 will be performed within 1 year following the designated river flow event. If the event-based monitoring event can be coordinated with an upcoming routine monitoring event, the 1-year timeframe may be extended to the next sampling season (i.e., during the warm-weather months [April through November]). Flows for OU1 are approximated using measurements from the Appleton gauging station, which is downstream of OU1 near Appleton. Hourly average flows exceeding the 5-year recurrence-interval flow rate will be used to trigger the initial event-based bathymetric survey. If cap integrity is verified following a 5-year flow event, the next event-based cap monitoring will occur following a 50-year flow event. No additional event-based cap monitoring is recommended if cap integrity is verified following a 50-year flow event because the 50-year flow event is 95% of the 100-year flow event.

Event-based monitoring in OUs 3-4 will be performed only in “sentinel” capping areas, which are identified and described in detail in the *COMMP REV3*, “Lower Fox River OU3 – Sentinel Cap Areas Selection” memorandum, and “Lower Fox River OU4 – Sentinel Cap Areas Selection” memorandum. The memoranda are provided in Appendix E. Sentinel capping area monitoring will be performed within 1 year following a river flow (combined flood and seiche discharge) event with a recurrence interval of 20 years or more. If the event-based monitoring event can be coordinated with an upcoming routine monitoring event, the 1-year timeframe may be extended to the next sampling season (i.e., during the warm-weather months [April through November]). Hourly average flows exceeding the 20-year return-interval flow rate will be used to trigger the supplemental bathymetric surveys. Furthermore, if cap integrity and performance are verified under a 20-year flow event, follow-on event-based cap monitoring will occur following a 100-year flow event. Similar to OU1 for a 50-year flow event, no additional event-based cap monitoring is recommended (with respect to high flow) if cap integrity is verified following a 100-year flow event. Table 5-1 lists the recurrence interval flow rates for OU1, OU3 and OU4. As required by the *CMMP* and *COMMP REV3,* Foth monitors flow monthly as described in detail in the following sections.

5.5.1.1 OU1

Fox River flows for OU1 are monitored at the Appleton, Wisconsin, USGS Station Number 04084445 (Appleton station). Hourly mean discharge values are calculated using 15-minute flow data at the Appleton gauge and a graph is prepared for each month to evaluate recurrence interval exceedances.

The 5-year flow monitoring event was triggered on April 22, 2011 through May 9, 2011, as documented in the "Lower Fox River OU1 Cap Monitoring Maintenance Plan – 5-Year Flow Hydrographic Survey Comparison" memorandum (Foth, 2013). Subsequently, based on the *CMMP* requirements stated in Section 2, Foth performed an evaluation of the 50-year recurrence-interval flow rate for the period between the Year 1 (July 2011) and Year 8 (September 2018) surveys. During this period, the 50-year recurrence interval was not exceeded. Flow monitoring will continue in OU1 until the 50-year recurrence interval is verified.

5.5.1.2 OU3

Fox River flows for OU3 were monitored in the past at the Rapide Croche Dam near Wrightstown, Wisconsin, USGS Station Number 04084500; however, the USGS discontinued monitoring this station as of September 30, 2013. Based on the lack of verified data after September 30, 2013, Foth was not able confirm that the 20-year flow monitoring event was triggered in OU3 between the Year 0 and Year 3 surveys (Foth, 2015). Regardless, no cap maintenance was required after the Year 3 survey evaluation. Going forward, Foth has documented a Response Agency-approved method for determining flows in OU3 using the OU1 data (i.e., the OU3/OU1 ratio model), as described in detail in the "OU3 River Flow Determination and Revised Recurrence Intervals for OU1, OU3, and OU4" Memo (Foth, 2019a). Using this method, Foth determined that hourly discharges exceeded the 20-year recurrence interval on May 9, 2018, and that the event-based monitoring requirement with respect to the 20-year recurrence level flow has been fulfilled, as described in detail in the *2018 Cap Integrity Assessment - Lower Fox River Operable Units 1, 3, and 4* (*2018 CIA*) (Foth, 2020). Follow-on event-based monitoring will be performed for the 100-year flow event.

Note that if a new gaging station is reestablished in OU2 or OU3, then this data will be used instead of using the OU3/OU1 ratio model.

5.5.1.3 OU4 Caps Placed 2013 through 2017

Flows near the mouth of the Fox River (including the combined effects of upstream floods and seiches) are measured approximately every 5 minutes at the U.S. Oil Tank Depot (USGS Station 040851385) (http://waterdata.usgs.gov/nwis/), which is the gauging station used for comparison of flow data to the appropriate recurrence intervals for OU4. Foth determined that hourly discharges exceeded both the 20-year and 100-year recurrence intervals (6/24/2015, 8/14/2015, and 12/14/2015 for caps completed 2013-2014 and 4/27/2018 for caps completed 2015-2017), and that the event-based monitoring requirement with respect to the 20-year and 100-year recurrence level flows has been fulfilled, as described in detail in the *2018 CIA*. Therefore, no additional event-based cap monitoring with respect to high flow is recommended for OU4 caps placed 2013-2017. Follow-on event-based monitoring of OU4 sentinel caps will be performed in the case of a low elevation event.

5.5.1.4 OU4 Caps Placed 2018 through 2020

The methods described in Section 5.5.1.3 were used to evaluate flow data for OU4 caps placed between 2018 through 2020. Foth determined that hourly discharges exceeded the 20-year recurrence interval for these caps during several events in 2020. A bathymetric survey of the associated sentinel cap area was completed in 2021. Further detail and the cap integrity assessment will be provided in a subsequent memorandum/report.

5.5.2 Low Water Elevation Event-Based Monitoring

In addition to the high flow-event based monitoring, the *COMMP REV3* requires: "Supplemental bathymetric surveys will also be performed in sentinel cap areas within 1 year following major river construction events (e.g., new bridge construction) in or nearby caps or if monthly average water levels drop more than 1 foot below the low-water elevations used to develop the cap designs, as summarized in the table below, to confirm the caps have remained intact and are functioning as designed." Note that if the event-based monitoring event can be coordinated with an upcoming routine monitoring event, the 1-year timeframe may be extended to the next sampling season (i.e., during the warm-weather months [April through November]). "If cap integrity and performance are verified following a low-water event, follow-on event-based cap monitoring would be triggered by a subsequent water level drop of 1 foot below the previous low-water elevation. If that subsequent 1 foot of water elevation drop occurs prior to the survey triggered by the initial low-water elevation, both events would be monitored during the same survey. If a planned 5-year monitoring survey is scheduled for the year following a low-water elevation trigger, monitoring surveys may be combined for efficiency. Long-term monitoring modifications will be documented in a revision to the *COMMP [REV3]*."

Operable Unit	Water Elevation Dynamic Height (NAVD88)*			Basis for Selection
	Design	1 ft below Design	2 ft. below Design	
OU 2	593.6 ft.	592.6 ft.	591.6 ft.	NOAA Low Water Datum above Little Kaukauna Dam
OU 3	587.5 ft.	586.5 ft.	585.5 ft.	Crest of De Pere Dam (and NOAA Low Water Datum)
OU 4 within Nav. Channel	577.6 ft.	576.6 ft.	575.6 ft.	Lower 1% occurrence frequency of hourly summer data from NOAA gage at Green Bay (adjusted for long-term data record through 1953)
OU 4 outside Nav. Channel	576.6 ft.	575.6 ft.	574.6 ft.	

*For IGLD85 elevation, subtract 0.1 foot from NAVD88 elevation

Lake Michigan water levels, which correspond to water levels in OU4, are currently measured at the National Oceanic and Atmospheric Administration (NOAA) gaging station near the mouth of the Fox River (Green Bay East, Station No. 9087077). Water levels in OU3 are currently measured at the NOAA gage station located at the Rapide Croche Dam (Station No. 040084500). Annual low-water elevations (defined as the lowest monthly average within a given water year) from the NOAA gaging stations will be assessed each April after typical annual low water periods between November and March. If the gage records indicate that the monthly average for any month during the previous water year (April to March) was more than 1 foot below the remedial design baseline water elevation (576.6 feet North American Vertical Datum of 1988 [NAVD88] in OU4, or 586.5 feet NAVD88 in OU3), supplemental bathymetric surveying will be triggered for the following fall after the spring flood season and summer recreational boating season. Follow-on maintenance activities will be scheduled and documented as appropriate.

In addition to bathymetric surveys for caps, bank surveys will be performed during low-water conditions to monitor caps placed on river banks and side-slope areas. The bank surveys will include the following:

- Field reconnaissance for evidence of erosional features (e.g., presence of gullies, escarpments, slumps).

- Drone surveying as necessary to verify elevation changes. Note that drone surveys will be completed during routine monitoring of the portions of shoreline caps that protrude from the water, as described in Section 5.1.1.

If the low-water field surveys document erosion along the banks, follow-on bathymetric or other geophysical surveys will be conducted in the adjacent areas of the river to determine whether the erosion extends into deeper water.

No low-elevation events have occurred in either OU3 or OU4 to date.

5.5.3 Survey Methods

During event-based monitoring, hydrographic and drone surveys are performed using the same methods as described in Section 5.1.1; however, only selected sentinel caps are surveyed and evaluated.

5.5.4 Reporting

For event-based monitoring, reporting is done similarly to routine monitoring described in Section 5.1.2; however, only selected sentinel caps are evaluated.

5.6 Event-Based Monitoring of Bulkhead Wall Caps

The low water conditions described above in Section 5.5 will also trigger event-based monitoring of the bulkhead wall caps at the RGL Slip and C. Reiss terminal. In addition to low water elevations, bulkheads experience a unique set of potential events that may require action, including, but not limited to:

- Vessel impacts
- Low water conditions
- Ice impacts or damage
- New construction
- Upland surcharge greater than the design specifications

Should one of the events occur at the RGL Slip or C. Reiss Terminal bulkheads, GP will be notified by the owners as requested in the letter that will be provided to RGL and C. Reiss on an annual basis to inform them of the need for evaluation in the event of these potential events. GP will then notify the Response Agencies within 48 hours. Event-based bulkhead wall cap monitoring will be conducted as deemed appropriate through collaborative discussions between GP and the Response Agencies and may include monitoring activities as described in Section 3.2 and Appendix B of the *COMMP REV3*.

In the event of a low water elevation that is more than 1 foot below the annual low water datum elevation in OU4 (see table above in Section 5.5.2), additional inspections of bulkhead wall caps may be conducted while there is a greater amount of exposed surface to visually assess the condition of the bulkhead. Follow-on event-based monitoring may be triggered by a subsequent water level drop of 1 foot below the previous low-water elevation if time permits an evaluation prior to water levels rising back up to typical elevations. If a planned 5-year monitoring survey is scheduled for the year following a low-water elevation trigger, monitoring surveys may be combined for efficiency.

An annual letter (draft attached to Appendix B of the *COMMP REV3*) will be sent to riparian property owners reminding them to notify the responsible parties if an event occurs. Appendix H of the *COMMP* includes agreements signed by GP, RGL, and C. Reiss that establishes a system of communication between the owners of the bulkheads and GP.

A communication process flow chart for riparian property owners and the responsible parties is also included as an attachment to Appendix B of the *COMMP REV3*.

5.7 Event-Based Monitoring of MGP NFA Engineered Cap

As noted in Section 5.4, if the final remedy for the MGP site has not been determined prior to 2022 (Year 3), the NFA armored cap will be included with the monitoring of all other caps addressed in the *COMMP REV3* and reported in the USEPA 5-year review, until such time as a final remedy for the MGP site is determined and the cap monitoring and maintenance responsibility has been legally transferred to WPS by the Response Agencies. The monitoring of the NFA cap under the *COMMP REV3* requirements includes event-based monitoring.

Similar to event-based monitoring for aggregate caps and bulkhead caps discussed in previous sections, low water conditions will also trigger monitoring of the NFA armored cap. In addition to low water elevations, the NFA armored cap may be subject to potential events that may require action, including, but not limited to:

- Vessel impacts
- Ice impacts or damage
- New construction

Should one of the events occur at the NFA armored cap, GP will notify the Response Agencies within 48 hours after receiving notice of the event. Event-based monitoring will be conducted as deemed appropriate through collaborative discussions between GP and the Response Agencies and will likely include a bathymetric survey of the armored cap and the structural buttress.

As noted previously, the *COMMP REV3* includes monitoring of sand buttresses installed for shoreline stability even though the buttresses have no impact on cap performance. The survey of the NFA buttress does not include metrics for additional evaluation, as it has no impact on cap performance; however, if significant changes in elevation are noted, the GP will discuss the results with Response Agencies to determine if additional evaluations are warranted.

6 References

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Tables

Table 3-1

Lake Winnebago and OU1-5 Water Sampling Locations

Transect	Position	X WTM27[1]	Y WTM27[1]	X WTM8391[2]	Y WTM8391[2]	Northing Y[3]	Easting X[3]
LW	W	625,571	392,512	645,559	412,726	129,256	2,380,580
	M	626,486	393,942	646,474	414,157	133,950	2,383,584
	E	627,390	395,354	647,378	415,569	138,586	2,386,549
OU1	W	624,566	399,927	644,554	420,141	153,587	2,377,262
	M	624,583	399,885	644,571	420,100	153,452	2,377,335
	E	624,618	399,838	644,606	420,053	153,297	2,377,449
OU2A	W	632,719	404,099	652,707	424,314	167,286	2,404,028
	M	632,733	404,036	652,721	424,251	167,078	2,404,076
	E	632,749	403,969	652,736	424,184	166,858	2,404,126
OU2B	W	642,374	408,027	662,362	428,242	180,181	2,435,707
	M	642,413	407,981	662,400	428,197	180,032	2,435,834
	E	642,452	407,936	662,440	428,151	179,883	2,435,963
OU2C	W	649,030	415,114	669,017	435,329	203,440	2,457,540
	M	649,070	415,075	669,057	435,290	203,314	2,457,672
	E	649,103	415,044	669,090	435,259	203,211	2,457,781
OU3	W	653,989	422,665	673,977	442,881	228,221	2,473,809
	M	654,035	422,628	674,022	442,844	228,100	2,473,959
	E	654,090	422,584	674,077	442,799	227,955	2,474,138
OU4	W	658,157	432,421	678,144	452,637	260,234	2,487,478
	M	658,219	432,409	678,206	452,625	260,195	2,487,681
	E	658,268	432,400	678,256	452,615	260,163	2,487,842
OU5A	W	661,674	447,915	681,661	468,130	311,069	2,499,009
	M	665,240	445,525	685,227	465,741	303,230	2,510,711
	E	668,193	443,546	688,180	463,762	296,740	2,520,399
OU5B	W	677,043	470,189	697,029	490,405	384,150	2,549,427
	M	680,385	468,332	700,371	488,548	378,058	2,560,391
	E	684,551	466,018	704,538	486,234	370,466	2,574,059
OU5C	W	694,097	493,040	714,083	513,256	459,109	2,605,376
	M	700,719	488,883	720,705	509,099	445,471	2,627,097
	E	705,334	485,986	725,320	506,202	435,967	2,642,234

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago (LW) and OU1-5 scope of work.

Sample location OU1 W was adjusted due to insufficient water depth at the location provided in the *FR-LTMP*.

[1] Wisconsin Transverse Mercator NAD 27 (WTM27) coordinate system.

[2] Wisconsin Transverse Mercator NAD 1983 (WTM8391) coordinate system.

[3] Fox River Baseline Monitoring Plan WIS State Plan Central coordinate system.

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Checked by: TMK1

Table 3-2
Lake Winnebago and OU1-5 Water Sampling Details

Sample ID	Sample Frequency	Order for Each Monthly Event	Number of Monthly Samples	Number of Field Replicates[4]	Total Number of Analyses	Field Parameters (temperature, turbidity)	Total Suspended Solids (SM2540D)[5]	Total Organic Carbon (SM5310C)[6]	PCB Congeners (EPA 1668A)
Laboratory Identification									
LWB-yy-mmdd[1]	Monthly (April-Nov)	1st	8	1	9		X	X	X
OU1-yy-mmdd[1]	Monthly (April-Nov)	2nd	8	1	9		X	X	X
OU2A-yy-mmdd[1]	Monthly (April-Nov)	3rd	8	1	9		X	X	X
OU2B-yy-mmdd[1]	Monthly (April-Nov)	4th	8	1	9		X	X	X
OU2C-yy-mmdd[1]	Monthly (April-Nov)	5th	8	1	9		X	X	X
OU3-yy-mmdd[1]	Monthly (April-Nov)	6th	8	1	9		X	X	X
OU5A-yy-mmdd[1]	Monthly (April-Nov)	7th	8	1	9		X	X	X
OU5B-yy-mmdd[1]	Monthly (April-Nov)	8th	8	0	8		X	X	X
OU5C-yy-mmdd[1]	Monthly (April-Nov)	9th	8	0	8		X	X	X
OU4-yy-mmdd[1]	Monthly (April-Nov)	10th	8	1	9		X	X	X
Field Identification									
LWB-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	1st	16[3]			X			
OU1-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	2nd	16[3]			X			
OU2A-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	3rd	16[3]			X			
OU2B-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	4th	16[3]			X			
OU2C-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	5th	16[3]			X			
OU3-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	6th	16[3]			X			
OU5A-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	7th	16[3]			X			
OU5B-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	8th	16[3]			X			
OU5C-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	9th	16[3]			X			
OU4-yy-mmdd-A,B,C,D,E, and F[2]	Monthly (April-Nov)	10th	16[3]			X			

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago (LW) and OU1-5 scope of work.

[1]Sample ID for composite of field collected "quarter point" aliquots. Compositing performed at laboratory.

[2]Field collected "quarter point" aliquots.

[3]Required to field collect two redundant sets of "quarter point" aliquots per transect for PCBs per monthly sampling event.

[4]Field replicates rotate between sample location, once per sampling event (i.e., LW, OU1, OU2A, OU2B, OU2C, OU3, OU5A, OU4).

[5]Previous TSS method EPA 160.2 referenced in *FR-LTMP* tables no longer valid as of 2006.

[6]Previous TOC method EPA 415.1 referenced in *FR-LTMP* tables no longer valid as of 2006.

yy = last two digits of the sampling year
mm = two digit sampling month
dd = two digit sampling day

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Table 3-3
Optimum and Minimum Completeness Goals for Individual Primary Fish Species

	Optimum	Minimum
Primary:		
Walleye	15 individual fish	8 individual fish
Carp (LW-OU4) [1,3]	35 individial fish, to be composited into 7 groups of 5 fish each	14 individual fish, to be composited into 7 groups of 2 fish each
Drum (OU4-OU5) [1,3]	35 individial fish, to be composited into 7 groups of 5 fish each	14 individual fish, to be composited into 7 groups of 2 fish each
Gizzard shad	175 individual fish, to be composited into 7 groups of 25 fish each	25 individual fish, to be composited into 5 groups of 5 fish each
Alternate:		
Smallmouth Bass	15 individual fish	15 individual fish
Drum (LW - OU3)[2]	25 individial fish, to be composited into 5 groups of 5 fish each	5 individual fish
Carp (OU5)[2]	10 individial fish, to be composited into 5 groups of 2 fish each	5 individual fish

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-5 scope of work. Lake Winnebago (LW) completeness goals are the same.

After the fish collection inventory is available, fish will be paired to create primary and duplicate individual or composite samples for each species of fish.

Refer to Figure 3-1 in the *FR-LTMP* for the Field Decision Flowchart for fish sampling.

[1]The maximum number of alternate 22-24 inch carp, retained for possible analysis, will be capped at 14. Minimum number of fish changed from "seven individual fish, to be analyzed separately (no compositing)" in the *FR-LTMP* to "14 individual fish, to be composited into seven groups of two fish each" as a result of availability of fish at the desired sizes during the 2012 and 2014 sampling events and the subsequent recommendations from the Agencies.

[2]For LW and OU1-3, drum optimum number of fish changed from "25 individual fish, to be composited into five groups of five fish each" in the *FR-LTMP* to "10 individual fish, to be composited into five groups of two fish each" as a result of availability of fish at the desired sizes and the excessive number of drum retrieved (creating a large amount of waste) during the 2012 and 2014 sampling events and the subsequent recommendations from the Agencies.

[3]As indicated in *FR-LTMP* Page 40, different ecological species are selected for monitoring in the Lower Fox River (carp) and Green Bay (drum) and to ensure overlapping coverage, both species will be monitoring in OU4.

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Table 3-4
Fish Tissue Sampling and Analysis Matrix

Sample ID	Number of Composites	No. Fish per Composite	No. Individual Fish	Total Number of Analyses	No. of Field Replicates[1]	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors (8082A/SLOH)	Lipid Content (EPA 2000)	Archive (Freeze)
Walleye											
LWB-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU1-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU2A-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU2B-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU2C-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU3-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU4-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU5A-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
OU5B-YY-WA-00	na	na	15	15	1	12	22	SOF	x	x	x
		Walleye Subtotal:	135	135	9						

Sample ID	Number of Composites	No. Fish per Composite	No. Individual Fish	Total Number of Analyses	No. of Field Replicates[1]	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors (8082A/SLOH)	Lipid Content (EPA 2000)	Archive (Freeze)
Smallmouth Bass											
LWB-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU1-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU2A-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU2B-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU2C-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU3-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU4-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU5A-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
OU5B-YY-SB-00	na	na	15	15	1	10	20	SOF	x	x	x
		Smallmouth Bass Subtotal:	135	135	9						

Table 3-4
Fish Tissue Sampling and Analysis Matrix

Sample ID	Number of Composites	No. Fish per Composite	No. Individual Fish	Total Number of Analyses	No. of Field Replicates[1]	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors (8082A/SLOH)	Lipid Content (EPA 2000)	Archive (Freeze)
Carp											
LWB-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU1-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU2A-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU2B-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU2C-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU3-YY-CA-00	7	5	35	7	1	12	22	WF	x	x	x
OU4-YY-CA-00	5	2	10	5	1	12	22	WF	x	x	x
OU5A-YY-CA-00	5	2	10	5	1	12	22	WF	x	x	x
OU5B-YY-CA-00	5	2	10	5	1	12	22	WF	x	x	x
		Carp Subtotal:	240	57	9						
Drum											
LWB-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU1-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU2A-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU2B-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU2C-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU3-YY-DR-00	5	2	10	5	1	12	22	WF	x	x	x
OU4-YY-DR-00	7	5	35	7	1	12	22	WF	x	x	x
OU5A-YY-DR-00	7	5	35	7	1	12	22	WF	x	x	x
OU5B-YY-DR-00	7	5	35	7	1	12	22	WF	x	x	x
		Drum Subtotal:	165	51	9						

Table 3-4
Fish Tissue Sampling and Analysis Matrix

Sample ID	Number of Composites	No. Fish per Composite	No. Individual Fish	Total Number of Analyses	No. of Field Replicates[1]	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors (8082A/SLOH)	Lipid Content (EPA 2000)	Archive (Freeze)
Gizzard Shad											
LWB-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU1-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU2A-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU2B-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU2C-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU3-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU4-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU5A-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
OU5B-YY-GS-00	7	25	175	7	1	2	4	WF	x	x	x
Gizzard Shad Subtotal:			1575	63	9						

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the Lake Winnebago and OU1-5 scope of work.

CA = Carp
DR = Drum
GS = Gizzard Shad
LWB = Lake Winnebago
na = Not Applicable
SOF = Skin-On Fillet
WA = Walleye
WF = Whole Fish

1. Number represents individual fish or composites of fish as per Table 3-3.

YY = last two digits of the sampling year

Updated by: SDJ 12/08/20
Checked by: TMK1
OU5C sample IDs removed by TMK1: 9/16/21

Table 3-5

Target Fish Species, Size Classes, and Compositing Plan

		2 -4"	4 - 6"	6 - 8"	8 - 10"	10 - 12"	12 - 14"	14 - 16"	16 - 18"	18 - 20"	20 - 22"	22 - 24"	Skin-On Fillet	Whole Fish	No. Individual Fish (Target)	No. Individual Fish (Minimum)	No. of Composites	No. of Fish per Composite (Target)	No. of Fish per Composite (Minimum)
Primary Species	**Objective**	**Per OU Sampling Transect**																	
Walleye	Human Health												x		15	8	0	na	na
Carp (LW, OU1, OU2, OU3 and OU4) [1,2]	Ecological													x	35	14	7	5	2
Drum (OU4, OU5)[2]	Ecological													x	35	14	7	5	2
Gizzard Shad	Young of Year													x	175	25	7	25	5

Alternate Species	**Objective**	**Per OU Sampling Transect**																	
Smallmouth Bass	Human Health												x		15	15	0	na	na
Drum (LW, OU1, OU2, OU3)	Ecological													x	10	5	5	2	1
Carp (OU5)[1]	Ecological													x	10	5	5	2	1

This table was adapted from the Fox River Long-Term Monitoring Plan (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-5 scope of work and also apply to Lake Winnebago.

na = Not Applicable (Walleye and Bass will not be composited)
= Target Size Class
= Alternate Size Class

[1]Carp alternate (22-24 inches) maximum - 14 individual fish retained for possible analysis.
[2]As indicated in *FR-LTMP* Page 40, different ecological species are selected for monitoring in the Lower Fox River (carp) and Green Bay (drum) and to ensure overlapping coverage, both species will be monitoring in OU4.

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Checked by: TMK1

Table 3-6
Fish Habitat and Collection Methods

Species	Species	Electrofish	Trawl	Rod and Reel	Seine Net	Commercial Fishing incidental catches	Baiting	Bongo Tows	Light trapping	Gill Net	Bow Hunting	Sharing samples with other research and regulatory entities	*Other
Walleye	Below dams, near discharges, submerged weed beds, hard rocky substrates, bridge pillars and abutments	x	x	x		x				x		x	x
Carp	Muddy flats and bays, aquatic vegetation and weed beds, below dams, near discharges, bridge pillars, creek mouths	x	x			x	x			x	x	x	x
Drum	Diverse and wide-ranging habitat, aquatic vegetation and weed beds, along reefs, below dams, near discharges, boulders, bridge pillars	x	x	x		x				x		x	x
Gizzard Shad	Nearshore areas, aquatic vegetation and weed beds, along reefs, below dams, near discharges, bridge abutments, creek mouths	x	x		x	x		x	x	x		x	x
Smallmouth Bass	Aquatic vegetation and weed beds, rocky substrates, below dams, near discharges, deep holes with structure (instream logs, rocks, outcrops), docks, bridge abutments	x	x	x		x				x		x	x

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-5 scope of work and also apply to Lake Winnebago.

Updated by: SDJ 11/7/20
Checked by: TMK1

Table 3-7

OU2 and OU5 MNR Sediment Sampling Summary

	No. Sampling Events	No. Sampling Locations	No. of Field Replicates	Total Number of Analyses	PCB Aroclors (Fox River method)	Drying and Grinding
OU2A OU2B OU2C	1	10	1	11	x	x
OU5A OU5B OU5C	1	21	3	24	x	x

Updated by: TMK1
Checked by: TRN

Table 3-8
OU2 and OU5 MNR Sediment Sampling Locations

OU	Sample ID	Northing (ft.)	Easting (ft.)	Approximate water depth (ft.)
OU2A	OU2A-YY-2P2.1	167220.18	2405749.18	5
	OU2A-YY-2P3.1	167477.00	2406861.29	4
	OU2A-YY-3T3.1	165177.46	2414763.98	2.5
	OU2A-YY-T1.1	165599.52	2415161.34	4
OU2B	OU2B-YY-2CC2.1	180915.26	2437982.36	7
	OU2B-YY-2V2.1	171185.73	2428643.8	4
	OU2B-YY-2W6.1	170390.03	2430030.94	7
	OU2B-YY-2X1.1	174003.77	2430993.65	6
	OU2B-YY-2X3.1NEW	172737.61	2430503.53	8.5
OU2C	OU2C-YY-DD2.1NEW	203838.36	2457933.86	11
OU5A	OU5A-YY-GB02-05	267399	2491618	10
	OU5A-YY-5008-12	267402.66	2489701.24	10
	OU5A-YY-S00040	271951.67	2512717.12	9
	OU5A-YY-5021.5-01	272672.15	2491599.41	10
	OU5A-YY-MNR02	301280	2511265	20
	OU5A-YY-MNR01	284642	2500836	10
	OU5A-YY-E339B04A	290267.16	2503308.84	14
OU5B	OU5B-YY-E165B02A	307926.18	2523425.28	22
	OU5B-YY-E323B05A	308244.04	2535390.80	23
	OU5B-YY-E323B06A	325736.79	2534921.05	28
	OU5B-YY-E326B04A	326182.72	2551294.66	28
	OU5B-YY-E169B03A	342260.57	2552409.73	35
	OU5B-YY-E240B07A	358252.03	2550408.54	45
	OU5B-YY-E323B07A	358702.81	2566497.31	36
	OU5B-YY-E323B08A	357806.82	2534059.96	38
	OU5B-YY-AA87GB0022a	374708.52	2552029.83	48
OU5C	OU5C-YY-AA88GB0020a	375571.80	2582366.78	50
	OU5C-YY-E010B02A	391605.83	2581898.98	69
	OU5C-YY-GC0378	393611.85	2569967.16	48
	OU5C-YY-E080B02A	392575.63	2614284.05	60
	OU5C-YY-E240B06A	405586.86	2633839.91	66

Table 3-8

OU2 and OU5 MNR Sediment Sampling Locations

Notes:

YY = last two digits of the sampling year

OU2 coordinates are proposed locations for the 2018 sampling event.

OU4 as-built coordinates of historical surficial sediment sample locations provided is the following data sources:

• WDNR Fox River Database (WDNR, 2006) - 1989/90 Green Bay Mass Balance Study (GLNPO), 1998 BBL Sediment/Tissue Data Collection, 1995 WDNR Sediment Data Collection.

• White Paper No. 19 (WDNR, 2003) – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach, June 2003 (data collected 2002).

• Core Chemistry Data Base provided by Tetra Tech (Tetra Tech, 2019) from the following subcategories:
 - Basis of Design Report 2004-2005 predesign sediment samples
 - 2017 Beyond the Arc data
 - May 2019 sampling in the Bay near the outlet of the Lower Fox for remedial design

Coordinates in WSPC_NAD83(86).

Prepared by: TMK1
Checked by: TRN
Updated by: NMG1
Checked by: TMK1
Updated 9-7-21: TMK1
Checked by: JRB2/DAT

Table 3-9

OU3 and OU4 Chemical Isolation Layer Sampling Summary

	No. Sampling Events	No. Sampling Locations	No. of Field Replicates	Total Number of Analyses	Grain Size	Total Organic Carbon (EPA 9060)	PCB Aroclors (Fox River method)	Drying and Grinding
OU3	1	3	1	4	x	x	x	x
OU4	1	15	1	16	x	x	x	x

Updated by: TMK1
Checked by: TRN

Table 3-10
OU3 and OU4 Chemical Isolation Layer Sampling Locations

OU	Sample ID	Northing (ft.)	Easting (ft.)	Approximate Water Depth (ft.)
OU3	FYY-3-CB2-1-1-C3	220708.04	2469780.20	14.8
	FYY-3-CB3B-1-1-C3	225895.96	2472623.30	13
	FYY-3-CB5-1-1-C3	227451.42	2473353.11	17.3
OU4	FYY-4-CB6-1-1-C2	232010.84	2473551.81	8.7
	FYY-4-CB6-1-1-C4	231844.67	2473574.79	8.5
	FYY-4-CB9A-1-C2	235124.64	2475458.36	20.9
	FYY-4-CB43-2-C20	236294.66	2476244.46	21.8
	FYY-4-CB30-1-C17	234488.89	2474807.43	16.7
	FYY-4-CB33-1-CIL2	238398.62	2477022.23	11.2
	FYY-4-CB45-3-C8	239551.55	2477963.84	20
	FYY-4-CB45-3-C16	239609.74	2477688.91	20.5
	FYY-4-CBD148-1-C4	244033.19	2481091.72	13.3
	FYY-4-CB47-1-C2	243748.00	2480561.82	10.2
	FYY-4-CB52-1-C2	243907.03	2481778.75	12.2
	FYY-4-CB52-1-C10	244004.16	2481726.37	11.6
	FYY-4-CB50-1-C23	245131.01	2482441.78	18.1
	FYY-4-CB33A-1-C1	245469.58	2482758.86	17.8
	FYY-4-CB33A-1-C5	245724.85	2482927.47	18.2

Notes:

YY = last two digits of the sampling year
OU3 coordinates are proposed locations for the 2018 sampling event.
OU4 as-built coordinates of post-construction CIL sample locations provided by TtEC.
Coordinates are in WSPC_NAD83(86).

Prepared by: TMK1
Checked by: TRN

Table 4-1

Sample Containers, Holding Times, and Preservation Requirements

Parameter	Analytical Method	Matrix	Container	Preservation	Minimum Sample	Maximum Holding
TOC - water	SM5310C	Water	Polyethylene / Glass	4º C, H_2SO_4 or H_3PO_4 to pH <2	100 mls	28 days
TSS	SM2540D	Water	1-Liter Polypropylene. Certified Clean	None	1000 mls	7 days
PCB Congeners	EPA 1668A	Water	2-Liter Amber Glass with Teflon® lined cap. Certified clean	4º C. Residual chlorine will be tested at the lab upon receipt. If residual chlorine is present, add 80 mg Sodium Thiosulfate.	1000 mls	1 year
PCB Aroclors	SW 8082A w/automated Soxhlet extraction (EPA 3541)	Fish	Clean Glass Container or Ziplock type Bags	Stored frozen	20 grams	Stored frozen until extraction and analyzed within 40 days of extraction.
Lipid Content	Pace SOP	Fish	Plastic Bags	Stored frozen	20 grams	Stored frozen until extraction and analyzed within 40 days of extraction.
Mercury	EPA 7471	Fish	Plastic Bags	Stored frozen	1 gram	Stored frozen until extraction and analyzed within 40 days of extraction.
PCB Aroclors	Fox River method	Sediment	Plastic Bags	4º C or frozen	100 g wet.	14 days or 1 year frozen. Hold time is suspended once sediments are dried.
TOC - sediment (1)	EPA 9060A	Sediment	Plastic Bags	Stored frozen	100 g wet.	28 days
Grain Size (1)	ASTM D422	Sediment	Plastic Bags	Stored frozen	1 gallon	—

(1) Chemical Isolation Layer (CIL) only, not required for Monitored Natural Recovery sediment samples. In the event that PCB concentration is detected in the CIL and it becomes necessary to assess correlation of PCB concentration to particle size distribution and TOC levels in the CIL samples, grain size and TOC analyses will be performed on the CIL and underlying sediment samples.

Prepared by: RLP1
Checked by: SVF
Updated by: Test America and Pace Analytical 11/17/20
Note (1) added by TMK1: 9/14/21

Table 4-2
Analytical Methods, Detection Limits, and Control Limits

Analytical Parameter	Matrix	Proposed Laboratory	Analysis Method(s)	Laboratory SOP Number	Reporting Limit	Method Detection Limit	Units
Aroclor 1016	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1221	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1232	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1242	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1248	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1254	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Aroclor 1260	Tissue	Pace	SW 8082A w/automated Soxhlet extraction (EPA 3541)	ENV-SOP-GBAY-0082 & ENV-SOP-GBAY-0129	25.0	8.21	µg/kg
Lipids	Tissue	Pace	Pace SOP	ENV-SOP-GBAY-0129 & ENV-SOP-GBAY-0131	0.1	0.1	%
TOC	Water	Pace	SM5310C	ENV-SOP-GBAY-0040	0.5	0.1384	mg/L
TSS	Water	Pace	SM2540D	ENV-SOP-GBAY-0044	10.0	4.75	mg/L
PCB Congeners	Water	TestAmerica	EPA 1668A	KNOX-ID-0013 & KNOXOP0021r9	0.020 - 0.031 (See Table 4-3)	0.020 - 0.031 (See Table 3-11)	ng/L
TOC (1)	Sediment	Pace	EPA 9060A	ENV-SOP-GBAY-0049	600	179	mg/kg
Aroclor 1016	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1221	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1232	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1242	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1248	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1254	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg
Aroclor 1260	Sediment	Pace	Fox River Method	ENV-SOP-GBAY-0079	50.0	15.22	µg/kg

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-5 scope of work.

(1) Chemical Isolation Layer (CIL) only, not required for Monitored Natural Recovery sediment samples. In the event that PCB concentration is detected in the CIL and it becomes necessary to assess correlation of PCB concentration to particle size distribution and TOC levels in the CIL samples, grain size and TOC analyses will be performed on the CIL and underlying sediment samples.

Originally prepared by: RLP1
Updated by: Test America and Pace Analytical 11/17/20
Note (1) added by TMK1: 9/14/21

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
2051-60-7	1	0.00128	0.02	0.02	NA	50-150
2051-61-8	2	0.00114	0.02	0.02	NA	
2051-62-9	3	0.00105	0.02	0.02	NA	50-150
13029-08-8	4	0.01263	0.03	0.0314	NA	50-150
16605-91-7	5	0.0079	0.02	0.02	NA	
25569-80-6	6	0.00726	0.02	0.02	NA	
33284-50-3	7	0.00759	0.02	0.02	NA	
34883-43-7	8	0.0073	0.03	0.0269	NA	
34883-39-1	9	0.00763	0.02	0.02	NA	
33146-45-1	10	0.00783	0.02	0,02	NA	
2050-67-1	11	0.00755	0.03	0.0239	NA	
2974-92-7	12	0.0073	0.04	0.0259	NA	
2974-90-5	13	0.00729	0.04	0.0259	NA	
34883-41-5	14	0.00719	0.02	0.02	NA	
2050-68-2	15	0.00637	0.02	0.02	NA	50-150
38444-78-9	16	0.00731	0.02	0.02	NA	
37680-66-3	17	0.00589	0.02	0.02	NA	
37680-65-2	18	0.00487	0.04	0.0224	NA	
38444-73-4	19	0.00636	0.02	0.02	NA	50-150
38444-84-7	20	0.00216	0.04	0.02	NA	
55702-46-0	21	0.00223	0.04	0.02	NA	
38444-85-8	22	0.00234	0.02	0.02	NA	
55720-44-0	23	0.0024	0.02	0.02	NA	
55702-45-9	24	0.00427	0.02	0.02	NA	
55712-37-3	25	0.00203	0.02	0.02	NA	
38444-81-4	26	0.00224	0.04	0.02	NA	
38444-76-7	27	0.00416	0.02	0.02	NA	
7012-37-5	28	0.00216	0.04	0.02	NA	
15862-07-4	29	0.00224	0.04	0.02	NA	
35693-92-6	30	0.00487	0.04	0.0224	NA	
16606-02-3	31	0.0022	0.02	0.02	NA	
38444-77-8	32	0.00382	0.02	0.02	NA	
38444-86-9	33	0.00223	0.04	0.02	NA	
37680-68-5	34	0.00233	0.02	0.02	NA	
37680-69-6	35	0.00231	0.02	0.02	NA	
38444-87-0	36	0.00216	0.02	0.02	NA	
38444-90-5	37	0.00193	0.02	0.02	NA	50-150
53555-66-1	38	0.00221	0.02	0.02	NA	
38444-88-1	39	0.00205	0.02	0.02	NA	
38444-93-8	40	0.00226	0.06	0.02	NA	
52663-59-9	41	0.00226	0.06	0.02	NA	
36559-22-5	42	0.0025	0.02	0.02	NA	
70362-46-8	43	0.00207	0.04	0.02	NA	
41464-39-5	44	0.00203	0.06	0.02	NA	
70362-45-7	45	0.00236	0.04	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
41464-47-5	46	0.00275	0.02	0.02	NA	
2437-79-8	47	0.00203	0.06	0.02	NA	
70362-47-9	48	0.00226	0.02	0.02	NA	
41464-40-8	49	0.00193	0.04	0.02	NA	
62796-65-0	50	0.00227	0.04	0.02	NA	
68194-04-7	51	0.00236	0.04	0.02	NA	
35693-99-3	52	0.00217	0.02	0.02	NA	
41464-41-9	53	0.00227	0.04	0.02	NA	
15968-05-5	54	0.00342	0.02	0.02	NA	
74338-24-2	55	0.0017	0.02	0.02	NA	
41464-43-1	56	0.00168	0.02	0.02	NA	
70424-67-8	57	0.00167	0.02	0.02	NA	
41464-49-7	58	0.00163	0.02	0.02	NA	
74472-33-6	59	0.00164	0.06	0.02	NA	
33025-41-1	60	0.00165	0.02	0.02	NA	
33284-53-6	61	0.00158	0.08	0.02	NA	
54230-22-7	62	0.00164	0.06	0.02	NA	
74472-34-7	63	0.00156	0.02	0.02	NA	
52663-58-8	64	0.00164	0.02	0.02	NA	
33284-54-7	65	0.00203	0.06	0.02	NA	
32598-10-0	66	0.00155	0.02	0.02	NA	
73575-53-8	67	0.00146	0.02	0.02	NA	
73575-52-7	68	0.00151	0.02	0.02	NA	
60233-24-1	69	0.00193	0.04	0.02	NA	
32598-11-1	70	0.00158	0.08	0.02	NA	
41464-46-4	71	0.00226	0.06	0.02	NA	
41464-42-0	72	0.00161	0.02	0.02	NA	
74338-23-1	73	0.00207	0.04	0.02	NA	
32690-93-0	74	0.00158	0.08	0.02	NA	
32598-12-2	75	0.00164	0.06	0.02	NA	
70362-48-0	76	0.00158	0.08	0.02	NA	
32598-13-3	77	0.00145	0.02	0.02	NA	50-150
70362-49-1	78	0.00161	0.02	0.02	NA	
41464-48-6	79	0.00136	0.02	0.02	NA	
33284-52-5	80	0.00145	0.02	0.02	NA	
70362-50-4	81	0.0016	0.02	0.02	NA	50-150
52663-62-4	82	0.00358	0.02	0.02	NA	
60145-20-2	83	0.00371	0.04	0.02	NA	
52663-60-2	84	0.00362	0.02	0.02	NA	
65510-45-4	85	0.00256	0.06	0.02	NA	
55312-69-1	86	0.00257	0.12	0.02	NA	
38380-02-8	87	0.00257	0.12	0.02	NA	
55215-17-3	88	0.00319	0.04	0.02	NA	
73575-57-2	89	0.00346	0.02	0.02	NA	
68194-07-0	90	0.00268	0.06	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
68194-05-8	91	0.00319	0.04	0.02	NA	
52663-61-3	92	0.00324	0.02	0.02	NA	
73575-56-1	93	0.00313	0.04	0.02	NA	
73575-55-0	94	0.00342	0.02	0.02	NA	
38379-99-6	95	0.00313	0.02	0.02	NA	
73575-54-9	96	0.00238	0.02	0.02	NA	
41464-51-1	97	0.00257	0.12	0.02	NA	
60233-25-2	98	0.00318	0.04	0.02	NA	
38380-01-7	99	0.00255	0.04	0.02	NA	
39485-83-1	100	0.00313	0.04	0.02	NA	
37680-73-2	101	0.00268	0.06	0.02	NA	
68194-06-9	102	0.00318	0.04	0.02	NA	
60145-21-3	103	0.00293	0.02	0.02	NA	
56558-16-8	104	0.00231	0.02	0.02	NA	50-150
32598-14-4	105	0.00141	0.02	0.02	NA	50-150
70424-69-0	106	0.00157	0.02	0.02	NA	
70424-68-9	107	0.00139	0.02	0.02	NA	
70362-41-3	108	0.00154	0.04	0.02	NA	
74472-35-8	109	0.00257	0.12	0.02	NA	
38380-03-9	110	0.00227	0.04	0.02	NA	
39635-32-0	111	0.00218	0.02	0.02	NA	
74472-36-9	112	0.00255	0.02	0.02	NA	
68194-10-5	113	0.00268	0.06	0.02	NA	
74472-37-0	114	0.00125	0.02	0.02	NA	50-150
74472-38-1	115	0.00227	0.04	0.02	NA	
18259-05-7	116	0.00256	0.06	0.02	NA	
68194-11-6	117	0.00256	0.06	0.02	NA	
31508-00-6	118	0.00131	0.02	0.02	NA	50-150
56558-17-9	119	0.00257	0.12	0.02	NA	
68194-12-7	120	0.0021	0.02	0.02	NA	
56558-18-0	121	0.00229	0.02	0.02	NA	
76842-07-4	122	0.00162	0.02	0.02	NA	
65510-44-3	123	0.0013	0.02	0.02	NA	50-150
70424-70-3	124	0.00154	0.04	0.02	NA	
74472-39-2	125	0.00257	0.12	0.02	NA	
57465-28-8	126	0.00159	0.02	0.02	NA	50-150
39635-33-1	127	0.00143	0.02	0.02	NA	
38380-07-3	128	0.0022	0.04	0.02	NA	
55215-18-4	129	0.00225	0.08	0.02	NA	
52663-66-8	130	0.00286	0.02	0.02	NA	
61798-70-7	131	0.00288	0.02	0.02	NA	
38380-05-1	132	0.00281	0.02	0.02	NA	
35694-04-3	133	0.00264	0.02	0.02	NA	
52704-70-8	134	0.00288	0.04	0.02	NA	
52744-13-5	135	0.00405	0.04	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
38411-22-2	136	0.003	0.02	0.02	NA	
35694-06-5	137	0.00215	0.02	0.02	NA	
35065-28-2	138	0.00225	0.08	0.02	NA	
56030-56-9	139	0.00242	0.04	0.02	NA	
59291-64-4	140	0.00242	0.04	0.02	NA	
52712-04-6	141	0.00256	0.02	0.02	NA	
41411-61-4	142	0.00283	0.02	0.02	NA	
68194-15-0	143	0.00288	0.04	0.02	NA	
68194-14-9	144	0.00396	0.02	0.02	NA	
74472-40-5	145	0.00307	0.02	0.02	NA	
51908-16-8	146	0.00232	0.02	0.02	NA	
68194-13-8	147	0.00233	0.04	0.02	NA	
74472-41-6	148	0.00404	0.02	0.02	NA	
38380-04-0	149	0.00233	0.04	0.02	NA	
68194-08-1	150	0.00294	0.02	0.02	NA	
52663-63-5	151	0.00405	0.04	0.02	NA	
68194-09-2	152	0.0029	0.02	0.02	NA	
35065-27-1	153	0.00198	0.04	0.02	NA	
60145-22-4	154	0.00347	0.02	0.02	NA	
33979-03-2	155	0.00281	0.02	0.02	NA	50-150
38380-08-4	156	0.00175	0.04	0.02	NA	50-150
69782-90-7	157	0.00175	0.04	0.02	NA	50-150
74472-42-7	158	0.00172	0.02	0.02	NA	
39635-35-3	159	0.00181	0.02	0.02	NA	
41411-62-5	160	0.00201	0.08	0.02	NA	
74472-43-8	161	0.00188	0.02	0.02	NA	
39635-34-2	162	0.00181	0.02	0.02	NA	
74472-44-9	163	0.00225	0.08	0.02	NA	
74472-45-0	164	0.00215	0.02	0.02	NA	
74472-46-1	165	0.00205	0.02	0.02	NA	
41411-63-6	166	0.0022	0.04	0.02	NA	
52663-72-6	167	0.00154	0.02	0.02	NA	50-150
59291-65-5	168	0.00198	0.04	0.02	NA	
32774-16-6	169	0.00174	0.02	0.02	NA	50-150
35065-30-6	170	0.00198	0.02	0.02	NA	
52663-71-5	171	0.00255	0.04	0.02	NA	
52663-74-8	172	0.00258	0.02	0.02	NA	
68194-16-1	173	0.00255	0.04	0.02	NA	
38411-25-5	174	0.00239	0.02	0.02	NA	
40186-70-7	175	0.00229	0.02	0.02	NA	
52663-65-7	176	10.00182	0.02	0.02	NA	
52663-70-4	177	0.00256	0.02	0.02	NA	
52663-67-9	178	0.00246	0.02	0.02	NA	
52663-64-6	179	0.0018	0.02	0.02	NA	
35065-29-3	180	0.00167	0.04	0.02	NA	

Table 4-3
PCB Congener Reporting Limits

CAS Registry	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Method Detection Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
74472-47-2	181	0.00239	0.02	0.02	NA	
60145-23-5	182	0.00232	0.02	0.02	NA	
52663-69-1	183	0.00229	0.04	0.02	NA	
74472-48-3	184	0.00169	0.02	0.02	NA	
52712-05-7	185	0.00229	0.04	0.02	NA	
74472-49-4	186	0.00184	0.02	0.02	NA	
52663-68-0	187	0.00217	0.02	0.02	NA	
74487-85-7	188	0.00176	0.02	0.02	NA	50-150
39635-31-9	189	0.0016	0.02	0.02	NA	50-150
41411-64-7	190	0.00185	0.02	0.02	NA	
74472-50-7	191	0.0018	0.02	0.02	NA	
74472-51-8	192	0.00195	0.02	0.02	NA	
69782-91-8	193	0.00195	0.04	0.02	NA	
35694-08-7	194	0.00209	0.02	0.02	NA	
52663-78-2	195	0.00229	0.02	0.02	NA	
42740-50-1	196	0.00313	0.02	0.02	NA	
33091-17-7	197	0.00229	0.02	0.02	NA	
68194-17-2	198	0.00311	0.04	0.02	NA	
52663-75-9	199	0.00311	0.04	0.02	NA	
52663-73-7	200	0.00229	0.02	0.02	NA	
40186-71-8	201	0.00228	0.02	0.02	NA	
2136-99-4	202	0.00241	0.02	0.02	NA	50-150
52663-76-0	203	0.00287	0.02	0.02	NA	
74472-52-9	204	0.00235	0.02	0.02	NA	
74472-53-0	205	0.00146	0.02	0.02	NA	50-150
40186-72-9	206	0.00146	0.02	0.02	NA	50-150
52663-79-3	207	0.00132	0.02	0.02	NA	
52663-77-1	208	0.00127	0.02	0.02	NA	50-150
2051-24-3	209	0.00096	0.02	0.02	NA	50-150

This table was adapted from the *Fox River Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA, 2009a). Modifications were made to reflect the OU1-5 scope of work.

[1] MS/MSD or LCS/LCSD not required by method

EDL = estimated detection limit

NA = Not applicable.

RPD = relative percent difference

Originally prepared by: BMS1

Updated by: John Reynolds-TestAmerica 3/13/18

Checked by: SDJ

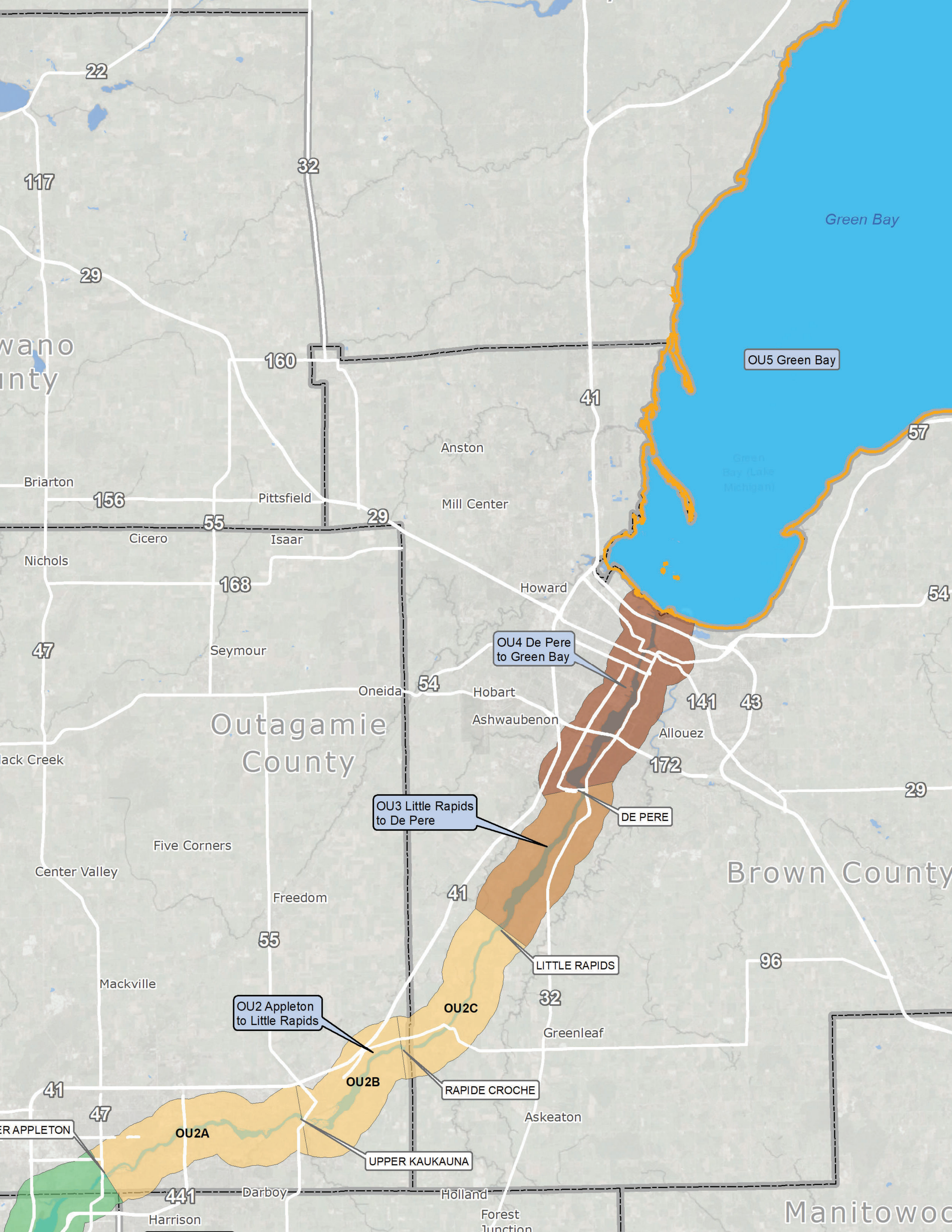
Table 5-1

Summary of Updated Lower Fox River Flow Rates(1)

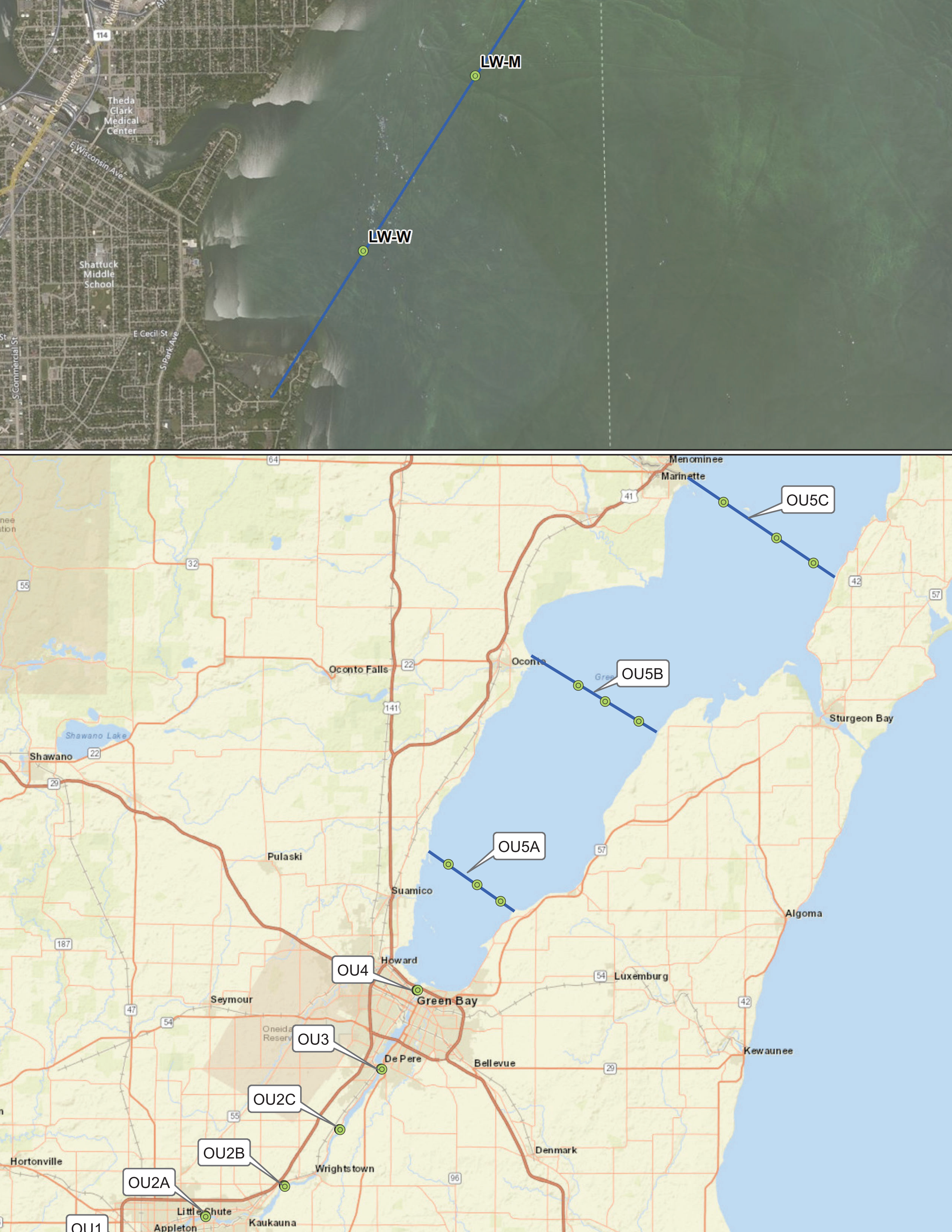
Recurrence Interval (Years)	OU1 Flows at Appleton (cfs) (USGS Station No. 04084445)	OU3 Flows at Rapide Croche (csf) (USGS Station No. 04084500)(2)	OU4 Flows at Oil Tank Depot (cfs) (USGS Station No. 040851385)
2	N/A	12,800	14,300
5	15,000	16,600	18,800
10	16,500	18,500	21,900
20	N/A	19,800	23,700
25	18,300	20,500	25,900
50	19,500	21,700	29,000
100	20,600	22,800	32,100

1. Flow rates rounded to the nearest one-hundred.
2. The proposed ratio for determining OU3 flows using the OU1 flows is described in the Foth March 13, 2019 memo, *OU3 River Flow Determination and Revised Recurrence Intervals for OU1, OU3, and OU4*.

Figures

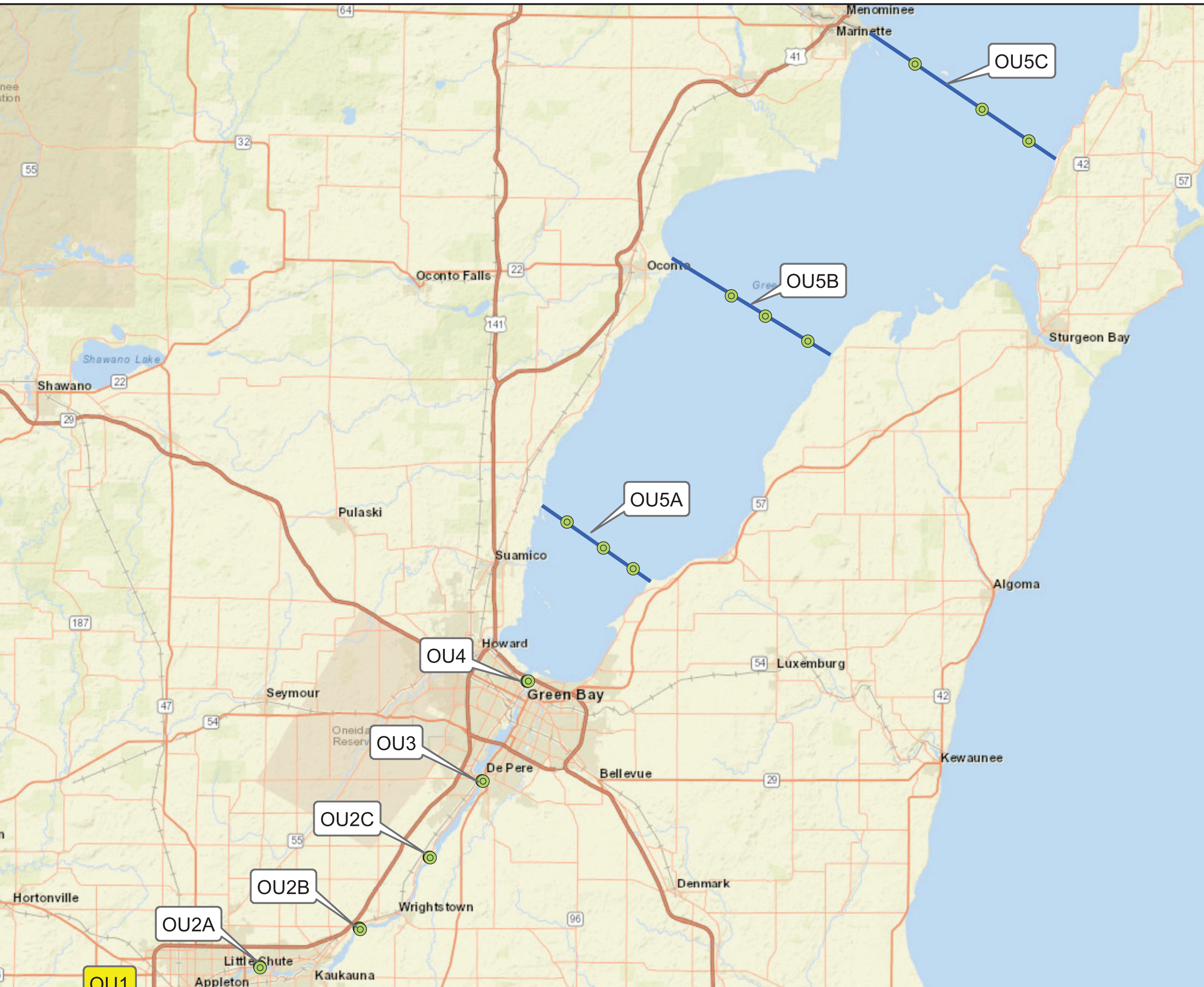


Green Bay
OU5 Green Bay
OU4 De Pere to Green Bay
OU3 Little Rapids to De Pere
OU2 Appleton to Little Rapids
DE PERE
LITTLE RAPIDS
RAPIDE CROCHE
UPPER KAUKAUNA
ER APPLETON
OU2A
OU2B
OU2C
Outagamie County
Brown County
Manitowoc
wano
unty
Anston
Mill Center
Howard
Hobart
Ashwaubenon
Allouez
Oneida
Seymour
Briarton
Pittsfield
Cicero
Isaar
Nichols
Five Corners
Center Valley
Freedom
Mackville
Greenleaf
Askeaton
Holland
Darboy
Harrison
Forest Junction
ack Creek
22
117
32
29
160
41
57
156
55
168
47
54
141
43
172
96
441



LW-M
LW-W
Theda Clark Medical Center
Shattuck Middle School
E Wisconsin Ave
E Cecil St
S Park Ave
S Commercial St
N Commercial St
114
Menominee
Marinette
OU5C
OU5B
OU5A
OU4
OU3
OU2C
OU2B
OU2A
OU1
Oconto
Oconto Falls
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
Suamico
Howard
Green Bay
Seymour
Oneida Reserv
De Pere
Bellevue
Luxemburg
Algoma
Kewaunee
Denmark
Wrightstown
Hortonville
Little Chute
Appleton
Kaukauna


OU1-W
OU1-M
OU1-E
Palisades Dr
River Oaks Ct
Anton Ct
Riverview Ct
Anton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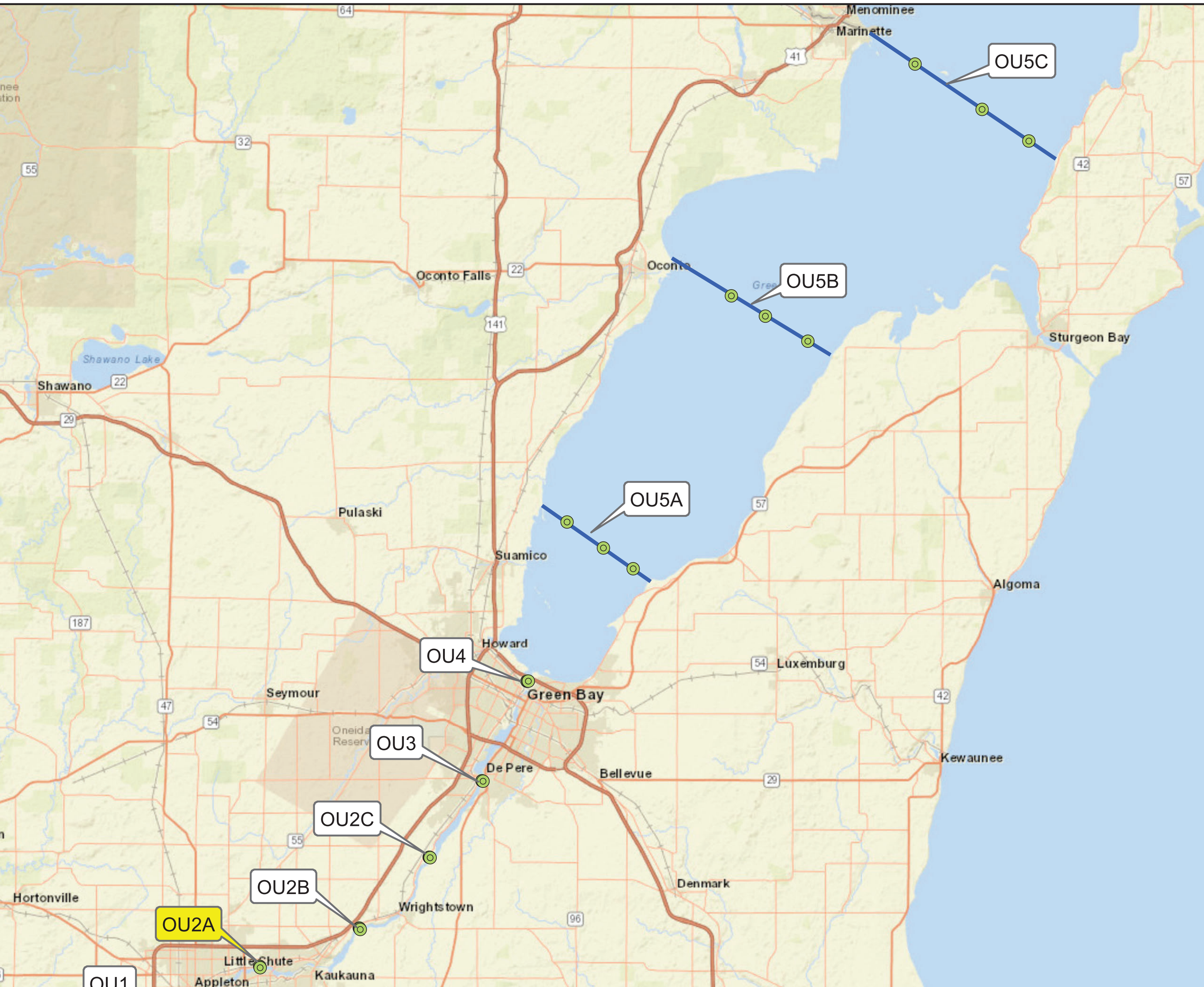
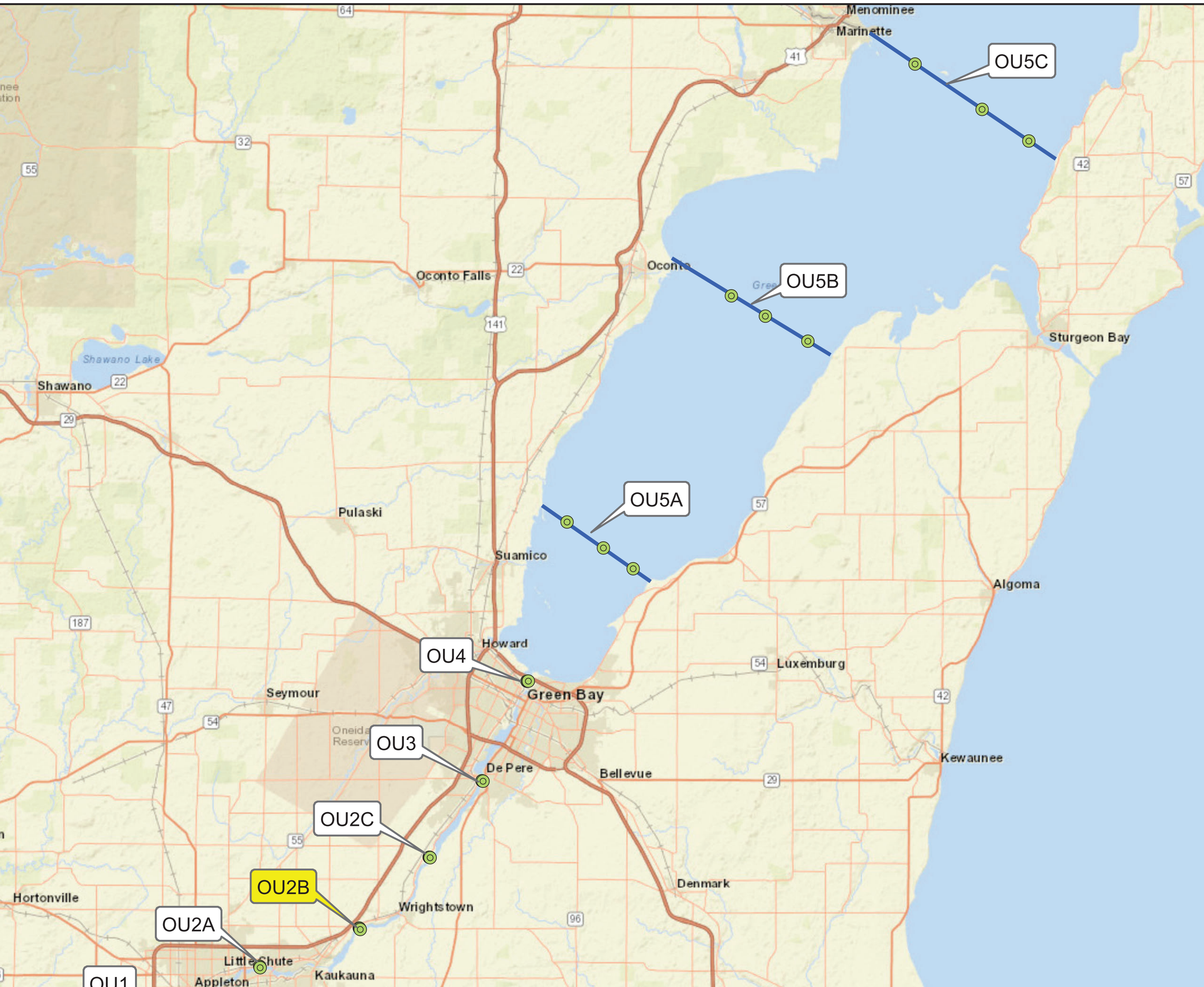
Marinette
OU5C
Oconto
OU5B
Oconto Falls
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
OU5A
Suamico
Algoma
OU4
Howard
Green Bay
Luxemburg
Seymour
Oneida Reserv
OU3
De Pere
Bellevue
Kewaunee
OU2C
Denmark
OU2B
Hortonville
Wrightstown
OU2A
Little Chute
Kaukauna
Appleton
OU1

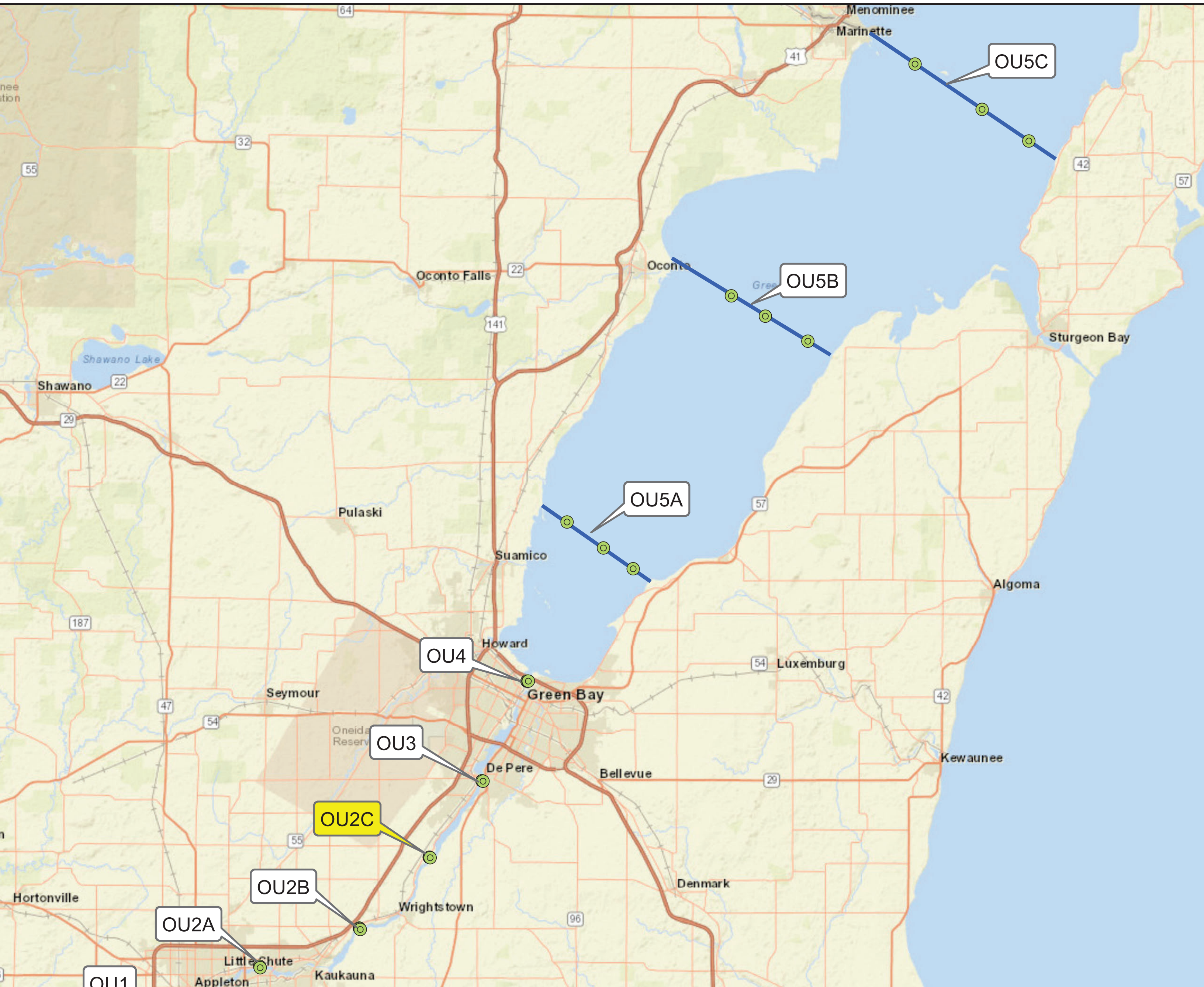

OU2A-M
OU2A-E
Fox
Fox
Kimberly Dam
Beverly St
N Sidney St
N Main St
Floral Dr


Menominee
Marinette
OU5C
Oconto
OU5B
Oconto Falls
Shawano Lake
Shawano
Sturgeon Bay
Pulaski
OU5A
Suamico
Algoma
Howard
OU4
Green Bay
Luxemburg
Seymour
Oneida Reserv
OU3
De Pere
Bellevue
Kewaunee
OU2C
OU2B
Denmark
Wrightstown
Hortonville
OU2A
Little Chute
Kaukauna
Appleton
OU1

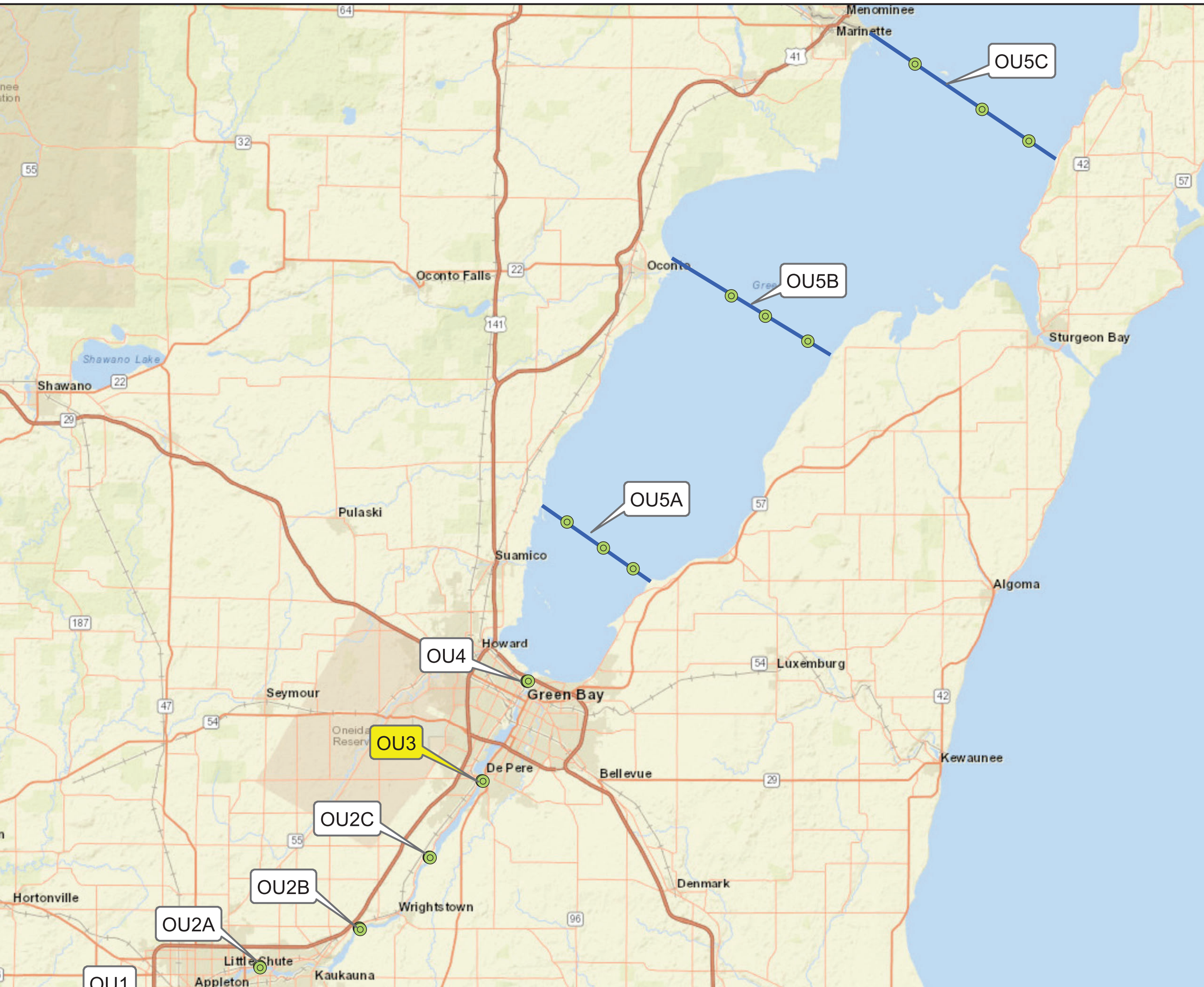

OU2B-W
OU2B-M
OU2B-E
Fox
Fox


Menominee
Marinette
OU5C
OU5B
OU5A
OU4
OU3
OU2C
OU2B
OU2A
OU1
Oconto Falls
Oconto
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
Suamico
Algoma
Howard
Luxemburg
Green Bay
Seymour
De Pere
Bellevue
Kewaunee
Denmark
Hortonville
Wrightstown
Little Chute
Kaukauna
Appleton
64
41
32
55
22
141
42
57
29
187
54
47
96

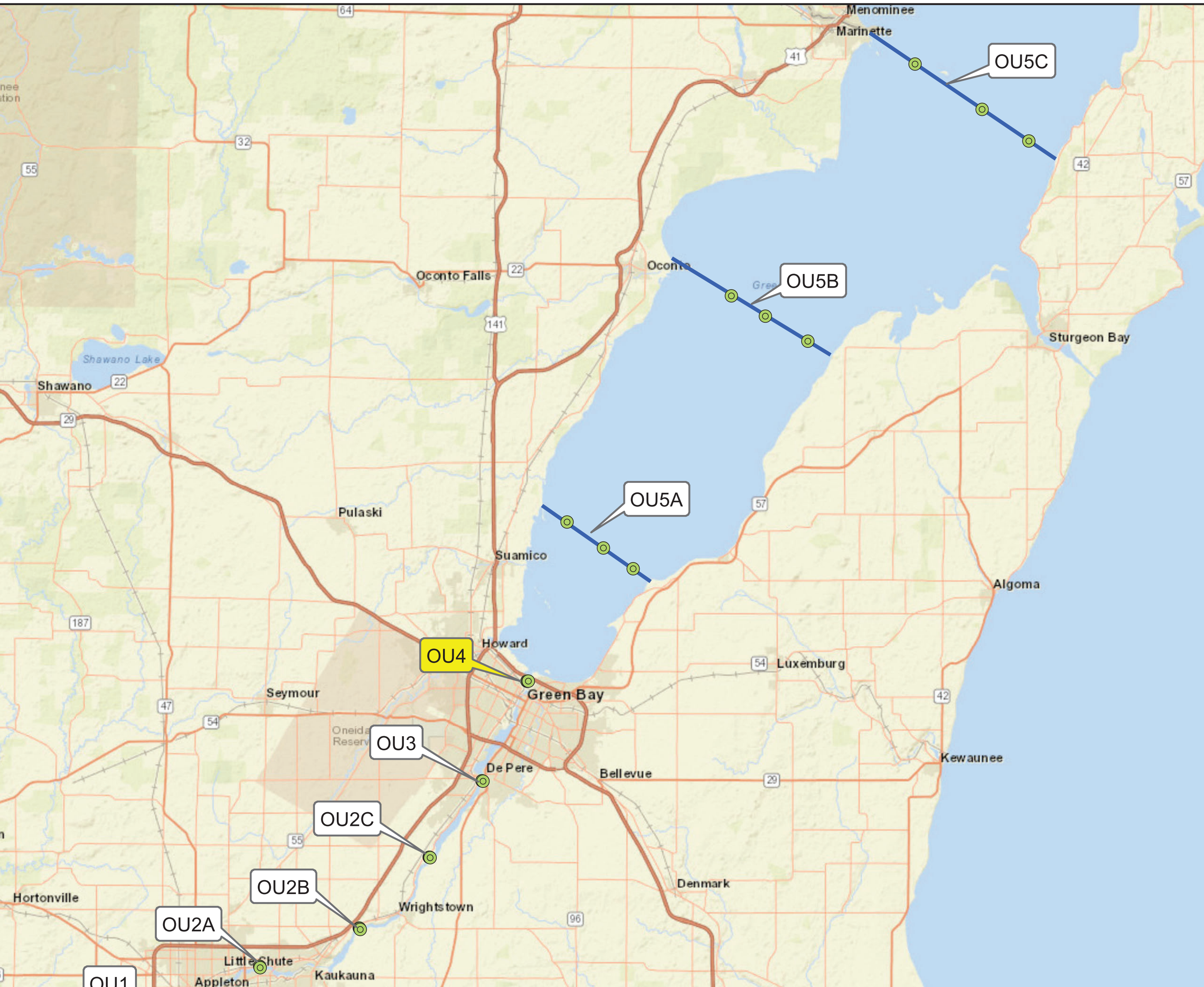

Lost Dauphin
Nelson Rd
OU2C-W
Fox
OU2C-M
OU2C-E
Fox


Menominee
Marinette
OU5C
Oconto Falls
Oconto
OU5B
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
Suamico
OU5A
Algoma
Howard
OU4
Green Bay
Luxemburg
Seymour
Oneida Reserv
OU3
De Pere
Bellevue
Kewaunee
OU2C
Denmark
OU2B
Wrightstown
Hortonville
OU2A
Little Chute
Kaukauna
Appleton
OU1


OU3-W
OU3-M
OU3-E
Burke Hall
Marsh St
Mulva Family Fitness and Sports Center
Stewart St
Pleasant Pl
Fox
Fox River Dr
Bomier St
Bomier St
Cook St
Georgia Dr
Ave

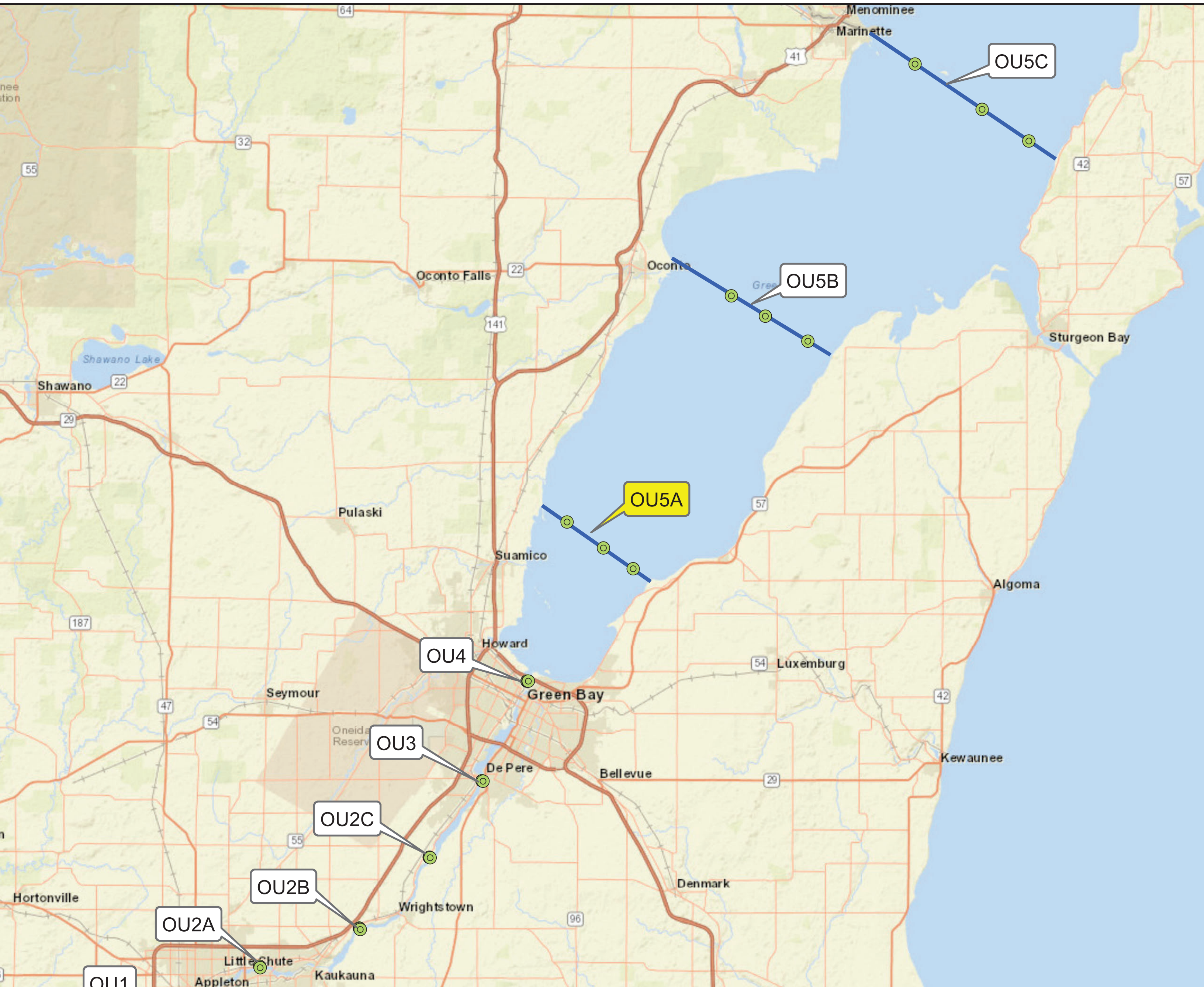

Menominee
Marinette
OU5C
OU5B
OU5A
OU4
OU3
OU2C
OU2B
OU2A
OU1
Oconto
Oconto Falls
Shawano
Shawano Lake
Pulaski
Suamico
Howard
Green Bay
Seymour
De Pere
Bellevue
Wrightstown
Denmark
Hortonville
Little Chute
Appleton
Kaukauna
Luxemburg
Kewaunee
Algoma
Sturgeon Bay

Fox
OU4-W
OU4-M
OU4-E
N Broadway
Alexander St
Warren St

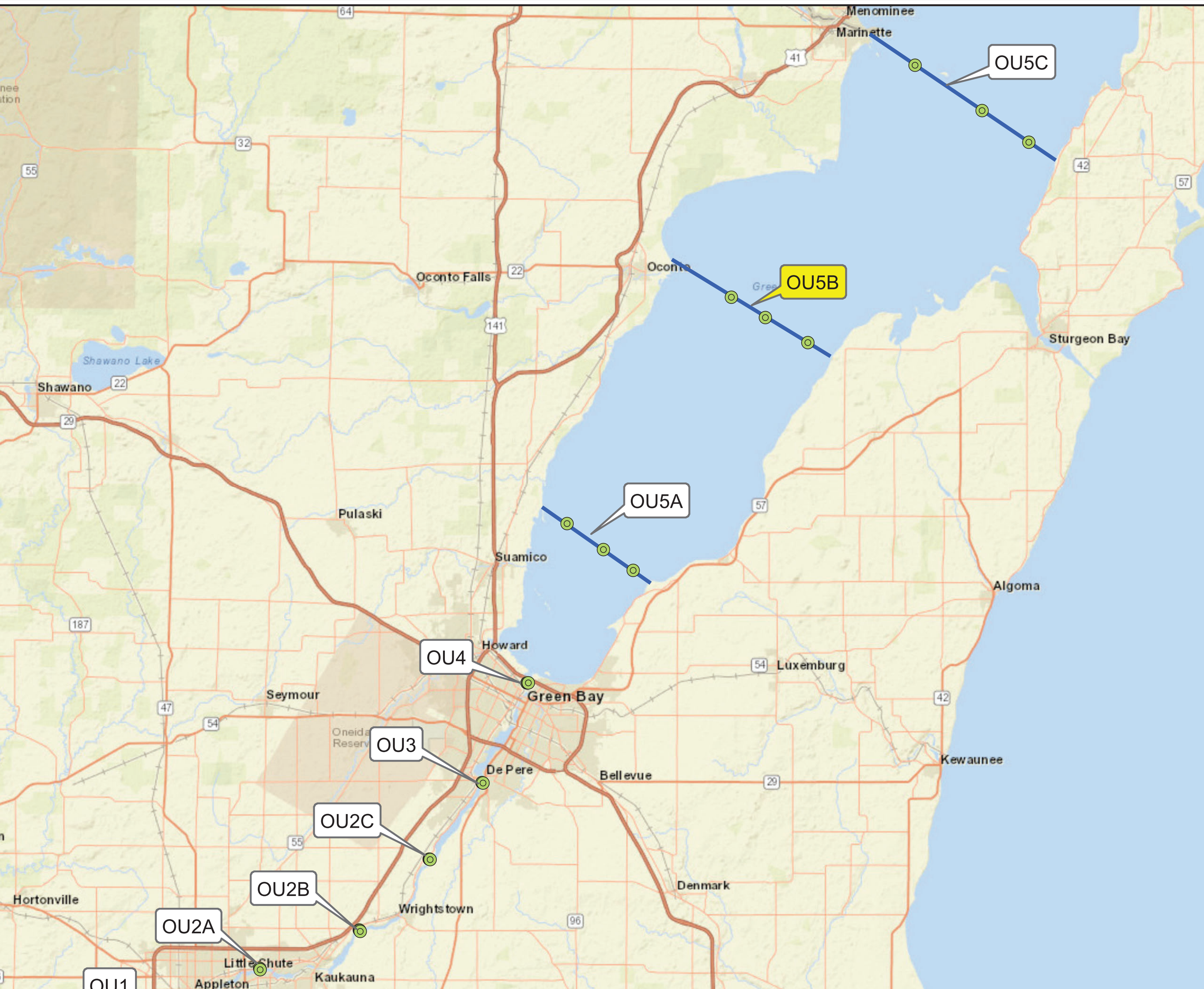


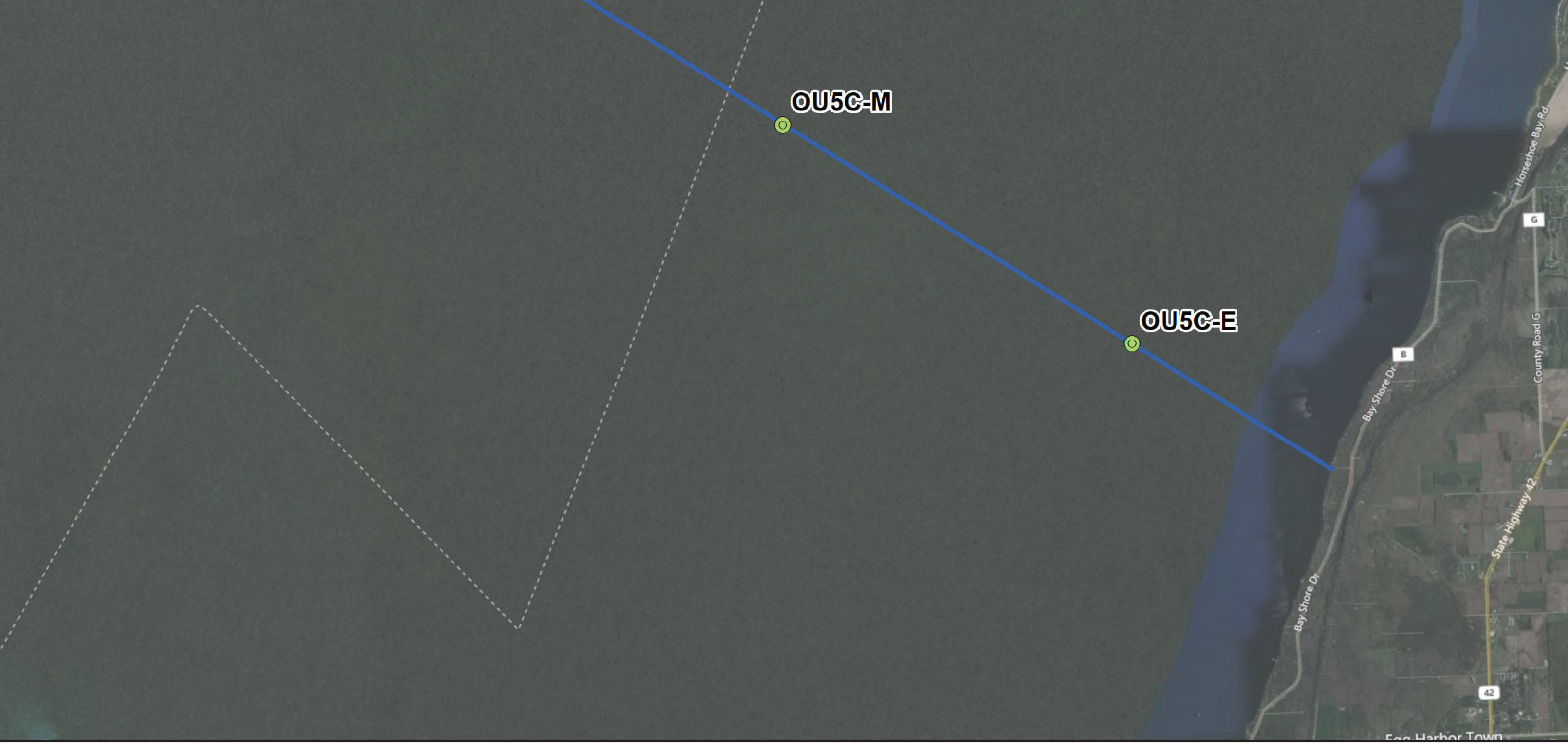
Menominee
Marinette
OU5C
OU5B
OU5A
OU4
OU3
OU2C
OU2B
OU2A
OU1
Oconto
Oconto Falls
Shawano
Shawano Lake
Pulaski
Suamico
Howard
Green Bay
Seymour
De Pere
Bellevue
Sturgeon Bay
Algoma
Luxemburg
Kewaunee
Denmark
Wrightstown
Hortonville
Little Chute
Appleton
Kaukauna


OU5A-M
OU5A-E
Suamico
Peters Marsh
Nicolet Dr
State Highway 57
N New Franken Rd
Fischer Rd
Champion Rd
County Road K


Menominee
Marinette
OU5C
OU5B
OU5A
OU4
OU3
OU2C
OU2B
OU2A
OU1
Oconto Falls
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
Suamico
Algoma
Howard
Green Bay
Luxemburg
Seymour
De Pere
Bellevue
Kewaunee
Denmark
Wrightstown
Hortonville
Little Chute
Appleton
Kaukauna


OU5B-M
OU5B-E
Brussels Rd
County Road N
Sugar Creek County Park


Menominee
Marinette
OU5C
Oconto
OU5B
Oconto Falls
Sturgeon Bay
Shawano Lake
Shawano
Pulaski
OU5A
Suamico
Algoma
Howard
OU4
Green Bay
Luxemburg
Seymour
OU3
De Pere
Bellevue
Kewaunee
OU2C
Denmark
Hortonville
OU2B
Wrightstown
OU2A
Little Chute
Kaukauna
Appleton
OU1


OU5C-M
OU5C-E
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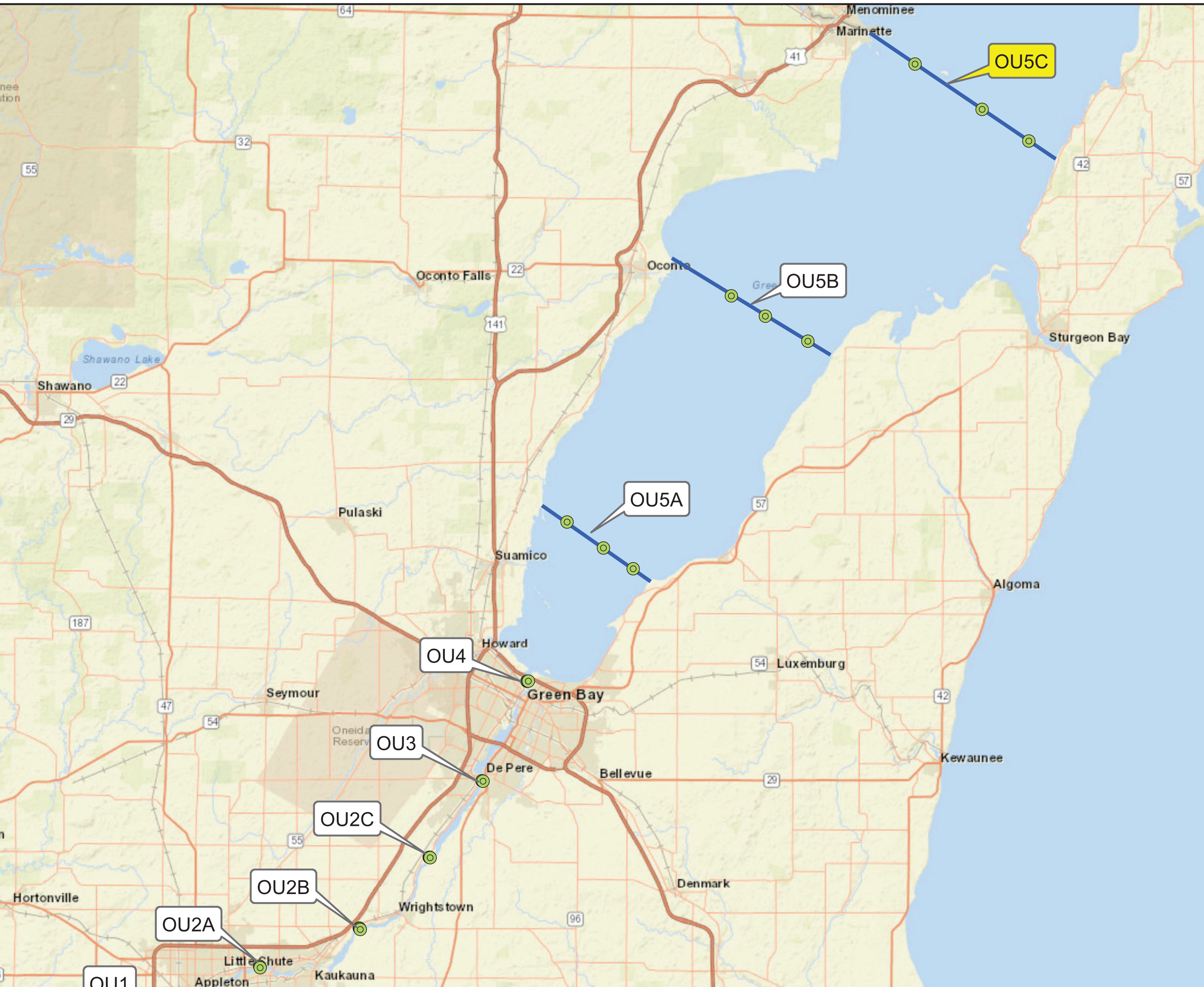
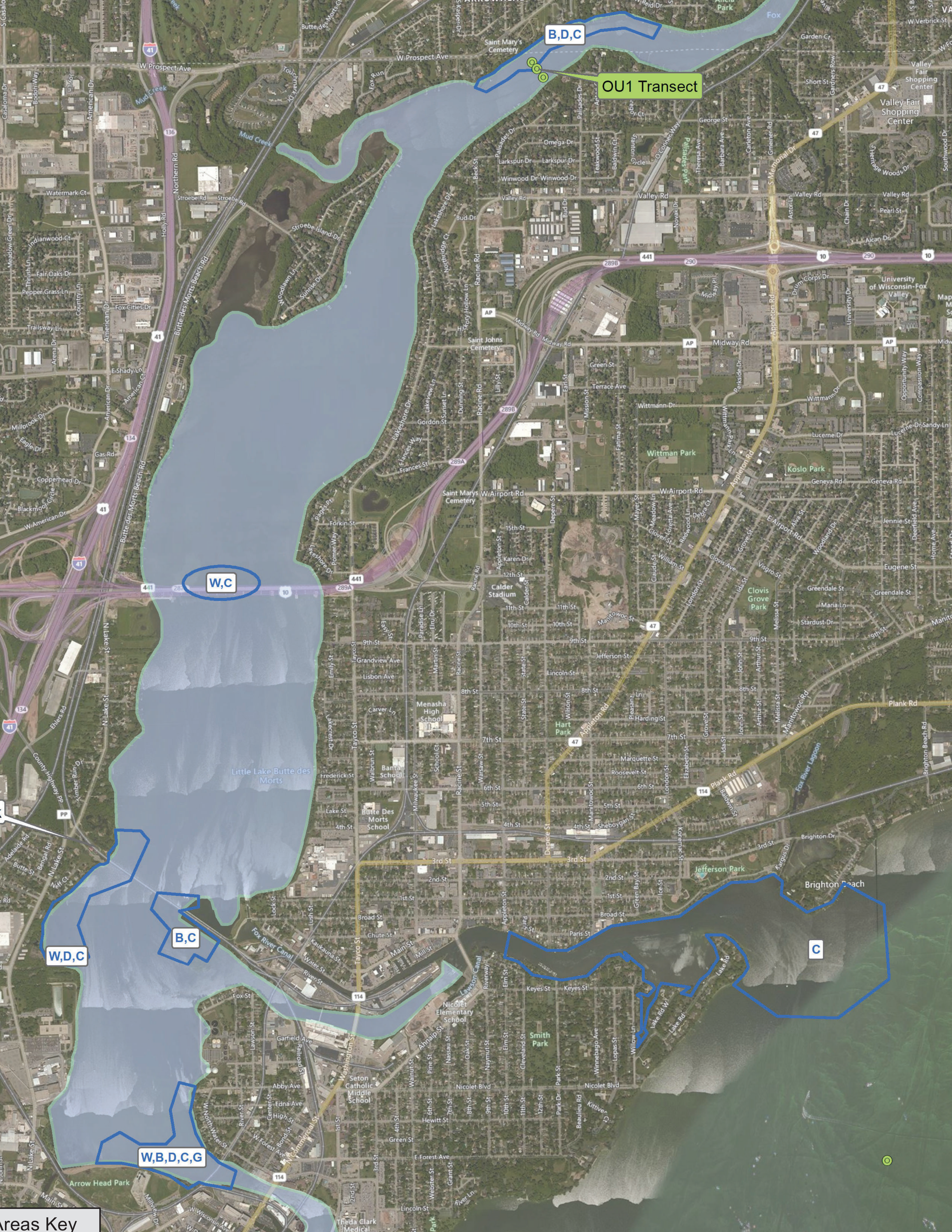
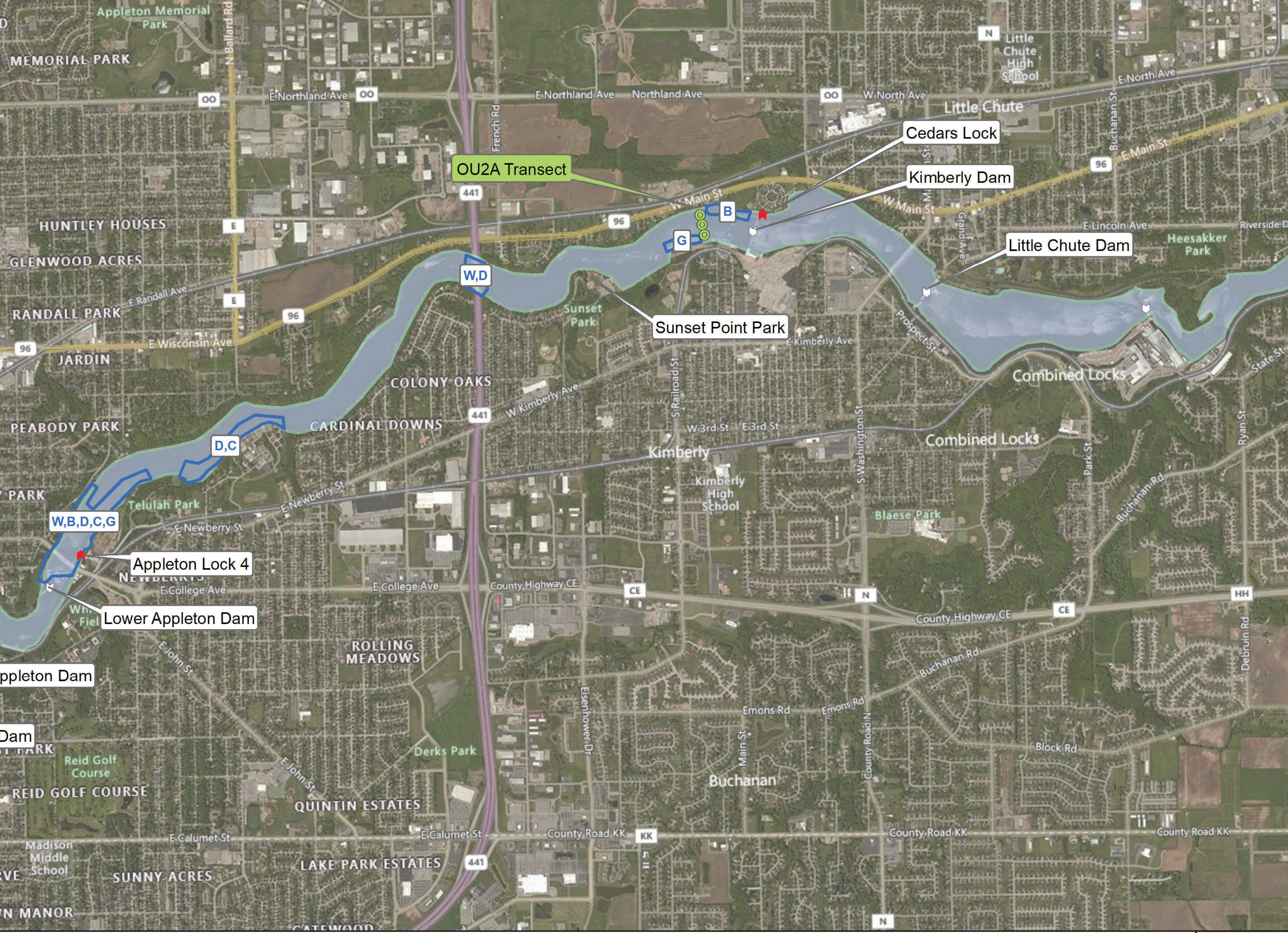
Egg Harbor Town


Menominee
Marinette
OU5C
Oconto
OU5B
Oconto Falls
Shawano Lake
Shawano
Sturgeon Bay
Pulaski
OU5A
Suamico
Algoma
Howard
OU4
Green Bay
Luxemburg
Seymour
OU3
De Pere
Bellevue
Kewaunee
OU2C
Denmark
Hortonville
OU2B
Wrightstown
OU2A
Little Chute
Kaukauna
Appleton
OU1

W,B,D
Village of Harrison
Oshkosh
W,D
NORTH PARK
Stockbridge
B
NORTHSHORE
LUMBER RIVER
Jackson St
Stockbridge Town
Lake Winnebago
Oshkosh
Fox River
D,C,G
S Main St
US Highway 151
B,D
G
Pond du Lac Rd
W,D
Wittman Regional Airport
Brothertown
Black Wolf
D,C,G
S US Highway 45
Calumet
Calumet Harbor
Van Dyne
Lakeshore Dr
Friendship
US Highway 151
St Peter
reas Key



B,D,C
OU1 Transect
W,C
Little Lake Butte des Morts
B,C
W,D,C
C
W,B,D,C,G
Areas Key



LEGEND

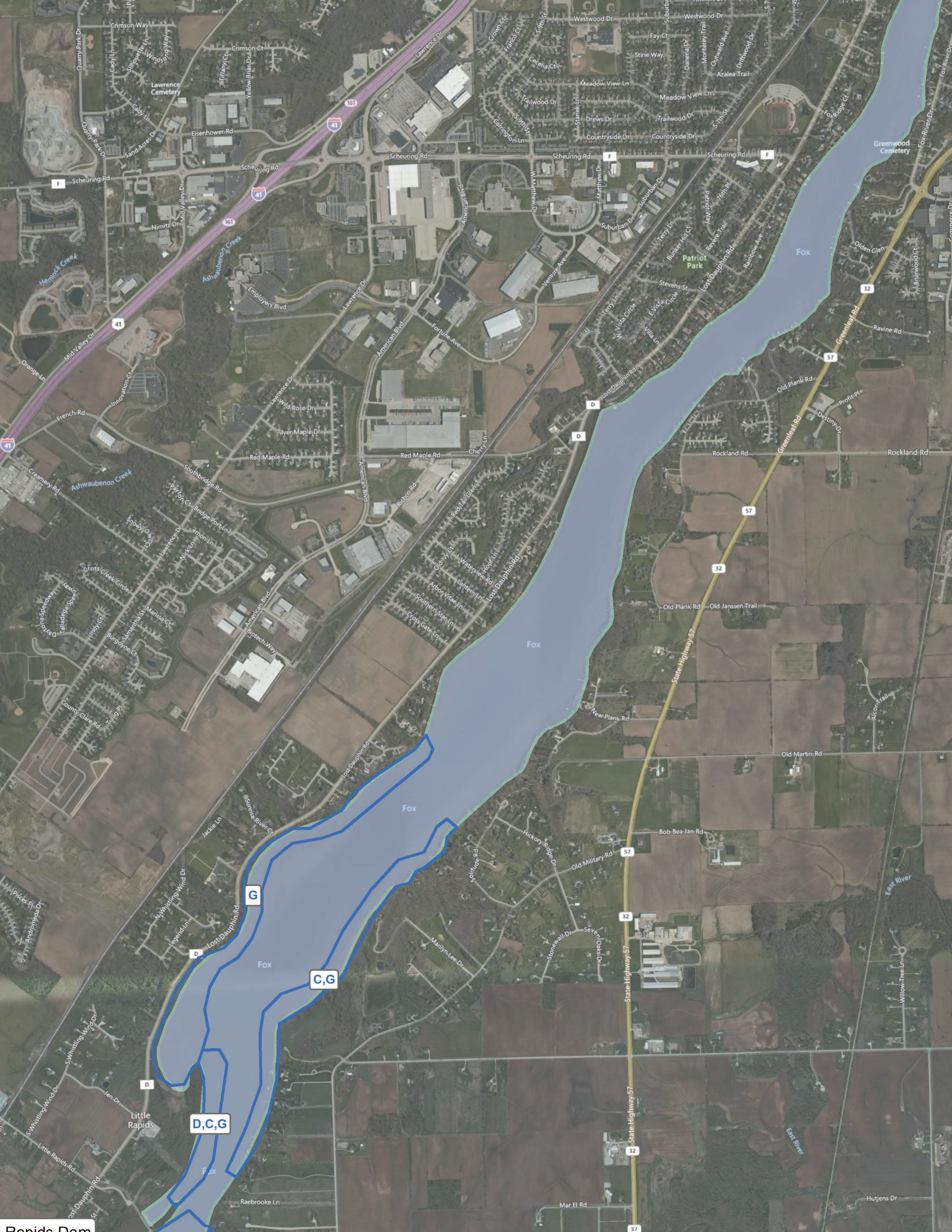
Transect Water Sample Locations

Locks

GLATFELTE

Rapide Croche Lock
Rapide Croche Dam
OU2B Transect
Former Marina Bar
End of Plank Rd.
(Boat Access)
Kaukauna 5 Lock
Grignon Park
G
B,D,C
W,B,D,C,G
Fox
Areas Key

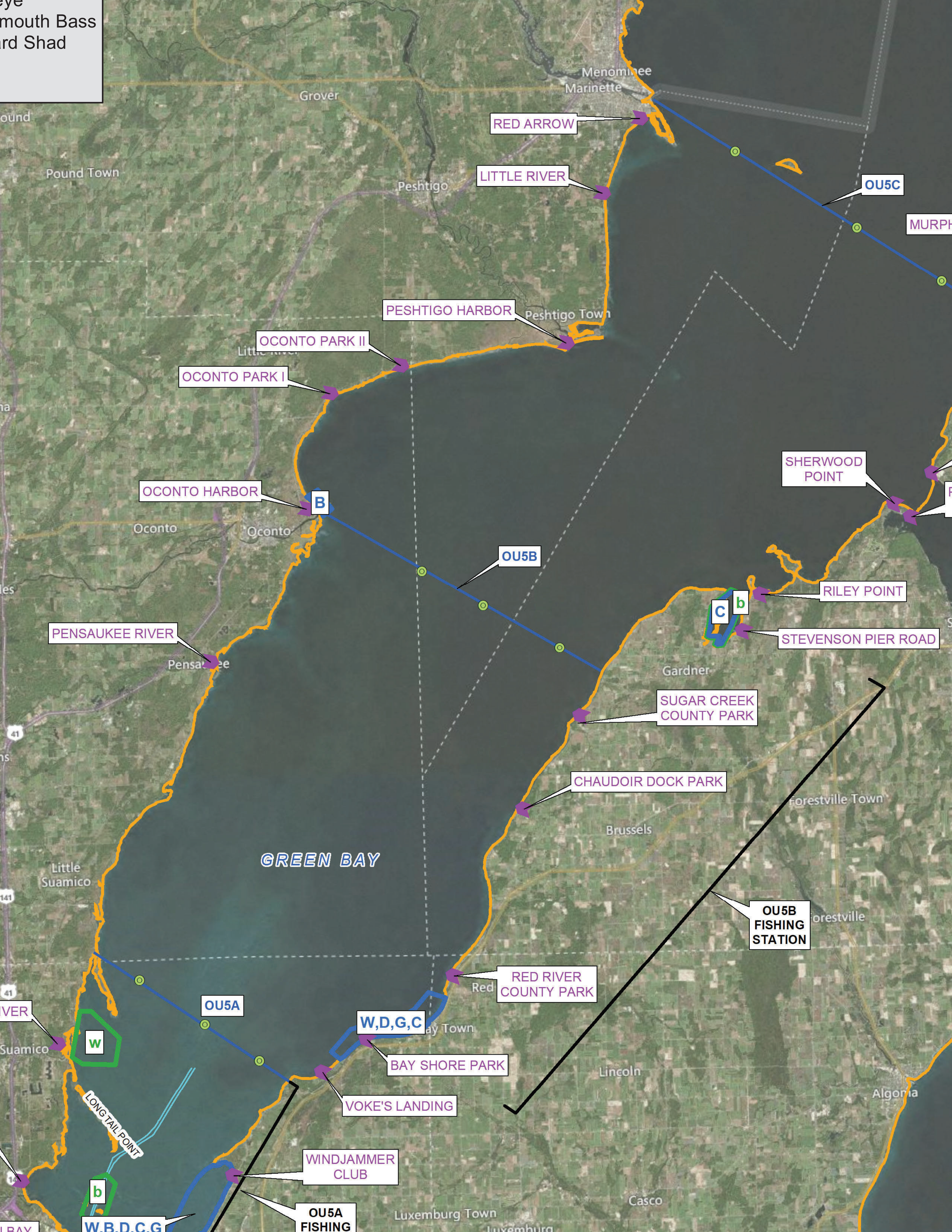

C,B,D
Wrightstown Park
Rapide Croche
Lock and Dam
C,D
C,G



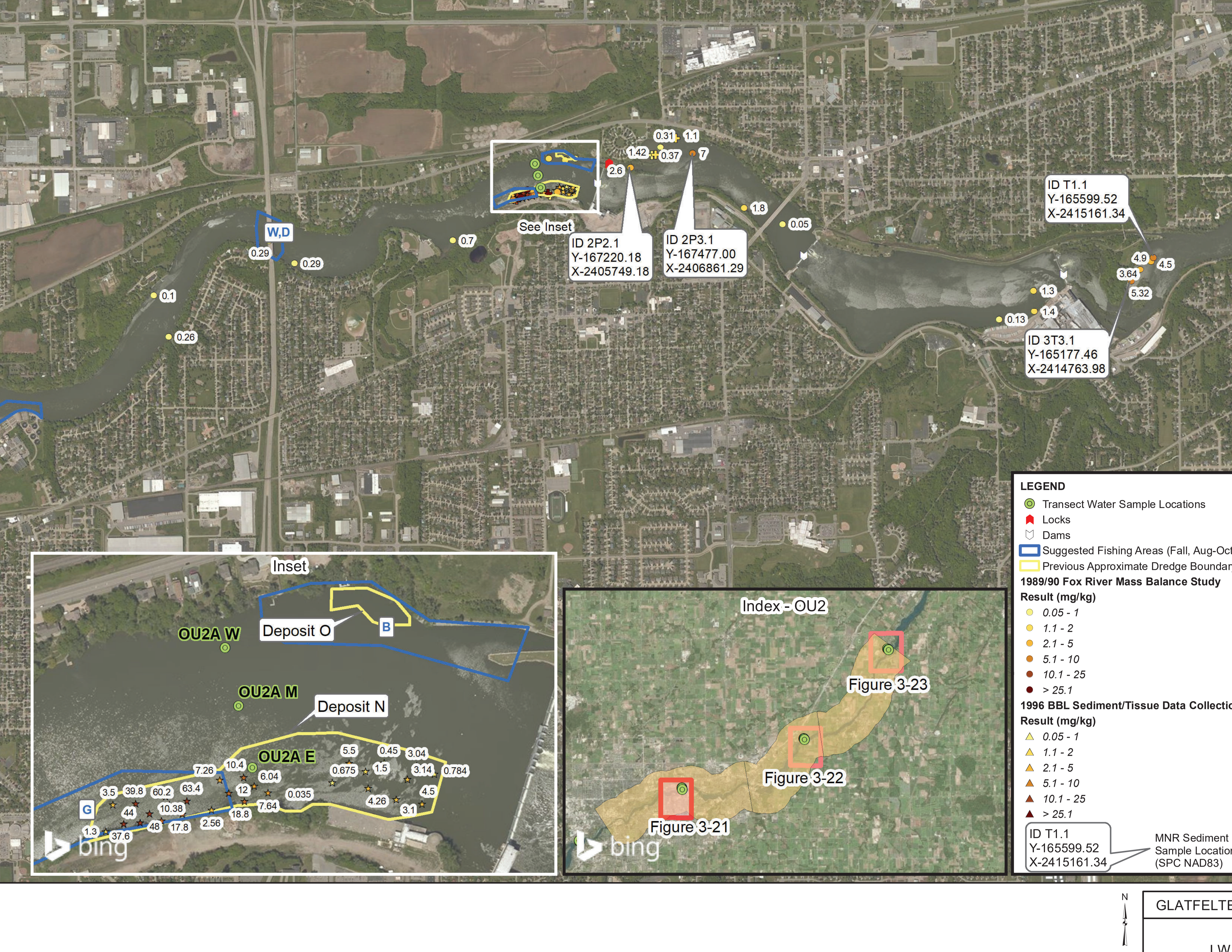
Fox
Fox
Fox
Fox
G
C,G
D,C,G
Rapids Dam
Little Rapids
Patriot Park
Greenwood Cemetery
Lawrence Cemetery
Ashwaubenon Creek
Hemlock Creek
East River
Scheuring Rd
Rockland Rd
Old Plank Rd
Old Martin Rd
Bob Bea Jan Rd
Red Maple Rd
Lost Dauphin Rd
State Highway 57
Greenleaf Rd
American Blvd
Lawrence Dr
Southbridge Rd
French Rd
Raebrooke Ln
Mar El Rd
Hutjens Dr
Old Military Rd
New Plank Rd
Westwood Dr
Meadow View Ln
Countryside Dr
Eisenhower Rd
Crimson Way
Crimson Ct
Mid Valley Dr
Orange Ln
Greenery Rd
Employers Blvd
Biotech Way
Fortune Ave
Venture Ave
Old Janssen Trail
Little Rapids Rd


E Channel Definition
W
FORT JAMES
TURNING BASIN
C,G
w,b
Dutchman Creek
to BR 41/Ashland Ave.
waubenon Creek
R 41/Ashland Ave.
C,G
FOX POINT
COUNTY
OUNDS
DE PERE
DAM
W,D
b


G
OU4
East River
to Monroe Av
B
W
FORT J
TURNIN
C,G
w,b



eye
mouth Bass
rd Shad
Menominee
Marinette
Grover
Pound Town
Peshtigo
RED ARROW
LITTLE RIVER
OU5C
MURPH
PESHTIGO HARBOR
Peshtigo Town
OCONTO PARK II
OCONTO PARK I
OCONTO HARBOR
B
Oconto
OU5B
SHERWOOD POINT
RILEY POINT
C
b
STEVENSON PIER ROAD
Gardner
PENSAUKEE RIVER
SUGAR CREEK COUNTY PARK
CHAUDOIR DOCK PARK
Forestville Town
Brussels
GREEN BAY
Little Suamico
OU5B FISHING STATION
Forestville
RED RIVER COUNTY PARK
OU5A
W,D,G,C
w
Suamico
BAY SHORE PARK
VOKE'S LANDING
LONG TAIL POINT
Lincoln
Algoma
WINDJAMMER CLUB
b
OU5A FISHING
W,B,D,C,G
Luxemburg Town
Casco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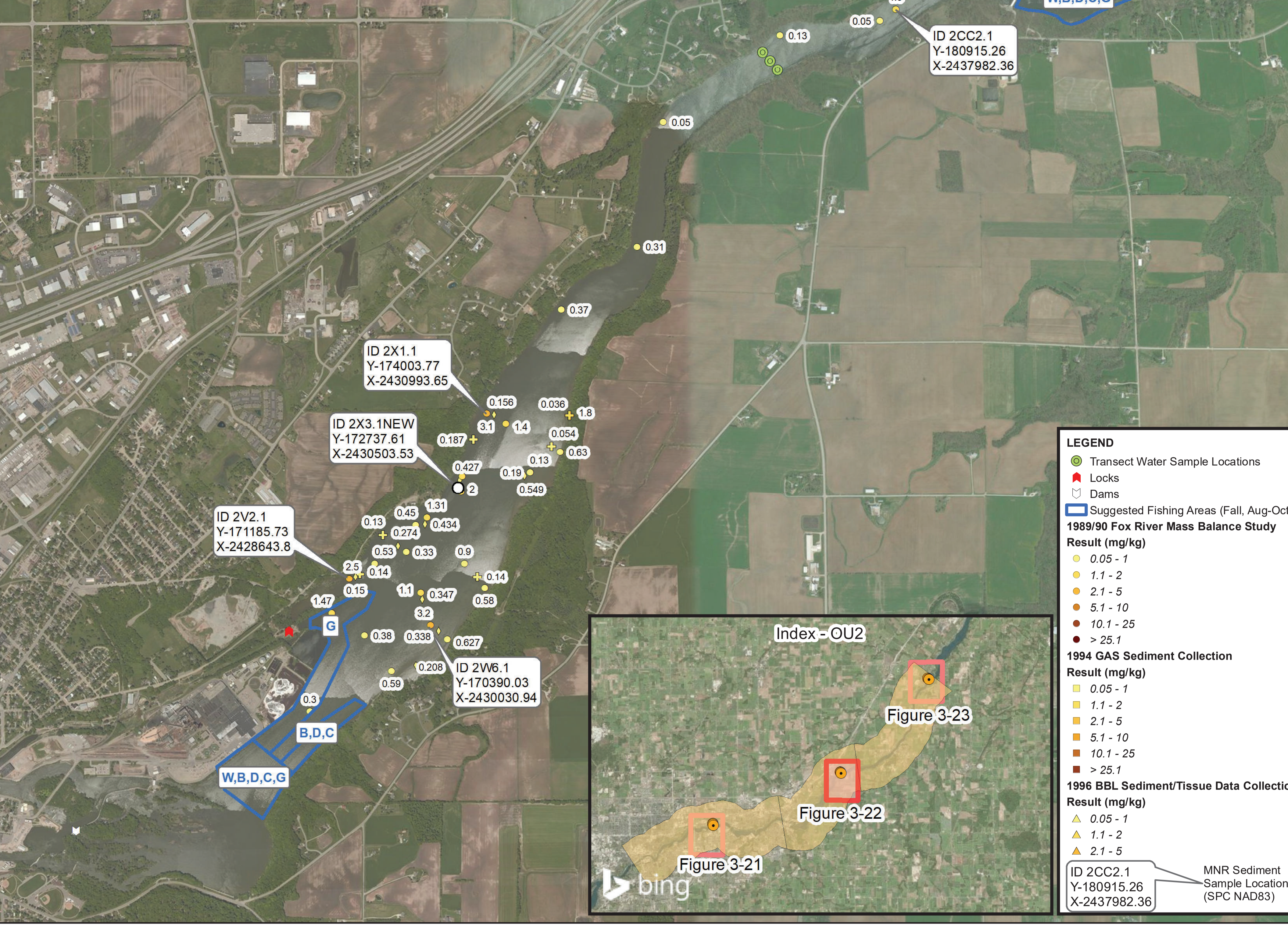
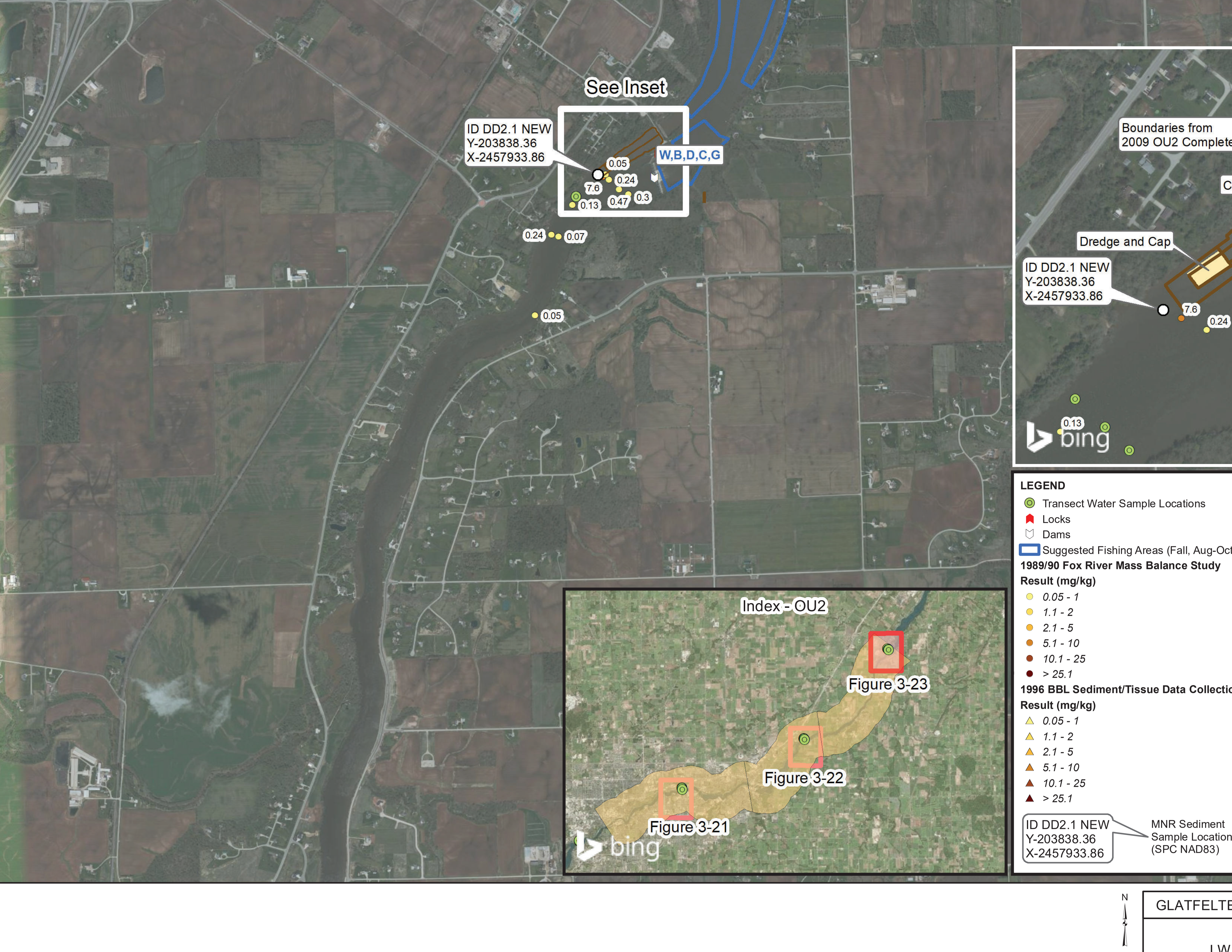
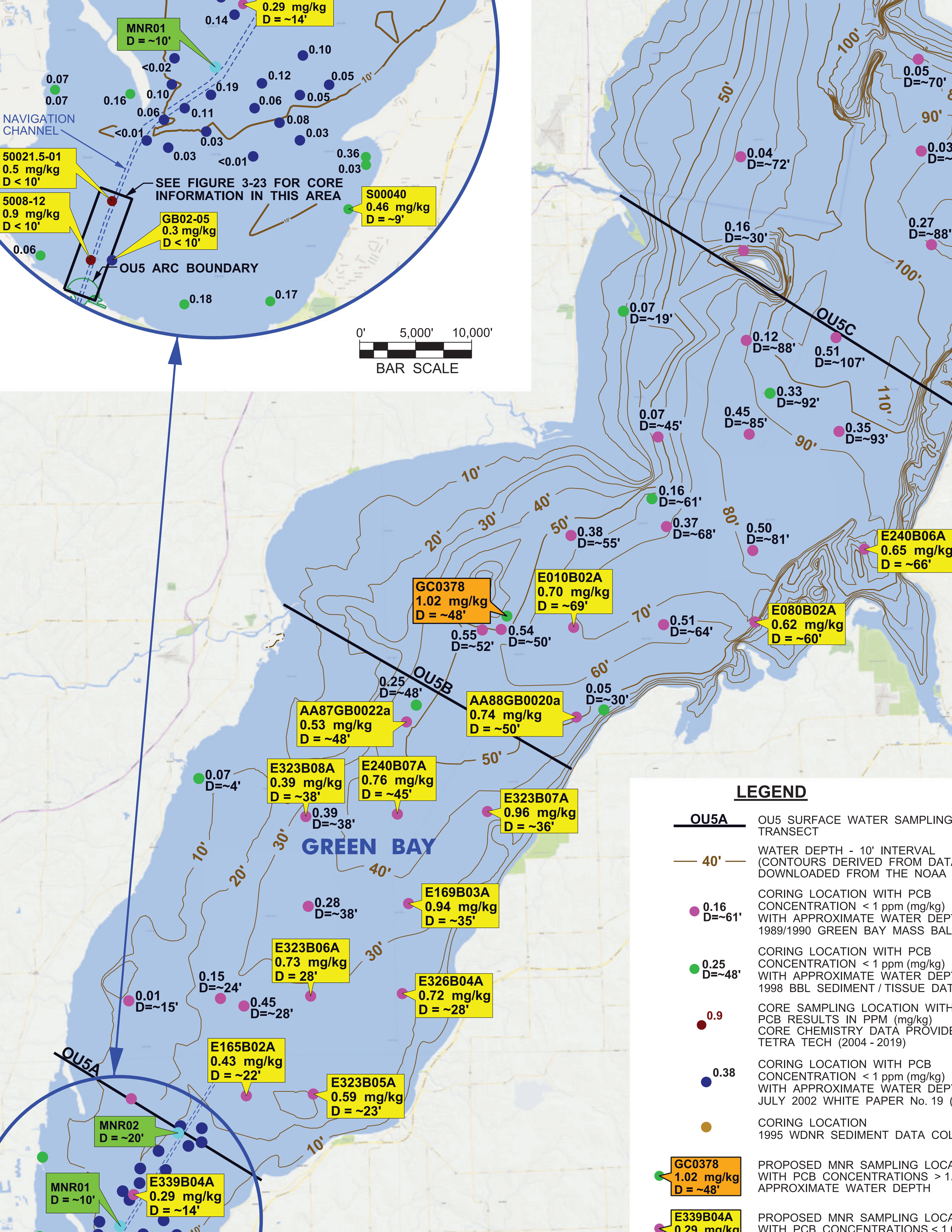
Y-167220.18
X-2405749.18
ID 2P3.1
Y-167477.00
X-2406861.29
See Inset
W,D
Inset
Deposit O
B
OU2A W
OU2A M
Deposit N
OU2A E
G
Index - OU2
Figure 3-23
Figure 3-22
Figure 3-21
LEGEND
Transect Water Sample Locations
Locks
Dams
Suggested Fishing Areas (Fall, Aug-Oct
Previous Approximate Dredge Boundar
1989/90 Fox River Mass Balance Study
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
1996 BBL Sediment/Tissue Data Collectio
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
ID T1.1
Y-165599.52
X-2415161.34
MNR Sediment
Sample Locatio
(SPC NAD83)
N
GLATFELTE



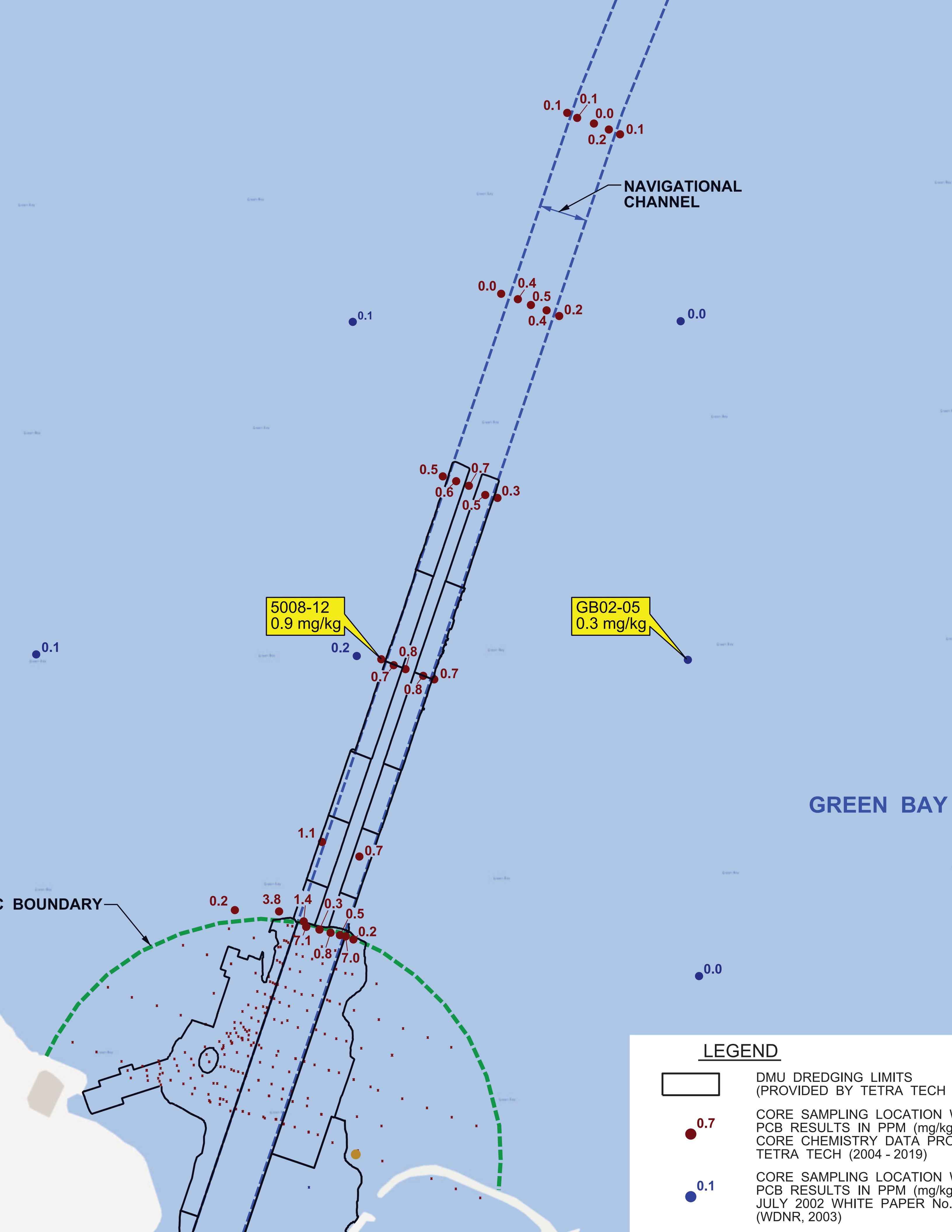
ID 2CC2.1
Y-180915.26
X-2437982.36
0.05
0.13
0.05
0.31
0.37
ID 2X1.1
Y-174003.77
X-2430993.65
0.156
0.036
1.8
3.1
1.4
0.054
0.187
0.63
0.13
ID 2X3.1NEW
Y-172737.61
X-2430503.53
0.427
0.19
0.549
2
1.31
0.45
0.434
0.13
0.274
0.53
0.33
0.9
ID 2V2.1
Y-171185.73
X-2428643.8
2.5
0.14
0.14
0.15
1.1
0.347
0.58
1.47
3.2
G
0.38
0.338
0.627
0.208
ID 2W6.1
Y-170390.03
X-2430030.94
0.59
0.3
B,D,C
W,B,D,C,G
Index - OU2
Figure 3-23
Figure 3-22
Figure 3-21
LEGEND
Transect Water Sample Locations
Locks
Dams
Suggested Fishing Areas (Fall, Aug-Oct
1989/90 Fox River Mass Balance Study
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
1994 GAS Sediment Collection
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
1996 BBL Sediment/Tissue Data Collectio
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
ID 2CC2.1
Y-180915.26
X-2437982.36
MNR Sediment
Sample Location
(SPC NAD83)
N

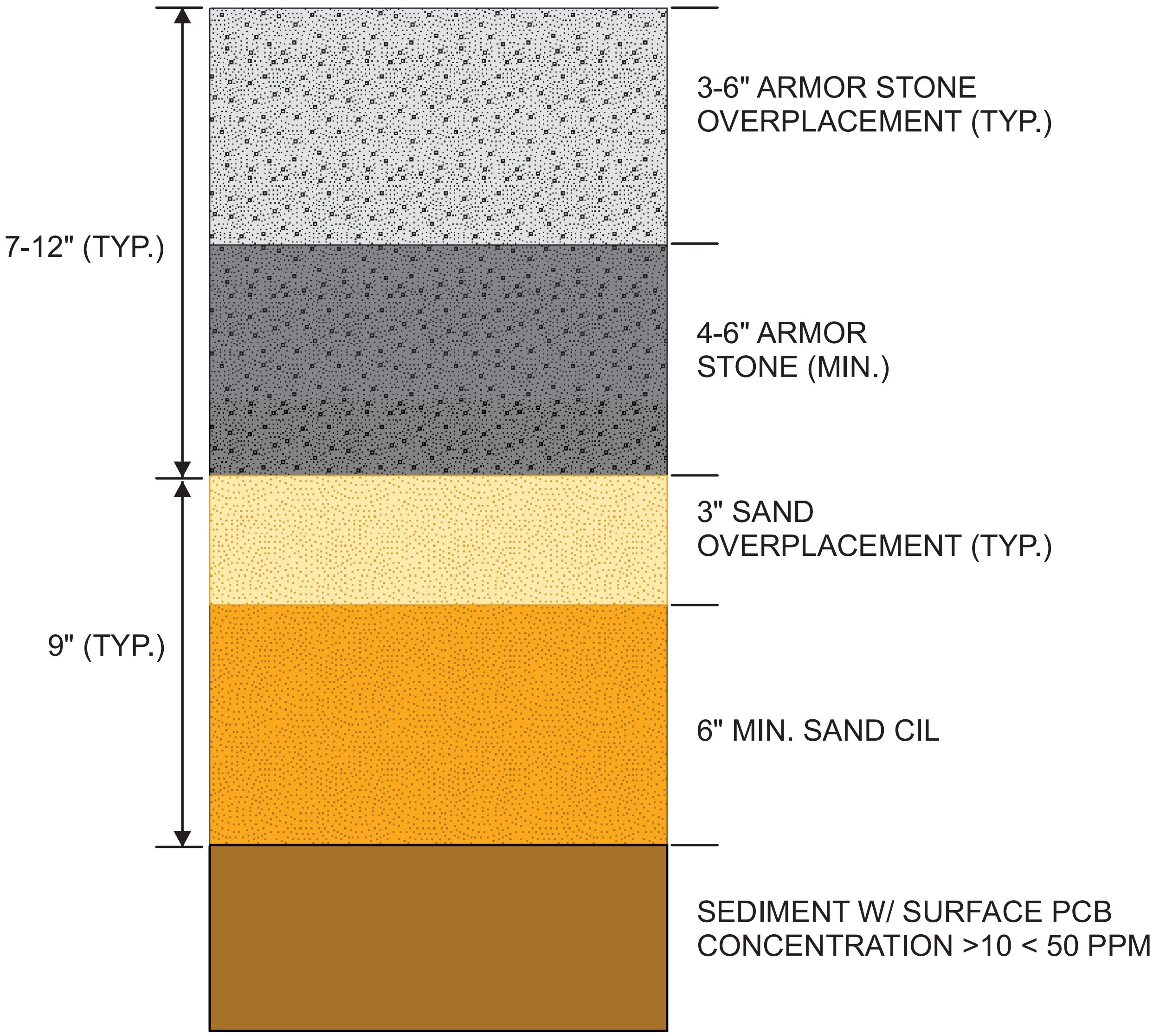
GLATFELTE


See Inset
ID DD2.1 NEW
Y-203838.36
X-2457933.86
W,B,D,C,G
0.05
0.24
7.6
0.47
0.3
0.13
0.24
0.07
0.05
Boundaries from
2009 OU2 Complete
Dredge and Cap
ID DD2.1 NEW
Y-203838.36
X-2457933.86
7.6
0.24
0.13
Index - OU2
Figure 3-23
Figure 3-22
Figure 3-21
LEGEND
Transect Water Sample Locations
Locks
Dams
Suggested Fishing Areas (Fall, Aug-Oct
1989/90 Fox River Mass Balance Study
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
1996 BBL Sediment/Tissue Data Collectio
Result (mg/kg)
0.05 - 1
1.1 - 2
2.1 - 5
5.1 - 10
10.1 - 25
> 25.1
ID DD2.1 NEW
Y-203838.36
X-2457933.86
MNR Sediment
Sample Location
(SPC NAD83)
N
GLATFELTE



0.29 mg/kg
D = ~14'
0.14
MNR01
D = ~10'
0.10
<0.02
0.12
0.05
0.07
0.07
0.16
0.10
0.19
0.06
0.05
0.06
0.11
0.08
NAVIGATION CHANNEL
<0.01
0.03
0.03
0.03
<0.01
0.36
0.03
50021.5-01
0.5 mg/kg
D < 10'
SEE FIGURE 3-23 FOR CORE INFORMATION IN THIS AREA
S00040
0.46 mg/kg
D = ~9'
5008-12
0.9 mg/kg
D < 10'
GB02-05
0.3 mg/kg
D < 10'
0.06
OU5 ARC BOUNDARY
0.18
0.17
0' 5,000' 10,000'
BAR SCALE
0.05
D=~70'
90'
0.04
D=~72'
0.16
D=~30'
0.27
D=~88'
0.07
D=~19'
OU5C
0.12
D=~88'
0.51
D=~107'
0.33
D=~92'
0.07
D=~45'
0.45
D=~85'
0.35
D=~93'
0.16
D=~61'
0.38
D=~55'
0.37
D=~68'
0.50
D=~81'
E240B06A
0.65 mg/kg
D = ~66'
GC0378
1.02 mg/kg
D = ~48'
E010B02A
0.70 mg/kg
D = ~69'
0.55
D=~52'
0.54
D=~50'
0.51
D=~64'
E080B02A
0.62 mg/kg
D = ~60'
0.25
D=~48'
OU5B
0.05
D=~30'
AA87GB0022a
0.53 mg/kg
D = ~48'
AA88GB0020a
0.74 mg/kg
D = ~50'
0.07
D=~4'
E323B08A
0.39 mg/kg
D = ~38'
E240B07A
0.76 mg/kg
D = ~45'
0.39
D=~38'
E323B07A
0.96 mg/kg
D = ~36'
GREEN BAY
0.28
D=~38'
E169B03A
0.94 mg/kg
D = ~35'
E323B06A
0.73 mg/kg
D = 28'
E326B04A
0.72 mg/kg
D = ~28'
0.01
D=~15'
0.15
D=~24'
0.45
D=~28'
OU5A
E165B02A
0.43 mg/kg
D = ~22'
E323B05A
0.59 mg/kg
D = ~23'
MNR02
D = ~20'
MNR01
D = ~10'
E339B04A
0.29 mg/kg
D = ~14'
LEGEND
OU5A
OU5 SURFACE WATER SAMPLING TRANSECT
40'
WATER DEPTH - 10' INTERVAL (CONTOURS DERIVED FROM DATA DOWNLOADED FROM THE NOAA
0.16 D=~61'
CORING LOCATION WITH PCB CONCENTRATION < 1 ppm (mg/kg) WITH APPROXIMATE WATER DEPT 1989/1990 GREEN BAY MASS BAL
0.25 D=~48'
CORING LOCATION WITH PCB CONCENTRATION < 1 ppm (mg/kg) WITH APPROXIMATE WATER DEPT 1998 BBL SEDIMENT / TISSUE DAT
0.9
CORE SAMPLING LOCATION WITH PCB RESULTS IN PPM (mg/kg) CORE CHEMISTRY DATA PROVIDE TETRA TECH (2004 - 2019)
0.38
CORING LOCATION WITH PCB CONCENTRATION < 1 ppm (mg/kg) WITH APPROXIMATE WATER DEPT JULY 2002 WHITE PAPER No. 19 (
CORING LOCATION 1995 WDNR SEDIMENT DATA COL
GC0378
1.02 mg/kg
D = ~48'
PROPOSED MNR SAMPLING LOCA WITH PCB CONCENTRATIONS > 1. APPROXIMATE WATER DEPTH
E339B04A
0.29 mg/kg
PROPOSED MNR SAMPLING LOCA WITH PCB CONCENTRATIONS < 1 (


NAVIGATIONAL
CHANNEL
5008-12
0.9 mg/kg
GB02-05
0.3 mg/kg
GREEN BAY
BOUNDARY
0.1
0.1
0.0
0.2
0.1
0.0
0.4
0.5
0.4
0.2
0.1
0.0
0.5
0.7
0.6
0.5
0.3
0.1
0.2
0.8
0.7
0.8
0.7
1.1
0.7
0.2
3.8
1.4
0.3
0.5
0.2
7.1
0.8
7.0
0.0
LEGEND
DMU DREDGING LIMITS
(PROVIDED BY TETRA TECH
0.7
CORE SAMPLING LOCATION W
PCB RESULTS IN PPM (mg/kg
CORE CHEMISTRY DATA PRO
TETRA TECH (2004 - 2019)
0.1
CORE SAMPLING LOCATION W
PCB RESULTS IN PPM (mg/kg
JULY 2002 WHITE PAPER No.
(WDNR, 2003)



Foth

GLATFELTER CORPORATION/GEORGIA-PACIFIC CORP.	
FIGURE 3-24 LW OU1-5 SAMPLING & ANALYSIS PLAN FOX RIVER TYPE B CAP DESIGN LOWER FOX RIVER, WISCONSIN	
NOT TO SCALE	Date: AUGUST 2021	Revision Date:
	Drawn By: DAT	Checked By: TMK1	Project: LFR LTM AND COMMP

Path: Q:\LFR LTM and COMMP\LTM and CAP Maintenance\GIS\mxd\LW OU1-5 LTM SAP\Figure 3-24 Type B Cap Design.mxd Date: 8/31/2021

LEGEND

- Approximate Chemical Isolation Layer Sampling Location
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

N

Foth

0 50 100
Feet

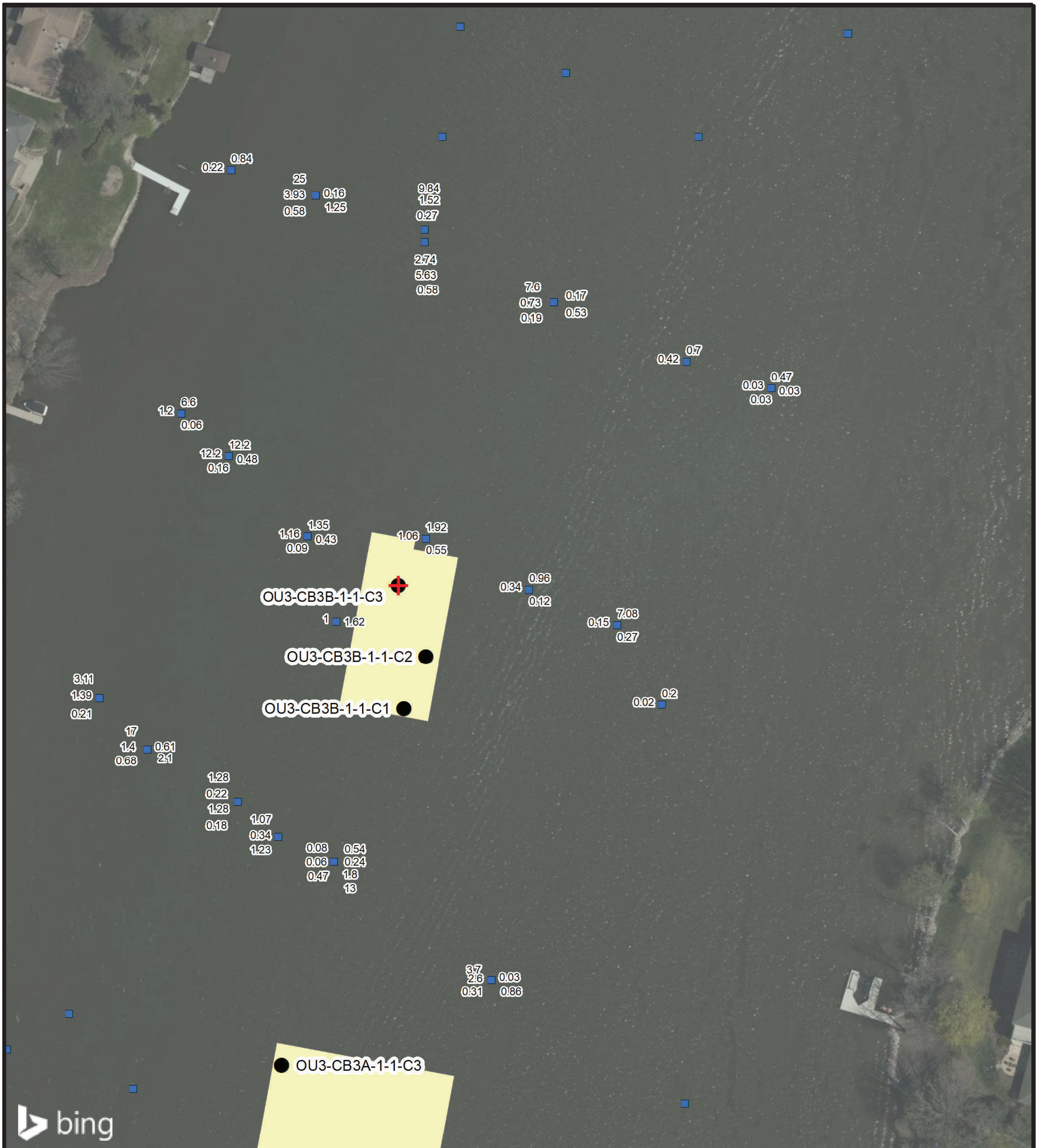
GLATFELTER CORPORATION/GEORGIA-PACIFIC CORP.

FIGURE 3-25
LW OU1-5 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - CB2
LOWER FOX RIVER, WISCONSIN

Date: AUGUST 2021	Revision Date:

Drawn By: DAT	Checked By: TMK1	Project: LFR LTM AND COMMP

Path: Q:\LFR LTM and COMMP\LTM and CAP Maintenance\GIS\mxd\LW OU1-5 LTM SAP\Figure 3-25 Chemical Isolation Layer Sample Location – CB2.mxd Date: 8/31/2021



LEGEND

- Approximate Chemical Isolation Layer Sampling Location
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

N

Foth

0 50 100 Feet

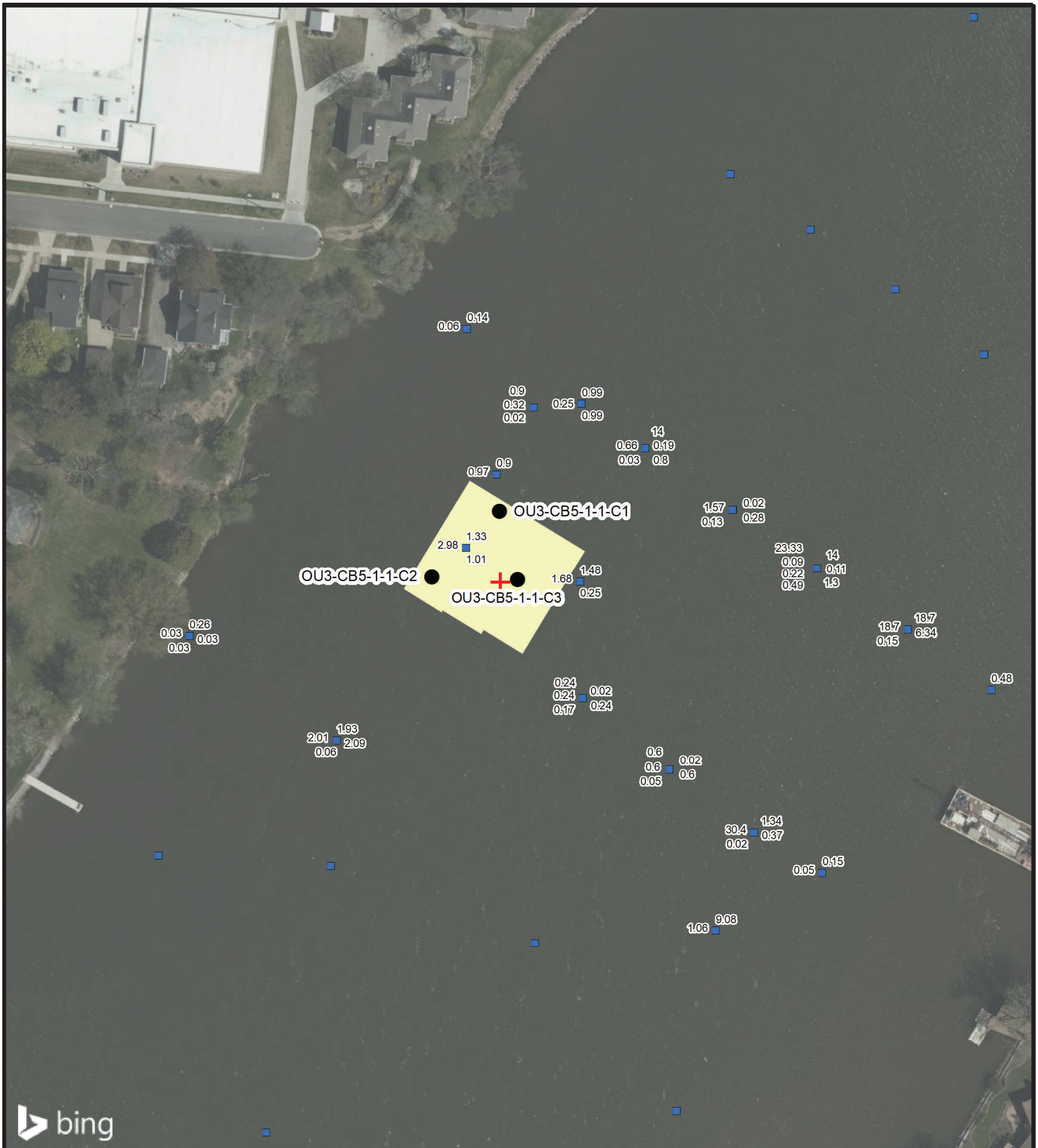
GLATFELTER CORPORATION/GEORGIA-PACIFIC CORP.

FIGURE 3-26
LW OU1-5 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - CB3B
LOWER FOX RIVER, WISCONSIN

Date: AUGUST 2021	Revision Date:

Drawn By: DAT	Checked By: TMK1	Project: LFR LTM AND COMMP

Path: Q:\LFR LTM and COMMP\LTM and CAP Maintenance\GIS\mxd\LW OU1-5 LTM SAP\Figure 3-26 Chemical Isolation Layer Sample Location – CB3B.mxd Date: 8/31/2021



LEGEND

- Approximate Chemical Isolation Layer Sampling Location
- Original Chemical Isolation Layer Sample
- PCB (ppm) Result from Fox Core Chemistry DB
- Cap B Placement Areas

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

SOURCE:
1. Basemaps by esri
2. Foth GPS Collection

N

Foth

0 50 100 Feet

GLATFELTER CORPORATION/GEORGIA-PACIFIC CORP.

FIGURE 3-27
LW OU1-5 SAMPLING & ANALYSIS PLAN
OU3 CHEMICAL ISOLATION LAYER
SAMPLE LOCATION - CB5
LOWER FOX RIVER, WISCONSIN

Date: AUGUST 2021	Revision Date:

Drawn By: DAT	Checked By: TMK1	Project: LFR LTM AND COMMP

Path: Q:\LFR LTM and COMMP\LTM and CAP Maintenance\GIS\mxd\LW OU1-5 LTM SAP\Figure 3-27 Chemical Isolation Layer Sample Location – CB5.mxd Date: 8/31/2021

& "C" CAP DESIGN LOCATION IDENTIFICATION

CAP DESIGN LOCATION IDENTIFICATION

CAP DESIGN LOCATION IDENTIFICATION NOTE 4)

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE). THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.
2. COLOR ORTHO PHOTO OBTAINED FROM THE MOST RECENT BING MAPS IMAGERY.

GLATFELTER CO

LW OU1

C" CAP DESIGN LOCATION
NTIFICATION

DESIGN LOCATION
NTIFICATION

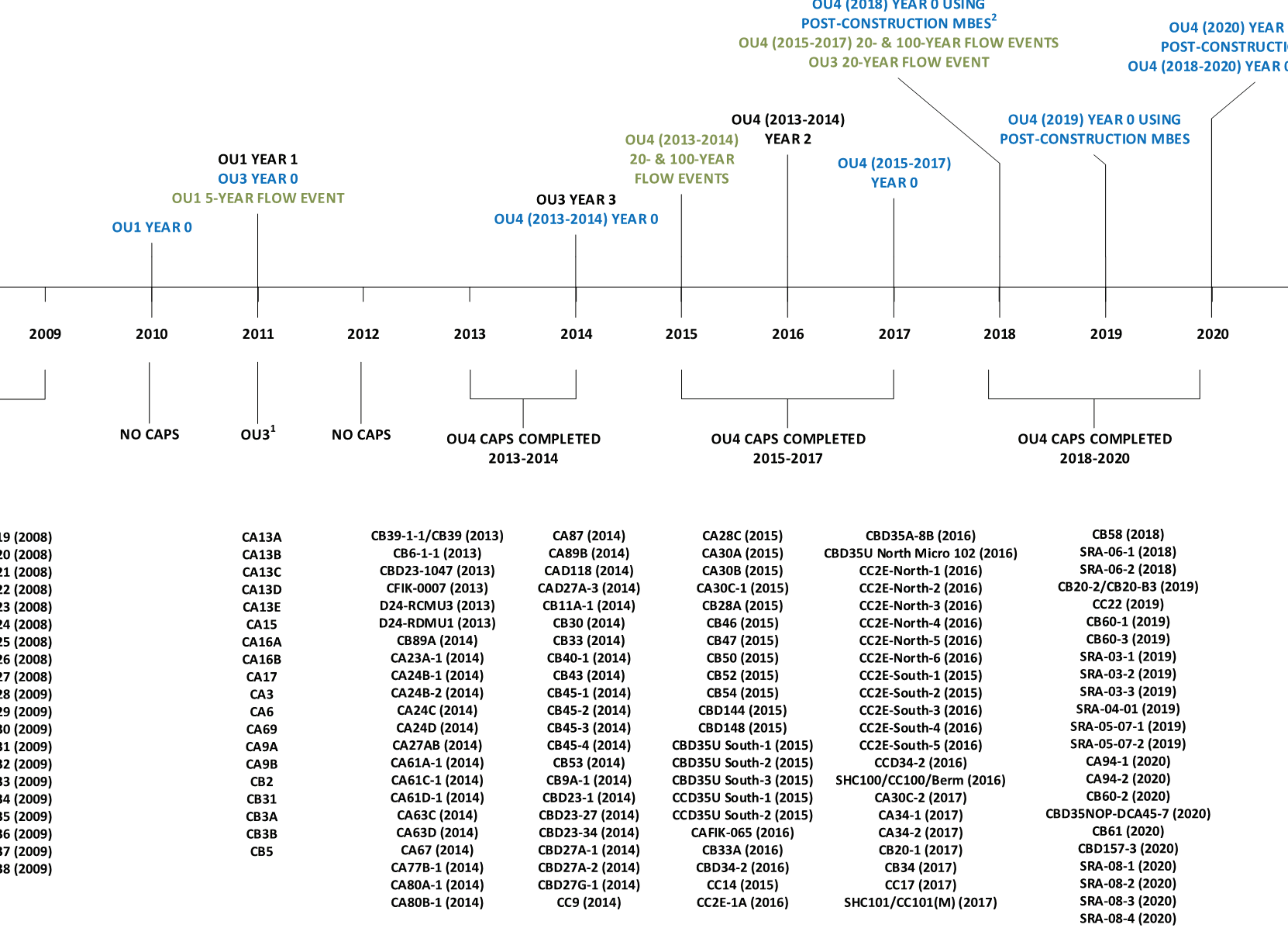
DESIGN LOCATION
NTIFICATION
TE 4)

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE). THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.
2. COLOR ORTHO PHOTO OBTAINED FROM THE MOST RECENT BING MAPS IMAGERY.

GLATFELTER CO

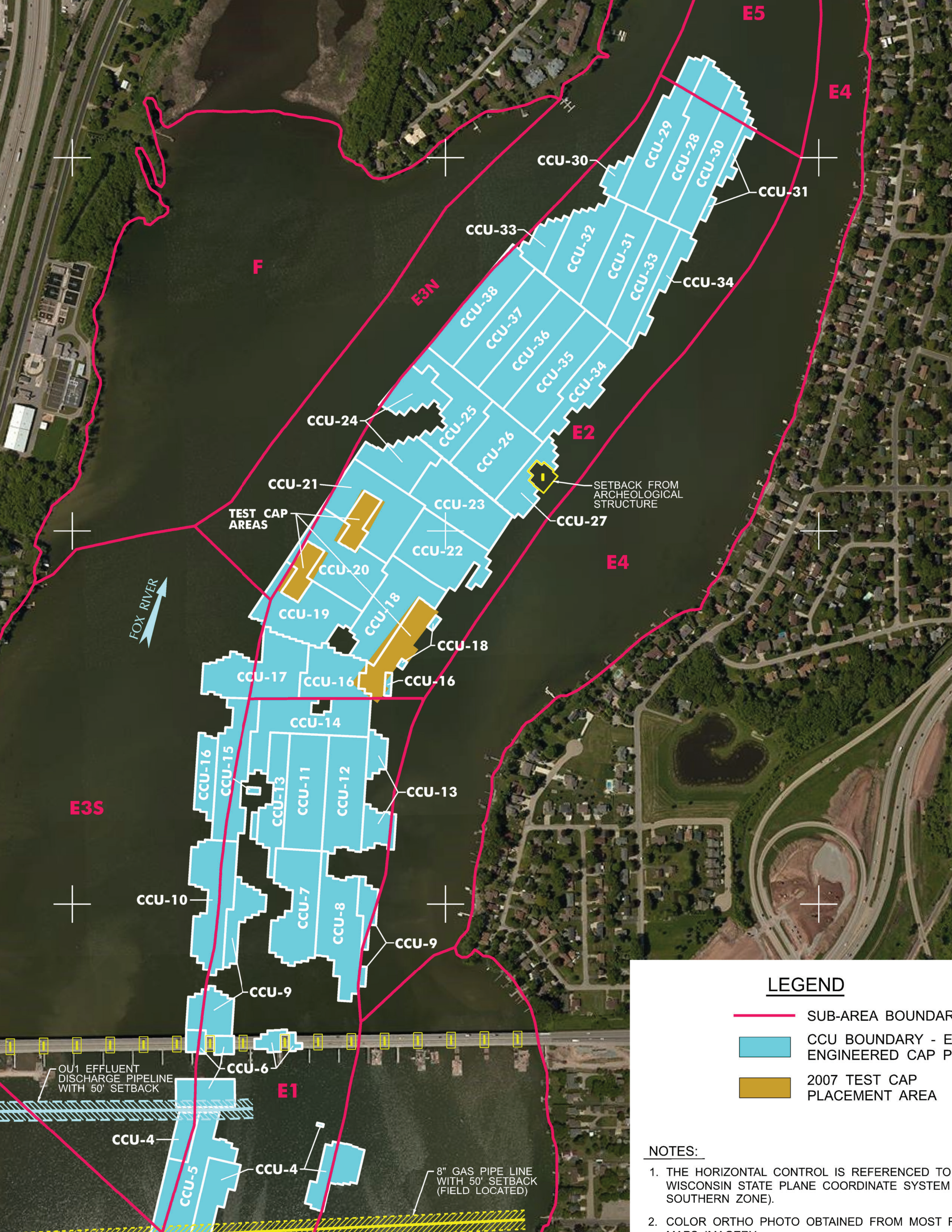
LW OU



ch was completed in 2009.

GLATFELTE

LW C



LEGEND

SUB-AREA BOUNDAR

CCU BOUNDARY - E
ENGINEERED CAP P

2007 TEST CAP
PLACEMENT AREA

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO
WISCONSIN STATE PLANE COORDINATE SYSTEM
SOUTHERN ZONE).

2. COLOR ORTHO PHOTO OBTAINED FROM MOST R

D

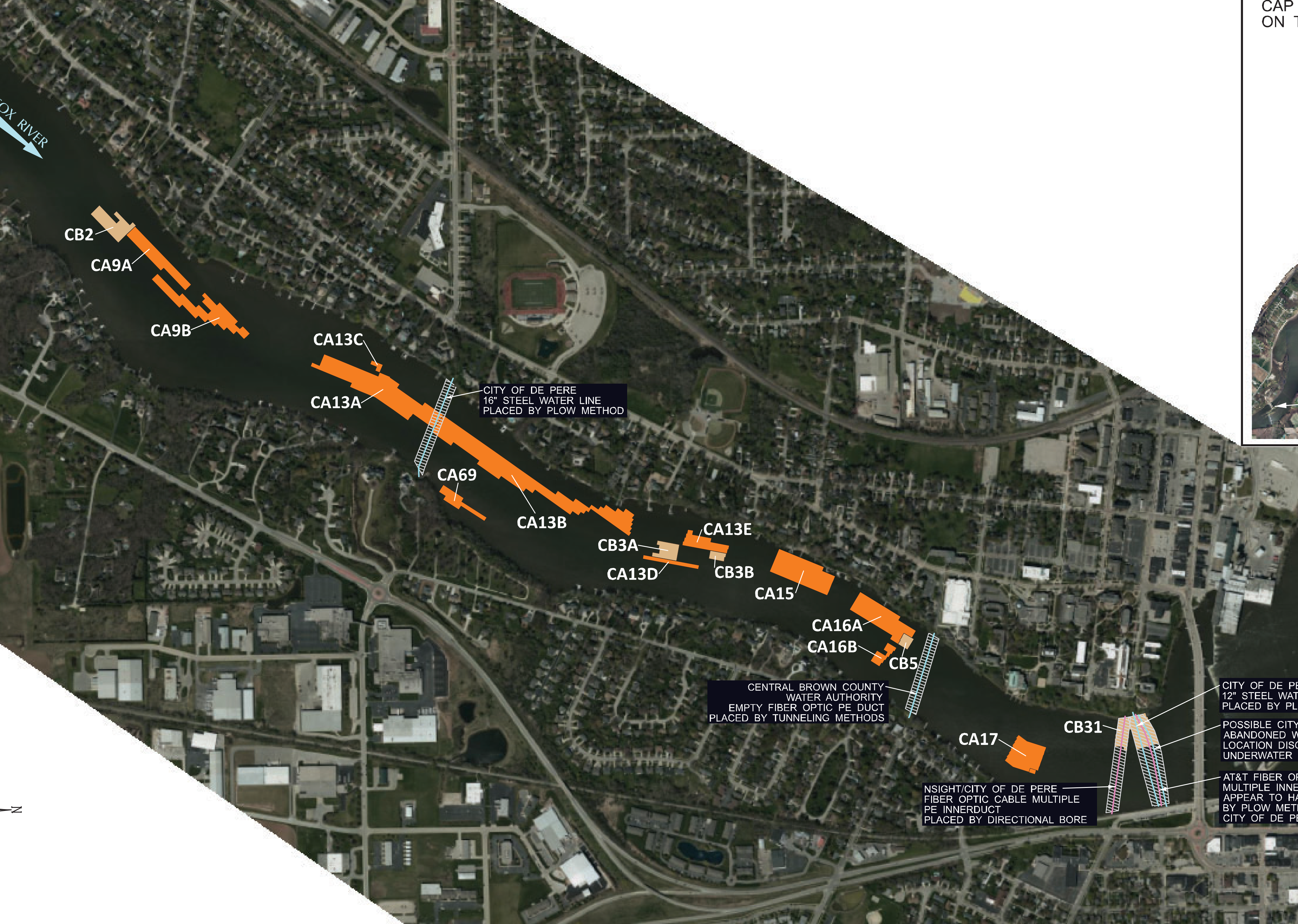
ESIGN CAP PLACEMENT
OCATION AND IDENTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE)

GLATFELTER CO

LW / OU



NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).

" CAP DESIGN PLACEMENT
OCATION AND IDENTIFICATION

GLATFELTER CO

LW / OU

P DESIGN PLACEMENT
ON AND IDENTIFICATION

P DESIGN PLACEMENT
ON AND IDENTIFICATION

P DESIGN PLACEMENT
ON AND IDENTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

GLATFELTER CO

LW / OU

DESIGN PLACEMENT
ON AND IDENTIFICATION

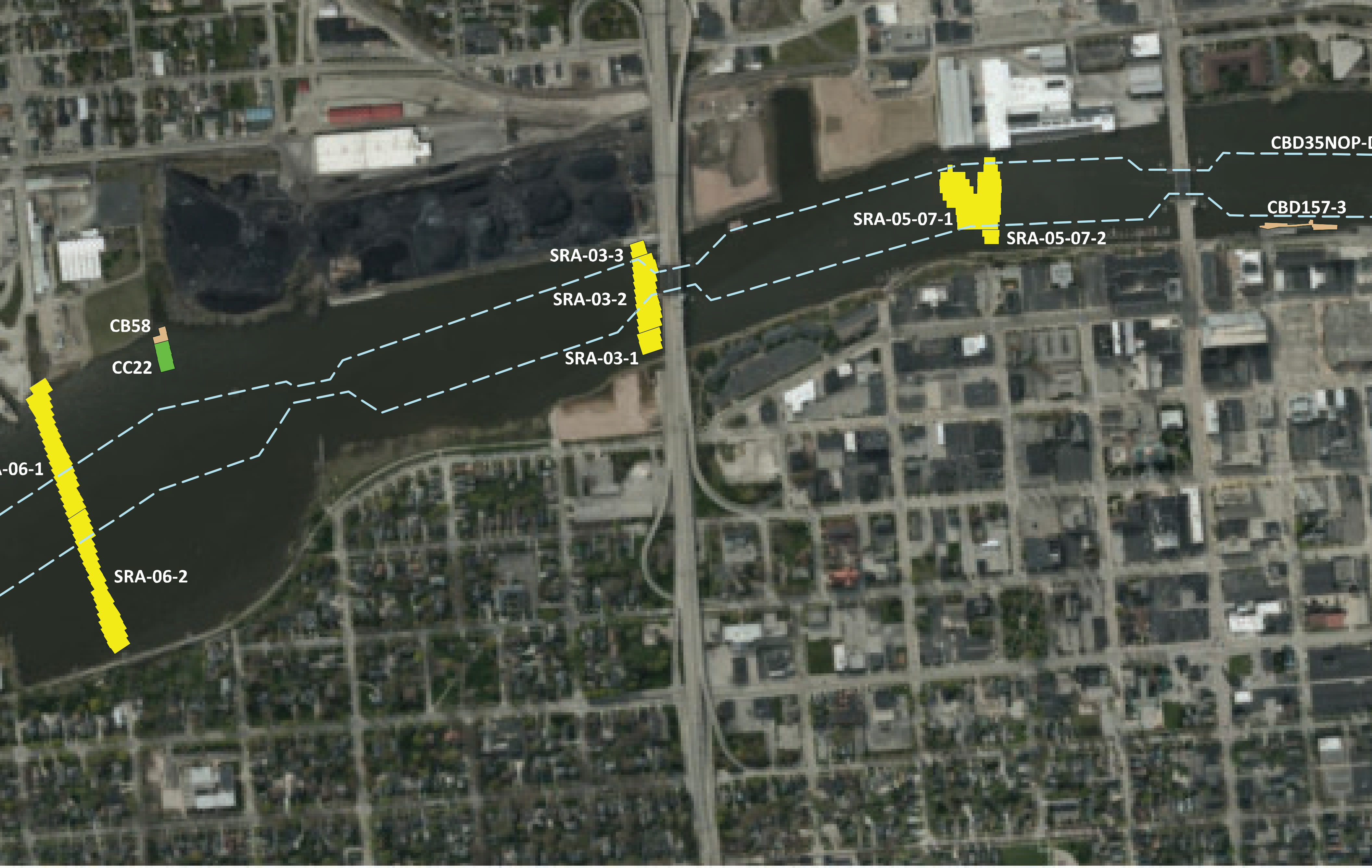
DESIGN PLACEMENT
ON AND IDENTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).

GLATFELTER CO

LW / OU



P DESIGN PLACEMENT
ON AND IDENTIFICATION

P DESIGN PLACEMENT
ON AND IDENTIFICATION

P DESIGN PLACEMENT
ON AND IDENTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).

GLATFELTER CO

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P DESIGN PLACEMENT
ON AND IDENTIFICATION

P DESIGN PLACEMENT
ON AND IDENTIFICATION

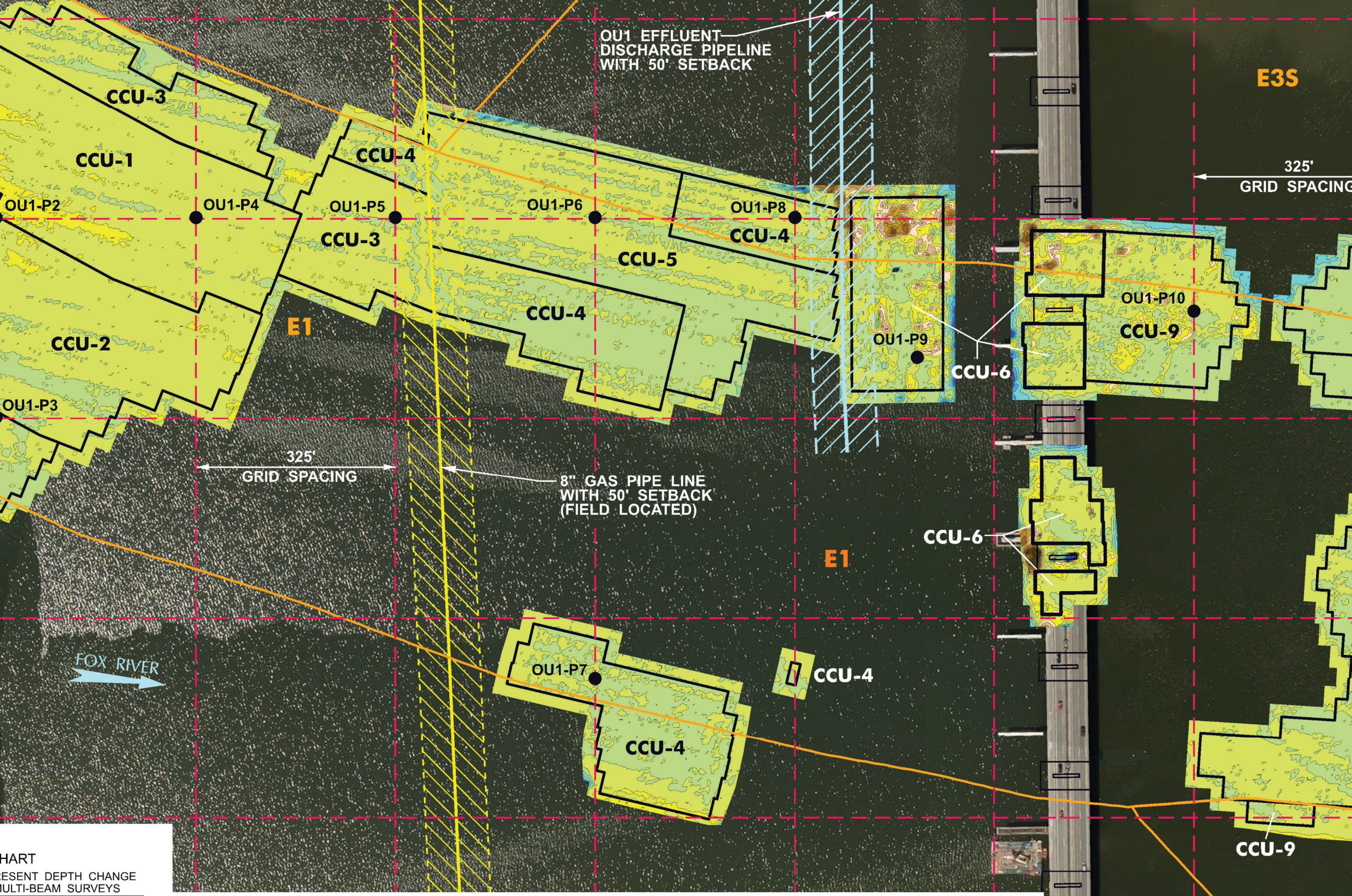
AP DESIGN PLACEMENT
ON AND IDENTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).

GLATFELTER CO

LW / OU



HART
ESENT DEPTH CHANGE
ULTI-BEAM SURVEYS

PTH 0.75' TO 1.00'
PTH 0.50' TO 0.75'
PTH 0.25' TO 0.50'
PTH 0.00' TO 0.25'
PTH 0.00' TO 0.25'
PTH 0.25' TO 0.50'
PTH 0.50' TO 0.75'

LEGEND

- E1 SUB AREA BOUNDARY
- 2008 CAP PLACEMENT AREA
- 325' GRID LINES USED FOR POLING / PROBING LOCATIONS

NOTES:

1. 200 & 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATES OF SURVEYS:
   200 (kHz): JULY 13, 14, 15, 18 & 21, 2011.
   400 (kHz): SEPTEMBER 17, 18 & 19, 2018.
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM. (WISCONSIN SOUTHERN ZONE).
   THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.

GLATFELTER CC

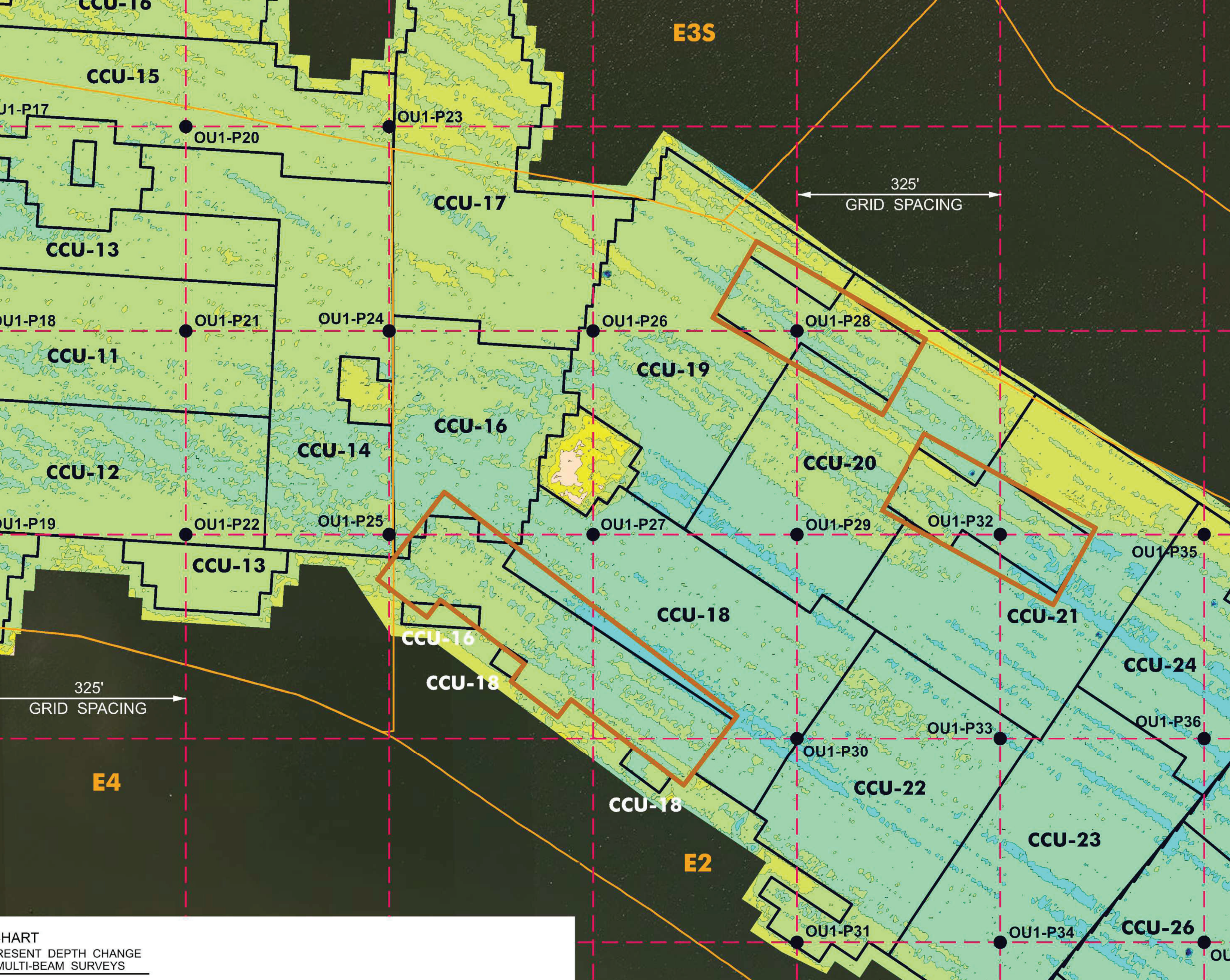
LW / OU1

2. THE HORIZONT
WISCONSIN STA
(WISCONSIN SO
THE VERTICAL

3. COLOR ORTHO
MAPS IMAGERY

4. PIPELINE LOCA

5. THE BATHYMET
ACCURATE DAT
THEREFORE NO



HART
RESENT DEPTH CHANGE
MULTI-BEAM SURVEYS

PTH 0.75' TO 1.00'
PTH 0.50' TO 0.75'
PTH 0.25' TO 0.50'
PTH 0.00' TO 0.25'

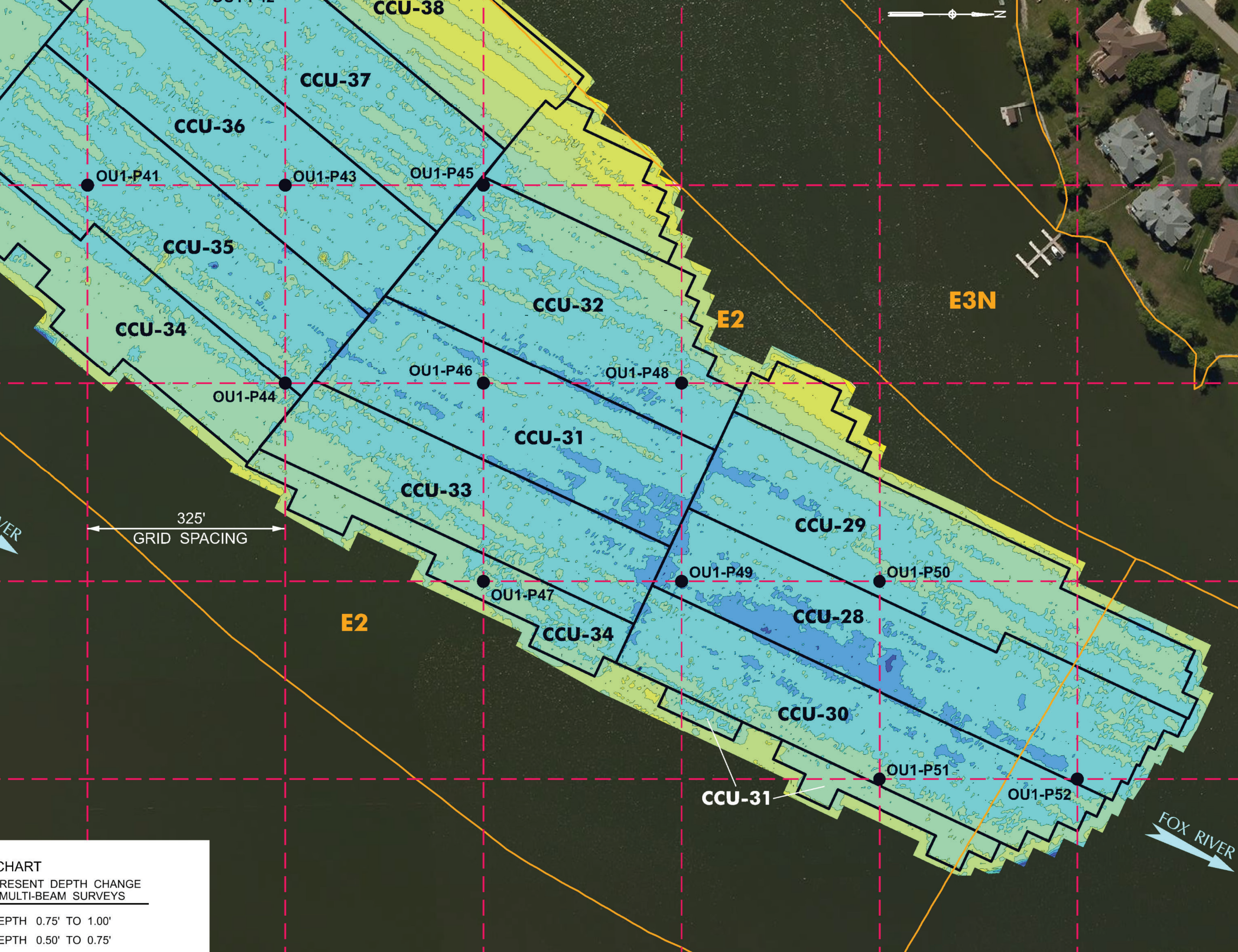
LEGEND

E1 SUB AREA BOUNDARY

2007 TEST CAP PLACEMENT AREA

GLATFELTER CO

LW / OU1



WISCONSIN
(WISCONSIN
THE VERTIC

3. COLOR ORT
MAPS IMAG

4. PIPELINE LO

5. THE BATHY
ACCURATE
THEREFORE

CHART
RESENT DEPTH CHANGE
MULTI-BEAM SURVEYS

EPTH 0.75' TO 1.00'
EPTH 0.50' TO 0.75'
EPTH 0.25' TO 0.50'
EPTH 0.00' TO 0.25'

EPTH 0.00' TO 0.25'
EPTH 0.25' TO 0.50'

LEGEND

E2 SUB AREA BOUNDARY

GLATFELTER CO

LW / OU1

DESIGN CAP PLACE

130' GRID USED FOR
POLING / PROBING L

OU3-P3 PROPOSED CAP PO
LOCATION AND INDE

COLOR ELEVATION CHA

COLOR ISOPACH CONTOURS SHOWN REPRES
FROM SEPTEMBER 12, 2014 TO SEPTEMBER

2018 MULTI-BEAM SURVEY HIGHER THAN 2014 MULTI-BEAM SURVEY

DEPT
DEPT
DEPT
DEPT
DEPT

2018 MULTI-BEAM SURVEY LOWER THAN 2014 MULTI-BEAM SURVEY

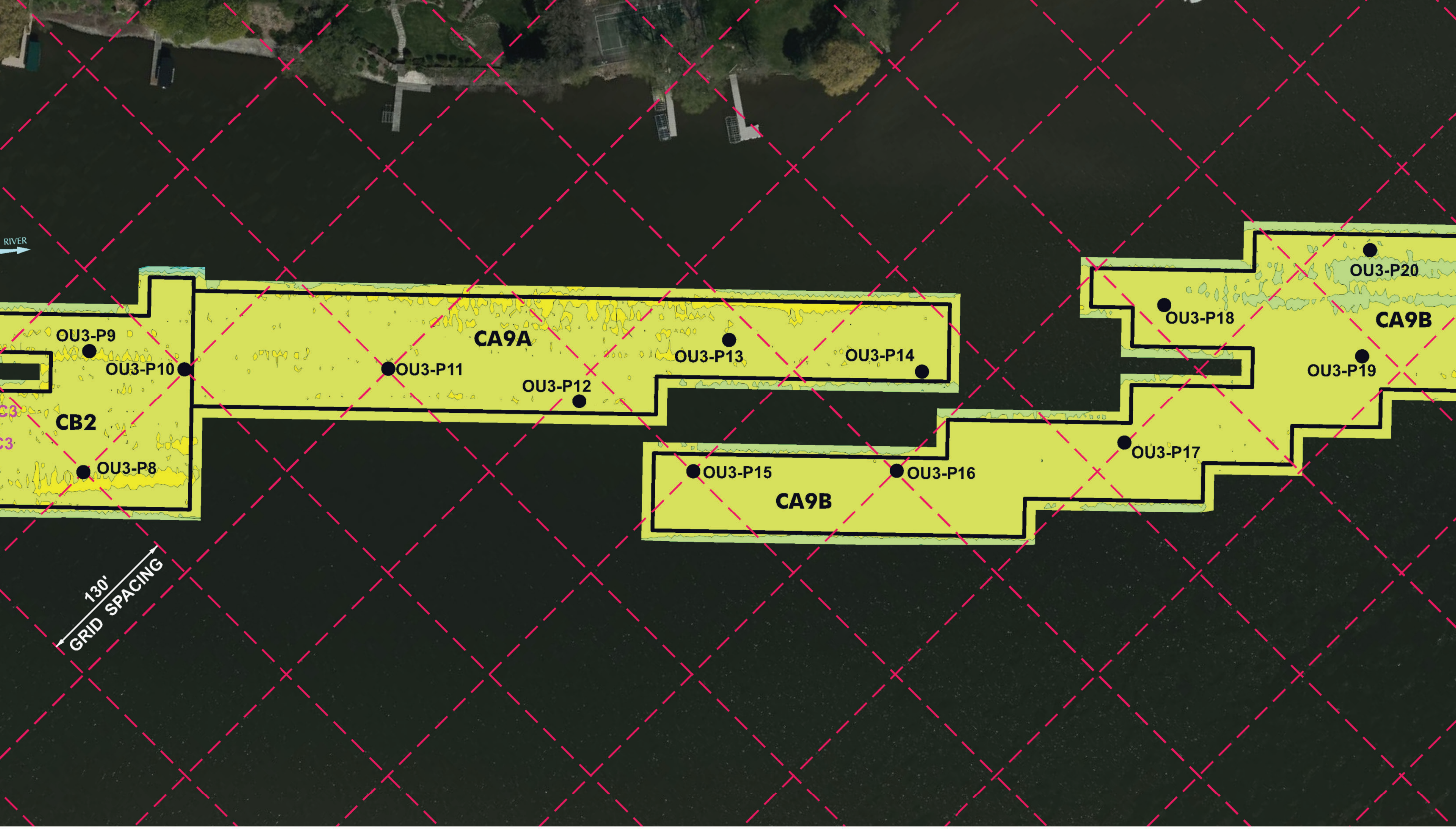
DEPT
DEPT
DEPT
DEPT
DEPT

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SURVEY PE
DATES OF SURVEYS: SEPTEMBER 12, 20
2. THE HORIZONTAL CONTROL IS REFEREN
STATE PLANE COORDINATE SYSTEM (WIS
THE VERTICAL CONTROL IS REFERENCE
3. COLOR ORTHO PHOTO OBTAINED FROM
MAPS IMAGERY.
4. DESIGN CAP PLACEMENT LIMITS DERIVE
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU1



VATION CHART
SHOWN REPRESENT DEPTH CHANGE
O SEPTEMBER 19 - 20, 2018 SURVEYS

DEPTH 1.00' TO 1.25'
DEPTH 0.75' TO 1.00'
DEPTH 0.50' TO 0.75'
DEPTH 0.25' TO 0.50'
DEPTH 0.00' TO 0.25'

DEPTH 0.00' TO 0.25'
DEPTH 0.25' TO 0.50'

LEGEND

DESIGN CAP PLACEMENT LIMITS

130' GRID USED FOR POLING / PROBING LOCATIONS

OU3-P9 PROPOSED CAP POLING / PROBING LOCATION AND INDENTIFACTION

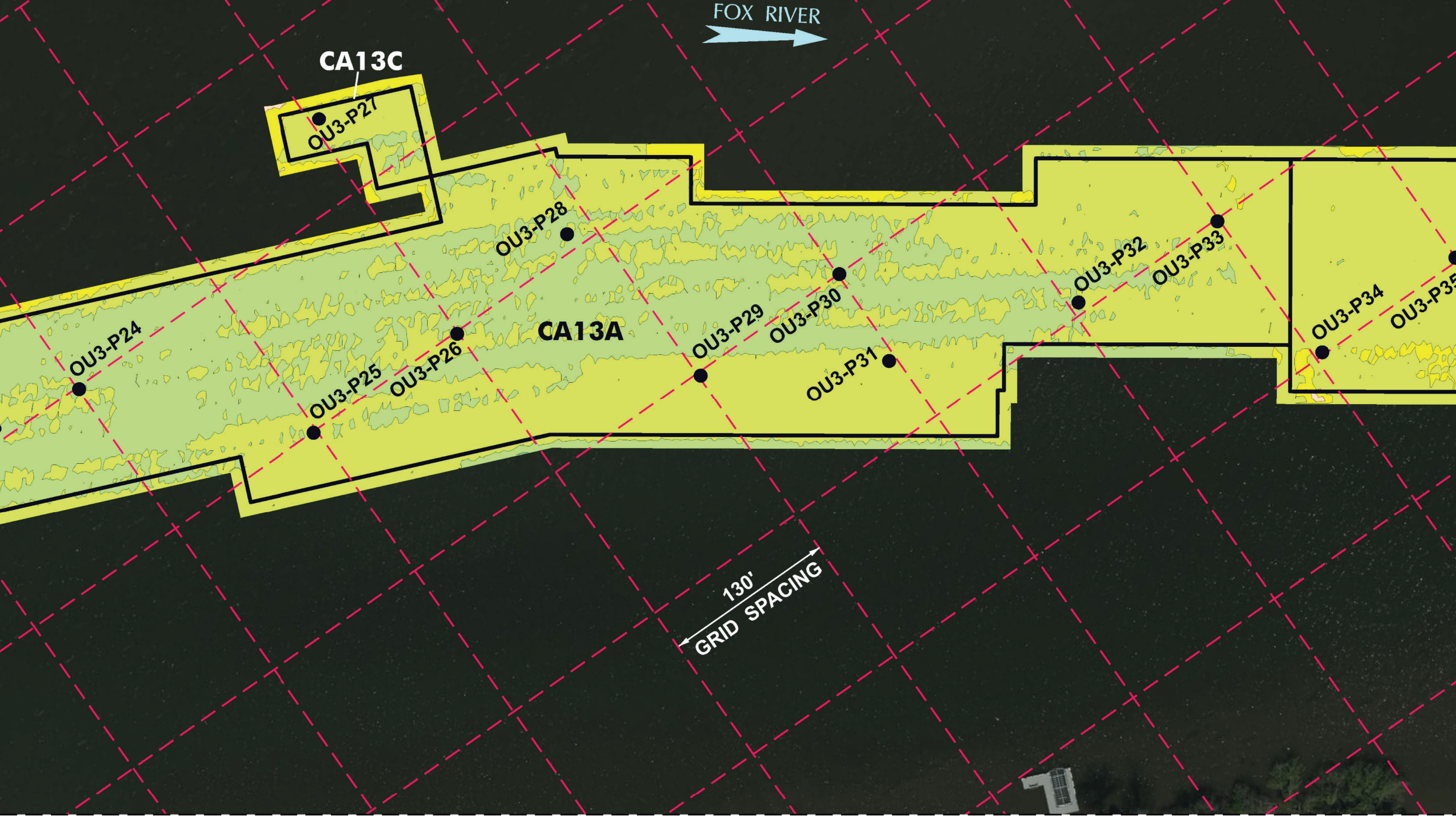
F12-3-CB2-1-1-C3 2012 AND 2014 CHEMICAL ISOLATION LAYER SAMPLING LOCATION AND IDENTIFICATION

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SURVEY
DATES OF SURVEYS: SEPTEMBER 12, 2
2. THE HORIZONTAL CONTROL IS REFERE
STATE PLANE COORDINATE SYSTEM (W
THE VERTICAL CONTROL IS REFERENC
3. COLOR ORTHO PHOTO OBTAINED FRO
4. DESIGN CAP PLACEMENT LIMITS DERIV
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU1



EVATION CHART
SHOWN REPRESENT DEPTH CHANGE
O SEPTEMBER 19 - 20, 2018 SURVEYS

	DEPTH 1.00' TO 1.25'
	DEPTH 0.75' TO 1.00'
	DEPTH 0.50' TO 0.75'
	DEPTH 0.25' TO 0.50'
	DEPTH 0.00' TO 0.25'
	DEPTH 0.00' TO 0.25'
	DEPTH 0.25' TO 0.50'

LEGEND

DESIGN CAP PLACEMENT LIMITS

130' GRID USED FOR POLING / PROBING LOCATIONS

OU3-P32 PROPOSED CAP POLING / PROBING LOCATION AND INDENTIFACTION

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SURVEY
DATES OF SURVEYS: SEPTEMBER 12, 2

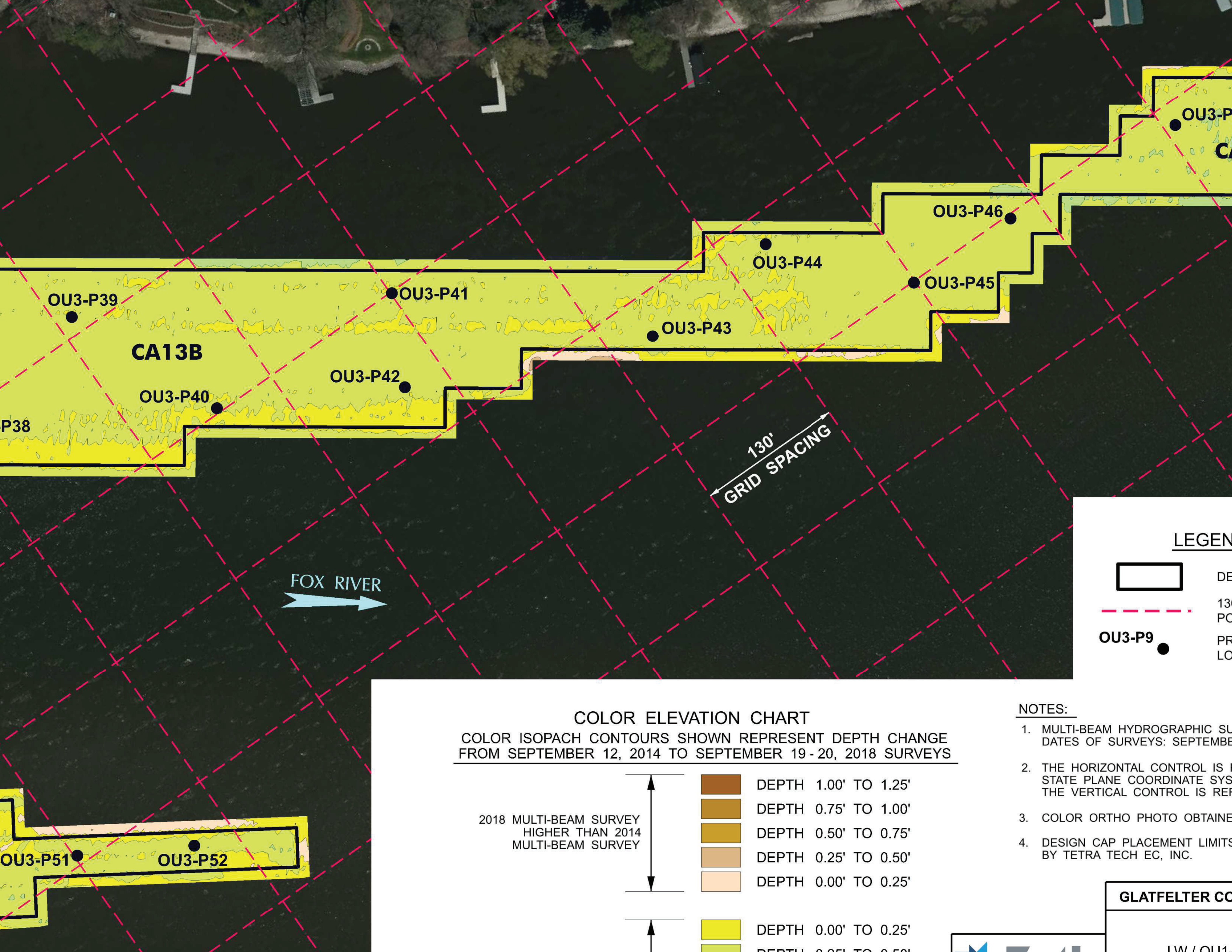
2. THE HORIZONTAL CONTROL IS REFERE
STATE PLANE COORDINATE SYSTEM (W
THE VERTICAL CONTROL IS REFERENC

3. COLOR ORTHO PHOTO OBTAINED FRO

4. DESIGN CAP PLACEMENT LIMITS DERIV
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU1



LEGEN

DE

13(
PO

OU3-P9 PR
LO

COLOR ELEVATION CHART

COLOR ISOPACH CONTOURS SHOWN REPRESENT DEPTH CHANGE FROM SEPTEMBER 12, 2014 TO SEPTEMBER 19 - 20, 2018 SURVEYS

2018 MULTI-BEAM SURVEY HIGHER THAN 2014 MULTI-BEAM SURVEY

DEPTH 1.00' TO 1.25'
DEPTH 0.75' TO 1.00'
DEPTH 0.50' TO 0.75'
DEPTH 0.25' TO 0.50'
DEPTH 0.00' TO 0.25'

DEPTH 0.00' TO 0.25'
DEPTH 0.25' TO 0.50'

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SU
DATES OF SURVEYS: SEPTEMBE

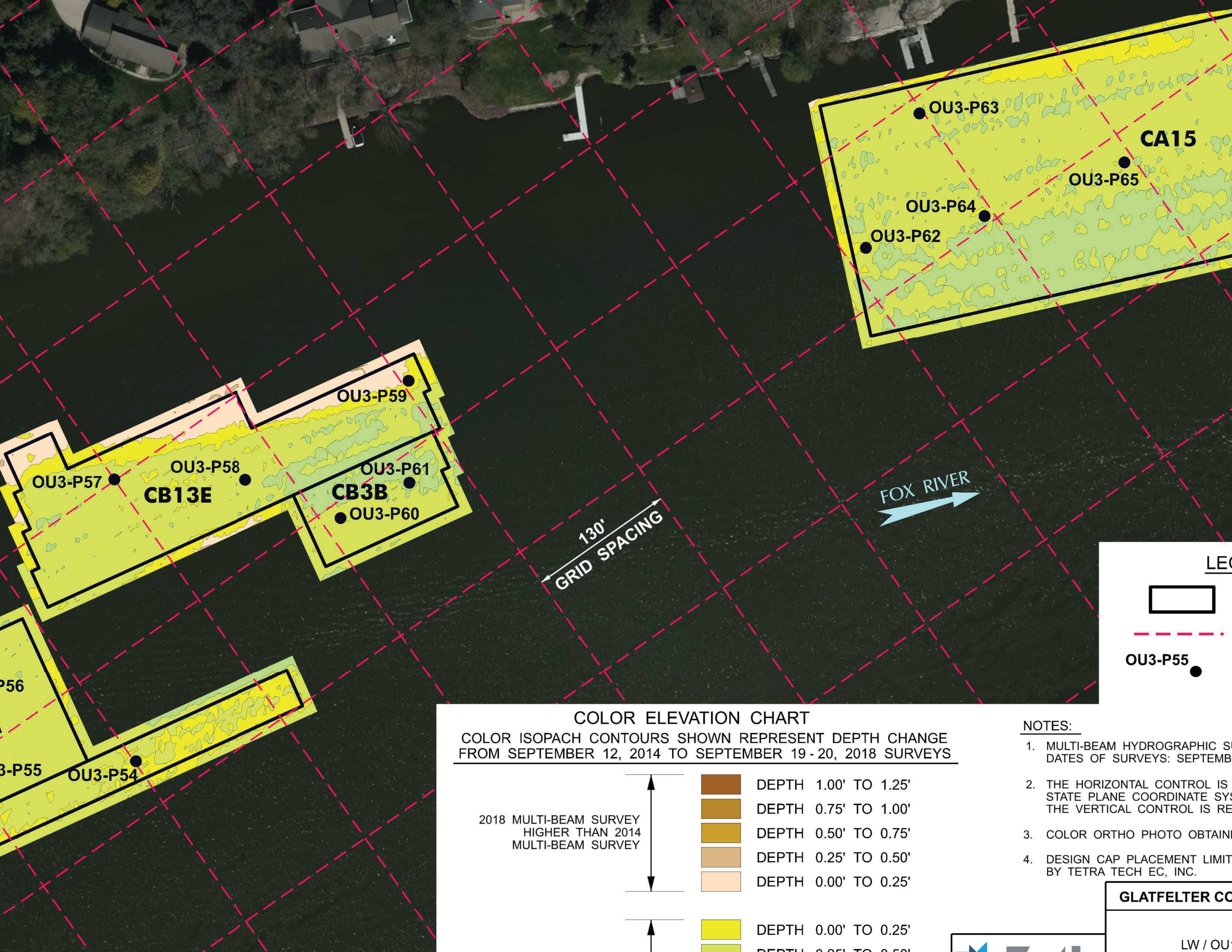
2. THE HORIZONTAL CONTROL IS I
STATE PLANE COORDINATE SYS
THE VERTICAL CONTROL IS REF

3. COLOR ORTHO PHOTO OBTAINE

4. DESIGN CAP PLACEMENT LIMITS
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU1



LEG

OU3-P55

COLOR ELEVATION CHART

COLOR ISOPACH CONTOURS SHOWN REPRESENT DEPTH CHANGE FROM SEPTEMBER 12, 2014 TO SEPTEMBER 19 - 20, 2018 SURVEYS

2018 MULTI-BEAM SURVEY HIGHER THAN 2014 MULTI-BEAM SURVEY

DEPTH 1.00' TO 1.25'
DEPTH 0.75' TO 1.00'
DEPTH 0.50' TO 0.75'
DEPTH 0.25' TO 0.50'
DEPTH 0.00' TO 0.25'

DEPTH 0.00' TO 0.25'
DEPTH 0.25' TO 0.50'

NOTES:

1. MULTI-BEAM HYDROGRAPHIC S
DATES OF SURVEYS: SEPTEMB

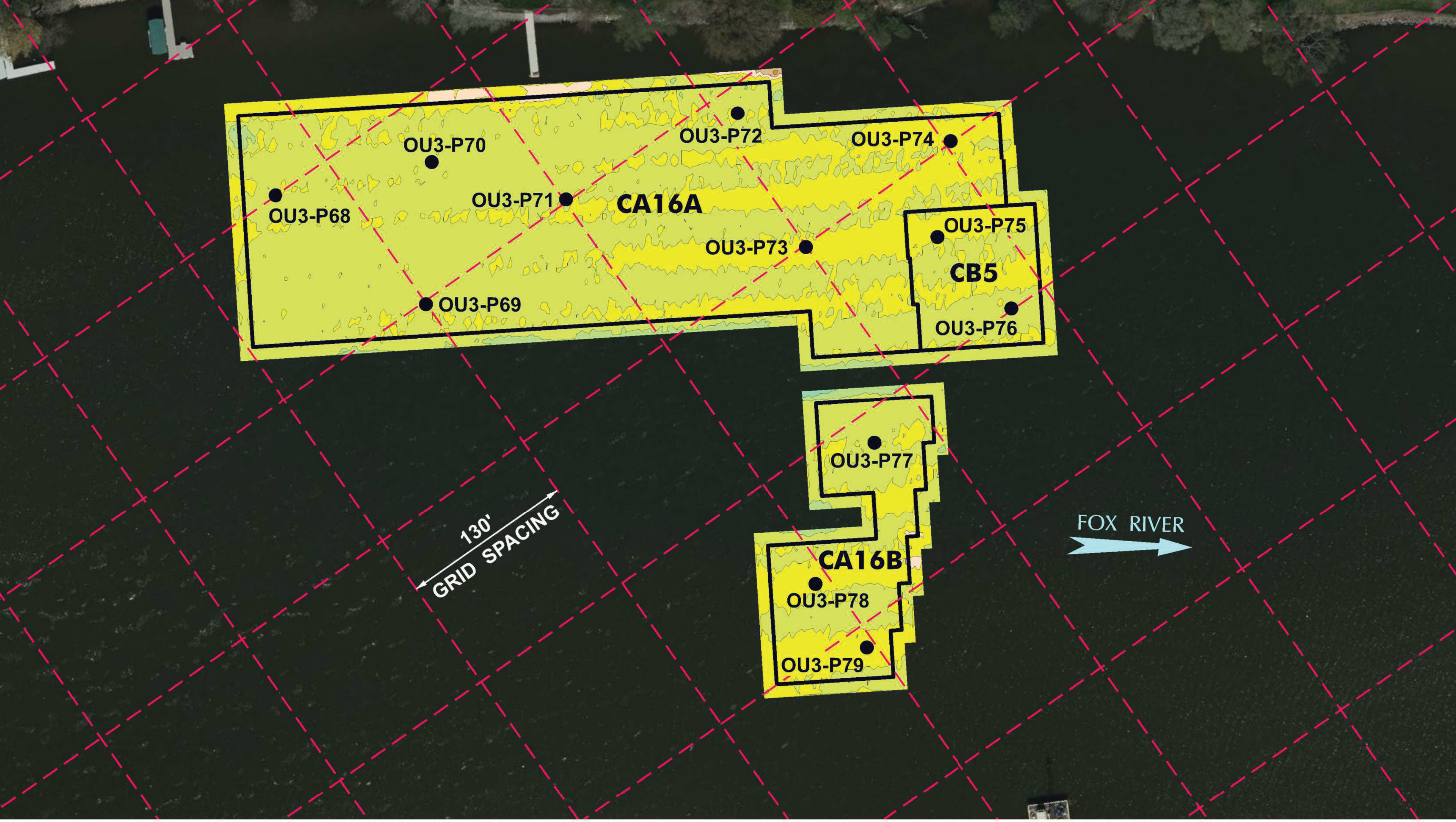
2. THE HORIZONTAL CONTROL IS
STATE PLANE COORDINATE SYS
THE VERTICAL CONTROL IS RE

3. COLOR ORTHO PHOTO OBTAIN

4. DESIGN CAP PLACEMENT LIMIT
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU



ELEVATION CHART
URS SHOWN REPRESENT DEPTH CHANGE
014 TO SEPTEMBER 19 - 20, 2018 SURVEYS

DEPTH 1.00' TO 1.25'
DEPTH 0.75' TO 1.00'
DEPTH 0.50' TO 0.75'
DEPTH 0.25' TO 0.50'
DEPTH 0.00' TO 0.25'

DEPTH 0.00' TO 0.25'

LEGEND

DESIGN CAP PLACEMENT LIMITS

130' GRID USED FOR POLING / PROBING LOCATIONS

OU3-P77 PROPOSED CAP POLING / PROBING LOCATION AND INDENTIFACTION

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SUR
DATES OF SURVEYS: SEPTEMBER
2. THE HORIZONTAL CONTROL IS R
STATE PLANE COORDINATE SYST
THE VERTICAL CONTROL IS REFE
3. COLOR ORTHO PHOTO OBTAINED
4. DESIGN CAP PLACEMENT LIMITS
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU3

ELEVATION CHART
URS SHOWN REPRESENT DEPTH CHANGE
014 TO SEPTEMBER 19 - 20, 2018 SURVEYS

DEPTH 1.00' TO 1.25'
DEPTH 0.75' TO 1.00'
DEPTH 0.50' TO 0.75'
DEPTH 0.25' TO 0.50'
DEPTH 0.00' TO 0.25'

DEPTH 0.00' TO 0.25'

LEGEND

DESIGN CAP PLACEMENT LIMITS

130' GRID USED FOR POLING / PROBING LOCATIONS

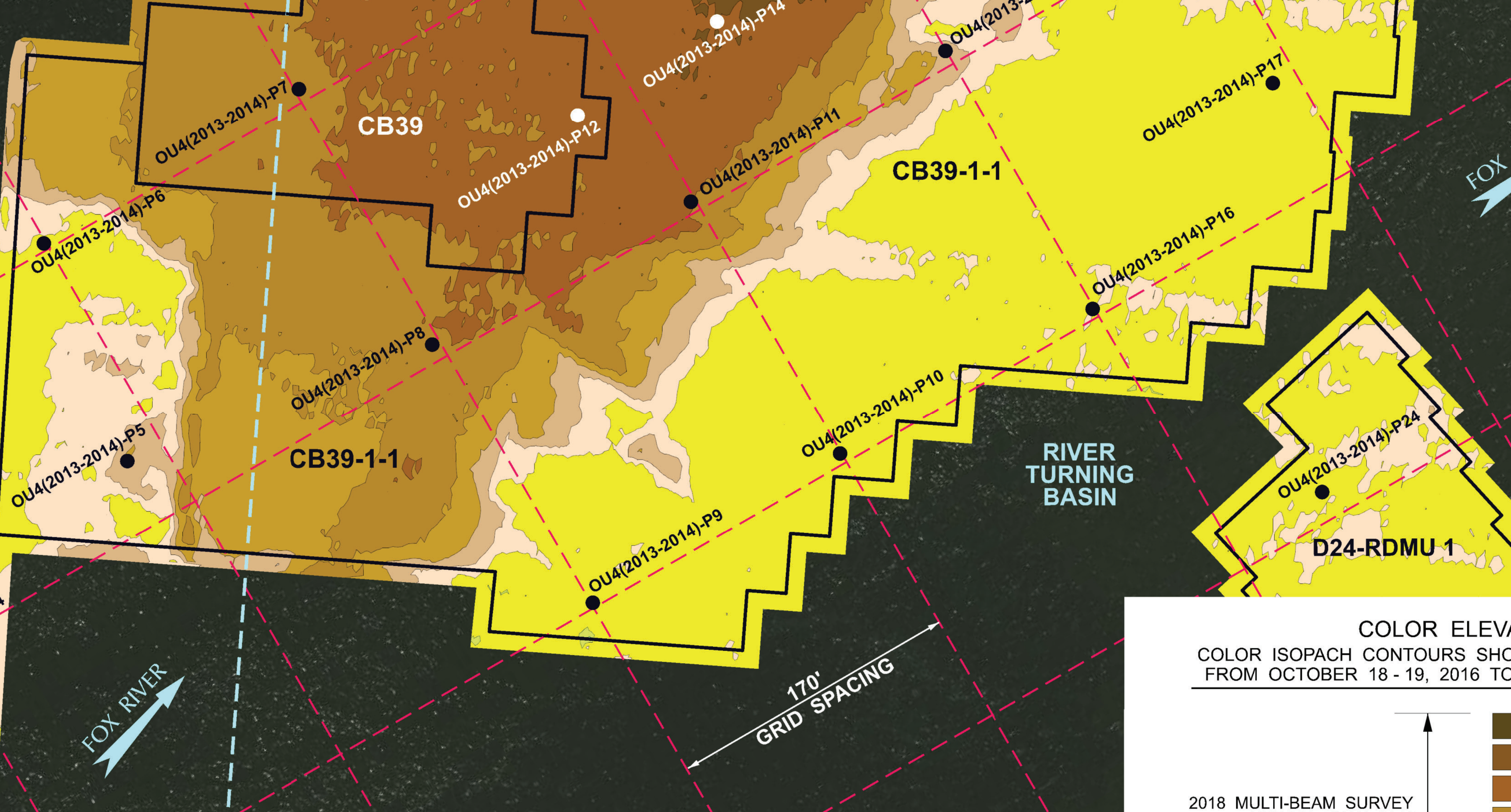
OU3-P83 PROPOSED CAP POLING / PROBING LOCATION AND INDENTIFACTION

NOTES:

1. MULTI-BEAM HYDROGRAPHIC SUR
DATES OF SURVEYS: SEPTEMBER
2. THE HORIZONTAL CONTROL IS R
STATE PLANE COORDINATE SYST
THE VERTICAL CONTROL IS REF
3. COLOR ORTHO PHOTO OBTAINED
4. DESIGN CAP PLACEMENT LIMITS
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU1



COLOR ELEVA

COLOR ISOPACH CONTOURS SHO
FROM OCTOBER 18 - 19, 2016 TO

2018 MULTI-BEAM SURVEY
HIGHER THAN 2016
MULTI-BEAM SURVEY

2018 MULTI-BEAM SURVEY
LOWER THAN 2016
MULTI-BEAM SURVEY

LEGEND

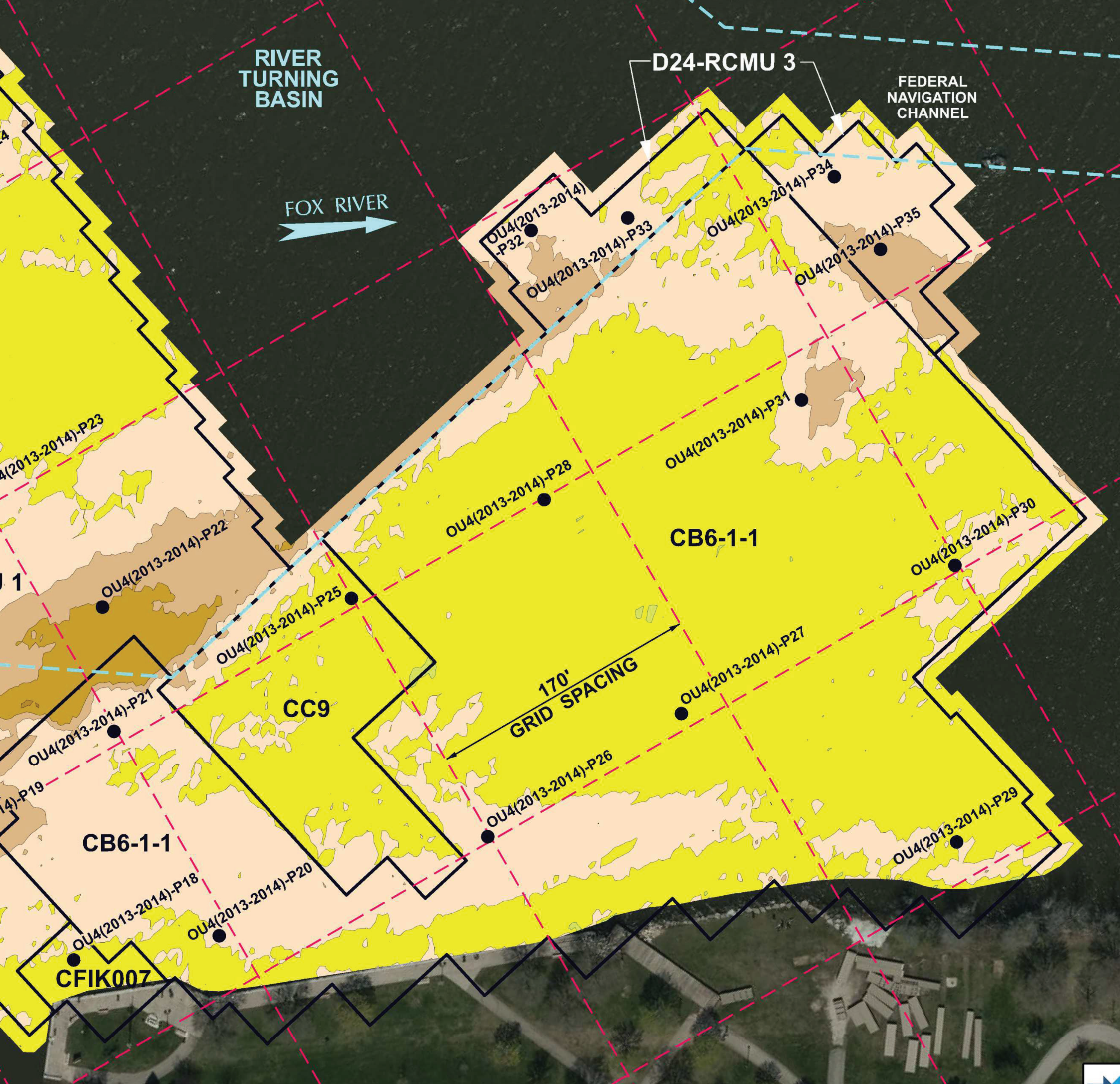
CB39	2013 - 2014 CAP DESIGN PLACEMENT LIMITS
	FEDERAL NAVIGATION CHANNEL
	170' GRID USED FOR POLING / PROBING LOCATIONS
OU4(2013-2014)-P10	PROPOSED CAP POLING / PROBING LOCATION AND IDENTIFICATION

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & SEPTEMBER 20, 2018.
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE)

GLATFELTER CO

LW / OU



LEGEND

CC9 2013 - 201

FEDERAL

170' GRID
POLING / I

OU4(2013-2014)-P31 PROPOSE
LOCATION

COLOR EL

COLOR ISOPACH CONTOURS S
FROM OCTOBER 18 - 19, 2016

2018 MULTI-BEAM SURVEY
HIGHER THAN 2016
MULTI-BEAM SURVEY

2018 MULTI-BEAM SURVEY
LOWER THAN 2016
MULTI-BEAM SURVEY

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HY
PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19
2. THE HORIZONTAL CONTROL IS REFE
STATE PLANE COORDINATE SYSTEM
THE VERTICAL CONTROL IS REFEREN
3. COLOR ORTHO PHOTO OBTAINED FR
4. DESIGN CAP PLACEMENT LIMITS DER
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU

LEGEND

CBD23-27 2013 - 2

170' GR
POLING

OU4(2013-2014)-P141 PROPOS
LOCATIO

COLOR ELEVA

COLOR ISOPACH CONTOURS SHO
FROM OCTOBER 18 - 19, 2016 TO

2018 MULTI-BEAM SURVEY
HIGHER THAN 2016
MULTI-BEAM SURVEY

2018 MULTI-BEAM SURVEY
LOWER THAN 2016
MULTI-BEAM SURVEY

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYD
PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19,
2. THE HORIZONTAL CONTROL IS REFER
STATE PLANE COORDINATE SYSTEM (W
THE VERTICAL CONTROL IS REFERENC
3. COLOR ORTHO PHOTO OBTAINED FRO
4. DESIGN CAP PLACEMENT LIMITS DERI
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU

CB40-1 2013 - 2014

FEDERAL N

170' GRID
POLING / P

OU4(2013-2014)-P39 PROPOSED
LOCATION

COLOR ELEVA

COLOR ISOPACH CONTOURS SHO
FROM OCTOBER 18 - 19, 2016 TO

2018 MULTI-BEAM SURVEY
HIGHER THAN 2016
MULTI-BEAM SURVEY

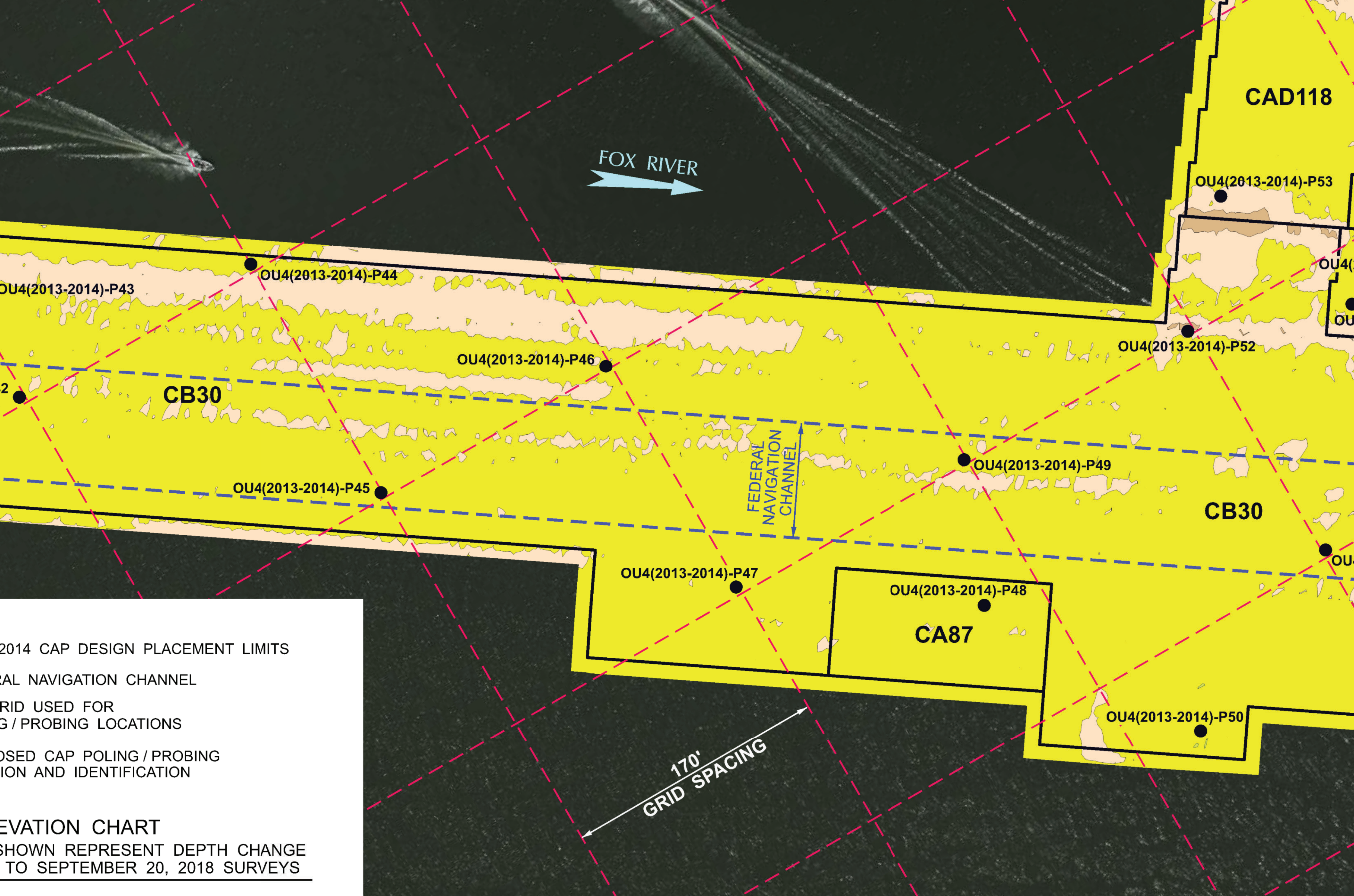
2018 MULTI-BEAM SURVEY
LOWER THAN 2016
MULTI-BEAM SURVEY

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM
PERFORMED BY J.F. BRENNAN, CO
DATE OF SURVEYS: OCTOBER 18 -
2. THE HORIZONTAL CONTROL IS RE
STATE PLANE COORDINATE SYSTE
THE VERTICAL CONTROL IS REFER
3. COLOR ORTHO PHOTO OBTAINED
4. DESIGN CAP PLACEMENT LIMITS D
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU



2014 CAP DESIGN PLACEMENT LIMITS

RAL NAVIGATION CHANNEL

RID USED FOR
G / PROBING LOCATIONS

OSED CAP POLING / PROBING
ION AND IDENTIFICATION

EVATION CHART

SHOWN REPRESENT DEPTH CHANGE
TO SEPTEMBER 20, 2018 SURVEYS

DEPTH 1.5' TO 2.0'

DEPTH 1.0' TO 1.5'

DEPTH 0.5' TO 1.0'

DEPTH 0.0' TO 0.5'

DEPTH 0.0' TO 0.5'

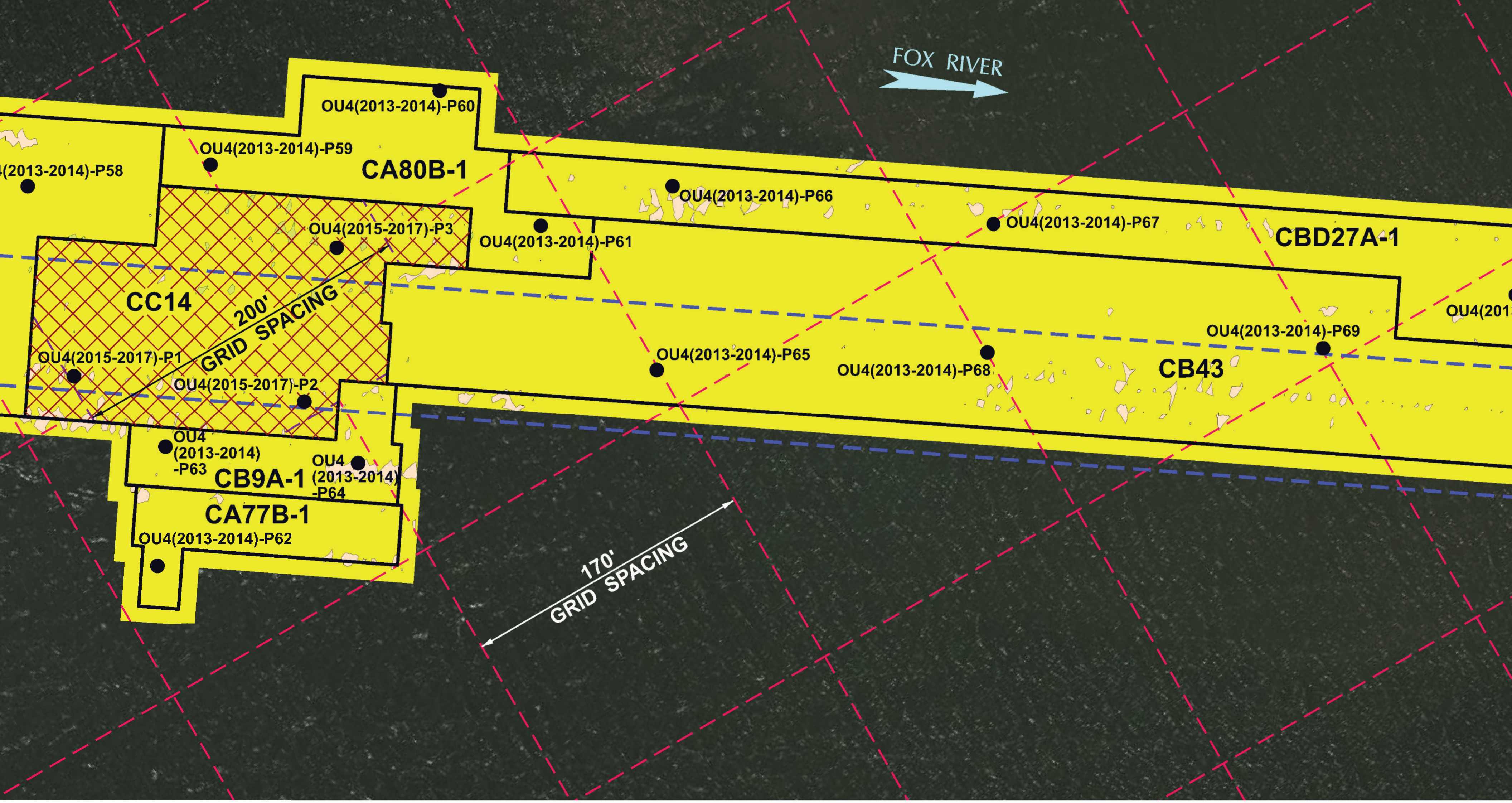
NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & SEPTEMBER 20, 2018.

2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).

GLATFELTER CO

LW / OU



ELEVATION CHART

RS SHOWN REPRESENT DEPTH CHANGE
016 TO SEPTEMBER 20, 2018 SURVEYS

Y 6 Y		DEPTH 1.5' TO 2.0'
		DEPTH 1.0' TO 1.5'
		DEPTH 0.5' TO 1.0'
		DEPTH 0.0' TO 0.5'
		DEPTH 0.0' TO 0.5'

NOTES:

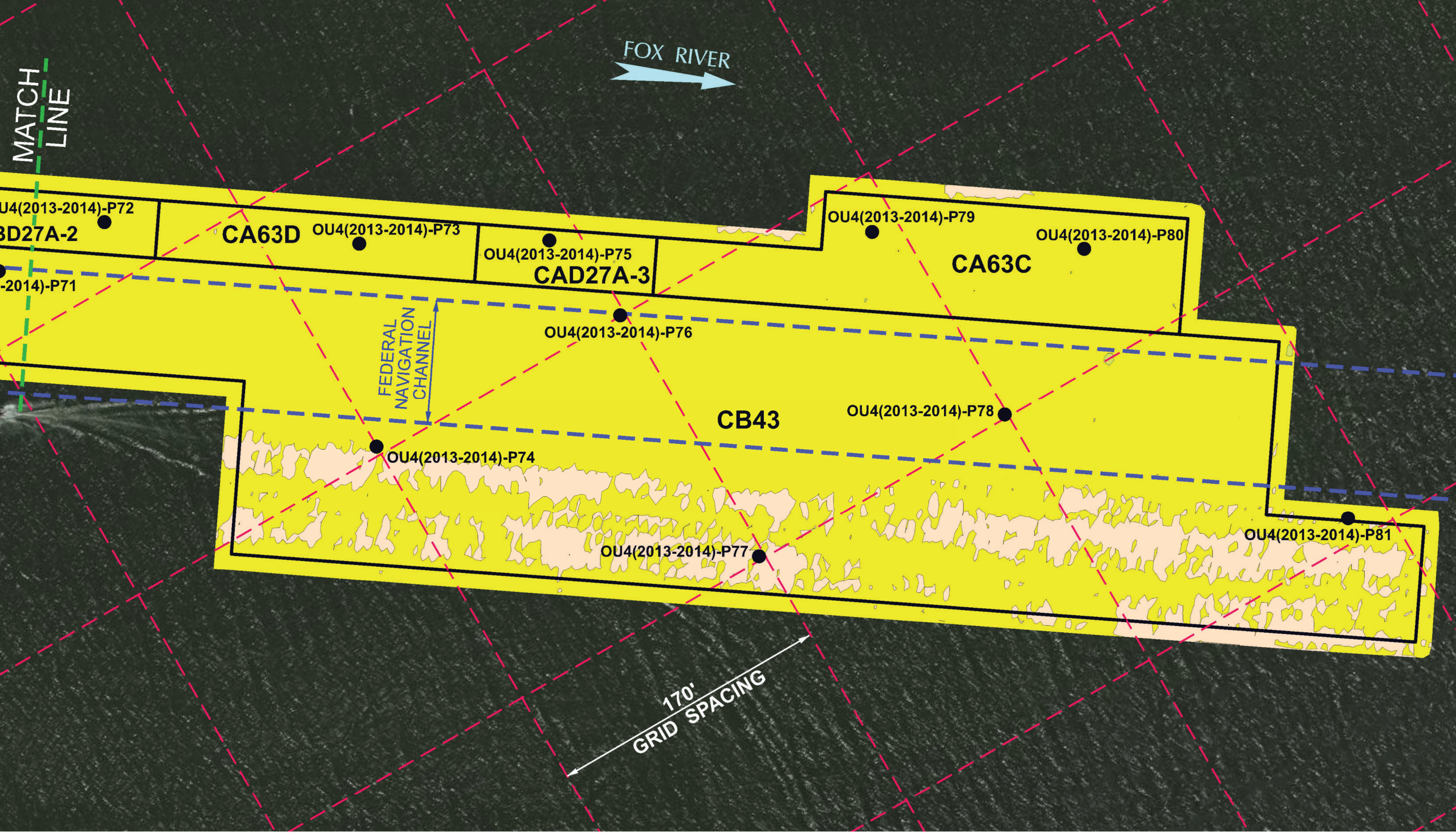
1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC POST CAP SURVEY PERFORMED BY J.F. BRENNAN COMPANY, INC. DATE OF SURVEY: SEPTEMBER 20, 2018.
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CB43	2013 - 2014 CAP DESIGN
~~CC14~~	2015 - 2017 CAP DESIGN
	FEDERAL NAVIGATION C
	170' GRID USED FOR 2
	200' GRID USED FOR 2
OU4(2013-2014)-P65	PROPOSED CAP POLIN LOCATION AND IDENTIF

GLATFELTER CO

LW / OU



LEVATION CHART
SHOWN REPRESENT DEPTH CHANGE
6 TO SEPTEMBER 20, 2018 SURVEYS

DEPTH 1.5' TO 2.0'
DEPTH 1.0' TO 1.5'
DEPTH 0.5' TO 1.0'
DEPTH 0.0' TO 0.5'
DEPTH 0.0' TO 0.5'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & SEPTEMBER 20, 2018.
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CB43 2013 - 2014 CAP DE
FEDERAL NAVIGATI
170' GRID USED FO
POLING / PROBING
OU4(2013-2014)-P77 PROPOSED CAP PO
LOCATION AND IDE

GLATFELTER CO

LW / OU

CTOBER 18 - 19, 2016 TO SEPTEMBER 21, 2018 SURVEYS

MULTI-BEAM SURVEY HIGHER THAN 2016 MULTI-BEAM SURVEY		DEPTH 1.5' TO 2.0'
		DEPTH 1.0' TO 1.5'
		DEPTH 0.5' TO 1.0'
		DEPTH 0.0' TO 0.5'
MULTI-BEAM SURVEY LOWER THAN 2016 MULTI-BEAM SURVEY		DEPTH 0.0' TO 0.5'
		DEPTH 0.5' TO 1.0'
		DEPTH 1.0' TO 1.5'
		DEPTH 1.5' TO 2.0'

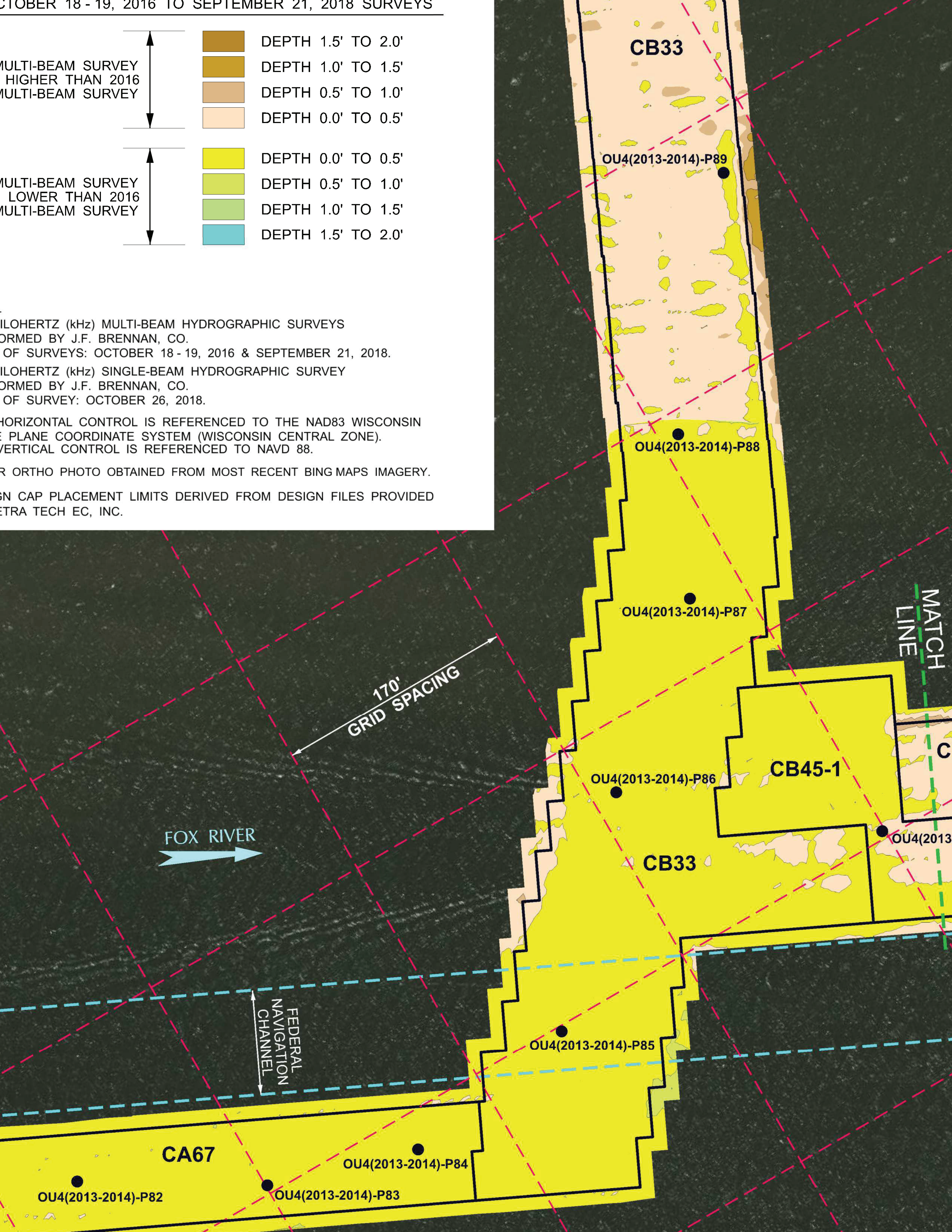
ILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS
ORMED BY J.F. BRENNAN, CO.
OF SURVEYS: OCTOBER 18 - 19, 2016 & SEPTEMBER 21, 2018.

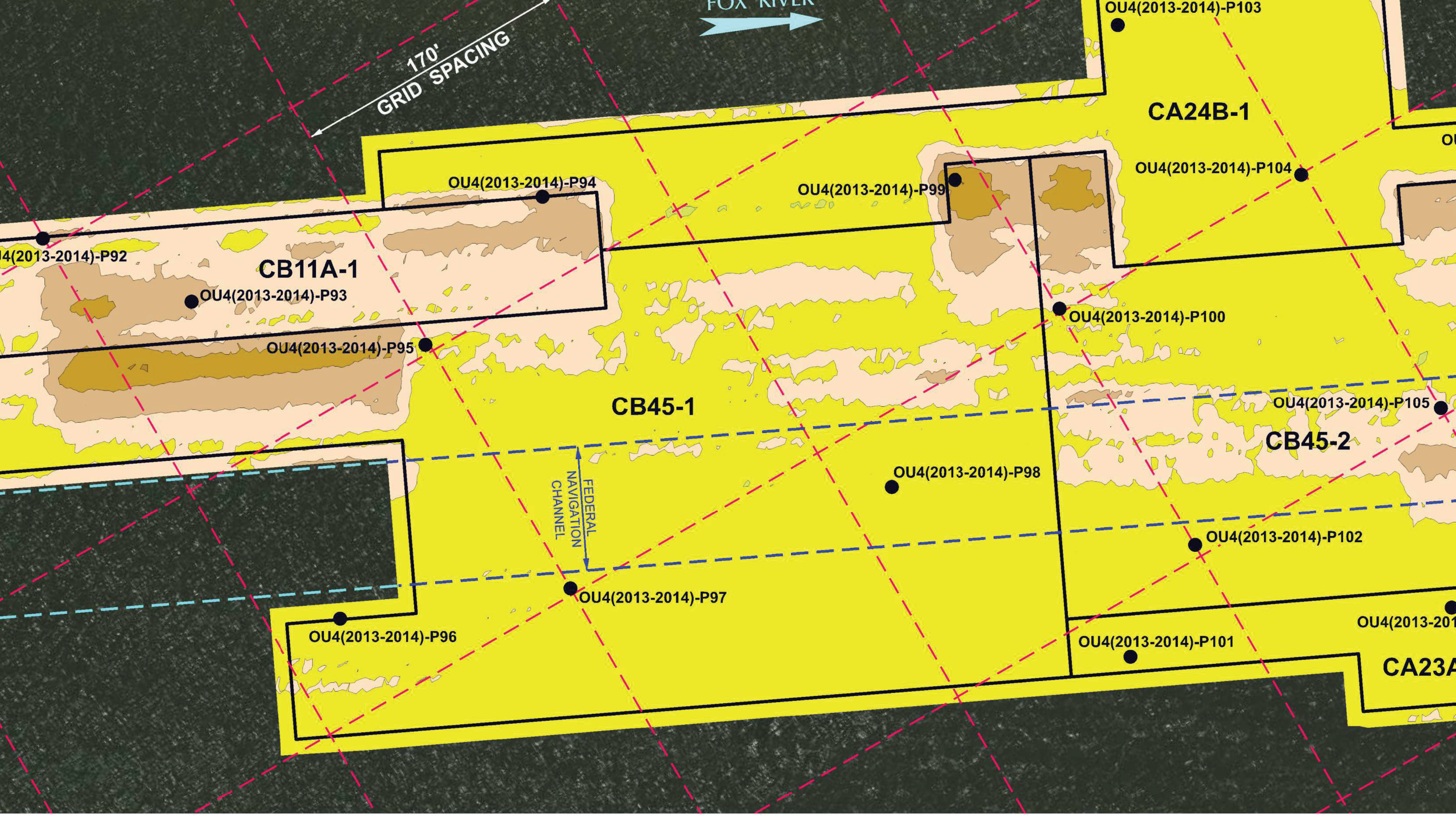
ILOHERTZ (kHz) SINGLE-BEAM HYDROGRAPHIC SURVEY
ORMED BY J.F. BRENNAN, CO.
OF SURVEY: OCTOBER 26, 2018.

HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN
E PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE).
VERTICAL CONTROL IS REFERENCED TO NAVD 88.

R ORTHO PHOTO OBTAINED FROM MOST RECENT BING MAPS IMAGERY.

GN CAP PLACEMENT LIMITS DERIVED FROM DESIGN FILES PROVIDED
ETRA TECH EC, INC.





LEVATION CHART

SHOWN REPRESENT DEPTH CHANGE
6 TO SEPTEMBER 21, 2018 SURVEYS

DEPTH 1.5' TO 2.0'

DEPTH 1.0' TO 1.5'

DEPTH 0.5' TO 1.0'

DEPTH 0.0' TO 0.5'

DEPTH 0.0' TO 0.5'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & SEPTEMBER 21, 2018.

2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CB45-1 DESIGN CAP PLA

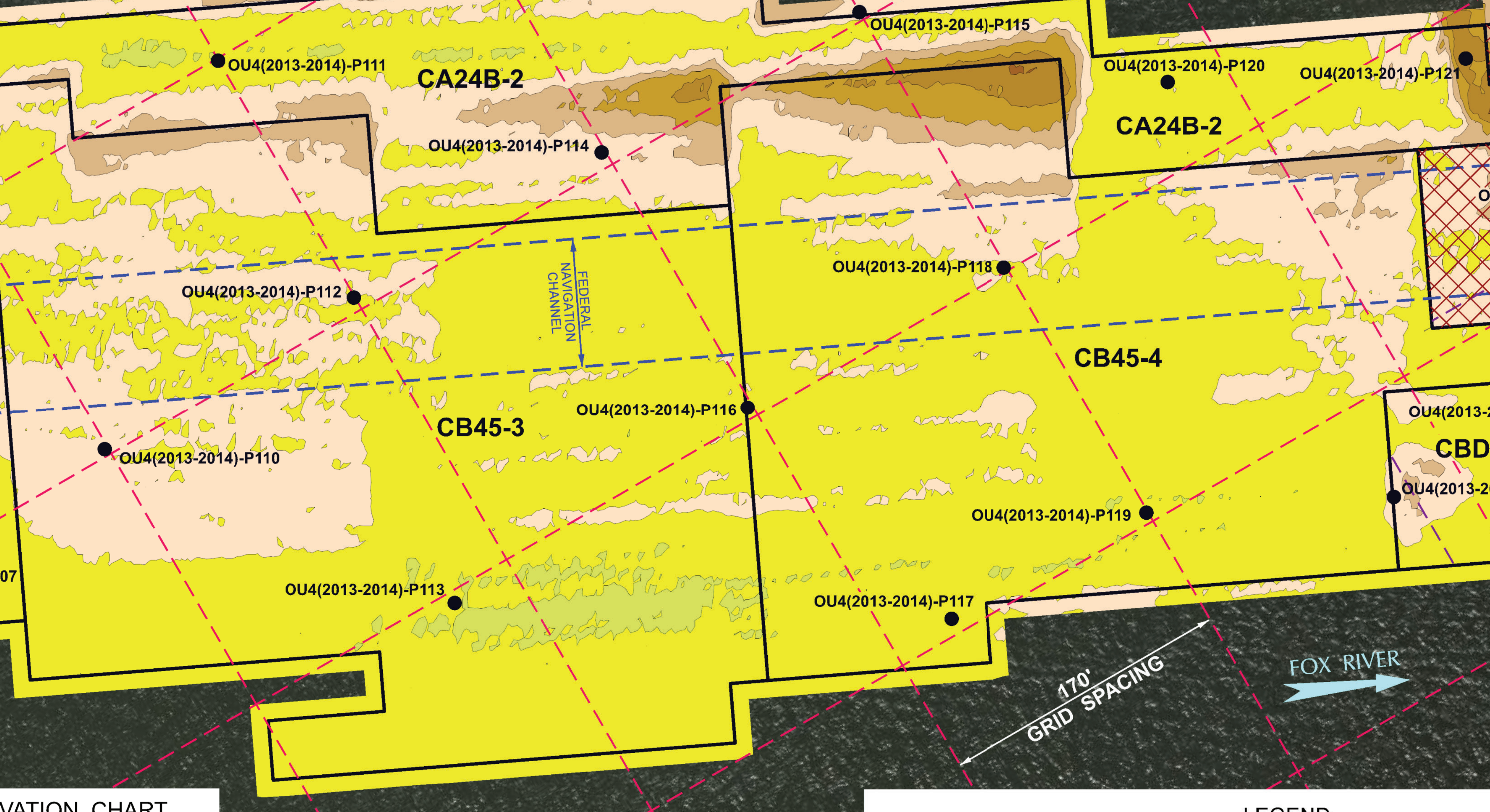
FEDERAL NAVIGAT

170' GRID USED F
POLING / PROBING

OU4(2013-2014)-P97 PROPOSED CAP F
LOCATION AND ID

GLATFELTER CO

LW / OU



VATION CHART
HOWN REPRESENT DEPTH CHANGE
TO SEPTEMBER 2018 SURVEYS

DEPTH 2.0' TO 2.5'
DEPTH 1.5' TO 2.0'
DEPTH 1.0' TO 1.5'
DEPTH 0.5' TO 1.0'
DEPTH 0.0' TO 0.5'

DEPTH 0.0' TO 0.5'
DEPTH 0.5' TO 1.0'
DEPTH 1.0' TO 1.5'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO. DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & OCTOBER 30, 2017 (CC2E S-1) & SEPTEMBER 21, 2018.

2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CB45-3 — 2013 - 2014 CAP DESIG

~~CC2ES-1~~ — 2015 - 2017 CAP DESIG

FEDERAL NAVIGATION

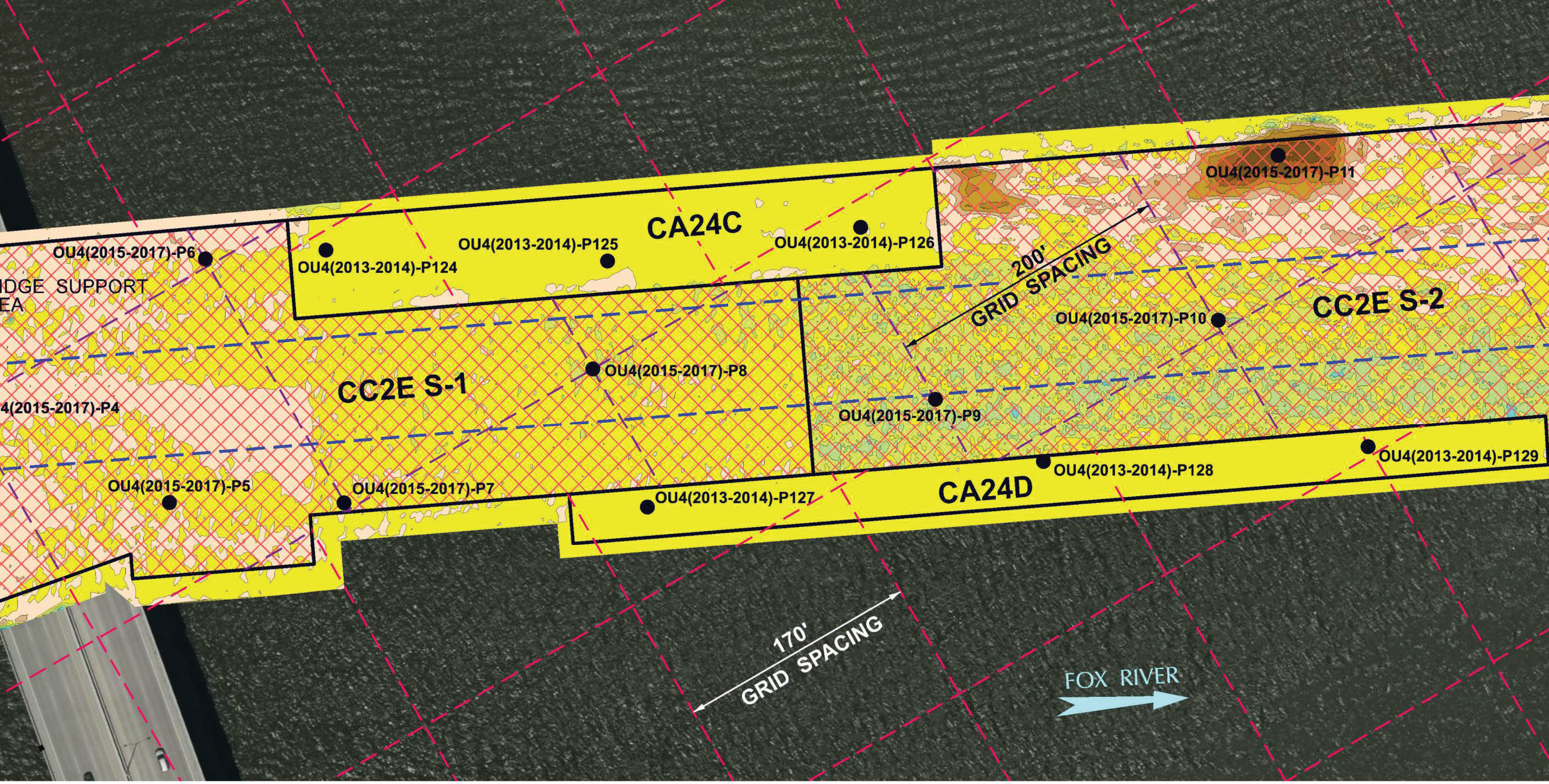
170' GRID USED FOR 2

200' GRID USED FOR 2

OU4(2013-2014)-P97 — PROPOSED CAP POLINC LOCATION AND IDENTIF

GLATFELTER CO

LW / OU



ELEVATION CHART

RS SHOWN REPRESENT DEPTH CHANGE
2017 TO SEPTEMBER, 2018 SURVEYS

DEPTH 2.5' TO 3.0'
DEPTH 2.0' TO 2.5'
DEPTH 1.5' TO 2.0'
DEPTH 1.0' TO 1.5'
DEPTH 0.5' TO 1.0'
DEPTH 0.0' TO 0.5'

DEPTH 0.0' TO 0.5'
DEPTH 0.5' TO 1.0'
DEPTH 1.0' TO 1.5'
DEPTH 1.5' TO 2.0'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 18 - 19, 2016 & OCTOBER 30, 2017 & SEPTEMBER 21, 2018.

200 KILOHERTZ (kHz) SINGLE BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS:
CCE S-2: NOVEMBER 10, 2015
CCE S-3: JUNE 2, 2016
SINGLE BEAM SURVEYS RAISED 0.12' BY FOTH FOR SURVEY COMPARISON.

2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CA24D 2013 - 2014 CAP DESIG

CC2E S-1 2015 - 2017 CAP DESIG

FEDERAL NAVIGATION

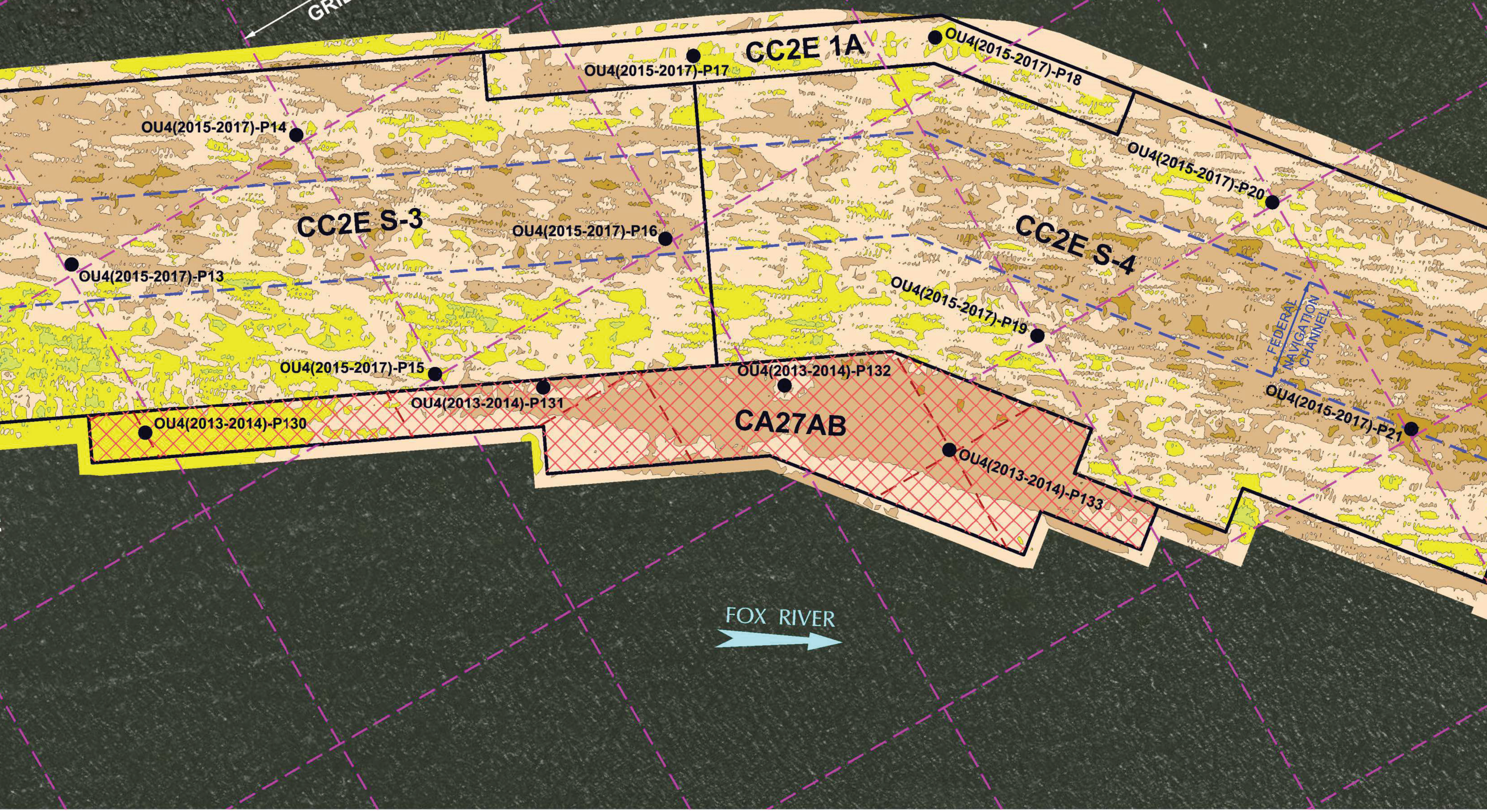
170' GRID USED FOR

200' GRID USED FOR

OU4(2015-2017)-P8 PROPOSED CAP POLIN LOCATION AND IDENTI

GLATFELTER CC

LW / OU



EVATION CHART
SHOWN REPRESENT DEPTH CHANGE
TO SEPTEMBER, 2018 SURVEYS

- DEPTH 2.0' TO 2.5'
- DEPTH 1.5' TO 2.0'
- DEPTH 1.0' TO 1.5'
- DEPTH 0.5' TO 1.0'
- DEPTH 0.0' TO 0.5'
- DEPTH 0.0' TO 0.5'
- DEPTH 0.5' TO 1.0'

NOTES:

1. 200 KILOHERTZ (kHz) SINGLE BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEYS:
   CCE S-2: NOVEMBER 10, 2015
   CCE S-3, CCE S-4: JUNE 2, 2016
   CCE S-5: JUNE 6, 2016
   SINGLE BEAM SURVEYS RAISED 0.12' BY FOTH FOR SURVEY COMPARISON.

   400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEYS: 10-18-16 (CA27AB), 12-1-16 (CB89A) & OCTOBER 30, 2017 (REMAINING) & SEPTEMBER 21, 2018 (ALL).

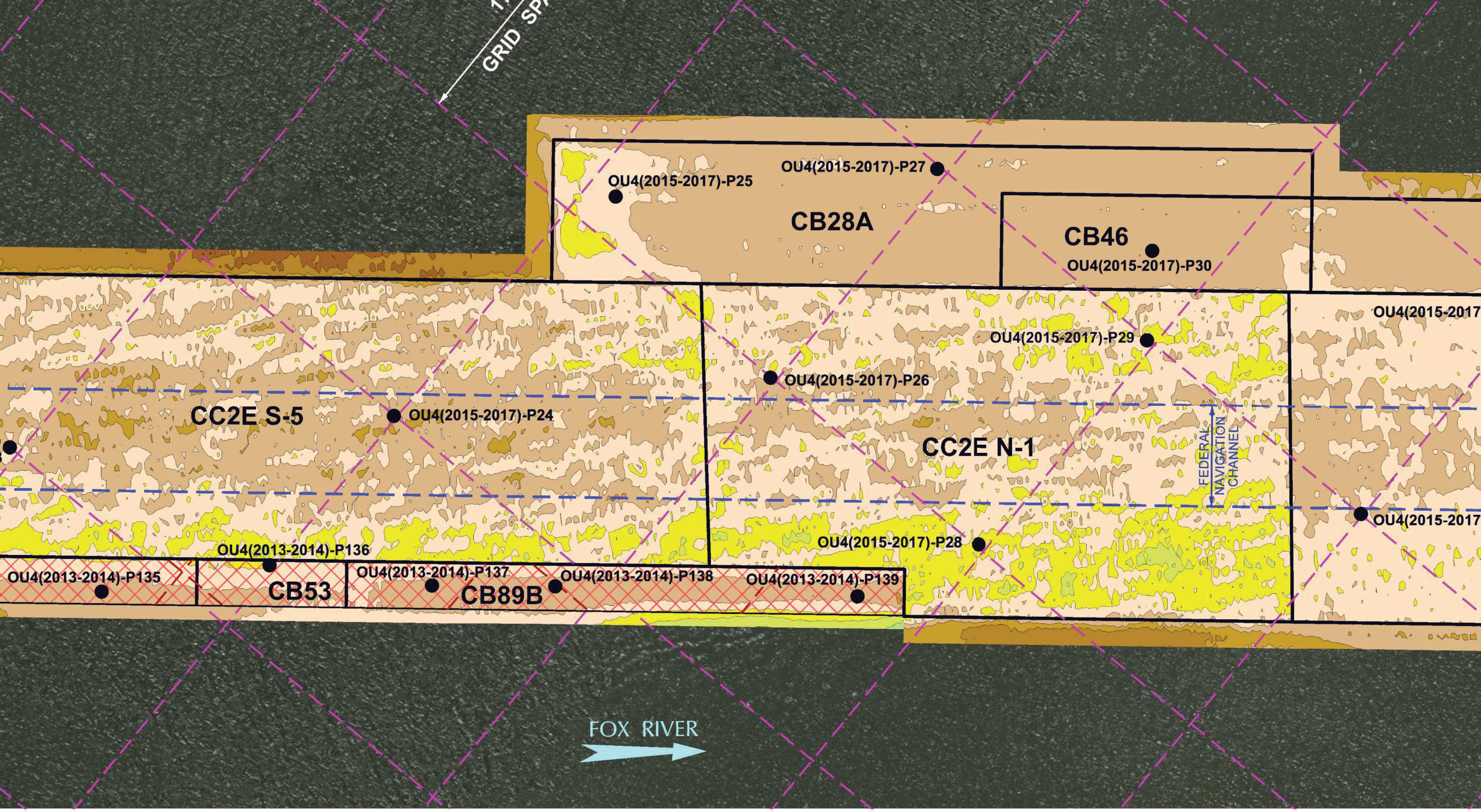
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

LEGEND

CA27AB	2013 - 2014 CAP DESIGN
CC2E S-3	2015 - 2017 CAP DESIGN
	FEDERAL NAVIGATION C
	170' GRID USED FOR 20
	200' GRID USED FOR 20
OU4(2013-2014)-P131	PROPOSED CAP POLING LOCATION AND IDENTIFI

GLATFELTER CO

LW / OU



EVATION CHART
URS SHOWN REPRESENT DEPTH
17 TO SEPTEMBER, 2018 SURVEYS

- DEPTH 2.0' TO 2.5'
- DEPTH 1.5' TO 2.0'
- DEPTH 1.0' TO 1.5'
- DEPTH 0.5' TO 1.0'
- DEPTH 0.0' TO 0.5'
- DEPTH 0.0' TO 0.5'
- DEPTH 0.5' TO 1.0'

NOTES:

1. 200 KILOHERTZ (kHz) SINGLE BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEYS:
   CCE S-4: JUNE 2, 2016
   CCE S-5 & CC2E N-1: JUNE 6, 2016
   SINGLE BEAM SURVEYS RAISED 0.12' BY FOTH FOR SURVEY COMPARISON.

   400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEYS: DECEMEBER 16, OCTOBER 18 - 19, 2016 & OCTOBER 30, 2017 & SEPTEMBER 21, 2018.

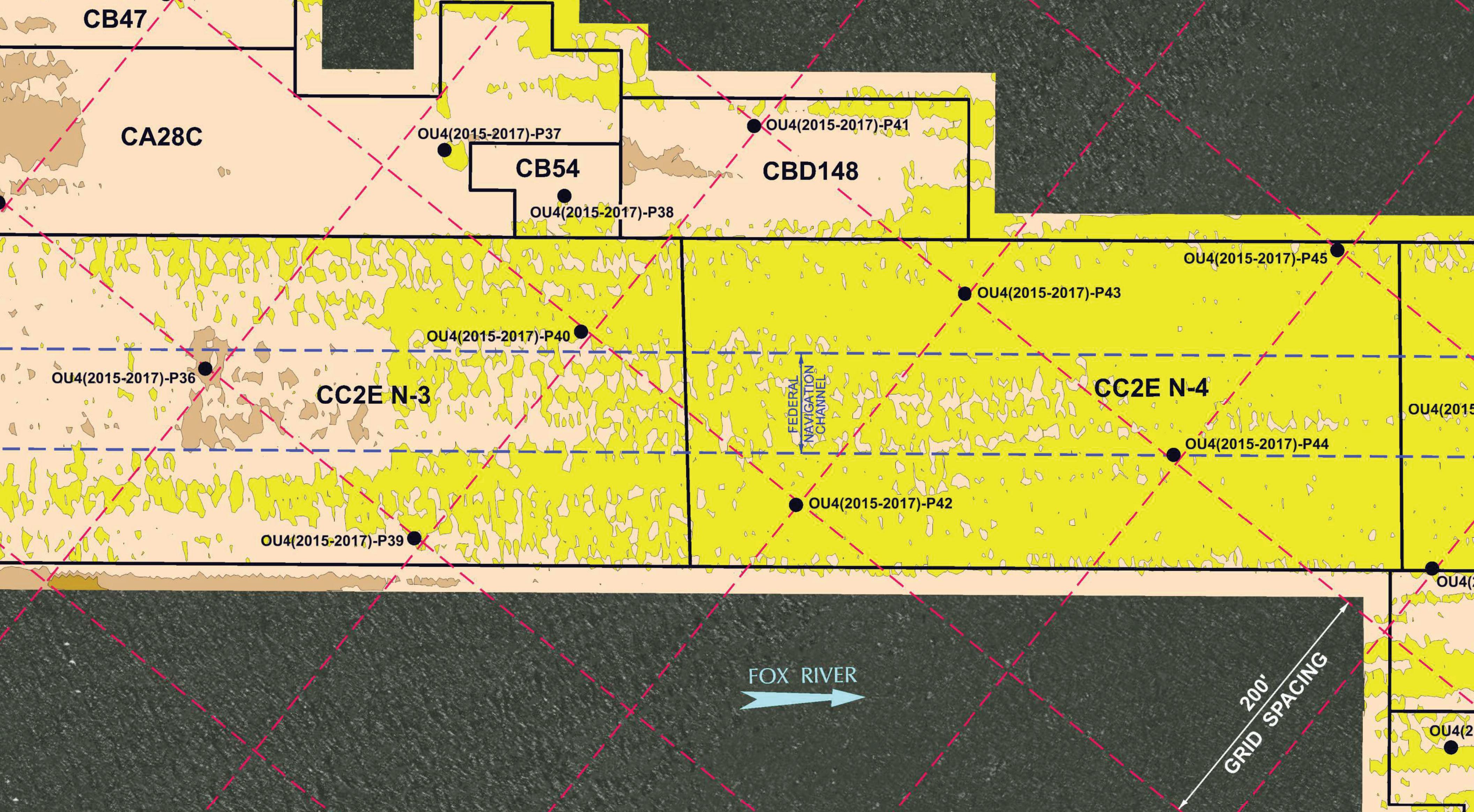
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE). THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.

LEGEND

CB89A	2013 - 2014 CAP DESIGN
CC2E S-5	2015 - 2017 CAP DESIGN
	FEDERAL NAVIGATION CH
	170' GRID USED FOR 201
	200' GRID USED FOR 201
OU4(2015-2017)-P31	PROPOSED CAP POLING LOCATION AND IDENTIFIC

GLATFELTER CO

LW / OU



LEVATION CHART
SHOWN REPRESENT DEPTH CHANGE
TO SEPTEMBER, 2018 SURVEYS

DEPTH 1.5' TO 2.0'
DEPTH 1.0' TO 1.5'
DEPTH 0.5' TO 1.0'
DEPTH 0.0' TO 0.5'
DEPTH 0.0' TO 0.5'
DEPTH 0.5' TO 1.0'

LEGEND

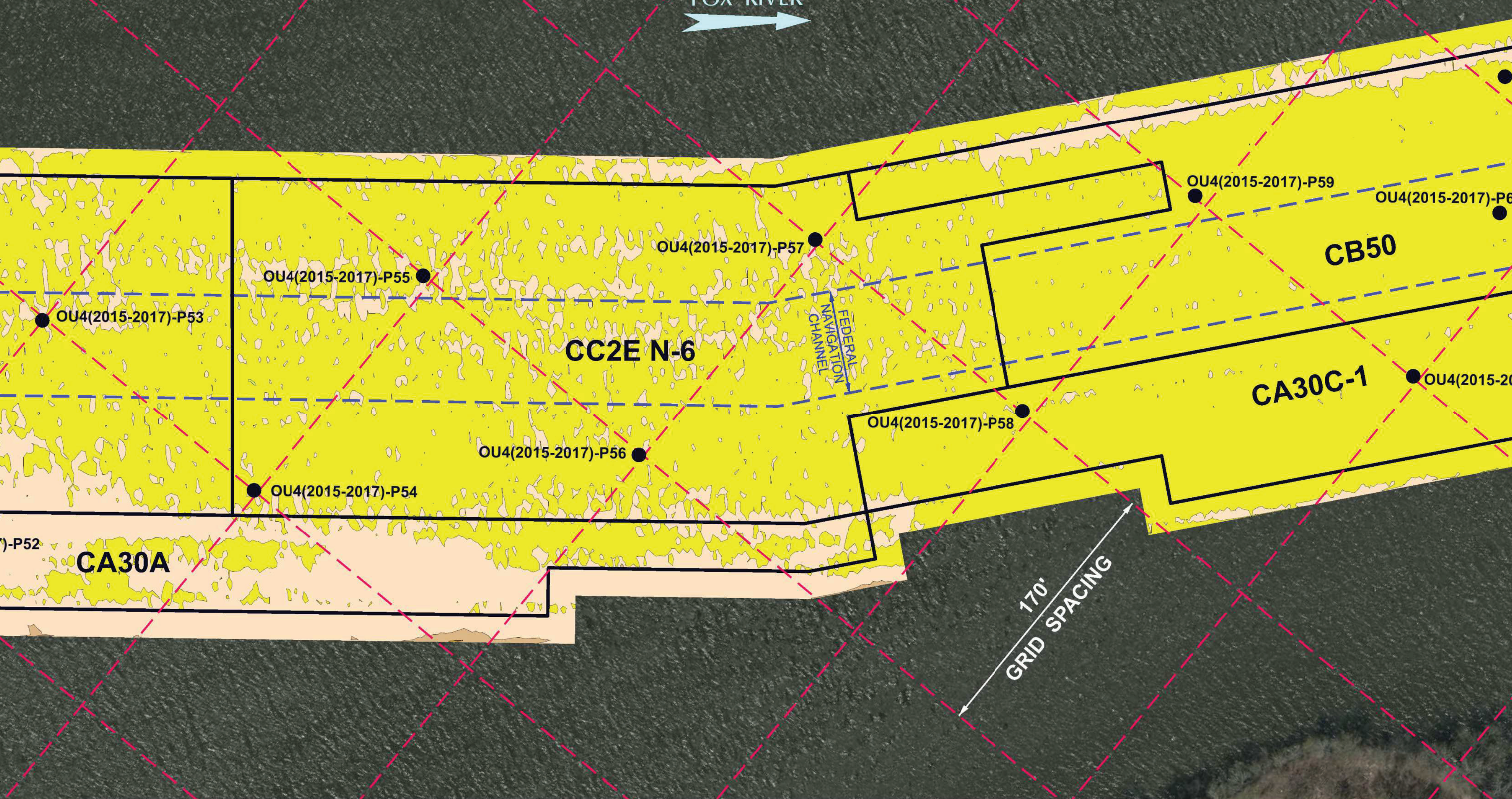
CA28C — 2015 - 2017 CAP DESIGN PLACEMENT LIMITS
FEDERAL NAVIGATION CHANNEL
200' GRID USED FOR POLING / PROBING LOCATIONS
OU4(2015-2017)-P42 — PROPOSED CAP POLING / PROBING LOCATION AND IDENTIFICATION

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO. DATE OF SURVEYS: OCTOBER 30, 2017 & SEPTEMBER 21, 2018.
2. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN

GLATFELTER CO

LW / OU



LEGEND

CA30A	2015 - 2017 CAP DESIGN PLACEMENT LIMITS
	FEDERAL NAVIGATION CHANNEL
	200' GRID USED FOR POLING / PROBING LOCATIONS
OU4(2015-2017)-P52	PROPOSED CAP POLING / PROBING LOCATION AND IDENTIFICATION

COLOR ELEVATION CHART

COLOR ISOPACH CONTOURS SHOWN REPRESENT DEPTH CHANGE FROM OCTOBER 2017 TO SEPTEMBER, 2018 SURVEYS

DEPTH 1.5' TO 2.0'

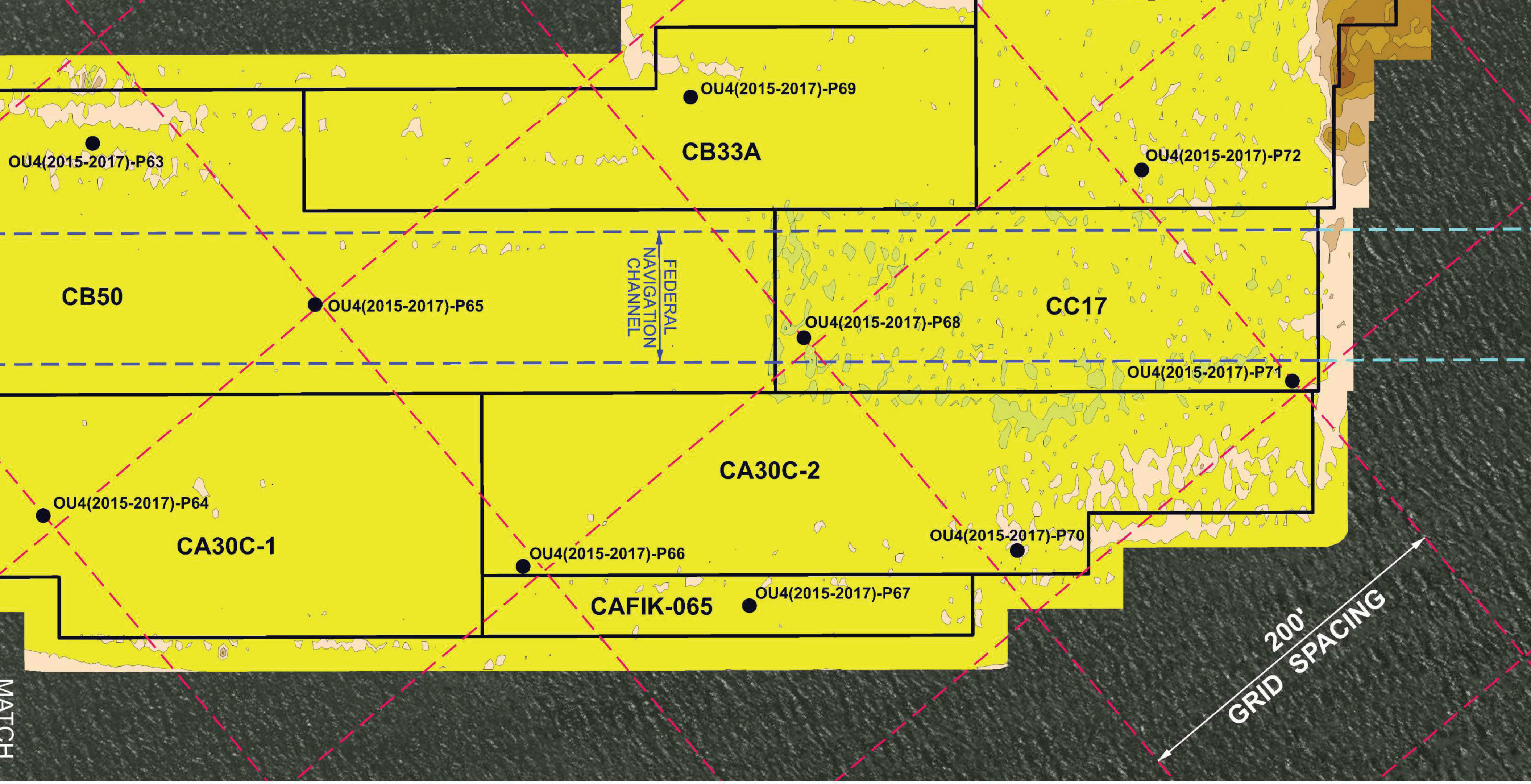
DEPTH 0.0' TO 0.5'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYD
PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 30, 201
2. THE HORIZONTAL CONTROL IS REFER
STATE PLANE COORDINATE SYSTEM (
THE VERTICAL CONTROL IS REFEREN
3. COLOR ORTHO PHOTO OBTAINED FRO
4. DESIGN CAP PLACEMENT LIMITS DERI
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / OU



LEGEND

CC17	2015 - 2017 CAP DESIGN PLACEMENT LIMITS
	FEDERAL NAVIGATION CHANNEL
	200' GRID USED FOR POLING / PROBING LOCATIONS
OU4(2015-2017)-P66	PROPOSED CAP POLING / PROBING LOCATION AND IDENTIFICATION

COLOR ELEVATION CHART

COLOR ISOPACH CONTOURS SHOWN REPRESENT DEPTH CHANGE FROM OCTOBER 2017 TO SEPTEMBER, 2018 SURVEYS

DEPTH 3.0' TO 3.5'
DEPTH 2.5' TO 3.0'
DEPTH 2.0' TO 2.5'
DEPTH 1.5' TO 2.0'

2018 MULTI-BEAM SURVEY LOWER THAN 2017

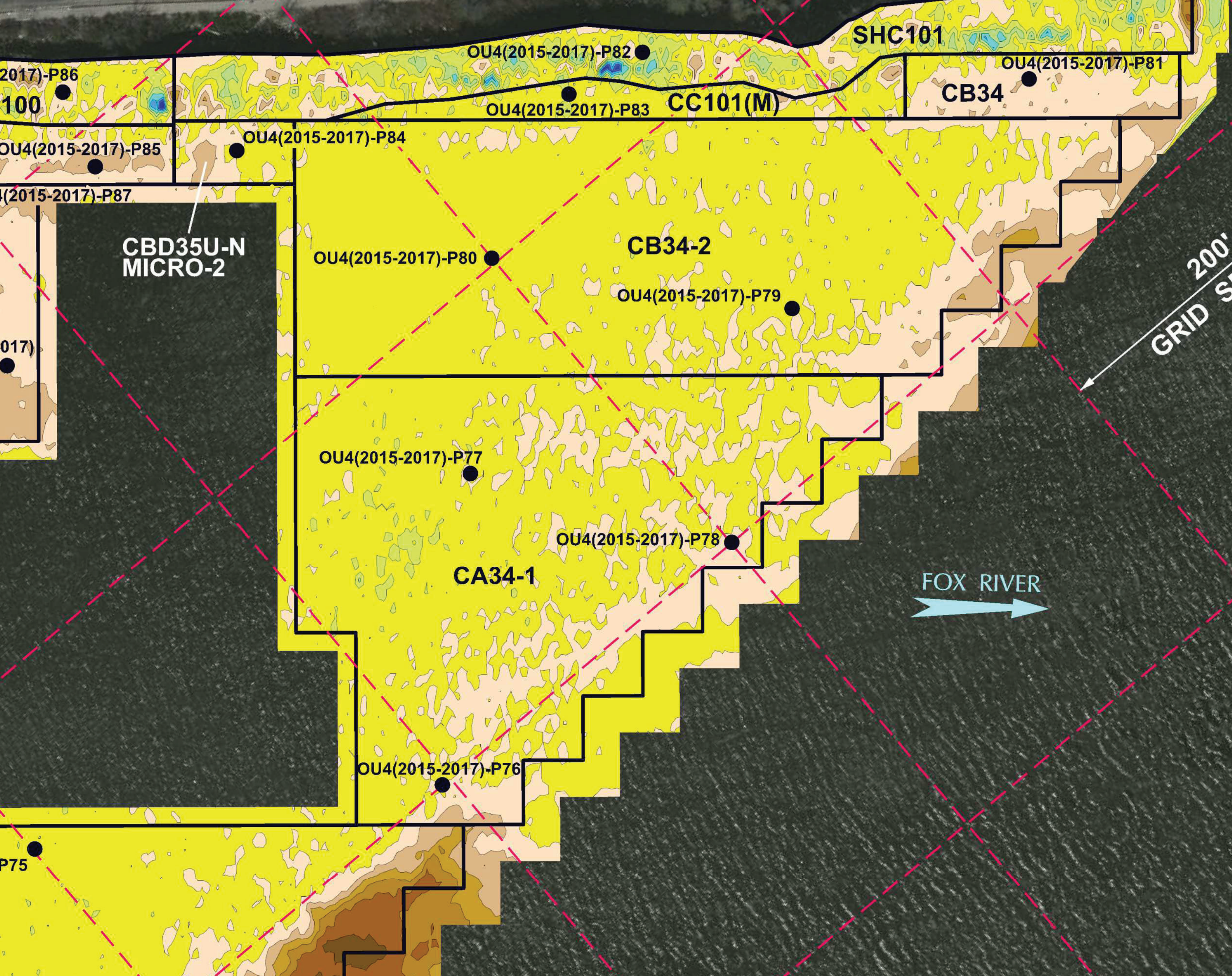
DEPTH 0.0' TO 0.5'
DEPTH 0.5' TO 1.0'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEAM HYD
PERFORMED BY J.F. BRENNAN, CO.
DATE OF SURVEYS: OCTOBER 30, 201
2. THE HORIZONTAL CONTROL IS REFER
STATE PLANE COORDINATE SYSTEM (
THE VERTICAL CONTROL IS REFEREN
3. COLOR ORTHO PHOTO OBTAINED FRO
4. DESIGN CAP PLACEMENT LIMITS DERI
BY TETRA TECH EC, INC.

GLATFELTER CC

LW / OU



LEGEND

CB20-1 — 2015 - 2017

200' GRID

OU4(2015-2017)-P84 — PROPOSED LOCATION

COLOR ELEV

COLOR ISOPACH CONTOURS
CHANGE FROM 2016 OR 2017

2018 MULTI-BEAM SURVEY HIGHER THAN 2016 / 2017 SURVEY

2018 MULTI-BEAM SURVEY LOWER THAN 2016 / 2017 SURVEY

NOTES:

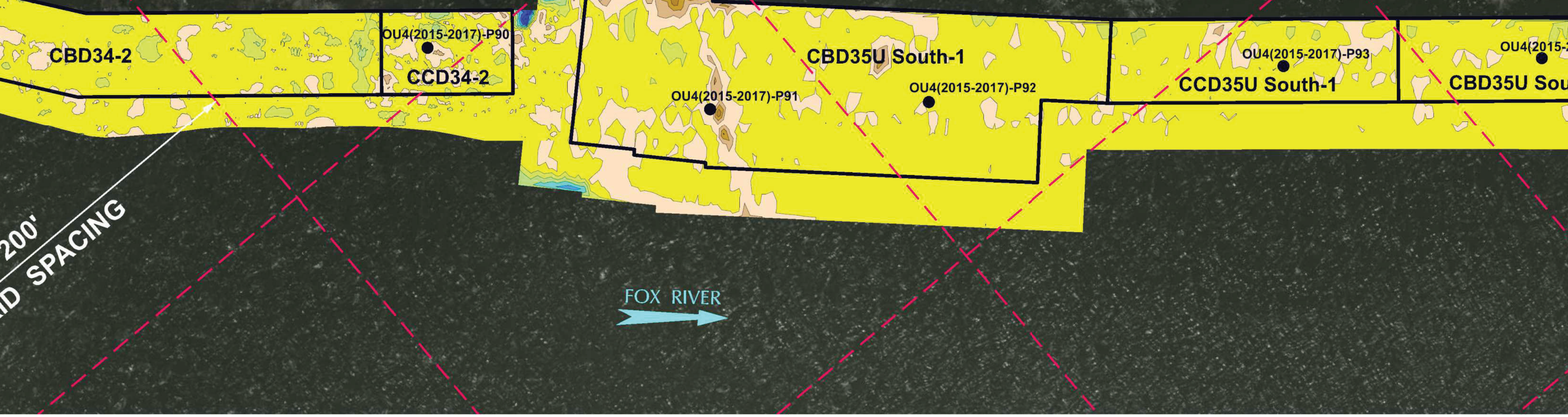
1. 200 KILOHERTZ (kHz) SINGLE BEAM HYDROGRAPHIC SURVEYS PERFORMED BY J.F. BRENNAN, CO.
   DATE OF SURVEY:
   CBD35A-8B: NOVEMBER 8, 2016
   SINGLE BEAM SURVEY RAISED 0.12' BY FOTH FOR SURVEY COMPARISON.

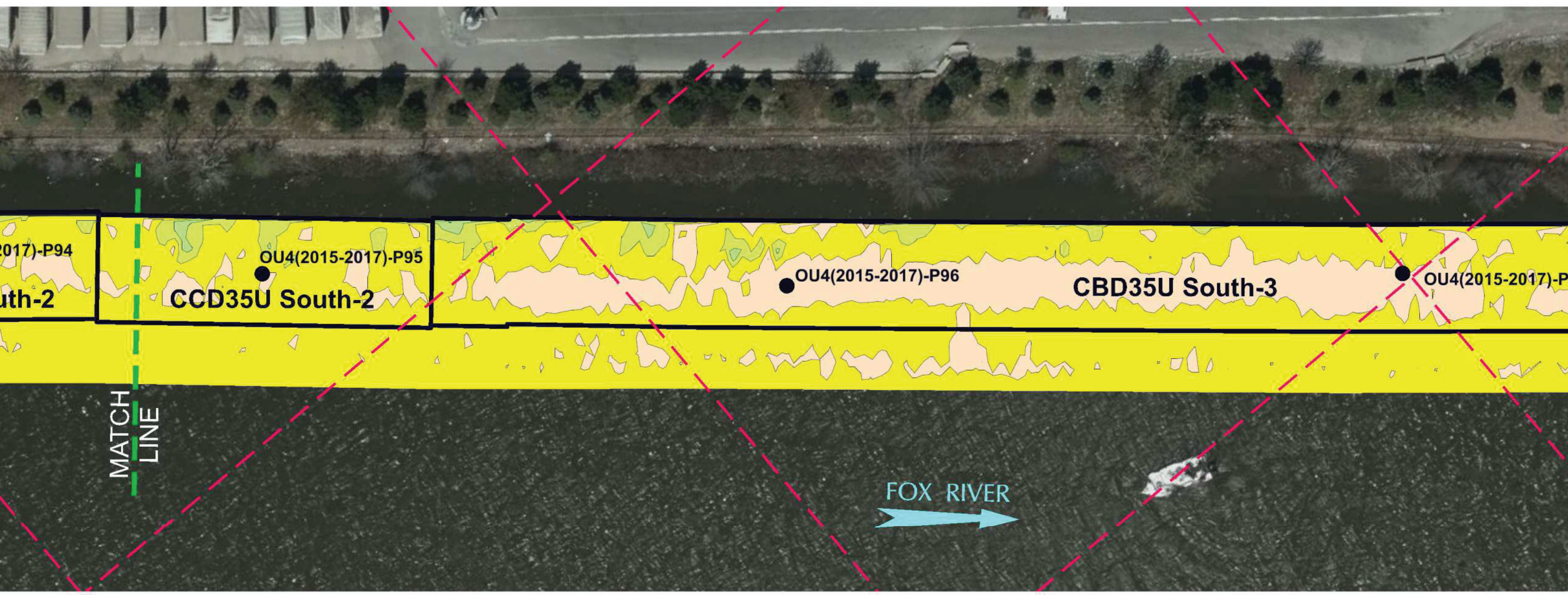
   400 KILOHERTZ (kHz) MULTI-BEAM HYDROGRAPHIC POST CAP SURVEY PERFORMED BY J.F. BRENNAN COMPANY, INC.
   DATE OF SURVEY: OCTOBER 30, 2017 AND SEPTEMBER 21, 2018

   SHORELINE TOPOGRAPHY PROTRUDING OUT OF THE WATER IN SHC100 AND SHC101 WAS CAPTURED USING DRONE DEVICE ON OCTOBER 26, 2018

GLATFELTER CO

LW / OU
OU4





LEGEND

CCD34-2	2015 - 2017 CAP DESIGN PLACEMENT LIMITS
— — —	200' GRID USED FOR POLING / PROBING LOCATIONS
OU4(2015-2017)-P94 ●	PROPOSED CAP POLING / PROBING LOCATION AND IDENTIFICATION

COLOR ELEVATION CHART

COLOR ISOPACH CONTOURS SHOWN REPRESENT DEPTH CHANGE FROM OCTOBER / DECEMBER 2017 TO SEPTEMBER, 2018 SURVEYS

DEPTH 1.5' TO 2.0'

DEPTH 0.0' TO 0.5'

NOTES:

1. 400 KILOHERTZ (kHz) MULTI-BEA
PERFORMED BY J.F. BRENNAN,
DATE OF SURVEYS: OCTOBER 3

200 KILOHERTZ (kHz) SINGLE BE
PERFORMED BY J.F. BRENNAN
DATES OF SURVEY: DECEMBER

2. THE HORIZONTAL CONTROL IS
STATE PLANE COORDINATE SYS
THE VERTICAL CONTROL IS REF

3. COLOR ORTHO PHOTO OBTAINE

4. DESIGN CAP PLACEMENT LIMITS
BY TETRA TECH EC, INC.

GLATFELTER CO

LW / O
OU4

Appendix A

Long-Term Chemical and Cap Monitoring Schedules

ies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
nit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

EPA 5 Year Report	OU1 Fish, and Water (Construction Completed 2009)	OU2 Fish, Water, and MNR Sediment (Construction Completed 2009)	OU3 Fish, Water, and Isolation-Layer (Construction Completed 2011)	OU4 Fish, Water, and Isolation-Layer (Construction Completed 2020)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2020)
Yes					
	Fish Tissue-OU1-Year 0 Water-OU1-Year 0				
	Fish Tissue-OU1-Year 2 Water-OU1-Year 2	Fish Tissue-OU2-Year 0 Water-OU2-Year 0 MNR Sediment-OU2-Year 0	Fish Tissue-OU3-Year 0 Water-OU3-Year 0 Isolation-Layer-OU3-Year 0		
Yes		Fish Tissue-OU2-Year 2 Water-OU2-Year 2 MNR Sediment-OU2-Year 2	Fish Tissue-OU3-Year 2 Water-OU3-Year 2 Isolation-Layer-OU3-Year 2		
	Fish Tissue-OU1-Year 8 Water-OU1-Year 8	Fish Tissue-OU2-Year 6 Water-OU2-Year 6 MNR Sediment-OU2-Year 6	Fish Tissue-OU3-Year 6 Water-OU3-Year 6 Isolation-Layer-OU3-Year 6		
Yes					
				Fish Tissue-OU4-Year 0 Water-OU4-Year 0 Isolation-Layer-OU4-Year 0	Fish Tissue-OU5-Year 0 Water-OU5-Year 0 MNR Sediment-OU5-Year 0
	Fish Tissue-OU1-Year 12 Water-OU1-Year 12	Fish Tissue-OU2-Year 10 Water-OU2-Year 10 MNR Sediment-OU2-Year 10	Fish Tissue-OU3-Year 10 Water-OU3-Year 10 Isolation-Layer-OU3-Year 10	Fish Tissue-OU4-Year 1 Water-OU4-Year 1 Isolation-Layer-OU4-Year 1	Fish Tissue-OU5-Year 1 Water-OU5-Year 1 MNR Sediment-OU5-Year 1
Yes					
	Fish Tissue-OU1-Year 17 Water-OU1-Year 17	Fish Tissue-OU2-Year 15 Water-OU2-Year 15 MNR Sediment-OU2-Year 15	Fish Tissue-OU3-Year 15 Water-OU3-Year 15 Isolation-Layer-OU3-Year 15	Fish Tissue-OU4-Year 6 Water-OU4-Year 6 Isolation-Layer-OU4-Year 6	Fish Tissue-OU5-Year 6 Water-OU5-Year 6 MNR Sediment-OU5-Year 6
Yes					
	Fish Tissue-OU1-Year 22 Water-OU1-Year 22	Fish Tissue-OU2-Year 20 Water-OU2-Year 20 MNR Sediment-OU2-Year 20	Fish Tissue-OU3-Year 20 Water-OU3-Year 20 Isolation-Layer-OU3-Year 20	3Fish Tissue-OU4-Year 11 Water-OU4-Year 11 Isolation-Layer-OU4-Year 11	Fish Tissue-OU5-Year 11 Water-OU5-Year 11 MNR Sediment-OU5-Year 11
Yes					
	Fish Tissue-OU1-Year 27 Water-OU1-Year 27	Fish Tissue-OU2-Year 25 Water-OU2-Year 25 MNR Sediment-OU2-Year 25	Fish Tissue-OU3-Year 25 Water-OU3-Year 25 Isolation-Layer-OU3-Year 25	Fish Tissue-OU4-Year 16 Water-OU4-Year 16 Isolation-Layer-OU4-Year 16	Fish Tissue-OU5-Year 16 Water-OU5-Year 16 MNR Sediment-OU5-Year 16
Yes					
	Fish Tissue-OU1-Year 32 Water-OU1-Year 32	Fish Tissue-OU2-Year 30 Water-OU2-Year 30 MNR Sediment-OU2-Year 30	Fish Tissue-OU3-Year 30 Water-OU3-Year 30 Isolation-Layer-OU3-Year 30	Fish Tissue-OU4-Year 21 Water-OU4-Year 21 Isolation-Layer-OU4-Year 21	Fish Tissue-OU5-Year 21 Water-OU5-Year 21 MNR Sediment-OU5-Year 21
Yes					
	Repeat year 2042 monitoring for fish tissue, water, chemical isolation-layer, and monitored natural recovery sediment every five (5) years in perpetuity.				

ies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
nit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule. Note: Cap Monitoring in OU2 is not required.

EPA 5 Year Report	OU1 Caps (Construction Completed 2009)	OU3 Caps (Construction Completed 2011)	OU4 Caps 2013 - 2014 (Construction Completed 2014)	OU4 Caps 2015 - 2017 (Construction Completd 2017)	OU4/OU5 Caps 2018 - 2020 (Construction Completed 2020)
Yes					
	Caps-OU1-Year 0 Note: Year zero for OU1 was the year after construction was completed.				
	Caps-OU1-Year 1 Note: Bathymetric Survey Triggered in 2011 by a 5 year recurrence flow rate.	Caps-OU3-Year 0			
	Caps-OU1-Year 2 Note: Bathymetric Survey of cap waived because of the 2011 Bathymetric Survey results for 5 year recurrence flow rate.				
Yes		Caps-OU3-Year 3	Caps-OU4-Year 0 (2013-2014)		
			Caps-OU4-Year 2 (2013-2014)		
				Caps-OU4-Year 0 (2015-2017)	
	Caps-OU1-Year 8	Caps-OU3-Year 7	Caps-OU4-Year 4 (2013-2014)	Caps-OU4-Year 1 (2015-2017)	
Yes					
					Caps-OU4/OU5-Year 0 (2018-2020)
	Caps-OU1-Year 12	Caps-OU3-Year 11	Caps-OU4-Year 8 (2013-2014)	Caps-OU4-Year 5 (2015-2017)	Caps-OU4/OU5-Year 2 (2018-2020)
Yes					
	Caps-OU1-Year 17	Caps-OU3-Year 16	Caps-OU4-Year 13 (2013-2014)	Caps-OU4-Year 10 (2015-2017)	Caps-OU4/OU5-Year 7 (2018-2020)
Yes					
	Caps-OU1-Year 22	Caps-OU3-Year 21	Caps-OU4-Year 18 (2013-2014)	Caps-OU4-Year 15 (2015-2017)	Caps-OU4/OU5-Year 12 (2018-2020)
Yes					
	Caps-OU1-Year 27	Caps-OU3-Year 26	Caps-OU4-Year 23 (2013-2014)	Caps-OU4-Year 20 (2015-2017)	Caps-OU4/OU5-Year 17 (2018-2020)
Yes					
	Caps-OU1-Year 32	Caps-OU3-Year 31	Caps-OU4-Year 28 (2013-2014)	Caps-OU4-Year 25 (2015-2017)	Caps-OU4/OU5-Year 22 (2018-2020)
Yes					
	Repeat year 2042 monitoring for Caps every five (5) years in perpetuity.				
Yes					

Appendix B

Standard Operating Procedures

SOP Acknowledgement Form

- B-1a Sample Vessel Location Control Using Handheld Differential Global Positioning System
- B-1b RTK-Global Positioning System for Sample Location Accuracy and Surface Elevation Calculations
- B-2 Trace PCB Sampling of Surface Water
- B-3 Water Quality Meter Use
- B-4 Field Log Book
- B-5 Fish Collection
- B-6 Biological Tissue and Plant Preparation
- B-7 Sediment Sampling Equipment Cleaning and Decontamination
- B-8 Sediment Sampling – Ponar Dredge
- B-9 Chemical Isolation Layer Sampling – Cap B
- B-10 Vibrocore Sampling
- B-11 Vacuum Push Core Sampling
- B-12 Piston Core Sampling
- B-13 Shipping and Packaging of Non-Hazardous Samples
- B-14 Sample Chain of Custody

SOP Acknowledgement Form

The undersigned agrees as follows:

I have read and understand the attached Standard Operating Procedures that apply to the task that I am completing and agree to comply with all of its provisions.

Name	Print Name	Date

B-1a

Sample Vessel Location Control Using Handheld Differential Global Positioning System

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sample Vessel Location Control Using Handheld Differential Global Positioning System

Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide positioning guidelines for location control for surface water surveys and sampling techniques, while using a handheld global positioning system (GPS) unit with differential GPS (DGPS) software, capable of locating stations to within a horizontal accuracy and repeatability of plus or minus (±) 1 meter (m).

References

None.

Responsibility

The Field Supervisor will be responsible for ensuring the navigation system is checked against known benchmarks and location control data is collected at the required times and frequencies, as specified in this SOP.

Personnel Qualifications/Requirements

- One person must be trained in boater safety training, vessel operation, and station positioning.
- A minimum of two people are required to complete sampling vessel positioning.

Equipment and Supplies

- Personal protective equipment (PPE) as required by the Health and Safety Plan (HASP).
- Navigation of the sampling vessel to the predetermined sampling locations and holding sample location will be accomplished using a handheld Trimble® GEOXT DGPS or equivalent navigation system; this unit is specified to provide sub-meter accuracy. This DGPS unit is capable of using either U.S. Coast Guard (USCG) beacons or Wide Area Augmentation System (WAAS) to achieve the required accuracy.
- The sampling team will also verify position with the Trimble® EOXT DGPS or equivalent. Water surface elevation or vertical measurement is not recorded with this device.
- Field Log Book or applicable field forms.

Procedures

Survey Datum

Location control for all sample stations will use a coordinate system referenced to the 1997 adjustments to the North American Datum (NAD) 83 (97) horizontal datum. The DGPS system will be referenced to appropriate monuments. Other datum may be used dependent upon project constraints. Be sure to identify the correct project datum prior to proceeding.

Positioning Sample Vessel

- Prior to vessel departure at each sampling transect, a calibration check shall be taken at two known benchmarks nearest to the sample locations. The acceptable tolerance for the benchmark check with the handheld DGPS unit shall be twice the instrument accuracy, or +/- 2 m. These readings shall be recorded in a Field Log Book by a project team member and stored electronically for later download. Location readings shall be recorded and compared to published values.

- The vessel navigation and sample station positioning shall be accomplished using the DGPS methodology and the handheld display. Actual coordinates of sample station starting position shall be recorded by a project team member and stored electronically for later download. Location readings and time shall be recorded.

- The position of the DGPS unit on the vessel shall be as close to the sampling team as possible during sampling activities without compromising field operations, worker safety, or sample integrity (i.e., potential for cross-contamination).

- At a minimum, DGPS locations shall be recorded at the beginning and end of each hydrocast during water column profiling; the beginning and end of each water subsampling event at a particular location and depth along a sampling transect (i.e., U.S. Geological Survey [USGS] quarter-point sampling procedures; or at the center of the moon pool or side of the boat at sampling location, once spudded or anchored for sediment sampling events). For prolonged sampling activities, intermediate DGPS location readings shall be recorded electronically at approximately two second intervals. These readings are collected at the end of the sampling event and used to generate drift plots. For stationary sampling (e.g., sediment sampling), DGPS coordinates shall be recorded at the center of the moon pool or side of the boat where sampling occurs once spudding or anchoring are completed.

- At the completion of sampling event, a calibration check shall be taken at one of the pre-determined benchmarks. This reading shall be recorded and compared to published values.

Measurement Tolerance

The field checks of DGPS locations against known benchmarks will be evaluated using the following tolerance intervals:

- Less than or equal to 2 m – accuracy within project control limits;
- Greater than 2 to 5 m – acceptable accuracy; locations of associated sampling locations will be qualified as estimated; and
- Greater than 5 m – unacceptable accuracy; corrective action required (see next section).

Corrective Action

In the event the DGPS unit fails to agree to within 5 m of the known locations at the two benchmarks assigned to a particular sampling station, the following corrective actions will be implemented:

- Check the DGPS unit against an alternate benchmark in case the original benchmark is compromised by interference, obstruction, or other signal deterioration;
- Wait for a stronger satellite signal and re-check the unit; and
- Obtain and check a new DGPS unit.

B-1b

RTK-Global Positioning System for Sample Location Accuracy and Surface Elevation Calculations

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

RTK-Global Positioning System for Sample Location Accuracy and Surface Elevation Calculations

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for precise positioning of station locations often required to meet sampling event goals. Both accuracy (the ability to define position) and repeatability (the ability to return to a sampling station) are essential.

For marine sampling activities, with rigid specifications for both horizontal and vertical positioning accuracy/repeatability, navigation of the sampling vessel to a sampling location and final positioning will be accomplished using specialized real-time kinematic (also called "On the Fly" [OTF]) Global Positioning System (RTK-GPS), which will achieve better than plus or minus (±) 1-meter (m) horizontal accuracy as well as the ±5-centimeter (cm) vertical accuracy. One advantage of the RTK-GPS methodology is that the system allows the determination of an accurate measurement of a reference elevation, and/or surface water elevation, at the time of sample acquisition. The availability of the vertical data avoids the requirement to rely on multiple water level boards and/or installation of water level gauges. The RTK-GPS will be referenced to known survey control monuments (x, y, and z) surrounding the sampling site.

References

None.

Responsibility

The Field Supervisor will be responsible for ensuring the navigation system is checked against known benchmarks and location control data is collected at the required times and frequencies, as specified in this SOP.

Personnel Qualifications/Requirements

- One person must be trained in boater safety training, vessel operation, and station positioning.
- A minimum of two people are required to complete sampling vessel positioning.

Equipment and Supplies

- Personal protective equipment (PPE) as required by the Health and Safety Plan (HASP).

- Watercraft with at least three anchors or two anchoring spuds.
- RTK-GPS equipment.
- Field Log Book or applicable field forms.

Procedures

Survey Datum

Location control for all sample stations will use a coordinate system referenced to the 1997 adjustments to the North American Datum (NAD) 83 (97) horizontal datum. The RTK-GPS system will be referenced to appropriate monuments. Other datum may be used dependent upon project constraints. Be sure to identify the correct project datum prior to proceeding.

Positioning of the Sampling Vessel and Elevation Measurements

1. Prior to daily departure of the sampling vessel, the sampling team will be informed of the planned locations and the frequency of sampling required at each location. The sampling team will ensure that there is sufficient equipment to complete the planned work aboard the sampling vessel prior to departure from the dock or launch ramp.

2. Vessel navigation and positioning shall be accomplished using RTK-GPS methodology. To achieve the precision afforded by RTK-GPS methodology, a reference station will be established at a secure shore side location directly over a control point with precisely known x, y coordinates and elevation (z) relative to the project grid and datum. The reference station transmits pseudo-range correctors to a Rover GPS receiver aboard the survey vessel. The Rover unit then computes the precise x, y, z position of the shipboard antenna, based on the transmitted correction information.

3. The RTK-GPS system antenna will be in a "transit" mount, which will allow it to be removed and manually repositioned over the sampling point to acquire final "as-collected" x, y position measurements. The transit mount will have a fixed height so that the antenna may consistently be returned to a fixed distance (height) above the vessel deck that will be used in subsequent measurement of the core and water level elevations. The height of the vessel deck, as well as the water depth, will also be used to calculate the top of sediment elevation at the sampling point.

4. The sampling vessel will transit to a sampling location directed by the RTK-GPS system. The helmsman will maneuver the vessel and inform the crew when the vessel is in position. To sample at the exact pre-plotted sampling coordinates, the mobile antenna may be repositioned directly over the moon pool (sampling port in the boat platform) for the final vessel positioning. As appropriate, either spudding or anchoring will be used to maintain vessel stability at the sampling location.

5. After the sampling vessel is anchored or spudded, the sampling team will measure and record the following:

a. The water depth from the water surface to the lake bottom using a survey rod attached to a 6-inch diameter metal plate.

b. The thickness of soft sediment using the "poling" method (measured by pushing a probing rod with a half-inch steel end into the sediment until refusal—applicable to sediment sampling activities only).

6. The above information will be recorded on the Core Collection and Processing Log prior to acquisition of the core sample. The Core Collection and Processing Log will also be annotated with the exact core sampling location coordinates, date, time, weather, and water surface conditions, as well as any other information or event(s) associated with the acquisition of each core sample.

To compute the surface water elevation referenced to the project datum, the height of the RTK antenna above the water surface can be subtracted from the RTK-measured elevation of the RTK antenna. To calculate the top of core elevation referenced to the project datum, the measured depth of water is subtracted from the calculated surface water elevation.

B-2

Trace PCB Sampling of Surface Water

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Trace PCB Sampling of Surface Water

Introduction

The objective of this Standard Operating Procedure (SOP) is to provide methods, procedures, and guidance for sampling trace levels of polychlorinated biphenyls (PCB) in surface waters such as lakes, streams, pits, sumps, lagoons, and similar reservoirs for environmental analysis.

This process is applicable to all Foth Infrastructure & Environment, LLC (Foth) projects where low level PCB surface water sampling will be performed and where no other project/program plan or procedure is in place to direct those activities.

These procedures are modified based on trace metal sample collection techniques. When sampling requirements indicate that both trace metal and PCBs are to be sampled, trace metals can be collected under this SOP.

References

Olson, Mark and, John F. De Wild. U.S. Geologic Survey Water Resource Division, "Low Level Collection Techniques and Species-Specific Analytical Methods for Mercury in Water, Sediment, and Biota." Reported in the U.S. Geologic Survey *Resource Investigations Report,* 99-4018B, 1999.

Telliard, William A., et al. U.S. Environmental Protection Agency, Method 1669, "Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels," July 1996.

Telliard, William A., et al. "Water Quality Criteria Levels," July 1996.

Foth, 2016. *Location Control Using Differential Global Positioning System* SOP - #3206.

Definitions

- "Clean Hands" is a gloved person (with shoulder length gloves, if needed). "Clean Hands" will only have contact with sample bottles.
- "Dirty Hands" is a gloved person and contacts all sampling material pumps and tubing.
- Composite Sample is a peristaltic pump with a flow weighted or time interval dependent sampling device that can composite samples into one container or into multiple containers enclosed within the device (i.e., ISCO sampler) or operated in manual mode to directly fill sample containers.

Foth Infrastructure & Environment, LLC

Personnel Qualifications/Requirements

As directed in the Foth Project Planning Document (PPD) and appointed by project manager (PM):

- Health and Safety Plan.
- A minimum of two people are required to complete sampling with one person trained in this sampling technique.
- A third person will be needed to operate a vessel and operate Global Positioning System (GPS).
- A boater safety course is required to operate the boat.

Equipment and Supplies

- Work boat (minimum 16 feet) cleaned prior to collecting samples, power washed inside and out if necessary. Boat should be equipped with sonar depth sounder, electric trolling motor, and downrigger.
- Proper safety precautions shall be maintained throughout sampling event including wearing of appropriate personal protective equipment (PPE), life jackets, and following all boating rules and regulations including Foth's boating Current Best Approach (CBA).
- Coolers containing sample bottles for PCB, Total Suspended Solids (TSS), and Total Organic Carbon (TOC) samples. PCB sample bottles shall be contained in inner and outer sealable plastic bags.
- Cooler of ice.
- Lab-grade or reagent-free deionized water supplied by the analytical lab for blanks.
- "PCB free" water for field decontamination procedures.
- Peristaltic pump (ISCO Sampler). Reference Owner's Manual for operations.
- Rod to measure depth and attach tubing for sample collection at predetermined depth.
- Battery: 12-volt marine to operate peristaltic pump or Honda generator.
- Trimble GEO7X GPS (DGPS), or equivalent, as the primary GPS instrument for acquiring sample station locations. (Reference: Foth SOP #3206).
- Horiba U52030 Water Quality Meter, or equivalent, will be used to take turbidity and temperature field readings. The Horiba U52030 Water Quality Meter also has a pressure transducer for measuring depth. Daily calibrations of the Horiba U52030 Water Quality Meter will occur prior to sample point data acquisition. Calibrations of all instruments shall be kept in the Field Log Book and shall contain, at a minimum, instrument serial number, make and model, manufacturer of standard(s), and standard lot number(s) and date of expiration. Calibration readings and any adjustments made to field instruments shall also be recorded. See Owner's Manual for calibration procedures. A calibration check will also be performed at the end of each day's activities to verify if any drift in the instrument readings has occurred. If unacceptable drift is detected, the drift will be recorded and equipment will be re-calibrated.

- Two sections of Teflon® lined tubing for each transect where a peristaltic pump is used. One section to be submerged to predetermined depth and the other, an approximate 4-foot section to discharge into sample bottles. A new section of tubing shall be used for each transect being sampled.
- Two-foot section of silicone tubing needed for peristaltic pump action. A new section of tubing shall be used for each transect being sampled.
- Face dust masks or full face shields may be worn by members of the sampling team if introduction of low level PCB contamination through respiration is suspected.

Procedures

Safety Note

Surface water sampling can sometimes require the use of boats or access into or across bodies of water. Observe all boating safety considerations in the Health and Safety Plan including donning of proper life jackets.

"Quarter Point" Sampling Procedures

Area-weighted composite samples will be collected on specified transects to obtain representative water concentrations averaged over the cross-section of flow. Water quality sampling transects are located to the extent possible in relatively straight reaches with simple, U-shaped cross-sections, avoiding areas with shallow benches or protrusions that could cause eddies, wind waves, or other hydraulic complications. It is assumed that the flow in these sections is relatively uniform and well mixed. In a uniform, well-mixed cross-section, an area-weighted sampling design provides a reasonable approximation of a flow-weighted design.

Representative transects are sampled in general accordance with USGS "quarter point" sampling procedures. The channel cross-sections are divided into three equal areas based on bathymetric data. Water sampling stations are positioned at the midpoint of each of the three flow areas. Multiple samples may be collected at each sampling station.

Sample Team Roles and PPE

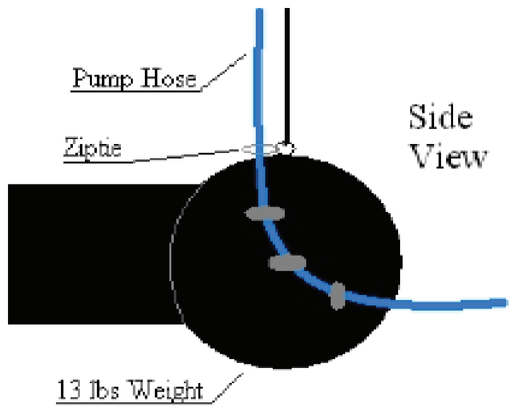
- A three person sampling team consisting of "Clean Hands," "Dirty Hands," and a boat driver who is an extra pair of hands in supporting the sampling effort.
  - All participants must wear, nitrile, or over life jackets and field clothing. Face dust mask or full face shields are recommended for all sampling team members if in PCB dust areas or if PCB inhalation is a concern.
  - "Clean Hands" is a gloved person (with shoulder length gloves, if needed) who will only have contact with sample bottles.
  - "Dirty Hands" is a gloved person who will have contact with all sampling material, pump hose, and depth rod.
  - The third person will handle driving of the boat, maintaining direction of route traveled during sampling into the waves/wind, or upstream in any current. Other duties of the third person include assisting with cooler manipulation,

controlling the Teflon® lined tubing and the laboratory-supplied "blank" water while collecting field blanks, recording DGPS coordinates, starting the peristaltic pump (ISCO Sampler) or generator, and monitoring safety conditions of sampling team during each sampling event.

Sample Collection Using Peristaltic Pump

1. Sample team shall calibrate the DGPS instrument with two known benchmarks.
2. Sample team should approach the predetermined sites using the DGPS instrument from down current or down wind to prevent vessel induced disturbance in the sampling area. No anchoring for sample collection. Sampling will take place from the bow of the boat, when possible, which should be oriented into the current or wind whenever possible. Work area shall be covered with plastic sheeting, if necessary, and duct taped to hold in place. Prepping the boat at each transect can be done on shore prior to launching.
3. Stratification measurements (such as turbidity and temperature) shall be measured at 1-meter intervals, starting at the surface and vertically measuring to within 1 meter of the bottom. DGPS measurements will be recorded at a minimum of 2-second intervals to record drift from starting position. Electronic sonar (used so as to not disturb bottom sediments) shall be used to verify total depth as the measurements are recorded. These measurements will be made before active sample collection begins for determining sample distribution. These results shall be recorded in the Field Log Book. Vessel control will be made with the engines or electric trolling motor to maintain sample collection tubing as vertical as possible and to remain as close as possible to the original starting DGPS location along each transect. Any variations in boat drift from targeted distances as a result of weather or boat traffic need to be documented in the Field Log Book.
4. Sampling equipment preparation of tubing and peristaltic pump, bottle prep, and sampling team gloving activities shall be completed before active sampling begins. Due to limited space in the boat and safety of sampling team, some of the preparation procedures can occur on shore prior to the launching of the boat. During actual collection of samples, the vessel direction must be maintained into the current or the wind with DGPS coordinates recorded.
5. All operations involving contact with sample bottle and with transfer tubing shall be handled by individuals designated as "Clean Hands" and "Dirty Hands." "Clean Hands" is responsible for all activities that involve direct contact with sample. "Dirty Hands" is responsible for all activities that do not involve direct contact with sample.
6. If collecting samples from multiple depths at a sampling station, collect water samples in order from shallow-to-deep in the water column.

7. The peristaltic pump tubing shall be deployed to a predetermined depth. To prevent the Teflon® lined tubing from curling and changing sample extraction depth, a weight or length of PVC pipe must be used to keep intake tubing at the desired depth. A downrigger with weight and tail fin is recommended to maintain sample depth and to keep intake tubing oriented in the direction of boat travel (refer to tubing attachment below). See Owner's Manual for operations of peristaltic pump.



8. Two tubing volumes shall be purged through the tubing system prior to sample collection.
9. "Dirty Hands" must open the cooler or storage container and remove the sample bottles from storage.
10. Sample bottle collection order: PCB bottle, PCB backup bottle, TSS (unpreserved bottle), TOC (sulfuric acid [H2SO4] preserved bottle).
11. Once gloves have been put on, "Clean Hands" must keep their gloved hands in view at all times.
12. "Dirty Hands" opens outer bag containing inner bag and PCB sample bottle.
13. "Clean Hands" opens inner bag and removes PCB sample bottle.
14. "Clean Hands" must keep PCB sample bottle in view at all times.
15. "Dirty Hands" reseals the outer bag containing inner bag and places back in storage container.
16. "Dirty Hands" controls the discharge hose from the peristaltic pump while "Clean Hands" opens the sample bottle cover. The sample bottle is filled after two tube volumes have been purged. The unpreserved PCB sample bottle is partially filled and rinsed with the sample water three times prior to sample collection.
17. Once "Clean Hands" replaces the sample bottle lid and returns the sample bottle to the original inner bag, "Dirty Hands" seals the outer sample bag and returns the bagged PCB sample bottle to the cooler.
18. "Dirty Hands" collects TSS and TOC samples and returns sample bottles to cooler.
19. Ice must be added to sample cooler.
20. Once all samples have been collected, the peristaltic pump can be turned off or moved to a lower depth in the water column, if required.

21. Document sample conditions, sample time, sample procedures, and any other observations pertinent to sample collection (wave action, boat activity, deviations from sampling plan). DGPS coordinates are continuously recorded during stratification measurements and sampling procedures to documentation drift around sampling station. (Reference: Foth SOP #1306)

Procedures for Additional Vertical Samples Collected at a Sample Station

- Repeat above procedure for samples at the next predetermined depth in the water column at the same sample location.
- Ensure a minimum of two tubing volumes are purged from depth before sample collection begins.
- Ensure that the bottom is not disturbed during drift by maintaining sonar depth.
- After all vertical samples are collected at sample location, rinse sample equipment with deionized water by pumping deionized water through peristaltic pump.
- Store peristaltic pump tubing in plastic bag for transport to next sample location along the transect.

Procedures for Addition Sample Stations Along a Transect

- Position the boat at the next sample location along transect.
- Repeat stratification measurements once at new sample location.
- Repeat sample collection procedures as necessary.

Decon Procedures After completing a Transect and Before Next Transect Sampling Event

- The used Teflon® lined tubing and silicone tubing shall be removed from the peristaltic pump.
- The used sampling tubing may be discarded or stored in a plastic bag and dedicated for future use along one transect.
- A decontamination area shall be determined by the sample team.
- Remove any particulate matter and other surface debris, including invasive species, from peristaltic pump and any other dedicated equipment (weights, pipes, etc.) used during the sampling event.
- Using appropriate tools such as a brush and non-phosphorus, laboratory-grade detergent, wash non-dedicated equipment and rinse with deionized water.
- Let air dry in a clean area.
- Place sampling equipment in a double bag and then in a plastic container ready for next event.

Procedures for QA Sample Collection

- For field blank samples, use laboratory-provided "blank" water and pass through a new section of tubing (Teflon® lined and silicone) prior to any sample collection.
- For replicate sample collection, sample bottle shall be alternated during sample collection.

B-3

Water Quality Meter Use

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Water Quality Meter Use

Introduction

This Standard Operating Procedure (SOP) is intended to provide general guidance and methods for using a field meter to measure water quality parameters from groundwater or surface water that is being purged, sampled, or monitored.

This procedure is applicable to all Foth projects where water quality monitoring is required using a water quality meter. The water quality meter may be a stand-alone meter or it may be a combined multi-probe unit used to measure temperature, pH, specific conductance, and/or other water quality parameters. The most common methods used for measuring water quality are instruments that measure in-situ parameters in one of the following two ways:

Water is extracted from its source using a pump and measured in a flow-through cell or in some instances captured and then measured in individual aliquots. This method is preferred when monitoring wells are sampled for laboratory analysis of chemical parameters, and groundwater purging is required.

The meter is submerged directly into the sample source, such as a monitoring well or surface water body, to collect in-situ monitoring parameters.

References

U.S. Army Corps of Engineers, 2001. *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, EM-200-1-3, Washington, D.C.

American Society of Testing and Materials, *Standard Guide for Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells*, D6634-01, West Conshohocken, PA.

American Society of Testing and Materials, *Standard Guide for Sampling Ground-Water Monitoring Wells*, D4448-01, West Conshohocken, PA.

Definitions

- Water Quality Meter – A device used to measure specific field parameters indicative of water quality, such as temperature, pH, specific conductance, and/or other parameters. The meter may be stand-alone or it may be a combined multi-probe unit.

- Pump – An electric, compressed air, or inert gas-driven device that raises liquids by means of pressure or suction. The types of pumps that should be used for water quality monitoring should be chosen based on the well size and depth, the type of contaminants, and the specific factors affecting the overall performance of the sampling or monitoring effort. The types of pumps that may be used include centrifugal, peristaltic, centrifugal submersible, gas displacement, and bladder pumps.

- pH – The negative log of the hydrogen ion concentration (-log10 [H+]); a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0 to 14.

- Turbidity – A measure of overall water clarity determined by measurement of the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU) but may also be measured in Jackson Turbidity Units (JTU).

- Specific Conductance (SC) – A measure of how well water can conduct an electrical current. Conductivity increases with increasing amount and mobility of ions such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution. The unit of conductance is expressed as microsiemens (1/1,000,000 siemen) per centimeter, or µS/cm.

- Oxidation-Reduction (Redox) Potential (ORP) – A measure in volts of the affinity of a substance for electrons compared with hydrogen. Liquids that are more strongly electronegative than hydrogen (i.e., capable of oxidizing) have positive redox potentials. Liquids less electronegative than hydrogen (i.e., capable of reducing) have negative redox potentials. Although the standard hydrogen electrode (SHE) is the ultimate reference for all ORP measurements, in practice an ORP field measurement may be made with other electrodes, such as silver chloride. These values may be converted to SHE values.

- Dissolved Oxygen (DO) – Refers to the amount of oxygen expressed as milligrams per liter (mg/L) that is contained in particular water. The amount of oxygen that can be held by the water depends on the water temperature, salinity, purity, and pressure.

- Salinity – The amount of dissolved salts in water, generally expressed in parts per thousand (PPt).

Responsibilities

Foth employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Foth employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e., checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

Equipment

The following equipment is recommended for use in performing water quality measurements:

- Water quality meter(s)
- Spare parts such as alkaline batteries (if used) and sensor probes
- Pump and discharge hose/line for use with a flow-through cell
- Paper towels or lint-free wipes
- Deionized water
- Sample gloves
- Calibration solutions for all parameters being measured; within expiration dates
- Plastic sheeting
- Field Log Book or log sheets

Procedures

General Instructions

- Ensure that the measuring range of the instrument encompasses the expected sample concentration or units.

- Before going to the field, locate all necessary field supplies such as deionized water, calibration solutions, decontamination supplies, and spare parts.

- Consult the instrument's operation manual as well as the project-specific sampling plan to verify that you have prepared the proper equipment and supplies to successfully complete the work.

Calibration

*Calibration **must** be performed **at least once per day** during operation. Calibrate the meter according to the instrument's operating manual. If sampling and monitoring is being performed for long periods of time, periodically check the instrument calibration using the operating manual's recommended frequency.*

In order to avoid limiting the field personnel to one particular model, only general calibration instructions are presented in this procedure.

- Locate a clean, protected area in which to set up and calibrate the instrument. Ensure that sufficient supplies of de-ionized water, clean paper towels, buffer solutions, and standard solutions are available.

- Inspect the meter and probes for damage. Some of the probes are very delicate or have a thin membrane installed over the probe. Be careful when handling the meter/probes so as not to damage them. If damaged, replace probes in accordance with the instrument's operating manual or obtain a different meter.

- Turn on the meter and allow it to "warm-up" for the manufacturer-specified time (usually 15 to 30 minutes). Check the battery power to determine if the meter has sufficient power to operate for the monitoring period. Replace the batteries, if necessary.

- Calibrate the meter according to the instrument's operating manual. In general, calibration is performed by immersing the probe(s) in aliquots of calibration standard solution(s) and following certain meter keystrokes to set the calibration for each parameter. Do not immerse the probe into the stock container of the solution. Always transfer a small amount of the solution into a separate container to calibrate the probe(s). If calibrating for multiple parameters using more than one solution, be sure to wipe off and rinse the probe with deionized water between solutions.

- Recheck each parameter after calibration by immersing the probe into the calibration solution and reading it like a sample reading. If the agreement is not within 25% of the solution's known concentration, repeat the calibration process with a new solution aliquot.

- Discard the used calibration solution aliquots when finished into an appropriate waste container.

- Record the calibration data in the Field Log Book or log sheet.

Operation of the Instrument

- If using a flow-through cell system, attach the extraction pump and lines in accordance with the pump and meter manufacturer's instructions. Allow the lines to fill and the probes to become immersed before switching the instrument to its measurement mode.

- If using a down-hole system, allow a few minutes for the probe to stabilize before taking a reading.

- Operate the meter in accordance with the instrument's operating manual.

- Collect the field parameter reading(s) per the project requirements, and record them in a Field Log Book or on log sheets.

- Decontaminate the meter before collecting data from the next sample source. For a flow-through system, flush the lines with three line volumes of deionized water or replace with new ones between samples.

B-4

Field Log Book

ID #: 1307 – Original
Revision #: 1
Date: 8/31/2012
Geographic Area: General

Competency: Env Sci
TCL: JSK
Technical Expert: SDJ

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Field Log Book

Introduction

The purpose of this Standard Operating Procedure (SOP) is to set the minimum criteria for content entry and form of a Field Log Book.

Foth Infrastructure & Environment, LLC (Foth) gathers information for scientific and engineering evaluations. As part of the information gathering process, Field Log Books are often the sole source for interpretation of information and are legal documents.

The purpose of Field Log Book documentation is to collect information that is not documented in any standard form and that can be used by scientists and engineers to interpret data. Field Log Book entries show the importance of:

- Data collection objectives
- Developing and following site specific sampling plans
- Following regulatory regulations and permits
- Documenting pre-sampling preparations
- Changing environmental conditions
- Locations and types of forms used in documenting the field work of a project.

A Field Log Book entry is a process of systematic planning for determining the type, quantity, and quality of information collected that is necessary to make well-informed, valid, and defensible scientific and engineering decisions. This process is applicable during all Foth site operations. Additional requirements for documenting Field Log Books are often included in other SOPs and project-specific documentation.

Definitions

- Field Log Book – A Field Log Book is a bound notebook that is used at field sites and contains detailed information regarding site activities including dates, times, personnel names, activities conducted, equipment used, weather conditions, etc. A Field Log Book is used by a variety of different field personnel and is part of the project file. A Field Log Book is brought to the site activity. Field Log Books can be checked out from project file location for daily use. Field Log Books are kept in individual office sites when not in use.

References

Not Applicable

Personnel Qualifications and Responsibilities

The project manager or designee is responsible for ensuring that project activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e., check prints, calculations, reports, etc.) that meet the requirements of this SOP.

Equipment and Supplies

- Site-specific plans
- Bound, 8x4 hard-covered, water-resistant Field Log Book(s) (Also available in soft-cover.)
- Indelible black ink pen
- Ruler or similar scale

Procedures

Specifications for the Field Log Book

1. Bound 8x4 book
2. Cover should have project name, project ID, and book number
3. Pages should be consecutively numbered
4. Table of contents and signature page should be on page 1
5. Name, address, and phone number(s) of key field contacts should be on page 1

Guidelines for Simplifying Entries

1. Enter procedures for the first sample point, and then reference those procedures for subsequent entries on the same day if procedures did not change.
2. To eliminate redundancy, reference other locations if information is available.

Field Log Book Documentation

Each site or operation where field activities are occurring will have Field Log Books. The details of all field activities shall be recorded in a Field Log Book. Multiple Field Log Books may be used depending upon the number of different types of field personnel conducting activities at the site.

The following requirements must be met when using a Field Log Book:

1. Enter events and entries in chronological order.

2. Record work, observations, quantity of materials, calculations, drawings, and related information directly in the Field Log Book. If data collection forms are specified by an activity-specific work plan, the information on the form does not need to be duplicated in the Field Log Book. However, forms used to record site information must be referenced in the Field Log Book.

3. Ensure information is factual and unbiased.

4. Fill up all pages and use both sides of each page. Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made.

5. Write in black, indelible ink. Do not write in pencil unless working in wet conditions.

6. Do not erase or blot out an entry. While changes to an entry may be made before it has been signed and dated, care must be taken not to obliterate what was originally written. Indicate deletions by a putting a single line through the material to be deleted and initial and date the change.

7. Do not remove any pages from the book.

8. Do not use loose paper and copy into the Field Log Book later.

9. Record sufficient information to completely document field activities.

10. Make sure entries are neat and legible.

11. Draw a diagonal line through the remainder of the final page at the end of the day.

12. Record the following information on a daily basis:
    a. Date and time
    b. Name of individual making entry
    c. Description of activity being conducted including well, boring, sampling, location number as appropriate
    d. Unusual site conditions
    e. Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
    f. Personnel on site (Foth and non-Foth members)
    g. Level of personal protection to be used

h. Arrival/departure of site visitors
i. Arrival/departure of equipment
j. Sample pickup (chain of custody [COC]) form numbers, carrier, time, electronic location of COC)
k. Start and completion times of borehole/trench/monitoring well installation of sampling activity
l. Health and safety issues
m. Instrumentation calibration details
n. Other equipment used
o. Description of SOP followed or other procedures used
p. Description and reason of any variations from standard procedures in sampling plan
q. Tracking information for analytical sample containers and coolers
r. Reference of all standard forms used, COCs, electronic data and its location
s. Sample point condition descriptions
t. Duplicates and field blank documentation
u. Problems and solutions encountered during field activities
v. Ending calibrations
w. Delivery and handling of samples

Signing and Initialing Requirements for Field Log Book Entries:

1. Initial and date each page.

2. Sign and date the final page of entries for each day.

3. Initial and date all changes.

Multiple authors must sign out the Field Log Book by inserting the following:

Above notes authored by:
_______________________________ (Sign name)
_______________________________ (Print name)
_______________________________ (Date)

4. A new author must sign and print his/her name before additional entries are made.

Entries into the Field Log Book shall be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (i.e., data logger) or on a separate form required by a standard operating procedure. In such cases, the Field Log Book must reference the automatic data record or form.

While collecting samples, note observations such as color and odor of samples collected. Indicate the locations from which samples are being taken, sample identification numbers, the order of filling bottles, sample volumes, and parameters to be analyzed. If field duplicate samples are collected, note the duplicate pair sample identification numbers. If samples are collected that will be used for matrix spike and/or matrix spike/matrix spike duplicate analysis, record that information in the Field Log Book.

A sketch of the station location may be warranted. All maps or sketches made in the Field Log Book should have descriptions of the features shown and a directional indicator. Maps and sketches should be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include (but are not limited to) the following:

1. Changes in weather that impact field activities
2. Subcontractor activities
3. Deviations from procedures outlined in any governing documents, including the reason for the deviation
4. Problems, downtime, or delays
5. Upgrade or downgrade of personal protective equipment

Post-Operation

At the conclusion of each activity or phase of site work, or a complete Field Log Book, the individual responsible for the Field Log Book will ensure that all entries have been appropriately signed and dated and that corrections were made. To guard against loss of data due to damage or disappearance of Field Log Books, copies of completed Field Log Books shall be securely stored within the project master file. Field Log Books are stored in project file 14350.

Restrictions/Limitations

Field Log Books constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Foth personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in the Field Log Book should be factual, clear, precise, and as non-subjective as possible. Field Log Books, and entries within, shall not to be utilized for personal use.

B-5

Fish Collection

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Fish Collection

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for fish collection, focusing on electrofishing and gill netting.

A predominant method of fish collection is electrofishing. Electrofishing is a form of active sampling with the use of electricity. Boat electrofishers are used when the water body is too large or too deep to be wadeable. Gill netting is a passive technique that uses entanglement gear to capture fish by gilling, wedging, and tangling. Gill nets consist of vertical panel(s) of mesh with a float line on top and lead weights on the bottom. Hook and line or trawling methods may be substituted for fish collection. If necessary, fish are composited according to an approved sampling plan.

Electrofishing activities will be conducted by a crew of three. The fish collection sub consultant's Field Supervisor will be in charge of all sampling activities. Two additional crew members will participate in the boat operation and/or dip netting activities. At all times that the boat is actively electrofishing, all crew members will wear rubber boots, and the netters will wear rubber gloves rated for 5,000-volt protection.

References

Foth Infrastructure & Environment, LLC (Foth), 2020. *Location Control Using Differential Global Positioning System SOP*.

C.B Portt, G.A. Coker, D.L Ming, and R.G. Randall, Fisheries and Oceans- Canada. *A review of fish sampling methods commonly used in Canadian freshwater habitats*. 2006.

Hubert, Wayne A.; Pope, Kevin L.; and Dettmers, John M., University of Nebraska – Lincoln. *Passive Capture Techniques, Nebraska Cooperative Fish & wildlife Research Unit –Staff Publications.* 2012.

United States Environmental Protection Agency (USEPA), USEPA Region IV. *Operating Procedure, Fish Field Sampling*. September 4, 2015.

Personnel Qualifications

Qualifications of personnel are as directed in the Project Planning Document (PPD) and Health and Safety Plan (HASP) and appointed by the Project Manager (PM).

Prior to electrofishing, the Field Supervisor will verify that all crew members have reviewed and become familiar with the site HASP in regard to boat and electrofisher operations. In addition to the HASP, personnel should also exercise professional judgment while performing this activity.

Equipment and Supplies

Electrofishing Equipment and Specifications

Fish are collected using a boat of appropriate length and draft for site conditions fitted with a Coffelt VVP-15 electrofisher (or equivalent) to collect fish from shoreline habitats and shallow water shoals (generally less than 10 feet deep) in areas adjacent to deep water or the main channel. The Coffelt VVP-15 (or equivalent) can be set from 20 to 120 pulses per second (pps). Specifications of the boat and electrofishing equipment are presented in Table 1.

All vessels will have up to date U.S. Coast Guard-approved and required safety equipment, personal flotation devices (PFD), fire extinguishers, marine 5-watt output very high frequency (VHF) communication equipment, and other equipment as described in the HASP. All personnel onboard vessels engaged in nighttime activities will wear strobe lights attached to their PFDs. Personnel should also exercise professional judgment while performing this activity.

Prior to each water deployment, the Field Supervisor will confirm adequate cell phone signal and confirm the appropriate way to contact emergency personnel. Additionally, prior to the inception of work, the Field Supervisor will coordinate with the onsite PM, or designee, via cell phone or handheld radio, the location and duration of planned activities and confirm the PM, or designee, is available for assistance in an emergency situation.

Prior to electrofishing, the Field Supervisor will check through the materials and equipment checklist to ensure that all gear is accounted for and in good working order and that all boat equipment required by the HASP are onboard the vessel. The boat and electrofisher specifications are provided in Table 1.

Table 1

Boat and Electrofishing Equipment Specifications

Boat	Electrofisher	Other Equipment
Lowe Roughneck 2007 aluminum Jon boat	Coffelt VVP-15	Bow and stem-mounted safety switches
Length: 19.5 feet	Volts of direct current (DC): 600	Circular ring and dropper electrodes
Beam: 85 inch (in)	Pulse/second: 20 to 120	Bow and stem mounted collection lights
Depth: 21 in / 0.53 meter (m)	Pulse width: 1 to 7 milliseconds (ms)	Navigation lights
Max capacity: 898 pound (lb) / 568 kilogram (kg)	Generator: 5,000 watt	Deck work lights
Bare hull weight: 277 lb / 126 kg		Fiberglass-insulated scapping nets
Engine: 2005 Mercury 40 horsepower (hp)		United States Geological Survey (USGS)-required safety equipment
VHF marine radio: 5-watt output		100-gallon aerated live well
Garmin eTrex Vista HCx		

Specific electrofishing equipment will include:

- Coffelt VVP-15 with extra fuses;
- Generator rated at least 4,500-watt output;
- Generator to electrofisher power cord;
- Foot operated voltage cut-off safety switches;
- Electrofisher output power cord;
- Electrode array;
- Fiberglass handle dip nets;
- Sets of rubber gloves rated for 5,000 volts;
- Pairs of rubber boots;
- 100-gallon live well;
- Headlamps;
- Extra lights for night electrofishing;
- Handheld spotlight; and
- Appropriate field documentation forms.

Specific Gill Netting Equipment

- Gill nets being used will have the following specification:
  - 100 to 300 feet long x 1.0- to 3.0-inch bar mesh (bar mesh refers to the length of one side of the square).
  - Gill nets are commonly constructed of multifilament or monofilament nylon.
- Netting will be treated with a black ultraviolet (UV) protectant and algaecide;
- Appropriate number and size of anchors will be onboard so that every net will be anchored at each end, if necessary;
- Floats will be attached to the top of the net; and
- Scientific Collectors License Number will be available.

Collection Procedures

Electrofishing

Electrofishing will be conducted at night to obtain the necessary sample sizes of each target fish species. The electrofishing unit will be fished in a downstream direction, where appropriate. Collection procedures are as follows:

1. Position the boat upstream (or downstream if needed) of the station.
2. Adjust electrofisher volts, pulse rate, and pulse width settings to maintain an average 4- to 5-amp output.

3. Record water temperature, air temperature, weather conditions, conductivity, and the electrical output of the electrofishing unit.

4. Record the starting location of electrofishing station using a handheld Global Positioning System (GPS) unit with differential GPS (DGPS) software capable of delivering submeter accuracy (Foth, 2020).

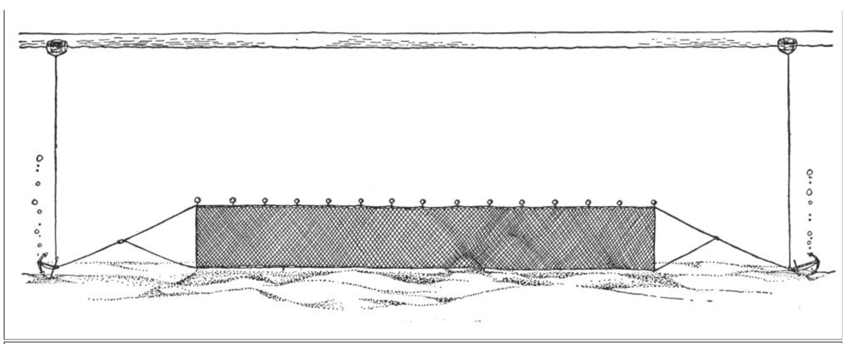
5. Place the boat in gear, turn on the electrofishing unit and collection lights, record the start time, and proceed at a slow speed along the collection area. Use the boat to position the electrode array near any in-stream cover such as overhanging vegetation, in-stream trees, rocky substrates, etc.

6. Capture all target species within reach of the netter and place in a 100-gallon holding tank.

7. At the end of electrofishing, place the boat in neutral, turn off the electrofisher and collection lights, and record the stop time and the end location from the GPS.

Gill Netting

Prior to gill netting, all crew members will have reviewed and be familiar with the site HASP in regard to boat operations. Gill nets will be used to sample in-water depths up to approximately 30 feet, primarily in areas with slow to moderate current adjacent to deep water or the main river channel. Gill nets should not be set in strong current or where there are noticeable obstructions such as brush, trees, and other obstructions near the surface that may tangle. Depending on the project-specific sampling and analysis plan, gill nets may be placed on the lake bottom or suspended to target certain depths. Gill nets are usually retrieved into the wind in a lake or downriver, which allows tension against the anchor to be maintained so that the net is not dragged along the bottom, increasing the likelihood that the net will become snagged. Before the net is set, the net is rigged with appropriate anchors, lines, and buoys. (See below image for common gill net layout.)



set gillnet = a gill net fixed to the bottom or a distance above it by anchors or ballast. Also called anchor net, straight net or sunk gillnet.

From Umali, A. F. 1950. Guide to the classification of fishing gear in the Philippines. Research Report 17, Fish and Wildlife Service, U.S. Department of the Interior, Washington.

The most common deployment is a stationary bottom set. Depending on the size of the watercraft used and the equipment used, required crew size may vary (i.e., when larger boats are used, gill nets are usually set from the stern by means of a roller or spreader).

The following deployment procedures are from a smaller watercraft and typically require a crew of at least two or more:

1. Once the boat is in the determined position of the fish collection area, the net's anchor is dropped from the bow;

2. The boat is then backed as the net is set;

3. As the boat is backed, one crew member will be leading out the float line while the other crew member shakes out tangles in the mesh; and

4. Crew members should keep the line tight as the boat reverses, leading out the end anchor and allowing the float to surface.

The following retrieval procedures are from a smaller watercraft and typically require a crew of at least two or more:

1. Approach the gill net starting at the downwind end or downriver;

2. Pull the net up over the side or the bow of the boat;

   a. When lifting long gill nets from deep water (greater than 65 feet deep), variable speed or hydraulic gill net lifters are commonly used.

3. Remove fish from the net and any debris stuck in the net; and

4. If necessary, deploy gill net for future fish collection.

B-6

Biological Tissue and Plant Preparation

Pace Analytical Services, Inc.
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Pace Analytical
www.pacelabs.com

STANDARD OPERATING PROCEDURE

Biological Tissue, Plant, Sediment and Synthetic Material Preparation

Reference Methods: N/A

SOP NUMBER:	S-GB-L-001-REV.09
EFFECTIVE DATE:	Date of Final Signature
SUPERSEDES:	S-GB-L-001-REV.08

LOCAL APPROVAL

Nils K Melberg	04/23/14
Nils Melberg, Laboratory General Manager	Date
Kate E. Grams	4/22/14
Kate Grams, Laboratory Quality Manager	Date
Chris Haase	04/22/14
Chris Haase, Department Manager	Date

PERIODIC REVIEW
SIGNATURES BELOW INDICATE NO CHANGES HAVE BEEN MADE SINCE APPROVAL.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

Any printed documents in use within a Pace Analytical Services, Inc. laboratory have been reviewed and approved by the persons listed on the cover page. They can only be deemed official if proper signatures are present.

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Table of Contents

1. PURPOSE/IDENTIFICATION OF METHOD

1.1 The purpose of this Standard Operating Procedure (SOP) is to describe the processes utilized to grind plant, biological tissue, sediment and synthetic samples into a homogenous sample suitable for use by the organic extraction and inorganic preparation staff.

2. SUMMARY OF METHODS

2.1 Necropsy and/or filleting of whole body animals may be performed to isolate the individual organs or portions of the specimen to be homogenized and utilized for analysis.

2.2 This SOP involves instruction to chop, grind, and blend plant materials, biological tissue, sediment and synthetic materials into a homogenized sample compatible with analysis of volatile organic compounds, semivolatile organic compounds, and metals.

3. SCOPE AND APPLICATION

3.1 **Personnel:** The policies and procedures contained in this SOP are applicable to all personnel involved in the preparation of plant, biological tissue, sediment and synthetic samples.

3.2 **Parameters**: Not applicable to this SOP.

4. APPLICABLE MATRICES

4.1 This SOP is applicable to biological tissue, plant material, sediment and synthetic samples.

5. LIMITS OF DETECTION AND QUANTITATION

5.1 Not Applicable to this SOP.

6. INTERFERENCES

6.1 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines causing misinterpretation of the analytical results. All of these materials must be free from interferences under the conditions of the analysis by performing method blanks.

7. SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

7.1 Unprocessed plant and biological tissue samples must be kept frozen in their original sample containers. Synthetic materials may be kept at room temperature.

7.2 Small rodents must undergo a special procedure to destroy any Hantavirus, which may be present. Refer to the most recent version of SOP S-GB-L-002 *Small Rodent Handling and Homogenization* for details.

7.3 After processing, plant and biological tissue samples must be kept frozen in glass jars. Individual jars of samples are grouped together as appropriate and stored in a labeled cardboard box within the freezer.

7.4 Sediment samples are received at ≤6°C. After the dry and grind procedure is completed the samples are retained at room temperature.

7.5 Synthetic materials may be kept at room temperature.

8. DEFINITIONS

8.1 Refer to glossary of the most current version of the Pace Quality Manual for the terms used at Pace Analytical. When definitions are not consistent with NELAC defined terms, an explanation will be provided in this SOP.

9. EQUIPMENT AND SUPPLIES (INCLUDING COMPUTER HARDWARE AND SOFTWARE)

Table 1: Biological Tissue and Plant Material Equipment and Supplies:

Supply	Description	Vendor/ Item #
Spatula	Stainless Steel	
Spoons	Stainless Steel	
Cutting Boards	HDPE or Stainless Steel	
Knives	Heavy Bladed/Meat Cleaver: Stainless steel or titanium	
Mallets	Plastic Face, 2 – 3 pounds	
Meat Grinder	Stainless Steel	Hobart
Blender	Stainless Steel or Glass blender cup Stainless Steel Blade	Industrial Grade or equivalent
Forceps	Stainless Steel	
Scaler	Stainless Steel	
Aluminum Foil	Heavy Duty	
Pliers	Stainless Steel	
Analytical Balance	Capable to 0.001g	
Vial	40mL Clear Glass, Teflon lined septum cap	QEC
Wide-Mouth Container	4 – 16 oz Clear Glass or Amber Glass, Teflon lined cap	

Table 2: Sediment Homogenization Equipment and Supplies

Supply	Description	Vendor/ Item #
Spatula	Stainless Steel	
Mallets	Rubber Face, 2 – 3 pounds	
Rolling Pin	Marble	
Cutting Board	Slate	
Scissors	Stainless Steel	
Plastic Bags	Gallon Size, Quart Size	Ziploc or Equivalent
Aluminum Foil Tray	Heavy Duty	
Weigh Boat	Large	Big Science Inc, P/N 80060
Pliers	Stainless Steel	
Analytical Balance	Capable to 0.001g	
Ear plugs		
Dust mask		
Paper Towels	NA	Bounty or Equivalent

10. REAGENTS AND STANDARDS

Table 3: Biological Tissue and Plant Material Reagents and Standards

Supply	Description	Vendor/ Item #
Deionized Water (DI)	ASTM Type II Reagent Grade or better	
Liquid Nitrogen		
Dry Ice	For Shipping purposes	NA
Tuna	Canned	Starkist or equivalent
Chicken	Ground	
Alfalfa	Dried	
Alconox	Cleaning Solution	Fisher / 50-212-165 or equivalent
Bleach	Commercial Grade	Clorox or equivalent

Table 4: Sediment Homogenization Reagents and Standards

Supply	Description	Vendor/ Item #
Deionized Water (DI)	ASTM Type II Reagent Grade or better	
Methanol	Pesticide Grade	
Acetone	HPLC Grade	

11. CALIBRATION AND STANDARDIZATION

11.1 Refer to the current revision of S-GB-Q-030 *Support Equipment* for additional instruction on appropriate balance calibrations.

12. PROCEDURE

12.1 Biological Tissue and Plant Homogenization:

12.1.1 Clean the work area by wiping the surfaces with a damp cloth. Follow procedure outlined in SOP: S-GB-L-007 *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials*, most current revision or replacement, to prepare utensils and grinders for use.

12.1.2 Depending on the sample matrix and specific instructions provided by the customer, the method for ensuring homogeneity may vary. Necropsy and/or filleting of whole body animals may be performed to isolate the individual organs or portions of the specimen to be homogenized and utilized for analysis. The project manager must be contacted for clarification prior to thawing the samples if there are any questions.

12.1.3 Select a set of samples for processing. Depending on the size of the specimen, remove the samples from the freezer to allow the specimen to partially thaw. Large specimen typically need to thaw overnight at room temperature. Small specimen require a shorter amount of time and may be placed in a refrigerator overnight or thawed at room temperature for 2-3 hours during the day of processing. It is important to make sure that each specimen is not touching another specimen during the thawing process.

12.1.4 Record the date and time that the specimen are taken out to thaw in the notebook.

12.1.5 Pre-label the appropriate sized sample jars with the LIMS numbers. Samples should be placed in the appropriate sized container dependent upon the sample mass received (40mL, 4oz, 6oz, 8oz or 16oz). Transport the clean, dry utensils and pre-labeled jars to the countertop work area.

12.1.6 If the client requires an equipment blank to be processed with the samples, the same equipment which is used to process the samples must be Deionized Water (DI) rinsed prior to sample processing. Multiple equipment blanks may be processed with each batch. The equipment blank must be logged into the LIMs system to report with the sample data.

12.1.7 Once the specimen is adequately thawed, processing may begin. Compare the label on the specimen with the pre-labeled jar to verify errors have not occurred.

12.1.8 Small fish, such as minnows, are usually collected as composites and will represent a single composite sample. Large whole fish that require compositing are chopped into cubes and put through the meat grinder together (refer to 12.1.10) and aliquots of the ground tissue are blended with liquid nitrogen (refer to 12.1.11).

12.1.9 If the specimen requires filleting prior to homogenization, thaw the fish to the point that it can be cut into with a sharp clean knife. Skinning or scaling may be necessary prior to filleting the fish.

12.1.9.1 **Skinning**: Catfish, bullheads, and other fish may need to be skinned prior to removing fillets. With a sharp knife slice the skin front to back along the dorsal side of fish. Make another incision from top to bottom just behind the gills. Hold the fish head with one hand and grasp an edge of the skin just behind the gill with pliers. Peel the skin back toward the tail.

12.1.9.2 **Scaling:** If scales are to be removed prior to filleting, lay the fish flat on a cutting board. Grasp the fish with one hand and with the other hand use a scaler to scrape the scales off the fish. Work the scaler from the tail toward the head. Rinse the scales and slime from fish prior to filleting.

12.1.9.3 **Filleting:** Begin with an incision just behind the gills, cutting through the fish from back to belly. Next, make a clean cut along the dorsal ridge towards the tail. Be careful not to cut into the gut cavity. After cutting through to the tail, separate the fillet from the rib cage, peeling the fillet from the carcass with the non-cutting hand. Pick out any bones with forceps.

12.1.10 Chop large whole body specimens, plant material, or fillets into 2-3 inch cubes using a sharp knife and mallet. Smaller samples of limited quantity must be finely ground using the blender in step 12.1.11.

12.1.11 Grind the cubes in a large commercial meat grinder to coarse texture. Repeat the procedure a minimum of two times to ensure proper texture.

12.1.12 Transfer the course ground sample to a stainless steel bowl containing liquid nitrogen. Place the frozen sample in a blender cup and blend the frozen tissue to a powder consistency.

12.1.13 Samples such as eggs, insects, and small individual organs (liver, brain) may be stirred vigorously with a metal spatula in an appropriate sized container to avoid loss of sample. The technician documents that the sample was prepared in the container on the prep worksheet or notebook.

12.1.14 Transfer the blended sample into the pre-labeled jars.

12.1.15 Clean the work area and the utensils in accordance with the procedure outlined in SOP: S-GB-L-007 *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials,* most current revision or replacement, between samples.

12.1.16 Periodically, canned tuna, chicken, or alfalfa is homogenized using this procedure for use as a quality control matrix within the laboratory. Each analysis may require a different quality control matrix, See Section 13 for additional information.

12.1.17 Sample integrity must be maintained throughout the digestion and analytical processes, therefore samples which were blended with liquid nitrogen should be kept within a freezer at ≤0°C up until the weighing process. Samples to be analyzed by 8081A/B, 8082, 8082A, 8270C and 8270C-SIM must be weighed in the homogenization prep lab.

12.2 Sediment Homogenization Procedure (Dry-Grind Procedure).

12.2.1 Clean the work area by wiping the surfaces with Methanol. Follow procedure outlined in SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, to prepare utensils and grinding equipment for use.

12.2.2 Pre-label the appropriate aluminum sample drying tray with the LIMS numbers. Double bagged client samples should be placed behind the aluminum sample drying tray. The secondary technician must verify the correct bag is placed behind the correct drying tray.

12.2.3 Remove the interior sample bag and place on top of the exterior client bag. Clean the top Ziploc portion of the bag using a methanol dampened paper towel. Rip along both side seams of the interior bag. Place the opened bag inside out slightly above the drying tray (the sample should fall from the bag into the tray). Ensure no contact occurs between the outside of the bag and the drying tray. The technician may need to manually transfer the sediment from the bag to the tray with their gloved hand. Once transferred, the sample is spread evenly throughout the bottom of the drying tray.

12.2.3.1 An aliquot of the wet sample must be taken in order to complete the dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.2.4 The interior sample bag is then placed bag into the exterior client bag. Both bags are then placed into a 2 gallon plastic bag labeled with the batch workorder number.

12.2.5 Prior to placing samples on the cart for transfer, clean the surface of the sample cart by sweeping it to remove visible particulates. Then wipe the surfaces clean with Methanol.

12.2.6 Place all drying trays on the clean sample cart and deliver to the drying room. Use Methanol to wipe the sample racks prior to placing the drying trays in the drying room and record the drying room temperature, which should not exceed 100 degrees Fahrenheit.

12.2.7 Samples should dry for a minimum of 8 hours or until moisture content is less than or equal to 10%. Once the sediment is adequately dried, processing may begin.

12.2.8 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement.

12.2.9 Obtain the appropriate number of plastic bags. For each sample, separately transfer the labels on the drying tray to the plastic bag. Immediately transfer the dried sample to the plastic bag by sliding the drying tray into the plastic bag and transferring the dried sediment.

12.2.10 Using a rubber mallet and/or a rolling pin, pulverize the sample until the sample is free-flowing in nature.

12.2.11 Transfer the labels on the processing bag to a new pre-labeled plastic bag, Immediately transfer the ground/homogenized sample to the new bag shifting all sediment to one side of the bag, and cutting one corner off with a methanol cleaned scissors.

12.2.11.1 An aliquot of the air-dried sample must be taken in order to complete the air-dry dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.2.12 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, between samples.

12.2.13 Dried/grind samples are stored at room temperature in individually labeled boxes by Work order.

12.3 Sample Compositing Procedure for Homogenized Sediment.

12.3.1 Clean the work area by wiping the surfaces with Methanol. Follow procedure outlined in SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, to prepare the work surface for use.

12.3.2 Pre-label the appropriate sample composite container with the LIMS numbers for the composite sample with one permanent label and one removable label.

12.3.3 Set out all samples that will be used to create the composite sample.

12.3.4 Transfer the Pace work order label to the composite sample container prior to the sample aliquot being taken. Weigh 20g of the first sample that will be used to create the composite sample into a large weigh boat. . Record the mass of the sample in the composite logbook. (Please see Appendix III).

12.3.5 Immediately after the sample aliquot is measured into the large weigh boat, transfer the 20g aliquot to the pre-labeled plastic Ziploc bag for the composite sample. .

12.3.6 Repeat steps 12.3.4 through 12.3.5 using a new large weigh boat each time, until all sample aliquots have been sub-sampled and placed into the composite sample container.

12.3.7 Thoroughly mix the sample in the container to create a homogenized sample.

12.3.8 Record the composite date and time in the composite logbook. The time should be the end time of the compositing process.

12.3.9 An aliquot of the air-dried sample must be taken in order to complete the air-dry dry weight analysis, please see SOP: S-GB-C-008 *Measurement of Percent Moisture in Soils and Solids* most current revision or replacement.

12.3.10 Clean the work area and all processing equipment with Methanol following SOP: S-GB-O-015 *Cleaning of Glassware and Sample Processing Hardware Used in the Analysis of Semivolatile Range Organics*, most current revision or replacement, between samples.

13. QUALITY CONTROL

13.1 Tuna is prepared as outlined in Section 12 to be utilized as the Method *Blank (MB) and Laboratory Control Spike (LCS) matrix for organic analysis by EPA 8081A/B, 8082, 8082A, 8*270C and 8270C-SIM. The tuna is an analyte free biota matrix.

13.2 Chicken is prepared as outlined in Section 12. The Chicken Blank (CB) must be prepared for every biota batch analyzed for metals analysis by EPA 6020/A, EPA 7471B and EPA 245.6. The CB will contain detectable amounts of elements such as K, Ca, Na, Mg, and P etc., and is used to ensure acceptable performance of the laboratory control spike. The chicken is also used as the matrix modifier for the Laboratory Control Spike (LCS) matrix.

13.3 Alfalfa is prepared as outlined in Section 12 to be utilized as the Method Blank (MB) and Laboratory Control Spike (LCS) matrix for organic analysis by EPA 8260B.

13.4 Sediment samples must be dried for a minimum of 8 hours until moisture content is ≤10%.

14. DATA ANALYSIS AND CALCULATIONS

14.1 Not Applicable to this SOP.

15. DATA ASSESSMENT AND ACCEPTANCE CRITERIA FOR QUALITY CONTROL MEASURES

15.1 Not Applicable to this SOP.

16. CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA

16.1 In instances where an identified labeling error occurs, the following steps will be taken:

16.1.1 Samples will be returned to the Sample Receiving Department.

16.1.2 Client identification labels will be compared to the appropriate Chain-of-Custody (COC).

16.1.3 New labels will be generated and affixed to the correct sample containers.

16.1.4 A nonconformance report (either hardcopy or through the LabTrack System) must be generated documenting the labeling error.

17. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

17.1 Not Applicable to this SOP.

18. METHOD PERFORMANCE

18.1 There are several requirements that must be met to insure that this procedure generates accurate and reliable data. A general outline of requirements has been summarized below. Further specifications may be found in the Laboratory Quality Manual and specific Standard Operating Procedures.

18.2 The analyst must read and understand this procedure with written documentation maintained in the training file.

19. METHOD MODIFICATIONS

19.1 Not Applicable to this SOP.

20. INSTRUMENT/EQUIPMENT MAINTENANCE

20.1 Please see manual provided with blender.

21. TROUBLESHOOTING

21.1 Not Applicable to this SOP.

22. SAFETY

22.1 The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of any chemical. A reference file of Safety Data Sheets (SDS) and a formal safety plan is made available to all personnel involved in chemical analysis and should be consulted prior to handling samples and standards.

22.2 Protective eyeware, gloves, and a lab coat must be worn at all times. Hearing protection should be worn when the blender is in operation, or during sediment processing when applicable.

23. WASTE MANAGEMENT

23.1 Excess reagents, samples and method process wastes are characterized and disposed of in an acceptable manner. For further information on waste management consult S-GB-W-001, *Waste Handling and Management*, most current revision or replacement.

24. POLLUTION PREVENTION AND WASTE MANAGEMENT

24.1 The quantity of chemicals purchased is based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes reflect anticipated usage and reagent stability.

24.2 The laboratory Chemical Hygiene Plan/Health and Safety Plan contains additional information on pollution prevention.

25. REFERENCES

25.1 USEPA National Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis-Third Edition.

25.2 SOP S-GB-L-002 *Small Rodent Handling and Homogenization*, most current revision or replacement

25.3 SOP: S-GB-L-007 Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials, most current revision or replacement.

26. TABLES, DIAGRAMS, FLOWCHARTS, APPENDICES, ETC

26.1 Appendix I : Biota Homogenization Log.

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Green Bay
Biota Homogenization Log

Project: ____
Date/Time Removed to Thaw: ____
Date/Time Prepped: ____
Prepped by: ____
Container Type/Lot#: ____

Location: 40FRG21/Room Temperature (circle one)

Logbook: ____

Sample ID	Sample Type (Fish, Eggs, etc.)	Gender (Optional) M/F/J[1]	Scales/Skin Removed (Y/N)	Whole Body/Fillet (WB/F)	Whole Clams/Shucked (WC/S)	Composite Sample (> 1 per Sample ID) (Y/N)	Nitrogen (Y/N)	Resection Performed (Y/N)[2]	Sample Comments

(1) M = Male, F = Female, J = Juvenille or Unknown Gender
(2) See Resection Worksheet#

Reviewed By ____ **Date** ____

F-GB-O-083-REV.02 (19Jul2011) Biota Prep Logbook
Green Bay Laboratory

Page____

26.2 Appendix II: Sediment Dry-Grind Tracking Logbook

Pace Analytical

Sediment Dry-Grind Tracking Logbook

Logbook#: ____________

Sample ID	Initials Set-up Tech	Int. 2° Rev.	Wet Wt Initials (IN)	WET WT (Batch)	Wet Wt Initals (OUT)	Air Dry Room	Air Dry Room Set-up		Initials	Grind Date	Initials (IN)	DRY-DRY WT Batch	Initials (OUT)
							Initials/Date/Time In	Initials/Date/Time Out					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
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						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					
						40DRY01 40DRY02	/ /	/ /					

Data Entry Instructions: If an error is made while recording information, the error must be corrected by drawing a single line through the mistake, and inserting the date and initials of the person making the change at a minimum. All changes should be made by the person making the original entries to insure there is an understanding of why a change is required. Alternate personnel, such as quality or laboratory management, may make the changes in the event that the original person is not available, but this must be clearly defined.

Peer Review: ______________________ Date: ____________

26.3 Appendix III: Fox River Sediment Composite Logbook

Pace Analytical™

Logbook # ____________

Fox River Sediment Air-Dried Composite Logbook

Balance ID: ____________

Initials of Weighing Technician: ____________

Date/Time of Composite: ____________

Dry-Dry Weight of Composite Batch: ____________

Composite ID:

AFFIX WORKORDER LABEL HERE

Individual Sample ID(s)	Weight of Air-Dried Sample Used to Make Composite (g)	Comments
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		
AFFIX WORKORDER LABEL HERE		

Data Entry Instructions: If an error is made while recording information, the error must be corrected by drawing a single line through the mistake, and inserting the date and initials of the person making the change at a minimum. All changes should be made by the person making the original entries to insure there is an understanding of why a change is required. Alternate personnel, such as quality or laboratory management, may make the changes in the event that the original person is not available, but this must be clearly defined.

Peer Review: ____________ Date: ____________

F-GB-O-143-Rev.00 (22April2014)
Pace Analytical Services, Inc. - Green Bay

27. REVISIONS

Document Number	Reason for Change	Date
S-GB-L-001-Rev.3	Section 9 – Removed Methanol Section 11.1 – Removed to clean surface area with Methanol Section 11.0 – Clarified number of times to process through commercial meat grinder. Section 11 – Updated references. Added Appendix I: Biota Homogenization Log	07Aug2009
S-GB-L-001-Rev.4	Cover Page: Updated SOP Name to Biological Tissue, Plant, and Synthetic Material Preparation. Throughout document: Incorporated language for the homogenization of synthetic material.	02Feb2011
S-GB-L-001-Rev.05	Sections 11.1, 11.14, and 15.3: Updated reference to SOP: S-GB-L-007, *Cleaning of Equipment Used in the Process of Homogenizing Biological Tissue, Plant, and Synthetic Materials,* most current revision or replacement Appendix I: Updated Biota Prep Logbook Page	24Aug2011
S-GB-L-001-Rev.06	Section 12: Added Tuna and Chicken Blank matrices to the QC Section.	09Sep2011
S-GB-L-001-Rev.07	General: Updated SOP format Updated SOP references throughout document. Added Dry/Grind procedure for sediment processing.	08Jan2014
S-GB-L-001-Rev.08	Section 12.2.3: Added requirement to clean the top of the Ziploc bag. Section 12.2.11: Added information to cut the corner of the Ziploc bag prior to processing. Section 13.4: Added moisture requirement to less than or equal to 10%. Section 16: Added corrective actions in place of a labeling error. Section 26: Added Sediment Dry-Grind Tracking Logbook.	06Feb2014
S-GB-L-001-Rev.09	Section 12.3: Added sample compositing process. Appendix III: Added Fox River Sediment Composite Logbook.	22Apr2014

B-7

Sediment Sampling Equipment Cleaning and Decontamination

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sediment Sampling Equipment Cleaning and Decontamination

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for decontamination of equipment used during collection and handling of sediment samples for analytical analysis.

Equipment and Supplies

- Health and safety equipment as required in the Health and Safety Plan (HASP)
- Distilled/deionized water
- Non-phosphate detergent
- Appropriate cleaning solvent (e.g., methanol, acetone, or hexane)
- Knife
- Scrub brushes
- Aluminum foil or sealable plastic bags
- Garbage bags
- Spray bottles
- Ziploc® type bags
- 5-gallon bucket
- Plastic sheeting, if necessary

References

American Society for Testing and Materials (ASTM). *ASTM D5088-20, Standard Practice for Decontamination of Field Equipment Used at Waste Sites*

Procedures

Cleaning Procedures for Small Equipment and Sampling Devices

1. Don the necessary Personal Protective Equipment (PPE) for handling items that are have come in contact with known contaminate(s) of concern. The recommended PPE will be outlined in the project specific HASP.

2. Clean reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.) using the following decontamination procedures:

   a. Scrub or scrape any excess material from the equipment.

b. Wash all small equipment and sampling devices with non-phosphate detergent and tap water.

c. Rinse thoroughly with deionized water.

d. For equipment used for disposal profiling purposes, rinse a second time with deionized water.

e. For equipment used to process samples for other characterization purposes or for post-dredge sediment residual analysis:

   i. Rinse with solvent (hexane for PCB sampling) using a plastic spray bottle.
   ii. Rinse with deionized water.
   iii. Collect and properly dispose of any decontamination fluids.

f. Allow to air dry and wrap in aluminum foil or place in sealed plastic bags.

3. Cleaning/decontamination will be conducted on board sampling vessels or in an appropriate decontamination area (e.g., inside the berms of a dewatering pad), as required.

Cleaning Procedures for Large Equipment (if applicable)

1. Don the necessary PPE for handling items that are have come in contact with known contaminate(s) of concern. The recommended PPE will be outlined in the project specific HASP.

2. Prepare wash water using deionized water and non-phosphate (e.g., Liquinox®). This mixture is known to be environmentally safe. Therefore, used wash water is not collected for off-site disposal. All contact wash water is allowed to be returned to the resource (river, lake, impoundment).

3. Conduct cleaning/decontamination on board sampling vessels or in an appropriate decontamination area (e.g., inside the berms of the dewatering pad), as required.

4. Wash all large sampling equipment with a high-pressure steam cleaner or water wash with non-phosphate detergent using a brush as deemed necessary to remove any particles.

   a. Rinse with deionized water twice.

B-8

Sediment Sampling – Ponar Dredge

Sediment Sampling – Ponar® Dredge

Introduction

The purpose of this Standard Operating Procedures (SOP) is to establish a standard procedure for the collection of sediment samples using a standard Ponar® dredge or a petite Ponar® sampling device (thereby referred to as a Ponar® dredge). Procedures are described for the collection of sediments from streams and lakes. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sediment collection.

Sediment collection for analysis of chemicals of concern can be accomplished using a number of mechanical devices (Ponar® dredge, Ekman dredge, gravity core, piston core, vibrocore/vibracore, etc.). Collection of surficial sediment samples is easily accomplished using a Ponar® dredge. The following procedure describes the use of a Ponar® dredge.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater*. 17th ed. APHA, Washington, D.C. 1989.

ASTM International (ASTM). *ASTM Annual Book of Standards*. Volume 11.04 Water and Environmental Technology. 1990.

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Guy, H.P. and V.W. Norman. *Field Measurements for the Measurement of Fluvial Sediments. In Techniques of Water Resources Investigations*, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA. 1969.

U.S. Army Corps of Engineers (USACE). *Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003*. Washington D.C. 2004.

U.S. Army Corps of Engineers (USACE). *Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003*. Washington D.C. 2013.

Personnel Qualifications

Personnel with training and experience with the Ponar® dredge sampler should be responsible for sampler operation and compliance with SOP protocols. A minimum of two people are required to complete sampling. One person must be trained in sediment sampling devices and should have a minimum of 1 year of field experience using such devices. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 Code of Federal Regulations [CFR] 1910.120) if hazardous materials are expected. The Captain of the sampling vessel shall have successfully completed a certified boater's safety course.

Equipment and Supplies

- Minimum 16-foot boat and motor (work platform) with minimum of three anchors or two anchoring spuds, if boat is required.
- Personal protective equipment (PPE) (as required by the Site Health and Safety Plan [HASP]).
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water).
- Ponar® sampling device with sufficient rope to obtain depth.
- Surveyor's leveling rod (English) or pole attached to a 6-inch diameter round metal plate (overall weight should be less than 8 pounds [lbs.]).
- Sediment probe (maximum 1-inch diameter), appropriate length, steel pipe (galvanized) with half-inch outer diameter probing end at least 12 inches in length.
- Tape measure.
- Camera.
- Boat Safety Checklist.
- Permanent marker.
- Pen with waterproof ink.
- Sediment Core Collection and Processing Logs.
- Electronic or bound Field Log Book.
- Handheld Differential Global Positioning System (DGPS) or Real-Time Kinematic (RTK) System.
- Waders (hip or chest waders), if necessary.
- Sample containers and cooler.

- Spoons and trawls (disposable mixing and sampling utensils preferred).
- Five-gallon pails and pans for homogenizing multiple samples.
- Plastic bags for lining the 5-gallon pails.

Procedures

1. Occupy sample locations using DGPS software or RTK GPS equipment (Foth, 2020a). If sample location is not previously surveyed and marked, record coordinates from GPS on electronic or paper field form. If sample location needs to be adjusted for any reason, record new GPS coordinates and reason for off-set in electronic or bound Field Log Book or on electronic or paper field form.

2. Once at sampling location, measure the depth to soft sediment using a pole or rod attached to a 6-inch diameter plate. Record the number on the rod at the water interface in the Field Log Book or on the field form. If water depths are greater than 20 feet or velocities are excessive, a "lead line" constructed by following USACE specifications (USACE, 2004) may be utilized in lieu of the pole with disc.

3. Measure the thickness of sediment using sediment probe will be attempted down to depths of 30 feet.

    a. For depths less than 30 feet, this is accomplished by pushing the probing rod into the sediment until refusal. Record the number on the rod at the water interface in an electronic or bound Field Log Book or on an electronic or paper field form, and describe the sediments as soft, medium, or firm.

    b. If the depth is greater than 30 feet the USACE specification for "lead-line" will be utilized as stipulated in Appendix B of the USACE Hydrographic Surveying (USACE, 2013). Record the number on the rod at the water interface in an electronic or bound Field Log Book or on an electronic or paper field form, and describe the sediments as soft, medium, or firm.

4. Prepare the Ponar® sampling device for deployment. Remove stationary pin, and replace with a spring-loaded pin.

5. If wading, sample collector should position themselves downstream of the sample location so as not to disturb the sediment surface. Lower the Ponar® sampler to just above the sediment surface (2 to 3 inches above the sediment surface).

6. Once lowered to just above the sediment surface, release the Ponar® sampler, letting it free-fall into the sediment, releasing the spring-loaded pin upon impact. If the pin does not release upon impact, apply a slight "jiggling" action to release the pin.

7. Retrieve the Ponar® using the attached rope. This action closes the Ponar® sampler and collects the surficial sediment sample.

8. Move to a clean work area on shore or in the vessel, and drain the excess water from the Ponar® sampler. This is achieved by carefully tipping the sampler to either side, allowing the water to drain from the screened portion on top of the sampler, while minimizing any loss of sediment particles.

9. Once water is drained, two methods may be used to collect a sediment sample:

   a. The first is to empty the sample contents into a clean pail (optional: lining the container with a single use plastic bag to prevent cross contamination), bowl, or other container large enough to accommodate the complete sampler contents without spillage. Homogenize the sample by mixing with a large spoon or trawl. Collect sample aliquot by using a spoon to fill the appropriate sample container.

   b. The second method is to remove one or both of the screened areas on the top of the Ponar® sampler by sliding them out of position. Both should be removable. Once the screens are removed, homogenize the sample with an appropriate mixing tool inside of the Ponar® device. Collect a sample aliquot using a spoon to fill the appropriate sample container.

   Where a composited sample from multiple locations is to be generated, aliquots of equal volume, using either method a or b (listed above), will be placed in a clean container and further homogenized. A single sample of adequate volume will be removed from the composited mass with a clean spoon and placed in the appropriate sample container.

10. After samples are placed into sample containers, label all relevant information and place in a cooler on ice for delivery or shipment to a laboratory. Where allowed by regulation, return unused sample portions to the waterbody. Otherwise, containerize and handle as required. Samples will be processed according to sediment compositing procedures in the appropriate Sampling and Analysis Plan (SAP).

11. Decontaminate Ponar® sampler and all other sampling materials before moving to the next sampling location, according to decontamination procedures presented in the *Sediment Sampling Equipment Cleaning and Decontamination* SOP (Foth, 2020b), taking care that all sediments have been removed. For homogenization purposes, the sampler has the choice to use a single-use plastic bag to line the 5-gallon pail prior to emptying the contents of the Ponar®. When the sampler chooses NOT to use the plastic bag liner, decontamination of the 5-gallon pail must be completed following the procedures mentioned above. One rinsate sample will be collected from each decontaminated sampling device as detailed in the project SAP.

B-9

Chemical Isolation Layer Sampling – Cap B

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Chemical Isolation Layer Sampling – Cap B

Introduction

The purpose of this Standard Operating Procedures (SOP) is to establish a standard procedure for collection of chemical isolation layer (CIL) samples in Cap Type B areas of the Lower Fox River Operable Units (OU) 2-5 during long-term monitoring activities. Also included are procedures to process the samples for chemical and physical analysis.

At the time of cap placement, CIL sampling may occur in the sand layer of Cap Types B and C prior to placement of the armor (coarse aggregate) layer. During the specified long term monitoring period in each OU, caps identified as Type B or C may also require post-placement CIL monitoring. These samples would be used to verify that the placed sand CIL includes a minimum 3-inch sand layer and has no or very low polychlorinated biphenyls (PCB) concentrations, allowing it to function as designed. This SOP describes procedures to collect CIL samples from the sand layer of Type B Caps following placement of the coarse aggregate armor stone during the long-term monitoring period. Core samples will be collected at a limited number of locations to assess PCB concentrations within CIL sand core layers. This SOP will also describe procedures and methods that will be used to collect field samples, describe core samples and process samples for laboratory analysis.

References

The following document will be followed when applicable:
Tetra Tech EC, Inc., 2009. *Quality Assurance Project Plan* (*QAPP*)

Methods and procedures are defined in the following document:
Tetra Tech EC, Inc., et al., 2011. *Construction Quality Assurance Project Plan* (*CQAPP*)

Foth Infrastructure & Environment, LLC, 2012. *Health and Safety Plan* (*HASP*). June 8, 2012.

Foth, 2012. *Vibrocore Sampling* SOP - #1806 (OU2-3 project).

Foth, 2012. *Vacuum Push Core Sampling* SOP - #1804.

Foth, 2012. *Piston Core Sampling* SOP - #1805.

U.S. Army Corps of Engineers. USACE Standards, Manual # 1110-2-1003.

Personnel Qualifications/Requirements

For sampling, refer to the *Vibrocore Sampling* SOP - #1806, *Vacuum Push Core Sampling* SOP - #1804, and *Piston Core Sampling* SOP - #1805. Divers must have appropriate state and/or federal certifications.

Equipment and Supplies

Sampling equipment needed:

- Watercraft (sampling platform) that complies with state of Wisconsin and U.S. Coast Guard regulations equipped with a minimum of three anchors or two spuds.
- Map of Cap B area boundary and proposed sampling locations.
- Personal protective equipment (PPE) specified in the *HASP*.
- Pole, surveyor's rod, or tape measure (lead line) with maximum graduations of 0.1 foot attached to a disc (6-inch diameter) and weight no greater than 8 pounds, to determine depth from reference elevation (boat deck or water surface) to sand or armor stone surface. For high current areas or water over 20-feet deep, a lead line meeting USACE's standards (Manual # 1110-2-1003) may be deployed in lieu of the pole fitted with disc.
- Tape measure with maximum graduations of 0.25 inch to determine sand thickness
- Vibrocore sampler
- Drill and bits
- Vacuum push core sampler (check-valve type) and rod extensions (alternate)
- Fixed piston-type piston sampler and rod extensions (alternate)
- Digital camera
- Field forms
- Real-time kinematic (RTK) Global Positioning System (GPS) with horizontal accuracy of ± 1 centimeter (cm)
- Portable computer
- Two-way radios (waterproof)

Sample Processing (core characterization and PCB samples):

- PPE specified in the *HASP*
- Refrigerator with rack to store sediment cores vertically
- Sediment core cutter (hook blade, electric reciprocating cutter, or equivalent)
- Full spectrum lighting and tables to support cores
- Drill and bits
- Duct tape, permanent markers, plastic sheeting for tables
- Ruler of at least 5-foot length with maximum graduations of 0.1 foot
- Clean disposable mixing containers and spoons
- Digital camera
- Laboratory provided sample containers for PCB analysis
- Coolers and ice for sample transport to laboratory

- Receptacles for waste sediment and other solids in contact with sediment (core liners, gloves, toweling etc.)
- Detergent for reusable equipment decontamination

Procedures

Safety

All work must comply with the Foth *HASP*. The *HASP* identifies proper PPE and identifies potential site/work hazards. Subcontracted divers must provide their own HASP pertaining to aquatic operations. Daily safety meetings will be conducted before commencement of work.

Special Precautions

Most sampling will be completed in close proximity to the sampling platform (boat). The safety of all sampling crew members, divers and Agencies Oversight Team (A/OT) (if present) personnel requires an awareness of the slip, trip, and fall hazards as well as the hazards of working beneath heavy equipment and below water. Two-way radio communication with the divers and boat captain will be maintained at all times.

CIL Sample Collection

a. Sample locations for verifying PCB concentration in the CIL will be adjacent (within 3-5 feet of) locations where CIL samples were collected prior to placement of the coarse aggregate armor stone. These locations will be provided to the A/OT for approval, prior to sampling.

b. A reference elevation, either the sampling vessel deck elevation or water surface elevation, will be measured at each sample location. The depth to top armor stone and the depth to top of sand CIL, following removal or armor stone, from the reference elevation will be measured at each sample location. Reference elevation recording and depth to top of armor stone and CIL measurement will be conducted when conditions provide for a measurement accuracy that is at least within 0.1 foot. All data will be documented in an electronic database and/or on field forms.

c. Following depth measurement to the top of armor stone, divers will be deployed to carefully remove the Cap B armor stone layer, thereby exposing the sand CIL. The divers will then direct the measuring rod to the top of CIL layer to allow measurement to be taken from the reference elevation. A core sampling device, either vibrocore, vacuum push core or fixed piston sampler will then be deployed to collect an undisturbed sample of the CIL and underlying sediment with minimum 4-foot section of minimum 3-inch diameter cellulose acetate butyrate (CAB) (Lexan^{TM}) core tube. Divers will direct the core barrel to the exposed CIL and gently place the barrel on the sand surface. Upon notification from the diver that the sampling device is appropriately located, the core device operator will advance the core device and collect a sample as detailed in the *Vibrocore Sampling* SOP - #1806; *Vacuum Push Core Sampling* SOP - #1804; or *Piston Core Sampling* SOP - #1805. Target penetration will be 24 inches below the top of CIL terminating in the soft sediment below the CIL. Upon core retrieval, the diver will place a cap on the end of the sample barrel to minimize sediment loss.

Note: In the unlikely event a vibrocore sampler proves ineffective at collecting undisturbed CIL samples, use of a vacuum push core sampler (check-valve sampler) or piston core sampler (minimum 2.5-feet long x approximate 2 to 3-inch diameter) will be attempted to collect CIL samples.

d. The top of the core tube will be capped following removal from sampler, and both caps will be duct taped. The core tube will be labeled with the location number, date, and core recovery. The core tubes will be stored vertically in the core rack on the boat, during transport to the processing facility, and in the refrigerator at the processing facility until they are prepared for logging and sampling.

Sampling Processing

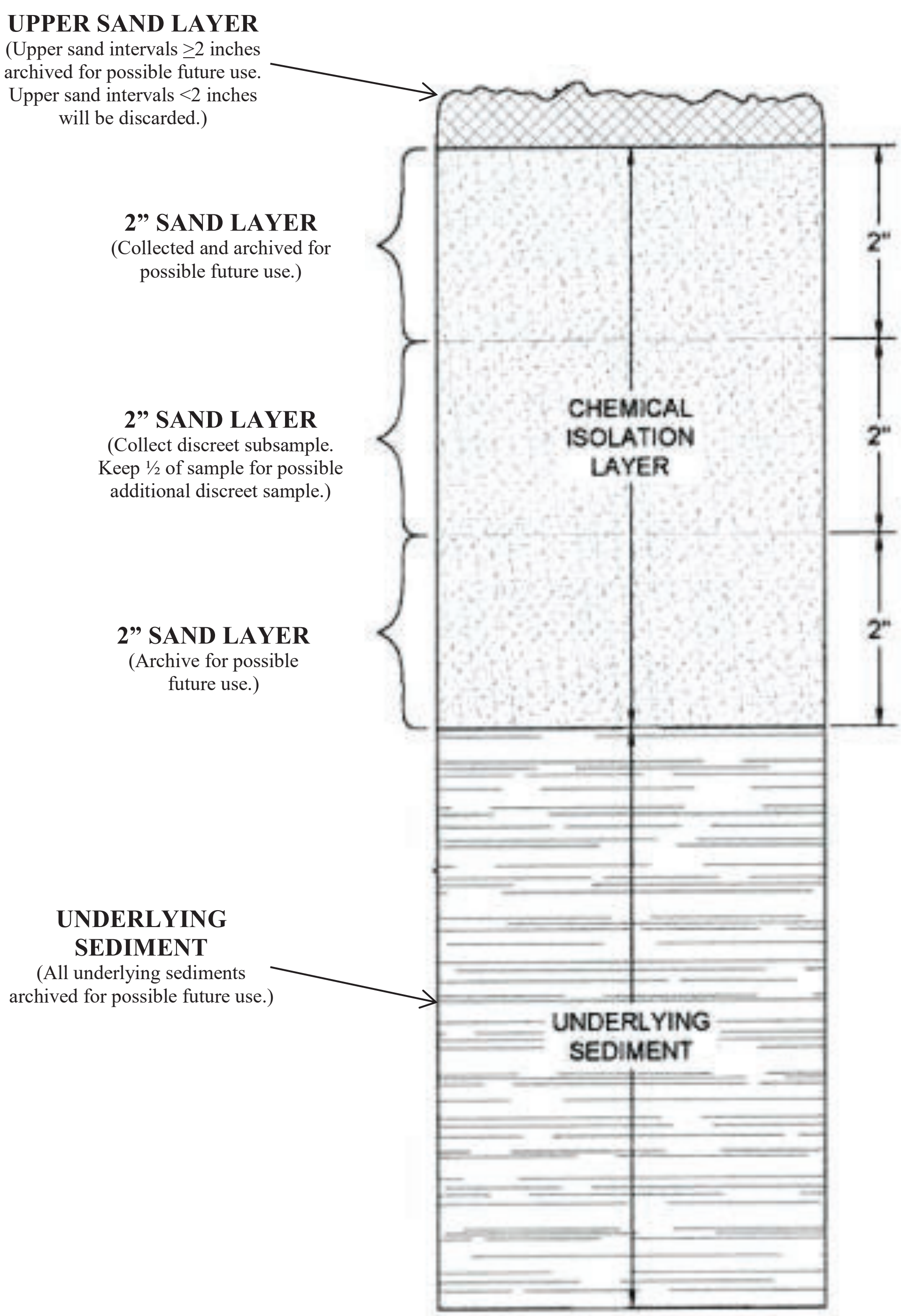
a. When the core samples are ready to be processed (prior to cutting), the top of sand surface will be marked on each core to define the undisturbed condition. Standing water will be removed from the core top of sand surface by drilling a drainage hole in the CAB. Core samples will be placed on an inclined core holder and cut laterally from top to bottom, minimizing disturbance to the sample as much as practical, to produce a split core.

b. The 2-inch sand interval between the interface of the sand CIL and the underlying sediment will be removed and archived for possible future use. Moving upward, the next 2-inch sand interval (2 to 4 inches above the interface of the sand CIL and the underlying sediment) will be a discrete subsample that will be submitted for PCB analysis (Fox River Method PCB Analysis). The work described in this paragraph will be performed on one half of the split core. The other half of the split core will be segmented into discrete subsamples matching the segments that were sent in for laboratory analysis and will be retained in the facility refrigerator until the analyses results from the primary sample have been evaluated.

c. Moving upward, the next 2-inch interval above the sampled isolation layer (4 to 6 inches above the interface of the sand CIL and the underlying sediment) will be collected and archived for possible future use.

d. Sediments below the CIL will also be collected and archived for possible future use. Particle size data from the sand interval and corresponding underlying sediment may be compared to assess particle size distribution in the CIL, if unacceptable PCB concentrations are detected in the CIL. This sampling is shown in Figure 1.

FIGURE 1



B-10

Vibrocore Sampling

Standard Operating Procedure

Vibrocore Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sediment samples (or samples in sand cover/cap areas) using a vibrocore device and cellulose acetate butyrate (CAB) (Lexan™) core tubes. Procedures are described for the collection of soft sediment. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sediment collection, but it does not contain all of the information required for an FSP (e.g., sample size, sample location, sampling preservation, sample processing and statistical approach).

Collection of continuous undisturbed samples up to 20 feet (ft) in length in water depths from 2 ft to over 15 ft can be readily accomplished using a vibrocore (samples can be obtained in deeper water with attention to orientation of the vibrocore). The following procedure describes the use of a vibrocore with CAB core tubes.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater.* 17th ed. APHA, Washington, D.C. 1989.

ASTM International (ASTM). *ASTM Annual Book of Standards.* Volume 11.04 Water and Environmental Technology. 1990.

Guy, H.P. and V.W. Norman. *Field Measurements for the Measurement of Fluvial Sediments. In Techniques of Water Resources Investigations*, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA. 1969.

U.S. Army Corps of Engineers (USACE). *Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003*. Washington D.C. 2004.

Personnel Qualifications

Personnel executing this protocol should be instructed in the use of the vibrocore apparatus. At least one person on the field crew should have knowledge and prior experience using the vibrocore and a minimum of two years of sediment/soil sampling field experience. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 Code of Federal Regulations [CFR] 1910.120), if hazardous materials are expected. The Captain of the sampling vessel shall have successfully completed a certified boater's safety course, or equivalent course offered by the U.S. Coast Guard.

Equipment and Supplies

Sediment Vibrocore Sampling

- Pontoon boat (work platform) with minimum of three anchors or two anchoring spuds.
- Boat Safety Checklist.
- Personal protective equipment (PPE) as required by the Health and Safety Plan (HASP). (Tyvek suits or other similar splash resistant protective outerwear are typically worn by those handling the collected vibrocores.)
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water, and on-board 12-volt pump, hose, and nozzle for initial cleaning).
- Vibrocore apparatus, including mast, generator, electric winch, and hand winches.
- Hand tools, including cordless impact wrench or socket wrench, cordless drill, riveting tool, hacksaw, reciprocating saw, hammer, required wrenches, screwdrivers, and other miscellaneous tools.
- CAB core tubes (3- or 4-inch outer diameter [OD]) (lengths depending on the length of core required) with "egg shell" core catchers riveted to the tubes.
- Core tube caps (two per core tube).
- Extra core catchers and rivets to attach catchers to core tubes.
- Surveyor's leveling rod (English), or equivalent, attached to a 6-inch diameter round metal plate (overall weight less than 8 pounds [lbs.]). A lead line consisting of a surveyor's tape attached to an 8-lb mushroom anchor will be used as an equivalent in deep water (water exceeding 20 to 25 feet) and high-flow areas.
- Sediment probing rod with 1-inch metal end of sufficient length to penetrate expected soft sediment thickness.
- Core tube stand. Longer tubes may be strapped securely to boat/equipment/framing in vertical orientation while awaiting transport.
- Cordless drill and quarter-inch drill bits.
- Duct tape (several rolls).
- Steel tape measure with maximum 0.1-foot graduations.
- Permanent markers.
- Pen with waterproof ink.

- Dry erase board and markers.
- Sand/Sediment Core Collection and Processing Logs.
- Field Log Book.
- EQuIS® database system (if applicable).
- Global Positioning System (GPS).
- Waders (hip or chest waders) (if necessary).
- Digital camera.

Procedures

1. Preparation prior to sampling:

   a. After launching the pontoon boat, erect the vibrocore mast, and secure all mast bolts.

   b. Check the oil and fuel supply on the generator and outboard motors.

   c. Test all mechanical equipment and make sure each is operable.

   d. Inventory all tools and expendables.

   e. Inventory all safety gear per the HASP.

   f. Assemble spuds and secure spuds in spud pockets.

   g. Secure vibrocore head to prevent damage or injury to personnel prior to departure.

   h. Complete Daily Equipment Inspection Form.

   i. Conduct a pre-launch "tool-box" safety briefing.

2. Obtaining Samples – General Considerations and Limitations:

   NOTE: At no time during the sample collection process outlined below is an employee permitted to work underneath the vibrocore sampling head while the winch is being used to raise or lower the vibrocore sampling head and attached core tube.

   The vibrocore sampling head may be guided, as necessary, while the vibrocore head is in motion from an adjacent position not directly under the sampling unit.

   a. The techniques and tools for sampling soft sediment or sand cover/cap with a core tube depend on the current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (pontoon boat) is anchored or spud in-place using at least three anchors or two anchoring spuds. Typically, the boat is anchored with the front or back facing directly into the wind or current, whichever exerts a stronger force on the sampling vessel.

b. The coordinates of the actual sample location and the water surface elevation are obtained using real-time kinematic GPS (RTK GPS) with sub-meter horizontal accuracy and sub-centimeter vertical accuracy and recorded on the Sediment Core Collection and Processing Log (refer to Attachment 1). Typically, the location should be within a few feet of the proposed horizontal sample location, depending on specific project requirements.

c. Measure the depth to the mud line from the sampling deck platform using a surveyor's rod, or similar device with no larger than 0.1-ft measurement graduations, attached to a 6-inch round metal plate. As a guideline, if wave action is severe, such that peak-to-peak fluctuations of more than 0.8 foot are observed during water depth measurement, the sampling team leader may make the decision to delay sampling until conditions improve. In all cases when wave action is encountered, the midpoint of the fluctuating depth will be recorded as the mud line depth from the deck. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. This depth will then be converted to elevation using the RTK GPS deck elevation recorded at the time of water depth measurement. The thickness of the soft sediment may be measured, if necessary, to meet project objectives, using a probing rod with a 1-inch diameter metal end. The length of the metal end is to be long enough to penetrate the expected thickness of soft sediment. Sediment thickness is measured by pushing the probe rod to refusal. Both measurements are recorded on the Sediment Core Collection and Processing Log.

d. The coring device is assembled with a core tube length sized to the appropriate length based on sand or sediment thickness or the targeted core depth. The appropriate length of core tube should be cut, and the core catcher riveted in-place prior to starting the field sampling. It is prudent to prepare more core tubes (approximately 10% to 20% more core tubes) than are required prior to going out in the field. If difficult sampling conditions are anticipated (e.g., presence of firm sand, gravel, cobbles, riprap, woody debris, etc.) make up additional core tubes since some tubes will likely be damaged during the sampling effort.

e. Mount the clean prepared core tube to the vibrocore, with the factory cut side up. Make sure the tube slides all the way up and is seated against the base of the vibrocore. Once core tube is seated, secure by tightening the bolts that hold the tube in-place. Two sampling personnel are required.

f. Measure the length of the tube and vibrocore to winch line. Add the known depth to top of the sediment to the distance the boat is above the water. Subtract the vibrocore measurement from this quantity. Mark this distance on the winch line with chalk, tape, or lumber crayon. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. Lower vibrocore with the winch until the mark is even with the floor. This should be the top of the sediment (mud line).

g. Guide core tube and vibrocore vertically through hatch and past the bottom of the pontoons by holding cable and guiding it. Care must be taken to prevent damaging the electrical connection to the vibrocore motor. Two sampling personnel are required.

h. When the core is in position as noted in Item f., mark the measured length of the core tube only on the cable. After slowly lowering the tip of the core tube 0.1 to 0.2 feet below the mud line, start vibration while holding onto the winch cable and keeping the cable vertical and slightly slack while the vibrocore penetrates into the sediment. Maintain the winch line in a vertical position. Vibrate the core tube and maintain slack until the target core depth is reached. Do not advance the core tube a greater distance than its length. It is prudent to stop 3 to 4 inches short of the total core tube length. Turn off the vibrocore when the required sample depth is reached.

i. Measure and record depth of core penetration and ease or difficulty of how the core barrel penetrated. Physical measurements should be completed by the sampling crew and verified (observed) by the auditing personnel. All manual measurements should be verified and agreed to by all sampling personnel prior to proceeding with additional sampling procedures. Pull the vibrocore with the winch and guide it until it is above the floor again, being very careful not to damage the electrical cord.

j. Once the core is brought near the floor of the boat (or near the water surface), quickly place a cap on the bottom of the core tube.

k. Attach the shield to the core tube above the sediment in the tube and drill two to three 0.75-inch holes into the sides of the CAB tube approximately 1 to 2 inches above the sediment surface. Place the shield over the holes and allow the water to drain out.

l. Secure the tube using the manila rope hand winch line with two full hitch knots, then remove the tube from the vibrocore unit by cutting it with a reciprocating saw 6 to 8 inches above the top of sediment in the tube.

m. Secure the cap on the top of the tube and clean the outside of the tube with water. Clean with a brush, if necessary, to remove sand or sediment from the outside of the core tube.

n. Duct tape the drilled holes and around both caps to secure them. The thickness of the sediment recovered in the core tube is measured and recorded, and the contents of the core tube are described and recorded on the Sediment Core Collection and Processing Log. The core is then secured in a vertical position until removed from the sampling vessel.

o. Determine the recovery while on the sampling vessel by measuring the sediment length in the recovered core and comparing that value to the distance the core was advanced. The recovery must meet guidelines established in the FSP, unless otherwise specified. If the required recovery is not reached on the first attempt, save the first core, relocate the boat (if necessary) and resample the location following the listed procedures. If the second attempt results in a greater recovery than the first attempt, and the recovery meets the determined FSP percent, sampling is complete at this location. The first core will be brought back to the processing facility and properly disposed of.

p. The core location and sampling date are recorded on the core tube caps. “Top” and “bottom” should also be noted on the respective core tube caps.

q. If cores will be processed in the laboratory, place the core tubes in a tube rack or as vertical as possible in a cooler, prior to processing, as required by the project specific FSP.

r. Cores in excess of 12 feet may need to be cut into two segments to allow for storage in the lab prior to processing. These cores will be transported to the lab in as vertical a position as practical. Once at the lab, the cores will be laid horizontally on a stable surface and the core top cap will be punctured with a drill bit to make sure the core is not pressurized. The core is then cut with a reciprocating saw into two roughly equal sections, and the ends are recapped. The new top cap of the bottom half is labeled to match the original top cap, and “1 of 2” and “2 of 2” are written on the upper and lower sections of the core, respectively.

Documentation

Observations and quantitative data collected during implementation of this sampling procedure should be recorded in one of the Field Log Book and Sediment Core Collection and Processing Log. The EQuIS® database system (by EarthSoft) is another tool that provides data in a more timely manner.

The Sediment Core Collection and Processing Log (attached) will be completed for each core location. The log will contain the following information: location, date, time, personnel, weather conditions, latitude/longitude (or other appropriate coordinate system for the state where work is being conducted), make/model of GPS equipment used, water depth, top of sediment elevation, sediment thickness (if probing is conducted), core tube identification (I.D.), sediment penetration, sediment recovery, and miscellaneous sampling information (i.e., problems encountered, etc.).

Attachment

Sediment Core Collection and Processing Log

CHECK-IN	CHECK-OUT
Time:	Time:
Ctrl Pt:	Ctrl Pt:
ΔN:	ΔN:
ΔE:	ΔE:
ΔV:	ΔV:
Tide-In:	Tide-Out:

Project Name: ______
Project Location: ______ DMU: ______
Project ID: ______

Sediment Core Collection and Processing Log

Date: ______ Time : ______

Sample Location ID:

Sampling Personnel: ______

Weather Conditions: ______

Vibrocore _____ Piston _____ RPB _____ Check Valve Sampler ______

Proposed Location Coordinates

Northing: ______

Easting: ______ ft.

Datum: Wisconsin SPC NAD 83 ft.

Offset from Proposed Coordinates

Actual Sampling Location

	1st Attempt	2nd Attempt	3rd Attempt
Northing:			
Easting:			
Water Elev.:			

	1st Attempt		2nd Attempt	
	Light Effort	To Refusal	Light Effort	To Refusal
Total Probed Length:				
Top of sediment depth from deck:				
Probed Sediment Thickness:				
Probing Observation:				

	1st Attempt	2nd Attempt	3rd Attempt
Sediment Core Penetration:			
Sediment Recovered:			
% Recovery:			

Field Observation

Processing Personnel: ______

Core Length (in): Core Processing (Observations) Date Processed:

Core Intervals (in)	Core Description	Core Intervals (in) top	Core Intervals (in) bottom	Sample Number

Comments:

Entered by: ______

Checked by: ______

B-11

Vacuum Push Core Sampling

Vacuum Push Core Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sand/sediment samples using a vacuum push corer (check-valve sampler). Procedures are described for the collection of soft sediments or sand covers/caps from streams, rivers and lakes for sand thickness verification, sediment characterization, and other quality assurance/quality control (QA/QC) verifications. This SOP should be consulted during the preparation of any Field Sampling Plan (FSP) involving sand/sediment collection, but it does not contain all of the information required for an FSP (e.g., sample size, sample location, and statistical approach, etc.).

Sediment collection for analysis of lithology, benthic organisms, chemical content, or toxicity testing can be accomplished using a number of mechanical devices (e.g., Ponar® dredge, Ekman dredge, push corer, Russian Peat Borer, vibrocore/vibracore or similar devices). Collection of soft sediment samples or sand thickness verification samples in areas where the sand overlays soft sediment is easily accomplished using a vacuum push corer. The following procedure describes the use of a vacuum push corer for collection of sand cover or soft sediment samples.

References

American Public Health Association (APHA). *Standard Methods for the Examination of Wastewater*. 17th ed. APHA, Washington, D.C. 1989.

ASTM International (ASTM). *ASTM Annual Book of Standards. Volume 11.04 Water and Environmental Technology*. 1990.

Guy, H.P. and V.W. Norman. *Field Measurements for the Measurement of Fluvial Sediments. In Techniques of Water Resources Investigations*, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA. 1969.

Foth Infrastructure & Environment, LLC (Foth), 2020a. *Location Control Using Differential Global Positioning System* SOP.

Foth, 2020b. *Location Control Using RTK- Global Positioning System* SOP.

Foth, 2020c. *Sediment Sampling Equipment Cleaning and Decontamination* SOP.

U.S. Army Corps of Engineers (USACE). *Engineering and Design, Hydrographic Surveying. Manual Number 1110-2-1003*. Washington D.C. 2004.

Personnel Qualifications

Personnel executing this protocol should be instructed in the use of the vacuum push corer. At least one person on the field crew should have knowledge of sediment sampling devices and a minimum of one year of field experience using such devices. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 Code of Federal Regulations [CFR] 1910.120), if exposure to hazardous materials is expected while conducting sampling. The Captain of the sampling vessel shall have successfully completed a certified boater's safety course.

Equipment and Supplies

- Minimum 16-foot (ft) boat and motor (work platform) equipped with two anchoring spuds or a minimum of three anchors.
- Boat must be equipped with appropriate equipment capable of efficiently collecting sand or sediment samples in water up to 15 ft deep (mast, winch, generator, rod extensions, etc.).
- Boat Safety Checklist.
- Vacuum push corer apparatus including the core tube and rod extensions.
- Surveyor's leveling rod (English) attached to a 6-inch diameter round metal plate (overall weight should be less than 8 pounds [lbs]).
- Sediment probe, appropriate length, steel pipe with half-inch outer diameter (OD) probing end.
- Duct tape (several rolls).
- Stainless steel bowls and spoons (alternative: disposable aluminum pans and wooden sterile tongue depressors) if cores are to be processed on sampling vessel.
- Personal protective equipment (PPE) as required by the site Health and Safety Plan (HASP).
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, and deionized water) (Foth, 2020c).
- Core processing table (if cores are to be processed on sampling vessel).
- High resolution digital camera.
- Sample containers (i.e., amber glass jars or quart or gallon size Ziploc® plastic bags). (If cores are to be processed on sampling vessel). Consult FSP.
- Cooler with ice (if samples are being retained for chemical/biological analysis).
- Steel tape measure in tenths of a foot.

- Pen with waterproof ink.
- Permanent marker.
- Dry erase board and markers.
- Waders (hip or chest waders), if not collecting samples from a boat.
- Core Collection and Processing Logs.
- Labels and chain-of-custody forms (if cores are to be processed on sampling vessel).
- Field Log Book.
- Global Positioning System (GPS) (Foth, 2020a; Foth, 2020b).

Procedures

1. Locating Sample Stations and Preparations Prior to Sampling:

   (Sample stations are located using GPS [Foth, 2020a; Foth, 2020b].)

   a. Check the boat engine oil and fuel supply and same for generator, if so equipped.

   b. Test all mechanical equipment and make sure each is operable.

   c. Inventory all tools and expendables.

   d. Inventory all safety gear per the HASP.

2. Obtaining Samples – General Considerations and Limitations:

   a. The techniques and tools for sampling with a vacuum push corer depend on current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (boat) is anchored or spudded in-place using at least three anchors or two spuds. Typically the boat is anchored with the front or back facing directly into the wind or current, whichever is stronger. The coordinates of the actual sample location and the water surface elevation are obtained using GPS and recorded on the Core Collection and Processing Log.

   b. Measure the water depth using a surveyor's rod attached to a 6-inch round metal plate. The depth is recorded on the Core Collection and Processing Log.

   c. The depth from the top of the sand/sediment to the deck should be marked on the vacuum push corer extension rods.

d. The core tube is attached to the check valve with a compression fitting. Sufficient extension rods are coupled together so that the sampler can be lowered to the sand/sediment interface within the water and advanced to the required penetration depth. The sampler can be lowered by hand.

e. With the core sampler in contact with the sand/sediment surface, use a twisting motion to gently push the core sampler into the underlying sand/sediment. The twisting motion will allow the sampler to cut into the sand/sediment with little disturbance to the surrounding material. If necessary, a post driver can be used to push the vacuum core sampler into clay material.

f. After the sampler has been pushed to the target depth, pull the vacuum push corer up to the surface. If post driver is used, you may need to use wench system to break free from the clay layer. Care must be taken to keep the sampler in a vertical position. Note: When sampling sand above soft sediment, the desired depth of penetration is to have a small void space above the sand layer in the sample core and sediment present below the sand layer to ensure that the full thickness of sand has been documented.

g. If sampling for sand thickness determination, determine the thickness of sand and sediment present by measuring the amount of material present in the core. If sediment is not present under the sand layer, discard the core, and attempt another sample from within a different portion of the moon pool. If the second attempt is unsuccessful, relocate the boat in accordance with the FSP and resample the location following the listed procedures. Note suspected reasons why the sample was not recoverable on the Field Log Book.

3. Handling of Samples:

a. Once the core tube is at the surface, place a cap on the bottom end of the core tube. If material is falling out of the core tube when retrieving sample from the water surface, the cap may need to be placed while the bottom of the core is still submerged. This will ensure that material does not fall out of the core while thickness measurements are taken. The vacuum push corer will be held vertically for sample examination.

b. A small hole is drilled into the side of the cellulose acetate butyrate (CAB) tube approximately 1 to 2 inches above the sand/sediment surface to allow the water to drain out. The top is capped and duct tape is placed over the drilled holes and around the caps to secure them.

c. The thickness of the sand/sediment recovered in the core tube is measured and recorded, and the contents of the core tube are described and documented on the Core Collection and Processing Log. The core is then secured in an upright position in a 5-gallon pail or cooler with holes cut in the cover, or similar device, and transported vertically to the processing facility.

d. An estimate of compaction (% recovery) is determined by measuring the length of metered recovered in the core and comparing the value to the core advance. Collection of sediment samples in deeper water (greater than 15 feet) should employ other coring methods.

e. The core location and sampling date are recorded on the core tube caps. "Top" and "bottom" should also be noted on the respective core tube caps.

f. If the desired thickness being sampled is not obtained on the first attempt, a second attempt will be made 3 and 10 feet in a random direction away from the location of the first attempt. If the second attempt fails to recover a viable sample, then no recovery is reported on the Core Collection and Processing Log. In such cases, an alternative method of sample collection (e.g., vibrocore) may be directed by the Field Team Leader.

4. Processing of Samples:

   a. Sediment core samples shall be processed as soon as possible after sampling.

   b. If cores cannot be processed immediately after sampling, they shall be chilled to 4 degrees Celsius (°C). Core samples will be processed or stored until processed in the laboratory.

   c. If present, the light, low-percent solids surficial sediment layer, commonly referred to as the "fluff" layer, will be removed from the top of the core by using a syringe or pipette. An estimate of the amount (thickness) of fluff removed will be made and recorded.

   d. The sediment thickness is measured while the sample tube is vertical and recorded on the Core Collection and Processing Log.

   e. The sample tube is cut in half length-wise while lying horizontally using a "Zip Drill." A stainless steel knife, or similar disposable utensil, is used to scrape the smeared sediment off of a small area on the top of the sediment sample. The description of the soil/sediment core is recorded on the Core Collection and Processing Log in the following order: color, soil/sediment description, moisture content, plasticity, and density.

   f. The top 6 inches of each core is homogenized in a stainless steel bowl using a stainless steel spoon, or similar disposable containers and utensils. The sample may also be homogenized in a sealable plastic bag (Ziploc® plastic bag or similar), by carefully rolling the sample until the sample is evenly homogenized. A sample jar or double plastic bag is filled with the homogenized sample. The minimum sample weight required is 100 grams wet. The remainder of the core is divided into 6-inch intervals, homogenized, and sampled per the FSP. The sample is labeled according to the FSP. The appropriate information is placed on a chain-of-custody form.

g. For composite samples, each core shall be processed as described above. Each secondary core is divided into 6-inch intervals. The top 6 inches of each sample (surficial interval) is segregated and homogenized as described above. The composite sample is prepared for laboratory analysis by taking equal amounts of each of the homogenized sample intervals and compositing the samples into one sample (refer to the FSP for additional compositing details). Samples shall be placed in sample jars or double Ziploc® plastic bags and labeled with sample identification per the FSP.

h. Field duplicate samples shall be processed per Quality Assurance Project Plan (QAPP) requirements.

i. Samples shall be kept at 4°C during shipment to the laboratory.

B-12

Piston Core Sampling

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Piston Core Sampling

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for the collection of sediment samples (or sand covers/caps) using a piston core sampling device. Procedures are described for the collection of soft sediments or sand layers of caps and covers for streams, rivers, and lakes. This SOP should be consulted during the preparation of a Field Sampling Plan involving sediment or sand layer collection, but it does not contain all of the required information (e.g., sample size, sample location, sampling preservation, sample processing and statistical approach).

Sample collection for analysis of chemicals of concern can be accomplished using a number of mechanical devices (Ponar® dredge, Ekman dredge, gravity corer, push corer, drive corer, vibrotory/vibratory corer, or similar device). Collection of continuous undisturbed, sediment/sand samples up to 4.5 feet (ft) in length in water depths up to approximately 15 ft can be readily accomplished with the above-described piston core sampling device.

References

ASTM International (ASTM). *ASTM Annual Book of Standards*. Volume 11.04 Water and Environmental Technology. 1990.

Foth, 2020a. *Location Control Using Differential Global Positioning System* SOP.

Foth, 2020b. *Location Control Using RTK-Global Positioning System* SOP.

Guy, H.P. and V.W. Norman. *Field Measurements for the Measurement of Fluvial Sediments. In Techniques of Water Resources Investigations*, Book 3, Chap. C2. U.S. Geological Survey, Reston, VA. 1969.

Personnel Qualifications

Personnel with training and experience with the piston core sampler should be responsible for sampler operation and compliance with SOP protocols. At least one person on the field crew should have knowledge and prior experience using the piston sampler and a minimum of two years of sediment/soil sampling field experience. All field personnel must have satisfied Occupational Safety and Health Administration (OSHA) training requirements (40 Code of Federal Regulations [CFR] 1910.120), if hazardous materials are expected. The Captain of the sampling vessel shall have successfully completed a certified boater's safety course.

Equipment and Supplies

Piston Core Sampling Equipment and Supplies

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

- Minimum 16-foot boat and motor (work platform) with minimum of three anchors or two spuds. Pontoon boat preferred.
- Personal protective equipment (PPE) (as required by the Health and Safety Plan [HASP]).
- Decontamination/cleaning equipment (non-phosphate detergent, 5-gallon buckets, scrub brush, deionized water and a clean garden pesticide-like sprayer, or an onboard 12-volt pump, hose and nozzle for initial cleaning).
- Piston coring device, including core holder, T-bar with extensions, and rope or cable with clip.
- Polycarbonate core tubes (2 5/8" ID x 2 3/4" OD, thin walled tubes with chamfered ends; 4.5-ft lengths, depending on target core length). (Note: tube diameter to match equipment manufacturer's specifications.)
- Core tube caps (two per core).
- Surveyor's leveling rod (English), or equivalent with maximum 0.1-ft graduations, attached to a 6-inch diameter round metal plate A lead line consisting of a surveyor's tape attached to an 8-pound [lb.] mushroom anchor will be used as an equivalent in deep water (water exceeding 25 ft) and high-flow areas.
- Sediment probe with 1-inch diameter metal end, of appropriate length to completely penetrate the expected thickness of soft sediment being sampled.
- Core tube stand (e.g., 5-gallon bucket). Longer tubes may be strapped securely to the boat/equipment/framing in vertical orientation during transport.
- Cordless drill and quarter-inch drill bits.
- Duct tape (several rolls).
- Steel tape measure with maximum 0.1-ft graduations.
- Boat Inspection Checklist.
- Camera.
- Permanent markers.

- Pen with waterproof ink.
- Sediment Core Collection and Processing Logs.
- Field Log Book.
- EQuIS® database system (if applicable).
- Real-time kinematic global positioning system (RTK GPS).
- Waders (hip or chest waders), if necessary.

Procedures

1. Preparation prior to sampling:

    a. Check the oil and fuel supply on the powered equipment.

    b. Test all mechanical equipment and make sure each is operable.

    c. Inventory all tools and expendables.

    d. Inventory all safety gear per the HASP.

    e. Assemble anchoring spuds, and secure spuds in spud pockets.

    f. Conduct a pre-launch "tool-box" safety briefing.

2. Obtaining samples – including general considerations and limitations:

    a. The techniques and tools for sampling soft sediment or sand layers with a core tube depend on current, depth of water, substrate characteristics, and the sampling program's objective. Once a sampling location is determined, the sampling platform (boat) is anchored or spud in-place using at least three anchors or two spuds. Typically, the boat is anchored with the front or back facing directly into the wind or current, whichever exerts a stronger force on the sampling vessel.

    b. The coordinates of the actual sampling location and the water surface elevation are obtained using GPS and recorded on the Sediment Core Collection and Processing Log. Typically, the location should be within a few feet of the proposed horizontal sample location, depending on specific project requirements. Refer to Foth SOPs for location control depending on project requirements in the Field Sampling Plan.

    c. Measure the depth to the top of sediment or sand layer from the sampling deck platform using a surveyor's rod, or a similar device with no larger than 0.1-ft graduations, attached to a 6-inch round metal plate. As a guideline, if wave action is severe, such that peak to peak fluctuations of more than 0.8 ft are observed during water depth measurement, the sampling team leader may make the decision to curtail sampling until conditions improve. In all cases when wave action is encountered, the midpoint of the fluctuating depth will be recorded as the mud line depth from the deck. This depth will then be converted to elevation using the reference elevation recorded at the time of water depth measurement.

d. The thickness of the soft sediment may be measured, if necessary to meet project objectives, using a probing rod with a 1-inch diameter metal end. The length of the metal end is to be long enough to penetrate the expected thickness of soft sediment being sampled. Sediment thickness is measured by pushing the probe rod to refusal. Both the top of sediment and the probing rod refusal depth measurements are recorded on the Sediment Core Collection and Processing Log.

e. The piston coring device is assembled to the appropriate length based on water depth and sediment/sand layer thickness to be sampled. Install the adjustable piston core assembly into the tubing so that it is near the end of the tube (make sure the adjustable piston core assembly is attached to the piston rope). Slide the core tube onto the piston core head and tighten in place with four bolts. The rod is then screwed into the top of the sampler. Measure the distance from the top of sediment/sand layer to the deck using the pole fitted with a 6-inch diameter metal plate. Measure this same distance from the tip of the sampler to a point on the T-bar. Mark this length on the T-bar with tape. Lower piston core sampler into the water until the tape mark is even with the floor. The tip of the sampler should be at the top of the sediment/sand layer.

f. The pull rope or cable is clipped to the piston as the coring tip is lowered to the sediment/water interface. The pull rope or cable is secured to the floor of the sampling boat such that it is taut when the tip of the sampler touches the top of the sediment.

g. The tip of the sampler is lowered to the top of the sediment/sand layer.

h. The core barrel is pushed or driven into the substrate until refusal or until target penetration has been reached. When performed, the distance the core barrel is driven/hammered will be noted on the logs. During advancement of the core barrel, the piston is fixed in place by keeping tension on the pull rope. If the piston fits too tightly in the core barrel, the core barrel will not be able to easily advance past the piston, and sampling results will be affected. Therefore, the core diameter must be sized to accommodate the piston for proper use.

i. Once the piston core is pushed to refusal or desired depth, the depth of core penetration is measured and recorded.

j. Retrieve the sampler, keeping it vertical as it is brought to the floor of the sampling boat. Two holes are drilled in the core tube between the top of the recovered sediment/sand and the bottom of the piston, the bottom hole no closer than a half-inch from the top of the captured material. Water is allowed to drain.

k. The piston and the top of the sampler are removed from the core holder and core.

l. Once the water has drained from the core, an end cap is placed on top of the core, and the core is lifted from the top apparatus. Following the removal of the top, an end cap is placed on the bottom of the core. Both end caps and the drilled holes are then covered with duct tape.

m. The sampler is then decontaminated, following the procedures outlined in the project SOP for decontaminating non-dedicated sampling equipment. A rinsate sample also may be collected if specified in the Quality Assurance Project Plan (QAPP). A rinsate sample is collected by pouring deionized water over and into the top of the decontaminated sampler and collecting the rinsate with a glass jar.

n. The thickness of the sediment/sand recovered in the core is measured and recorded, and the contents of the core are described and documented on the Sediment Core Collection and Processing Log. The core is then secured in an upright position in a core rack or strapped to sturdy vessel framing in a vertical orientation.

o. Determine the percent recovery (recovered material length/tube advancement length x 100) for each core while on the sampling vessel by measuring the length of recovered material in the core and comparing that value to the distance the core was advanced. The recovery must meet guidelines established in the Field Sampling Plan. If the required recovery is not reached on the first attempt, save the first core, relocate the boat (if necessary) and resample the location following the listed procedures. If the second attempt results in a greater recovery than the first attempt, the contents of the first core will be discarded through the moon pool or side of boat after the location has been sampled.

p. The core location, sampling date, recovered sediment length, and tube advancement length are recorded on the core tube caps.

q. Maintain the core tubes in as vertical a position as practical during transport to the processing laboratory. If cores cannot be processed immediately, cores will be maintained on ice or in a walk-in cooler at 4 degrees Celsius (ºC).

Documentation

Observations and quantitative data collected during implementation of this sampling procedure should be recorded in either the Field Log Book or Sediment Core Collection and Processing Log.

The Sediment Core Collection and Processing Log will be completed for each core location. The log will contain the following information: location, date, time, personnel, weather conditions, latitude/longitude (or other appropriate coordinate system for the state where work is being conducted), make/model of GPS equipment used, depth from mudline to sampling deck platform, top of sediment/sand elevation, sediment/sand thickness (if probing is conducted), core tube identification (ID), core penetration length, recovered sediment/sand length, and miscellaneous sampling information (i.e., problems
encountered, etc.).

B-13

Shipping and Packaging of Non-Hazardous Samples

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Shipping and Packaging of Non-Hazardous Samples

Introduction

The purpose of this Standard Operating Procedure (SOP) is to establish a standard procedure for packaging and shipping of non-hazardous samples. The primary use of this SOP is for the transportation of samples collected on site to be sent off site for physical, chemical, and/or radiological analysis. Samples may be coordinated for courier pick-up. Contact the contracting lab for options. The sampler should consider the following options when selecting the appropriate way to deliver samples to the laboratory: potential for sample breakage and loss due to carrier handling practices, potential for sample tampering during shipment, sample delivery time versus sample holding time, ability to maintain chain-of-custody procedures, compliance with any regulatory restrictions or limitations, and carrier pick-up or drop-off stations.

Non-hazardous samples are those that do not meet any hazard class definitions found in 49 Code of Federal Regulations (CFR) 107-178, including materials designated as Class 9 materials and materials that represent Reportable Quantities (hazardous substances).

References

ASTM International (ASTM). ASTM Designation D6911 – 03, *Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis*. 2003.

Code of Federal Regulations (CFR), Transportation (Title 49 CFR Parts 107 – 178). *Hazardous Materials*. https://www.govinfo.gov/content/pkg/CFR-2019-title49-vol2/xml/CFR-2019-title49-vol2-part107.xml

Please refer to the appropriate regulations from the State Department of Transportation (DOT) and/or International Air Transport Association (IATA), and contact the shipping carrier for instructions, if necessary.

Personnel Qualifications

Qualifications of personnel are as directed in the Field Sampling Plan (FSP), Health and Safety Plan (HASP), and appointed by the Project Manager (PM).

Equipment and Supplies

- Shipping container(s);
- Samples;
- Bubble wrap;

- "Quality" cubed ice (not ice from motel ice machine);
- Various types of packing supplies, such as packing tape, permanent inked markers, duct tape (or equivalent), etc.;
- 55-gallon bag or appropriate sized bag for holding ice in shipping container;
- Ziploc® plastic bags or equivalent;
- Custody seals; and
- Chain-of-custody form(s).

Specific Equipment Definitions

- Cooler/Shipping Container – Any hard-sided insulated container meeting any state DOT or IATA's general packaging requirements. The container should be sufficiently large enough to hold a number of sample containers or bottles without exceeding weight limitations.
- Bubble Wrap – Plastic sheeting with entrained air bubbles for protective packaging purposes.

Procedures

Packaging Procedure

1. Follow shipping instructions from contracting lab.
2. Use tape to seal off the cooler drain on the inside and outside to prevent leakage.
3. Place packing material on the bottom of the shipping container (cooler) to provide a soft impact surface.
    a. It is recommended to place absorbent materials on the bottom of the shipping container to prevent any potential leakage from the inside.
4. Place a 55-gallon or equivalent plastic bag into the cooler (to minimize possibility of leakage during transit).
5. Starting with the largest glass container, wrap each container with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.
6. Pack the largest glass containers in the bottom of the cooler, placing packing material between each of the containers to avoid breakage from bumping.

7. Double-bag the ice (chips or cubes) in gallon or quart freezer Ziploc® plastic bags or equivalent, if required, and wedge the ice bags between the sample bottles. (Use "quality" ice, not ice from a motel ice machine.)

8. Add enough ice to sufficiently keep sample temperatures consistent cool during shipment.

9. When sufficiently full, seal the inner protective plastic bag, and place additional packing material on top of the bag to minimize shifting of containers during shipment.

10. Tape a gallon Ziploc® bag or equivalent to the inside of the cooler lid, place the completed chain-of-custody document inside (a copy of the chain-of-custody should be retained by the shipper), and seal the cooler shut.

11. Tape the shipping container (cooler) shut using packing tape, duct tape, or other tear-resistant adhesive strips. Taping should be performed to ensure the lid cannot open during transport. A minimum of three rotations at two points of tape on the cooler is recommended.

12. Place a custody seal on two separate portions of the cooler to provide evidence that the lid has not been opened prior to receipt by the intended recipient.

Labeling Procedure

1. "This Side Up" arrow must be adhered to all sides of the cooler.

    a. Other recommended labels include: "Fragile" and "Packed in Wet Ice."

2. The name and address of the receiver and the shipper must be on the top of the cooler.

3. The air bill must be attached to the top of the cooler. Applying packing tape to the shipping label is recommended to ensure that the label is not inadvertently removed during shipment.

Shipping Procedure

1. If a project has a specific cooler shipment checklist requirement, it shall be completed and kept in the project file. Custody seal numbers may need to be recorded and tracked.

2. It is recommended that the laboratory should be contacted the day samples are expected to be delivered to verify that samples were received and in good condition.

3. Shipping tracking numbers should be kept in the project file and provided to the laboratory upon shipment.

B-14

Sample Chain of Custody

Foth Infrastructure & Environment, LLC

Standard Operating Procedure

Sample Chain of Custody

Introduction

As part of consulting services, Foth Infrastructure & Environment, LLC (Foth) collects a wide range of environmental samples. All samples collected must be accompanied by a chain of custody when submitted for analysis to ensure proper security and legal handling of samples.

Proper documentation of sample custody is necessary to trace a sample from point of origin through the final report or completion of the project. Requiring samples to have a chain of custody ensures proper security and legal handling of samples as they move between the different parties that are responsible for their collection and analysis. A chain of custody is prepared by completing a chain of custody record form (see Foth's form that is attached as example). Typically, these forms are provided by the laboratory that is providing the sample bottles and analysis. If the laboratory does not supply a form, Foth has a generic chain of custody form which can be used. These forms are available on SharePoint or as an excel template. Chain of custody record forms will be filled out by the sampler(s) at the time of sampling and shipping.

This process is intended to be used for both paper and electronic chain of custody forms.

References

None.

Personnel Qualifications

The sampler(s) must be trained in properly filling out chain of custody forms.

Equipment and Supplies

- Electronic or paper copy of chain of custody form
- Pen

Procedures

Sample chain of custody documentation will be prepared by the sampler(s) immediately following the collection of samples. A chain of custody is a legal document. Therefore, it must be completed in pen. Foth also has an electronic chain of custody form that can be completed on the computer and printed. However, signatures on both electronic and paper chain of custody forms are required and must be in ink. Once completed, the chain of custody paper copy will be placed in the master file. Copies are to be stored electronically in the project file on Project Wise.

Chain of custody forms will generally include the following information:

1. A unique chain of custody number
2. Laboratory shipping address
3. If using a laboratory chain of custody, use Foth as the company name, including branch office location
4. Project contact (in most cases, that will be the lab coordinator)
5. Contact phone number
6. Project number ID
7. Project name
8. Project (site) license number (if applicable)
9. Project state
10. Name of sampler
11. Field ID and unique number (if applicable)
12. Sample description
13. Date sample collected
14. Time sample collected
15. Analyses with analytical method requested
16. Sample matrix
17. Preservation of samples
18. Indicate whether or not sample was field filtered
19. Page numbers if more than one chain of custody
20. Address for where reports should be mailed
21. Address of where invoice should be sent. Invoices that are not sent to the client's address must be sent to invoices@foth.com per accounting procedures.
22. Regulatory program
23. Special quality assurance (QA) needs (turnaround time)
24. Any request for data submitted by e-mail or any other format other than printed copy
25. Laboratory receiving information section completed by the laboratory

Foth Infrastructure & Environment, LLC

26. Shipping method and tracking numbers
27. Signature section for transfer of custody with date and time section

After collection, samples are securely stored and packaged as required by analytical protocol until delivered to the laboratory. The chain of custody document remains with the samples during transport and serves as a written record of sample possession and transference. A sample is considered to be in custody if it is in one's possession, is locked and sealed during shipment, or is placed in a secure area limited to authorized personnel. The chain of custody must be signed and dated by everyone who takes possession of the sample. If the electronic chain of custody form is used, a minimum of two printed copies must accompany the samples to the laboratory. All copies are signed and dated during sample transfer. Laboratory personnel will note any damaged sample containers, or discrepancies between the sample label and information on the chain of custody.

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately

Page: of | **COC Number:** COC-100040

Company: Foth	Report To:	Requested Due Date:	Quote Reference:
Address: 2121 Innovation Court, Suite 300	Copy To:	*TAT:	Project Manager:
De Pere, WI 54115-5095	Invoice To		Project #:
Phone / Fax: (920) 497-8516	P.O.		Profile #:
Email Address	Project Name:	Regulatory Agency:	Sampling Team Members:
Site License No.:	Project Numbe	State Location:	

Valid Matrix Codes	
Matrix	Code
Soil	SO
Sediment	SE
Surface Water	WS
Wastewater	WW
Groundwater	WG
Ambient Air	AA
Other	X

ITEM NUMBER	SAMPLE ID	MATRIX CODE	SAMPLE TYPE G = Grab C = Composite	DATE COLLECTED MM/DD/YYYY	TIME COLLECTED (Military time)	Preservatives: # Containers	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Requested Analysis (Filtered (Y/N))												REMARKS / Lab ID
1																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										

SHIPMENT METHOD	AIRBILL NO.	SHIPPING DATE	NO. OF COOLERS	ITEM #	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME

SAMPLE CONDITION: **SAMPLE NOTES:**

Temp in C	
Received on Ice	Y / N
Sealed Cooler	Y / N
Sample Intact	Y / N

Additional Comments:

SAMPLER NAME AND SIGNATURE	
PRINT Name of SAMPLER:	
SIGNATURE of SAMPLER	DATE Signed:

Appendix C

Collectors Permit for the Current Sampling Year

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Tony Evers, Governor
Preston D. Cole, Secretary

State Natural Resources Office
101 South Webster Street
Madison, Wisconsin 53707-7921
FAX 608-266-2244
Telephone 608-264-9257
TTY Access via relay - 711

05/12/2021

Nicholas Glander
Foth Infrastructure & Environment, LLC
2121 Innovation Court, Suite 300
De Pere, WI 54115-5126

Subject: Scientific Collectors Permit #SCP-FM-2021-061

Mr. Glander,

Thank you for submitting a 2021 Scientific Collection Permit application as part of your scientific research and monitoring. Included in this document is your **approved** Scientific Collectors Permit. This permit allows for the collection of fish species from the waterbodies specified in your application. Please keep this permit with you when conducting collection activities.

Locations: Green Bay

Your permit is valid until December 31st of the issuing year. You must keep records of all collections, and if prompted must supply all information requested by the Department. You are required to submit an annual report on January 10th, 2022 detailing work performed under this permit the previous year (NR 19.11(6)). On your annual report form, please indicate if you would like to renew or discontinue your permit. Failure to submit annual reports will result in the revocation of your Scientific Collectors Permit.

Annual report forms can be found by visiting http://dnr.wi.gov/topic/EndangeredResources/permits.html, selecting the "Other Permits" tab, and selecting the "SCP or SRL Annual Report Form" link.

Please send the annual report to:

Fisheries Scientific Collectors Permits WDNR
P.O. Box 7921
Madison, WI 53707-7921

There are some provisions of the permit that the Department would like you to review before you begin collection of species. They can be found in the attached Conditions document.

Please contact Joe Bevington at Joseph.Bevington@wisconsin.gov or (608) 264-9257 for any **fish related** questions about your permit.

Please contact Nomi Rivers at Naomi.Rivers@wisconsin.gov or (608) 279-1270 for all other questions about your permit.

Sincerely,

Joe Bevington
Fisheries Permit Coordinator
Wisconsin Department of Natural Resources
Bureau of Fisheries Management

Wisconsin Scientific Collectors Permit #SCP-FM-2021-061
CONDITIONS

1. All holders of Scientific Collection Permits are required to follow the laws related to SCP's identified in ss. 29.614 and NR 19.11.

2. All Scientific Collectors Permit holders and all agents acting under the authority of a Scientific Collectors Permit are required to keep a copy of the permit on them while conducting research or collecting animals from the wild.

3. This permit does not apply to any endangered & threatened species (as identified on the state endangered & threatened species list on the Wisconsin DNR website), bald eagles, or federally endangered or threatened species. If there is incidental take of a species not allowed under this permit, contact a warden by calling 1-800-TIP-WDNR or 1-800-847-9367.

4. It is the responsibility of the permittee to contact property managers (for public lands) and private landowners at least 48 hours prior to collecting to inform them of the intent to collect and to obtain any necessary permissions for property access.

5. A federal Scientific Collectors Permit is required prior to collecting alive or deceased migratory birds. Information about and applications for federal migratory bird permits can be found by visiting https://www.fws.gov/birds/policies-and-regulations/permits.php

6. Contact the local fisheries biologist and conservation warden before beginning fish collection activities. Contact information can be found using the DNR's staff directory http://dnr.wi.gov/staffdir/_newsearch/contactsearchext.aspx. This will keep us informed of your activities should we receive inquiry calls from the public.

7. All equipment used for your collections shall be de-contaminated following the most current protocols for invasive and exotic viruses and species prior to and after use. The most current decontamination protocols used by DNR staff can be found at the following website: http://dnr.wi.gov/topic/Invasives/disinfection.html#general. No live fish may be transported away from the collection location unless maintained in a biosecure facility with water disposed of through a sewage treatment system and killed before movement out of that facility.

8. All traps, nets, or other gear used for capturing fish shall be marked with a black and white striped mast style buoy with a 10"x10" square white flag on the top that lists the permit number, name, and address of the permittee. Survey equipment/nets/traps may not be set in a manner which would constitute an obstruction to navigation and must be emptied at least once each 24-hour period. Gill nets may not be used in inland waters unless specifically authorized by this permit. Hook and line fishing equipment and spearing equipment may not be possessed on a boat operating under a permit without prior approval on the permit.

State of Wisconsin
Department of Natural Resources
dnr.wi.gov

Scientific Collectors Permit or Research License Application and Authorization

Form 9400-379 (R 10/16)

Notice: Use of this form is required by the department to apply for a scientific collectors permit or research license pursuant to ss. 29.614 and 169.25, Wis. Stats. State Natural Areas require an additional separate permit for research and scientific collection purposes. The license/permit authority may cover migratory birds, nests and parts, but may not be exercised without an appropriate federal permit issued by the U.S. Fish and Wildlife Service. Personal information provided may be used to determine identity of the applicant, participation in natural resources surveys, eligibility for approvals and enforcement purposes. Information may be made available to requesters under Wisconsin's open records law, ss. 19.31 to 19.39, Wis. Stats. A social security number or federal employer identification number is REQUIRED when applying for licenses according to ss. 169.34 and 169.35, Wis. Stats., but the DNR may only disclose it to the Departments of Workforce Development and Revenue.

Mail or deliver this completed form to the appropriate department service center.

Check the one that applies:

- [x] **Scientific Collectors Permit** **Fee:** $0
  (Used when collecting live fish, nests or the carcasses of wild animals for scientific purposes)
- [ ] **Scientific Research License** **Fee:** $25.00
  +$20.00 late fee if application filed after license expiration date.
  (Used when taking and possessing live wild animals [other than fish] from the wild for research purposes.)

Include the required fees and copy of an Institutional Animal Care and Use protocol and approval (9 CFR 2.31) with application.

Applicant Information (please print or type)

Last Name	First	MI	Current License/ Permit No. (if renewal)	DNR Customer ID No.
Glander	Nicholas	M		

Agency or Organization	Daytime Telephone Number	Alternate Telephone Number
	(920) 362-8744	

Street or Route	Social Security OR Federal Employer Identification No.:
2121 Innovation Ct. , Suite 300	

City	State	ZIP Code	Date of Birth	Eye Color	Hair Color	Weight	Height	Gender:
De Pere	WI	54115	09/24/1978	Brn	Gray	240	5'10"	[x] Male [ ] Female

Federal Permit No. (if any)	Date Federal Permit Expires	E-Mail Address

Were you at any time during the past year convicted of any violation of the fish or game laws of Wisconsin?

[ ] Yes [x] No If Yes, Explain:

Explain Scientific Qualifications of Applicant – Required if applying for scientific research license
BS Degree - Natural Resources Management

Collection Information

Species, Age or Size Class*, and Number of Specimens or Description of Items to be Collected or Possessed

See Attached Table 3-5

* For game fish and pan fish species list young-of-year separately from larger length ranges

Purpose of Collecting or Possession
Long Term Monitoring for Fox River Remediation Project

Method(s) of Collecting (for Chemical Immobilization, List Agents(s))

Electrofishing, Trawl, Seine, Rod / Reel, Bongo Tows, Baiting, Light Trapping, Bow Hunting (carp), sharing samples with other research and regulatory entities including but not limited to WDNR, US Fish and Wildlife, UWGB. Gill nets may only be used if attended on the water and checked at least every 4 hours. Use of gill nets must be discontinued if causing mortality of non-target species.

Location of Collecting or Possession Site(s) – County for all sites; waters for aquatic collections and civil township for all others

From the Bay of Green Bay starting at Sturgeon Bay, WI across to Marinette, WI south to the De Pere Dam. See attached Figure Numbered 3-17 and 3-18.

Collection or Possession Period Requested

Collection Information (continued)

Will State Natural Areas Be Used?	If Yes, List Area(s)	Natural Areas Permit Applied For?
☐ Yes ☑ No		☐ Yes ☑ No

Location Where Specimens or Items Will be Kept for Study (Be specific, including name or type of facility and street address.)

Samples will be processed for analysis at Pace Analytical Services, Inc. located at 1241 Bellevue St, Suite, 9, Green Bay, WI 54302. Sample storage will be at Foth Environment & Infrastructure, LLC located at 2121 Innovation Ct, De Pere, WI

Final Disposition of Specimens or Items Will be:

Lab to dispose of carcasses that are analyzed. A portion will be frozen and stored for a minimum of five years for possible future analysis.

Agents – List names of all agents of the permittee/license holder that are authorized to act under the Scientific Collectors Permit or Scientific Research License

The permittee/licensee is responsible for actions of agents under the scientific collectors permit or research license. Each agent shall comply with all terms and conditions of the permit or license.

Agent Name	Date of Birth	Agent Name	Date of Birth
Agent Name	Date of Birth	Agent Name Travis Nickel	Date of Birth 08/02/1995
Agent Name Denis Roznowski	Date of Birth 12/23/1959	Agent Name	Date of Birth

Certification

I certify that the information provided on this application is true and correct and that I will comply with the terms and conditions of this permit or license, including special restrictions. I understand that providing incorrect information may result in revocation of my permit or license and possible penalties.

Applicant Signature	Date Signed
Nick Glander — Digitally signed by Nick Glander DN: C=US, E=Nick.glander@foth.com, CN=Nick Glander Date: 2021.04.27 15:17:48-05'00'	04/27/2021
If Applicant Less than 18 Years of Age, Signature of Parent or Guardian	Date Signed

Authorization – DNR Use Only

The license is subject to the following special restrictions and all conditions listed on the back of the license/permit.	License/Permit No.	
Please see the attached cover letter and list of conditions for more information	SCP-FM-2021-061	
	Date Begins 05/12/2021	Date Ends** 12/31/2021

DNR Personnel Approval (Print Name)	Signature	Date Signed
Joe Beivngton		05/12/2021

** *A scientific research license is valid from the date of issuance until the following December 31.*
A scientific collectors permit expires on the date specified on the permit.

Section 29.614, Wis., Stats., Scientific Collector Permit

(1) Application for a scientific collector permit shall be submitted to the department. The department may issue a scientific collector permit if the department determines that the applicant is a natural person and is engaged in a bona fide program leading to increased, useful scientific knowledge.
(2) A scientific collector permit shall state the name and address of the permittee, the date of issuance, the purposes for which it is issued, the type, species and number of specimens authorized to be collected or salvaged, the area and period of time in which the specimens may be collected or salvaged, the place where the specimens may be kept and other conditions and limitations that the department requires. A scientific collector permit is not transferable.
(3) A scientific collector permit authorizes the permittee to collect or salvage from the wild, for scientific purposes only, live fish and the nests and carcasses of any wild animals specified in the permit subject to the conditions and limitations specified in the permit and rules of the department. The permittee may use the specimens for the scientific purposes for which collected or salvaged and may transport them or cause them to be transported by common carrier.
Possession of these specimens may not be transferred to any other person, except that these specimens may be exchanged for other specimens for scientific purposes. A scientific collector permit may authorize the use of net guns and tranquilizer guns for activities related to the purpose for which the permit is issued. Any person who is convicted of violating this chapter shall forfeit the person's permit and the permit is thereby revoked, in addition to all other penalties. Any person so convicted is not eligible for a permit under this section for one year following the conviction.

Section 169.25, Wis., Stats., Scientific Research License

(1) Issuance. (a) The department shall issue a scientific research license to any person who is engaged in a study or in research that the department determines will lead to increased, useful scientific knowledge and who files a proper application and who pays the applicable fee.
(b) The department may also require the person to submit with the license application a copy of any of the following: 1. The person's study plan or research proposal. 2. An approval received by the person under 9 CFR 2.31.
(2) Authorization. A scientific research license authorizes the holder of the license to take from the wild, possess, kill, or propagate the species of native wild animals that the department authorizes under the license.
(3) Scope of license; contents. A scientific research license shall contain the holder's name and address, the date of issuance, and all of the following conditions or limitations: (a) The specific purposes for which it is issued.
(b) The species of wild animals and the number of each species to be studied.
(c) The locations from where the wild animals will be taken.
(d) The locations at which the wild animals will be kept and studied.
(e) The periods of time in which the wild animals may be studied.
(f) Any other conditions or limitations that the department considers reasonable.
(4) Equipment. A scientific research license may authorize the use of net guns, tranquilizer guns and other equipment or supplies for activities related to scientific research or study.
(5) Title to; transfer and disposal of wild animals. (a) A person holding a scientific research license may not transfer and wild animal or its carcass held under the authority of the license unless the purpose of the transfer is to trade the wild animals for other animals for scientific research or classroom demonstrations and the transfer is specifically authorized by the department at the time of the transfer.
(b) A person holding a scientific research license shall release or dispose of a live wild animal possessed under the authority of the license, or its carcass, only in the manner specifically authorized by the department.
(6) Rules. The department may promulgate rules to establish additional standards, limitations, and requirements for scientific research licenses.

Section 169.36, Wis., Stats., Record-keeping and reporting

(5) Scientific Research License. Each person holding a scientific research license shall keep a correct and complete record of all of the following information for each animal:
(a) The disposition of the wild animal, including the date and location of its release into the wild or its transfer to the department.
(b) The cause of death, if known, for a wild animal that dies.

NR 19.11 Scientific collectors permits and scientific research licenses

(1) DEFINITIONS. For the purposes of implementing ss. 29.614 and 169.25, Stats., and within this section, the following definitions apply:
(a) "Qualified natural person" or "person" means any individual complying with s. 29.614, Stats., and this section, not including a corporation, partnership, cooperative, society, association or other organization.
(b) "Bonafide research program" means planned study and investigation undertaken to discover or establish facts or principles leading to increased, useful scientific knowledge.
(c) "Useful scientific knowledge" means new information contributing to the long-term well-being of wild animals and their habitats, or providing educational opportunities in the natural sciences.

(2) APPLICABILITY.
(a) Permits not required. Scientific collectors permits are not required for the collection of wild plants, unprotected wild animals taken legally, or wild animals obtained from licensed game farms or fish hatcheries.
(b) Bird banding. Scientific collectors permits will be required for trapping and banding protected nonmigratory upland game birds.
(c) Licenses. A person is not required to possess a separate hunting, fishing or trapping license while collecting under a scientific collector permit.
(d) Endangered species. Endangered or threatened wild animals may be collected only under authority of endangered species permits issued by the department pursuant to s. 29.604, Stats., and ch. NR 27.
(e) Tagging of fish. Scientific collectors permits are required to capture a wild fish, attach a tag to any part of it, and then to release it back into waters of the state.

(3) PERMIT APPLICATIONS.
(a) Forms. Applications for scientific collectors permits shall be made on application forms provided by the department and include:
1. Name and address of the applicant;
2. Applicant's personal description;
3. Purpose of the request;
4. Species and number of specimens to be collected;
5. Places and times when specimens are to be collected;
6. Method of collecting;
7. Place where collections will be kept; and
8. Such additional information as may be requested by the department.
9. The period of the permit.

(b) Narrative proposal. All permit applications shall be accompanied by a written proposal stating the objectives, justifications, procedures, times and places of collection, application of results and sponsor, if any, of the project described in the application.

(4) PERMIT ISSUANCE.
(a) Issuance. Permits shall be issued in the name of the applicant. All agents of the permittee assisting in the permitted collections will be listed on the permit. Separate copies of permits shall be signed and carried by each person named in the permit when that person is acting under it in the absence of the permittee.

(b) Specimen materials. A permit will be issued for collections yielding preserved specimen materials only when such materials are to be kept in a place and manner where students and the public have access to them. Private collections to be kept in a manner not open to the public will not be approved.

(c) Conditions.
1. 'Contents.' Permits will contain conditions deemed necessary by the department to protect the resources of the state and assure use of specimens taken are in compliance with s. 29.614, Stats.
2. 'Nonresidents.' Permits issued to nonresidents will set forth conditions of removal of specimens from the state.
3. 'Federal permits.'
a. Permits involving the capture, marking, collection, possession or salvage of migratory birds or parts, nests or eggs of migratory birds will not be issued under this section until the applicant possesses a permit issued by the U.S. fish and wildlife service for that activity.
b. Permits under this section are not required for banding or marking capture-and-release activities authorized under a permit issued by the U.S. fish and wildlife service.
4. 'Size of collections.' Permits will not be issued which authorize collections endangering the population of animals the collection would draw from, or exceeding the number of animals required to meet the permittee's objectives.
5. 'Unprotected species.' Permits will not be issued for the collection of protected species if unprotected species can be used to accomplish the same purposes.

(5) PERMIT USAGE.
(a) Disposition of specimens.
1. Living unharmed specimens collected during the course of permitted activities shall be returned to the wild at the point of capture, unless otherwise provided in the permit.
2. Any endangered or threatened species taken unintentionally during the course of permitted activities shall be immediately released if unharmed.
3. Injured or dead wild animal specimens shall be immediately turned over to the department employee named in the permit unless otherwise provided in the permit.
(b) Notification of department. Each permittee shall notify the department employee named in the permit at least 48 hours prior to collecting of the time and place where specimens will be collected.
(c) Marked gear. All traps, nets and any other gear used for capturing wild animals under terms of a permit shall be marked with the permit number, name and address of the permittee.
(d) Trap and net tending. All traps, nets and other capture emptied by the permittee at least once each 24-hour period.
(e) Fishing gear restrictions.
1. 'Gill nets.' Gill nets may not be used in inland waters unless specifically authorized by a permit.
2. 'Buoys.' All buoys and buoy staffs shall be marked and maintained as required by the department. The permit number, name and address of the permittee shall be maintained in plain figures on the bowl of the buoy.
3. 'Sport fishing equipment.' Hook and line fishing equipment and spearing equipment may not be possessed on a boat operating under a permit without prior approval of the department.

(6) RECORDKEEPING AND ANNUAL REPORTS.
(a) Records. Each permittee shall keep current records, in the English language, of all collections under the permit. Records of collections shall be made available to the department during normal business hours, or upon 8 hours notice at other times.
(b) Required reports. Permittees shall supply information requested by the department and annually file a complete and accurate report on forms covering activities conducted under authority of the permit. Unless otherwise provided in the permit, such reports shall be filed using a report form provided by the department not later than January 10 of the year following expiration of the permit.
(c) Content. Annual reports by permittees shall include:
1. The common name, scientific name and number of each species and type of specimen material collected;
2. The date and geographic location of each collection;
3. Disposition of collected specimens; and
4. Any other information requested by the department.

(7) DISPOSITION. Specimens collected under the authority of the scientific collector permit may be transferred to and possessed by an educational institution for exhibition or education purposes upon completion of the project or expiration of the permit. Environmental consulting organizations may retain specimens following permit expiration provided the specimens are marked in a manner prescribed by the department. An educational institution or environmental consulting organization possessing specimens shall possess written proof of source, including the scientific collector permit number of the source and present that proof upon request by the department.

Please Note:
State Natural Areas and **Threatened or Endangered Species**
A separate permit is required for research and scientific collection involving state natural areas or for the collection or possession of threatened or endangered species.
An application can be obtained by writing to or calling:

Department of Natural Resources
Natural Heritage Conservation
Box 7921
Madison, WI 53707
Phone: (608) 261-6449

Federal permits for migratory birds may be obtained from the Special Agent in Charge, U.S. Fish and Wildlife Service, Federal Building, Fort Snelling, Twin Cities, MN 55111.

Notice of Appeal Rights

If you believe that you have a right to challenge this decision, you should know that Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed.

For judicial review of a decision pursuant to section 227.52 and 227.53, Wis. Stats., as renumbered by 1985 Wisconsin Act 182, you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review shall name the Department of Natural Resources as the respondent.

To request a contested case hearing pursuant to section 227.42, Wis. Stats., as renumbered by 1985 Wisconsin Act 182, you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. The filing of a request for a contested case hearing is not a prerequisite for judicial review and does not extend the 30-day period for filing a petition for judicial review.

This notice is provided pursuant to section 227.48(2), Wis. Stats., as renumbered by the 1985 Wisconsin Act 182.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Tony Evers, Governor
Preston D. Cole, Secretary

Southeast Region Headquarters
2300 N. Dr. Martin Luther King, Jr. Drive
Milwaukee, Wisconsin 53212-3128
FAX 414-263-8606
Telephone 414-263-8500
TTY Access via relay - 711

05/18/2021

Nicholas Glander
Foth Infrastructure and Environment, LLC
2121 Innovation Court, Suite 300
De Pere, WI 54115

Subject: Addendum to Scientific Collector Permits # SCP-FM-2021-061

Ms. Kuber,

This letter is to inform you that the requested addendum to SCP-FM-2021-061has been approved. This letter will serve as the addendum and should be kept with SCP-FM-2021-061 when collections or other research activities are taking place.

The addendum allows for the following Agents of the Permit not stated in the original permit:

- Scott Janssen, DOB 05/29/1963
- Andy Pierre, DOB 05/15/1990
- Brandon Wotachek, DOB 12/08/1980

All other restrictions and requirements stated in the original permit remain in place. Information on the activities conducted under this addendum shall be reported in the annual reports required under SCP-FM-2021-061.

Please contact the local fisheries biologist and conservation warden before beginning collection activities, contact information can be found using the DNR's staff directory http://dnr.wi.gov/staffdir/_newsearch/contactsearchext.aspx. This will keep us informed of your activities should we receive inquiry calls from the public. If I can be of further assistance, please give me a call at (608) 264-9257.

Sincerely,

Joe Bevington
Fisheries Permit Coordinator
101 South Webster Street
Madison, WI 53707
joseph.bevington@wisconsin.gov

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tony Evers, Governor
Preston D. Cole, Secretary

Southeast Region Headquarters
2300 N. Dr. Martin Luther King, Jr. Drive
Milwaukee, Wisconsin 53212-3128
FAX 414-263-8606
Telephone 414-263-8500
TTY Access via relay - 711

07/12/2021

Michael Kacinski
EA Engineering, Science, and Technology
44 Lake Cook Road Suite 18
Manitowoc, WI 54220

Subject: Addendum to Scientific Collector Permits #SCP-FM-2021-051

Mr. Kacinski,

This letter is to inform you that the requested addendum to SCP-FM-2021-051 has been approved. This letter will serve as the addendum and should be kept with SCP-FM-2021-051 when collections or other research activities are taking place.

The addendum allows for the following:

- **Species, Age or Size Class*, and Number of Specimens or Description of Items to be Collected or Possessed:**
  Per OU (Operable Unit) there are a total of 3 OUs (OU4, OU5A, and OU5B)
  Walleye: 15 specimens, 10 – 24”
  Carp: 35 specimens, 10 – 24”
  Drum: 25 specimens, 10 – 24”
  Gizzard Shad: 175 specimens, 2 – 6”
  Smallmouth Bass: 15 specimens, 8 – 22”
- **Purpose of Collecting or Possession:** Tissue analysis
- **Method(s) of Collecting:** Electrofishing, Seining, Gill netting, Fyke netting, and Hook and Line
- **Location of Collecting or Possession Site(s):** Lower Fox River in Brown County from De Pere to Lake Michigan (OU4), Lake Michigan, lower Green Bay in Brown County (OU5A), and Lake Michigan lower to mid Green Bay from Little Tail Point to Oconto Harbor in Brown, Oconto, Marinette, and Door Counties (OU5B). See figures for detailed descriptions.
- **Collection or Possession Period Requested:** Collection will occur in August and September 2021
- **Location Where Specimens or Items Will be Kept for Study:** Specimens will be sent to Pace Analytical 1241 Bellevue St, Suite 9 Green Bay, WI 54302 for tissue analysis.

Additionally, this addendum requires the following Conditions of the Permit:

- **Gillnets shall be checked at least once every 24hrs.**
- **Minimal gillnet footage shall be implemented to accomplish research objectives**
- **Dead specimens shall be collected and legally disposed at an off-site location**
- **DNR Conservation Wardens shall be notified 24-48hrs before gillnets are deployed. Contact information can be found here:**
  https://dnr.wi.gov/staffdir/_NewSearch/ContactSearchExt.aspx?exp=warden

All other restrictions and requirements stated in the original permit remain in place. Information on the activities conducted under this addendum shall be reported in the annual reports required under SCP-FM-2021-051.

Please contact the local fisheries biologist and conservation warden before beginning collection activities, contact information can be found using the DNR's staff directory http://dnr.wi.gov/staffdir/_newsearch/contactsearchext.aspx. This will keep us informed of your activities should we receive inquiry calls from the public. If I can be of further assistance, please give me a call at (608) 264-9257.

Sincerely,

Joe Bevington
Fisheries Permit Coordinator
101 South Webster Street
Madison, WI 53707
joseph.bevington@wisconsin.gov

Appendix D

Hydrographic Survey Audit Forms

Hydrographic Survey Audit Form

Date of Survey: ____________________
HYPACK Project Name: ____
Area(s) Surveyed: ____

Captain: ______________________
Technicians: ______________________
Boat Name: ______________________
Trimble RTK GPS Equipment: ______________________
Type of Survey:

☐ Pre-Dredge ☐ Post-Dredge
☐ Pre-Sand/Cap ☐ Post-Sand/Cap

Weather Conditions				
Time	**Wave Heights**	**Wind Spd/Dir**	**Temp °F**	**Cloud Cover**

Control Data			
Pt. Name	**Northing**	**Easting**	**Elevation**

Minimum of 2 control points to be checked at both Start and End.	**Check IN (at start)**	**Check OUT (at end)**
Time		
Point Name		
Δ Horizontal:		
V. Vertical:		
Vertical and Horizontal within 0.13 ft. of published value		
Tide Elevation:		
Time:		

Sonic Sounder Calibration/Bar Check Information
Sounder # 320
Transducer at 200/20 Hz w/ beam width of 9.0°

Latency: __	**Date:** ____________
Vertical Offset: ________	**Draft:** ____________

Plan Lines for Cross Lines: ☐ **(check when added)**

	Bar Check			
	(at start)		(at end)	
	Bar at	**Fatho-meter (0.1 ft)**	**Bar at**	**Fatho-meter (0.1 ft)**
Min. 2 ft below transducer (ft)				
Min. 5 ft below transducer (ft)				
Min 10 ft below transducer (ft)				
Min 15 ft below transducer (ft)				
Min 20 ft below transducer (ft)				
Nearest ft. to bottom (ft)				
Speed of Sound Velocity Reading (ft/sec)				
Time when bar check made (hrs)				

Polings

Poling points to be evenly distributed within the area of survey.

Pre-Dredge Surveys – Min. 1 poling per hour

Post-Dredge Surveys - Min. of 3 polings required per certification unit or per day or more depending on specific project requirements.

Area:

Pt. #	**Pole Depth (0.1 ft)**	**Fathometer**
1		
2		
3		
4		
5		
6		
7		
8		
9		

Additional Notes: ____

Appendix E

OU3 and OU4 Sentinel Cap Memoranda

Memorandum

Foth Infrastructure & Environment, LLC

2121 Innovation Court, Suite 300
P.O. Box 5126 • De Pere, WI 54115-5126 (920) 497-2500 • Fax: (920) 497-8516 www.foth.com

October 15, 2019

TO:	Pablo Valentin, EPA Beth Olson, WDNR Gary Kincaid, WDNR	George Berken, Boldt Rick Fox, OBG Larry DeBruin, Boldt
CC:	Bill Hartman, P.H. Glatfelter Paul Montney, Georgia Pacific Bryan Heath, NCR Rebecca Frey, EPA Bill Nelson, WDNR Jim Killian, WDNR Jordan Salley, WDNR Denis Roznowski, Foth Sharon Kozicki, Foth	Michael Davis, Georgia Pacific Roger Kaminski, Georgia Pacific Jay Grosskopf, Boldt Phil Brochocki, OBG Jennifer Hagen, OBG Ava Grosskopf, Boldt John Kern, Kern Statistical Services Scott Janssen, Foth Steve Lehrke, Foth
FR:	Tim Wagner, Foth	Tara Van Hoof, Foth
RE:	Lower Fox River OU3 – Sentinel Cap Areas Selection	

Introduction

P.H. Glatfelter Company (Glatfelter) retained Foth Infrastructure & Environment, LLC (Foth) to evaluate and select sentinel cap areas within the Lower Fox River (LFR) Operable Unit 3 (OU3), as required by the revised *Cap Operations, Maintenance, and Monitoring Plan – Revision 1 (COMMP*) for the LFR OUs 2-5 (Anchor QEA and Tetra Tech EC [TtEC], 2012).

Specifically, the *COMMP* requires the following:

> "In addition to the scheduled monitoring of all capped areas in OU3-5, supplemental bathymetric surveys will be performed only in "sentinel" capping areas following major river-flow events, periods of extended low water, or construction activities that may have a significant impact on river hydrodynamics. Sentinel capping areas are defined herein as those areas most likely to exhibit erosion under extreme flow events or areas with the greatest risk of contaminant exposure. They are located in areas with relatively high peak bottom shear stresses from river flows, seiches, wakes, and/or propeller wash, and also in areas with relatively high near-surface polychlorinated

biphenyls (PCB) concentrations. Such sentinel cap monitoring locations will be located in areas potentially subjected to the upper 10% of predicted peak bottom shear stresses within capping areas (based on project-specific hydrodynamic modeling), and will be generally distributed across OUs 3 to 5, including areas of relatively high near-surface PCB concentrations (e.g., greater than 20 ppm) and high recreational vessel use (e.g., near boat launches)."

This evaluation looked at hydrodynamic modeling predictions, location, near-surface PCB concentrations, cap type, and bathymetry to establish sentinel cap areas for monitoring. Evaluation of cap stability, including the hydrodynamic modeling results, were presented in a 2018 technical memorandum by TtEC (TtEC, 2018). Candidate sentinel caps represent areas of higher shear stress, and other factors as described below.

Evaluation

Sentinel cap areas were selected to focus on areas of higher shear stress, high near- surface PCB concentrations as well as a range of geomorphological conditions and water depths to provide a good representation of the cap areas within OU3. Table 1 (end of memo) lists all caps in OU3, the sheer stress values present as determined by Tetra Tech, and PCB concentrations at sediment cores collected within the cap footprint. All cap locations are shown on Figure 1. Sentinel cap candidates were then chosen to represent areas that vary across depth, location within the river width, predicted flow velocities, near-surface PCB concentrations, and cap grain size, in order to capture responses to varied storm events and potential man-made impacts such as boat traffic. While the caps have been designed to be stable under a 100-year flood event, other forces may pose hazards in lesser events (e.g., propwash), and the varied sentinel cap locations and cap types will help monitor for those impacts.

Table 2 lists the six areas that have been chosen as sentinel cap areas. These areas are also shown on Figure 2.

Table 2

Maximum Predicted Bed Shear Stress for Selected Sentinel Cap Areas

Cap Area	Water Depth Range (ft)	Maximum Predicted Bed Shear Stress (dyn/cm^2)	Maximum Near-Surface PCB Concentration (ppm)
CA3	7.3	7.3	2.3
CA9A	14.6-15.6	15.9	9
CA69	2.9-11.4	11.4	7.1
CB3A	18.8-19.8	21.7	2.88
CA15	9.4-24.9	25	16.2
CB31	13.7-22.7	22.8	53.2

dyn/cm^2 = dyne per square centimeter
ft = feet
ppm = parts per million

Prepared by: TSW1
Checked by: TMK1

CA3

The farthest upstream cap area in OU3, CA3 is located in relatively shallower water than the downstream cap areas. Its location makes it susceptible to rapidly varying flows as well as influences from possible debris and recreational boating. In addition, this cap area could provide a good baseline for cap behavior during low flow events.

CA9A

Cap area CA9A lies at the beginning of a stretch of river where the river width narrows as it approaches the De Pere dam. Located adjacent to CB2 and CA9B, CA9A provides a representative area for monitoring the effectiveness and stability of the caps within that small reach. Located on the west side of the main channel, there is potential for impacts from recreational boating activities.

CA69

CA69 was chosen for its location off the main channel area, in a small cove. It is not anticipated that flow events would have significant impacts on this cap; however, water depths within this area are shallow and increase the potential for impacts from recreational boating activities. Several homes along the shoreline in the vicinity have docks and, therefore, increased boat traffic is anticipated in the cove.

CB3A

CB3A lies at the beginning of high velocity/ higher bed shear stress areas, as the influence from the De Pere dam operations begin to be felt in the river channel. Predicted bed shear stress is approximately 22 dyn/cm^2, which is representative of the neighboring cap areas and indicates that CB3A would be a suitable sentinel cap for that stretch of river.

CA15

CA15 has been identified as having the second highest predicted bed shear stress in OU3 (25 dyn/$cm^{2,}$), has relatively high near-surface PCB concentrations (maximum of 16.20 ppm), and is located along the edge of the navigation channel where more turbulence would be expected. It is located on the outside of the last bend in the river before it reaches the De Pere dam and will be subjected to turbulent flows and erosional forces under varying river conditions.

CB31

CB31 is the farthest cap area downstream in OU3. It's located just upstream from the De Pere dam. Flow velocities at the bed in CB31 are dependent upon dam operations. When water is released through the bascule gates, flow is focused at top elevation of the gate sills, which results in higher flow velocities across the bed and increasing bed shear stress. It is anticipated that during high events, the flow through the bascule gates would be increased. CB31 also has the highest near-surface PCB concentration of the OU3 caps (53.20 ppm).

Recommendations

Based on the evaluation presented herein, Foth recommends that the above six selected sentinel cap locations (CA3, CA9A, CA69, CB3A, CA15, and CB31) be monitored as part of the event-based monitoring in OU3 as required by the *COMMP*. Foth is requesting approval from the A/OT for this recommendation.

References

Anchor QEA, LLC and Tetra Tech EC, Inc., 2012. *Cap Operations, Maintenance, and Monitoring Plan –Revision 1* (Appendix H in the *Lower Fox River Remedial Design 100 Percent Design Report for 2010 and Beyond Remedial Actions,* Volume 2 of 2). Prepared for Lower Fox River Remediation LLC. October 2012.

Tetra Tech, Inc. 2018. "Hydrodynamic Modeling of Post-Remedy Conditions in OU3 to Evaluate Cap Stability" technical memorandum. Fairfax, VA.

Tables

Table 1

Total PCB Concentrations and Predicted Bed Shear Stress for OU3 Cap Areas

OU3 Cap Areas	Maximum Predicted Bed Shear Stress [dyn/cm^2]	Location ID	Logged Interval Top	Logged Interval Bottom	Total PCB
CA13A	19.8	3048-21	0.00	0.50	3.30 ppm
CA13A	19.8	3048-21	0.50	1.00	1.40 ppm
CA13A	19.8	3048-21	1.00	1.50	0.41 ppm
CA13A	19.8	3048-21	1.50	2.00	0.07 ppm
CA13A	19.8	3048-21	2.00	2.50	0.07 ppm
CA13A	19.8	3049-01.5	0.00	0.50	0.97 ppm
CA13A	19.8	3049-01.5	0.50	1.00	0.73 ppm
CA13A	19.8	3049-01.5	1.00	1.50	0.44 ppm
CA13A	19.8	3049-21	0.00	0.50	10.00 ppm
CA13A	19.8	3049-21	0.50	1.00	1.10 ppm
CA13A	19.8	3049-21	1.00	1.50	1.30 ppm
CA13A	19.8	3049-21	1.50	2.00	0.51 ppm
CA13A	19.8	3049-21	2.00	2.50	0.29 ppm
CA13A	19.8	3050-02	0.00	0.50	7.50 ppm
CA13A	19.8	3050-02	0.50	1.00	0.76 ppm
CA13B	18.7	3050.5-90	0.00	0.50	2.02 ppm
CA13B	18.7	3050.5-90	0.50	1.00	1.60 ppm
CA13B	18.7	3050.5-90	1.00	1.50	0.02 ppm
CA13B	18.7	3051.5-05	0.00	0.50	6.28 ppm
CA13B	18.7	3051.5-05	0.50	1.00	4.40 ppm
CA13B	18.7	3051.5-05	1.00	1.50	0.95 ppm
CA13B	18.7	3051-02	0.00	0.50	5.90 ppm
CA13B	18.7	3051-02	0.50	1.00	0.90 ppm
CA13B	18.7	3051-02	1.00	1.50	1.10 ppm
CA13B	18.7	3051-02	1.50	2.00	0.35 ppm
CA13B	18.7	3051-02	2.00	2.50	0.06 ppm
CA13B	18.7	3051-02	2.50	3.00	0.03 ppm
CA13B	18.7	3051-02.5	0.00	0.50	3.48 ppm
CA13B	18.7	3051-02.5	0.50	1.00	2.23 ppm
CA13B	18.7	3051-02.5	1.00	1.50	1.83 ppm
CA13B	18.7	3051-02.5	1.50	2.00	0.11 ppm
CA13B	18.7	3051-02.5	2.00	2.50	0.03 ppm
CA13B	18.7	3051-02.5	2.50	3.00	0.02 ppm
CA13B	18.7	3052.5-91	0.00	0.50	1.70 ppm
CA13B	18.7	3052.5-91	0.50	1.00	1.70 ppm
CA13B	18.7	3052.5-91	1.00	1.50	0.31 ppm
CA13B	18.7	3052.5-91	1.50	2.00	0.07 ppm
CA13B	18.7	3052-02	0.00	0.50	3.30 ppm
CA13B	18.7	3052-02	0.50	1.00	1.02 ppm
CA13B	18.7	3052-02	1.00	1.50	0.24 ppm
CA13B	18.7	3052-02	1.50	2.00	0.03 ppm
CA13B	18.7	3052-02	2.00	2.50	0.03 ppm
CA13B	18.7	3053-93	0.00	0.50	3.24 ppm
CA13B	18.7	3053-93	0.50	1.00	8.98 ppm
CA13B	18.7	3053-93	1.00	1.50	0.95 ppm
CA13B	18.7	3053-95	0.00	0.50	1.14 ppm
CA13B	18.7	3053-95	0.50	1.00	0.91 ppm
CA13B	18.7	3053-95	1.00	1.50	0.67 ppm
CA13B	18.7	3053-95	1.50	2.00	0.19 ppm
CA13B	18.7	3054.5-90	0.00	0.50	6.31 ppm
CA13B	18.7	3054.5-90	0.50	1.00	6.59 ppm
CA13B	18.7	3054.5-90	1.00	1.50	0.93 ppm
CA13B	18.7	3054-01	0.00	0.50	1.90 ppm
CA13B	18.7	3054-01	0.50	1.00	1.30 ppm
CA13B	18.7	3054-01	1.00	1.50	0.73 ppm
CA13B	18.7	3054-01	1.50	2.00	0.15 ppm
CA13B	18.7	3054-01	2.00	2.50	0.03 ppm
CA13B	18.7	3054-01	2.50	3.00	0.03 ppm
CA13B	18.7	3054-01	3.00	3.50	0.13 ppm

Table 1
Total PCB Concentrations and Predicted Bed Shear Stress for OU3 Cap Areas

OU3 Cap Areas	Maximum Predicted Bed Shear Stress [dyn/cm^2]	Location ID	Logged Interval Top	Logged Interval Bottom	Total PCB
CA13C (A3)	15.3	3048.5-01	--	--	--
CA13D (A3)	22.5	3056-22	0.00	0.50	3.70 ppm
			0.50	1.00	2.60 ppm
			1.00	1.50	0.86 ppm
			1.50	2.00	0.31 ppm
			2.00	2.50	0.03 ppm
CA13E (A3)	17.1	3056.5-04	0.00	0.50	1.35 ppm
			0.50	1.00	1.16 ppm
			1.00	1.50	0.43 ppm
			1.50	2.00	0.09 ppm
		3056.5-91	0.00	0.50	1.62 ppm
			0.50	1.00	1.00 ppm
		3056-90	0.00	0.50	1.28 ppm
			0.50	1.00	1.28 ppm
			1.00	1.50	0.18 ppm
			1.50	2.00	0.22 ppm
		3056-91	0.00	0.50	1.23 ppm
			0.50	1.00	1.07 ppm
			1.00	1.50	0.34 ppm
CA15 (A2)	25.0	3057.5-90	0.00	0.50	5.44 ppm
			0.50	1.00	1.54 ppm
			0.00	0.50	0.64 ppm
			0.50	1.00	0.25 ppm
		3058-92	0.00	0.50	14.90 ppm
			0.50	1.00	3.88 ppm
			1.00	1.50	0.17 ppm
		3058-94	0.00	0.50	2.36 ppm
			0.50	1.00	16.20 ppm
			1.00	1.50	0.51 ppm
CA16A (A3)	21.2	3059.5-90	0.00	0.50	4.70 ppm
			0.50	1.00	22.90 ppm
			1.00	1.50	11.20 ppm
		3059-93	0.00	0.50	4.04 ppm
			0.50	1.00	5.45 ppm
			1.00	1.50	0.60 ppm
		3060-01	0.00	0.50	2.80 ppm
			0.50	1.00	1.10 ppm
			1.00	1.50	0.24 ppm
			1.50	2.00	0.07 ppm
			2.00	2.50	0.09 ppm
		3060-97	0.00	0.50	1.93 ppm
			0.50	1.00	2.01 ppm
			1.00	1.50	2.09 ppm
			1.50	2.00	0.06 ppm
CA16B (A3)	24.9	3060.5-04	0.00	0.50	0.24 ppm
			0.50	1.00	0.24 ppm
			1.00	1.50	0.24 ppm
			1.50	2.00	0.17 ppm
			2.00	2.50	0.02 ppm
		3060-96	0.00	0.50	9.08 ppm
			0.50	1.00	1.06 ppm
CA17 (A3)	25.4	3063.5-102	0.00	0.50	1.07 ppm
			0.50	1.00	8.84 ppm
		3064-95	0.00	0.50	2.16 ppm
			0.50	1.00	3.81 ppm
CA3	7.3	3007-05	0.00	0.50	0.62 ppm
			0.50	1.00	2.30 ppm
			1.00	1.50	0.83 ppm

Table 1

Total PCB Concentrations and Predicted Bed Shear Stress for OU3 Cap Areas

OU3 Cap Areas	Maximum Predicted Bed Shear Stress [dyn/cm^2]	Location ID	Logged Interval Top	Logged Interval Bottom	Total PCB
CA6 (A3)	14.7	3035-06	0.00	0.50	5.50 ppm
			0.50	1.00	3.10 ppm
			1.00	1.50	1.40 ppm
			1.50	2.00	0.60 ppm
			2.00	2.50	0.86 ppm
			2.50	3.00	0.31 ppm
			3.00	3.50	0.03 ppm
CA69 (A1)	11.4	3051.5-10	0.00	0.50	3.46 ppm
			0.50	1.00	5.54 ppm
		3051-05	0.00	0.50	0.18 ppm
			0.50	1.00	0.33 ppm
			1.00	1.50	0.03 ppm
		3052-04.5	0.00	0.50	7.10 ppm
			0.50	1.00	2.18 ppm
CA9A	15.9	3043-21	0.00	0.50	9.00 ppm
			0.50	1.00	1.40 ppm
			1.00	1.50	0.03 ppm
			1.50	2.00	0.03 ppm
			2.00	2.50	0.03 ppm
		3043-21.5	0.00	0.50	7.08 ppm
			0.50	1.00	0.76 ppm
			1.00	1.50	0.30 ppm
		3044-21	0.00	0.50	3.70 ppm
			0.50	1.00	2.10 ppm
			1.00	1.50	0.03 ppm
			1.50	2.00	0.03 ppm
			2.00	2.50	0.03 ppm
CA9B (A3)	15.4	3043.5-05	0.00	0.50	12.20 ppm
			0.50	1.00	0.79 ppm
			1.00	1.50	0.22 ppm
		3044.5-90	0.00	0.50	0.78 ppm
			0.50	1.00	0.87 ppm
		3044-02	0.00	0.50	6.80 ppm
			0.50	1.00	1.10 ppm
			1.00	1.50	0.40 ppm
			1.50	2.00	0.19 ppm
		3045-02	0.00	0.50	7.00 ppm
			0.50	1.00	4.30 ppm
			1.00	1.50	1.30 ppm
			1.50	2.00	0.03 ppm
CB2 (B3)	16.0	3042-21	0.00	0.50	13.00 ppm
			0.50	1.00	0.53 ppm
			1.00	1.50	2.40 ppm
			1.50	2.00	1.60 ppm
			2.00	2.50	0.03 ppm
		3042-90	0.00	0.50	1.15 ppm
			0.50	1.00	2.51 ppm

Table 1

Total PCB Concentrations and Predicted Bed Shear Stress for OU3 Cap Areas

OU3 Cap Areas	Maximum Predicted Bed Shear Stress [dyn/cm^2]	Location ID	Logged Interval Top	Logged Interval Bottom	Total PCB
CB31	22.8	3066.5-02	0.00	0.50	14.50 ppm
			0.50	1.00	53.20 ppm
			1.00	1.50	15.40 ppm
			1.50	2.00	10.10 ppm
			2.00	2.50	0.14 ppm
		3067-01	0.00	0.50	3.30 ppm
			0.50	1.00	36.00 ppm
			1.00	1.50	25.00 ppm
			1.50	2.00	1.20 ppm
			2.00	2.50	0.30 ppm
			2.50	3.20	0.08 ppm
		3067-01.5	--	--	--
		3067-02	0.00	0.50	28.00 ppm
			0.50	1.00	42.00 ppm
			1.00	1.50	21.01 ppm
			1.50	2.00	0.03 ppm
			2.00	2.50	0.03 ppm
			2.50	3.00	0.03 ppm
			3.00	3.40	0.03 ppm
CB3A	21.7	No cores collected within cap footprint - closest core 3055-90	0.00	0.50	2.88 ppm
			0.50	1.00	0.95 ppm
			1.00	1.50	0.22 ppm
CB3B	20.5	No cores collected within cap footprint - closest core 3056.5-05	0.00	0.50	1.92 ppm
			0.50	1.00	1.06 ppm
			1.00	1.50	0.55 ppm
		No cores collected within cap footprint - closest core 3056.5-91	0.00	0.50	1.62 ppm
			0.50	1.00	1.00 ppm
CB5 (B3)	21.2	3060.5-91	0.00	0.50	1.33 ppm
			0.50	1.00	2.98 ppm
			1.00	1.50	1.01 ppm

Proposed sentinel caps dyn/cm^2 = dyne per square centimeter

Prepared by: TRN
Checked by: TMK1

Figures

LEGEND

OU3 Cap Areas

NOTES:
1. Imagery from esri and its data suppliers.

Foth

N

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

0 1,500 3,000
Feet

P.H. GLATFELTER COMPANY

FIGURE 1

OU 3 CAP AREAS
FOX RIVER, WISCONSIN

Date: SEPTEMBER 2019	Revision Date:

Drawn By: JRS6	Checked By: TSW	Project: 19G007

Path: Q:\Glatfelter\19G007\GIS\mxd\Figure 1 - All cap areas.mxd Date: 9/5/2019

LEGEND

Proposed Sentinel Cap Locations

NOTES:

1. Imagery from esri and its data suppliers.

Foth

N

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

0 1,500 3,000 Feet

P.H. GLATFELTER COMPANY

FIGURE 2

OU 3 PROPOSED SENTINEL CAP AREAS
FOX RIVER, WISCONSIN

Date: SEPTEMBER 2019	Revision Date:

Drawn By: JRS6	Checked By: TSW	Project: 19G007

Path: Q:\Glatfelter\19G007\GIS\mxd\Figure 2 - Sentinel.mxd Date: 9/5/2019

Memorandum

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September 16, 2020

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Beth Olson, Project Coordinator – WDNR, Green Bay, WI

CC: Tim Wagner – Foth Infrastructure & Environment, LLC
Tara Van Hoof – Foth Infrastructure & Environment, LLC

FR: Bill Hartman – P.H. Glatfelter
Paul Montney – Georgia-Pacific
George Berken – Boldt Technical Services
Gary Kincaid – Wisconsin Department of Natural Resources
Sharon Kozicki – Foth Infrastructure & Environment, LLC
Denis Roznowski – Foth Infrastructure & Environment, LLC

RE: Lower Fox River OU4 – Sentinel Cap Areas Selection

Introduction

P.H. Glatfelter Company (Glatfelter) and Georgia-Pacific (GP) retained Foth Infrastructure & Environment, LLC (Foth) to evaluate and select sentinel cap areas within the Lower Fox River (LFR) Operable Unit 4 (OU4), as required by the revised *Cap Operations, Maintenance, and Monitoring Plan – Revision 3 DRAFT (COMMP*) for the LFR OUs 2-5 (Anchor QEA et al, 2019).

Specifically, the *COMMP* requires the following:

> "In addition to the routine monitoring of all capped areas in OUs 3 to 5, supplemental bathymetric surveys will be performed only in sentinel capping areas following major river flow events, periods of extended low water, or construction activities that may have a significant impact on river hydrodynamics. Sentinel capping areas are defined herein as those areas most likely to exhibit erosion under extreme flow events or areas with the greatest risk of contaminant exposure. They will be located in areas with relatively high peak bottom shear stresses from river flows, seiches, wakes, and/or propeller wash, and also in areas with relatively high near-surface PCB concentrations. Selection of sentinel cap areas for each cap type included the following considerations:
>
> - Peak shear stress resulting from river flows and seiches

- Near-surface PCB concentration
    - Cap (especially Cap B) areas with relatively high polychlorinated biphenyls (PCB) concentrations in the 6 inches of sediment immediately below the cap

- Transition areas (i.e., the northern end of the unmaintained recreational navigation channel, where it transitions to the maintained navigation channel for commercial and industrial use that may be subject to elevated erosional forces from propeller wash or anchor drag)"

This evaluation looked at hydrodynamic modeling predictions, location, near-surface PCB concentrations, cap type, and bathymetry to establish sentinel cap areas for monitoring. Evaluation of cap stability, including the hydrodynamic modeling results, were presented in a 2020 technical memorandum by Tetra Tech EC (TtEC) (TtEC, 2020). Candidate sentinel caps represent areas of higher shear stress, and other factors as described below.

Evaluation

Sentinel cap areas were selected to focus on areas of higher shear stress, high near-surface PCB concentrations as well as a range of geomorphological conditions and water depths to provide a good representation of the cap areas within OU4. All cap locations are shown on Figures 1, 2, 3, and 4. Sentinel cap candidates were then chosen to represent areas that vary across depth, location within the river width, predicted flow velocities, near-surface PCB concentrations, and cap grain size, in order to capture responses to varied storm events and potential man-made impacts such as boat traffic. While the caps have been designed to be stable under a 100-year flood event, other forces may pose hazards in lesser events (e.g., prop wash), and the varied sentinel cap locations and cap types will help monitor for those impacts.

Table 1 lists the five areas that have been chosen as sentinel cap areas. These areas are also shown on Figures 1, 2, 3, and 4.

CB39

The farthest upstream cap area in OU4, CB39 (Stone Size D50=1.5") is located in relatively shallower water (550' to 570') than the downstream cap areas (Figure 1). Refer to FIGURE 11-5 in Attachment 1 for top of cap elevations and stone sizes. CB39's location downstream of the De Pere dam makes it susceptible to rapidly varying flows, and direct prop wash impacts from recreational boaters. Near top of sediment maximum PCB concentration was 33.10 parts per million (ppm).

CB30-2

Cap area CB30-2 (Stone Size D50=0.75" and 1.5") lies in the authorized navigational channel (Figure 1). The maximum modeled bed shear stress is 4.87 Newtons per square meter (N/m^2), and the maximum PCB concentration near the sediment surface is 42.40 ppm. This PCB concentration is the highest among the proposed sentinel cap areas. Adjacent caps (e.g., CC14 Stone Size D50=6.0") have the same modeled bed shear stress and PCB concentrations; however, the cap design for CB30-2 has a lower grain size diameter range which may make it more susceptible to potential loss of material from various forces. Refer to FIGURE 11-025 and FIGURE 11-026 in Attachment 1 for top of cap elevations and stone sizes.

CB45-4

CB45-4 (Stone Size D50=0.75" and 1.5") was chosen for its location adjacent to the State Highway (STH) 172 bridge (Figure 2), and the high bed shear stresses resulting from increased channel flows around the bridge. Refer to FIGURE 11-075 and FIGURE 11-076 in Attachment 1 for top of cap elevations and stone sizes. The location of CB45-4 also makes it susceptible to boat traffic at lower water elevations. The maximum modeled bed shear stress was 4.59 N/m^2, and the maximum near surface PCB concentration was 41.0 ppm. CB45-4 lies in the middle of a long stretch of cap areas, either side of the STH 172 bridge. It makes for a good representative location for sentinel caps in that stretch.

CC17

CC17 (Stone Size D50=8.0") lies within the navigation channel (Figure 3) and is comprised of the "c" type cap due to the high modeled bed shear stresses and influences from large vessel traffic that may operate adjacent to the cap. Refer to FIGURE 11-5 in Attachment 1 for top of cap elevations and stone sizes. Bed shear stresses are not as high as other cap areas with a maximum modeled bed shear stress of 3.73 N/m^2, however the location within the turning basin presents a cap which may be subjected to a full range of forcing from flow and vessel traffic. The near surface PCB concentration 6.26 ppm.

CB60-1

CB60-1 (Stone Size D50=1.5") is located at the mouth of the Fox River in the bay of Green Bay (Figure 4). It is located to the west of the navigation channel. While CB60-1 is not subjected to the main flow path of the Fox River, it is subjected to flows due to lake seiche. Modeled maximum bed shear stress was 2.27 N/m^2. The maximum PCB concentration is 8.4 ppm. Other caps were evaluated for this stretch of river, however their surface PCB concentrations and maximum bed shear stresses were lower.

Recommendations

Based on the evaluation presented herein, Foth recommends that the above five selected sentinel cap locations be monitored as part of the event-based monitoring in OU4 as required by the *COMMP*. Foth is requesting approval from the Agencies Oversight Team for this recommendation.

References

Anchor QEA, LLC, Tetra Tech EC, Inc., and Foth Infrastructure & Environment, LLC, 2019. *Cap Operations, Maintenance, and Monitoring Plan –Revision 3 DRAFT*. Prepared for Georgia-Pacific Consumer Products LLC. October 2019.

Tetra Tech, Inc., 2020. "Hydrodynamic Modeling of Post-Remedy Conditions in OU4/5 to Evaluate Cap Stability" technical memorandum. May 2020.

Tables

Table 1

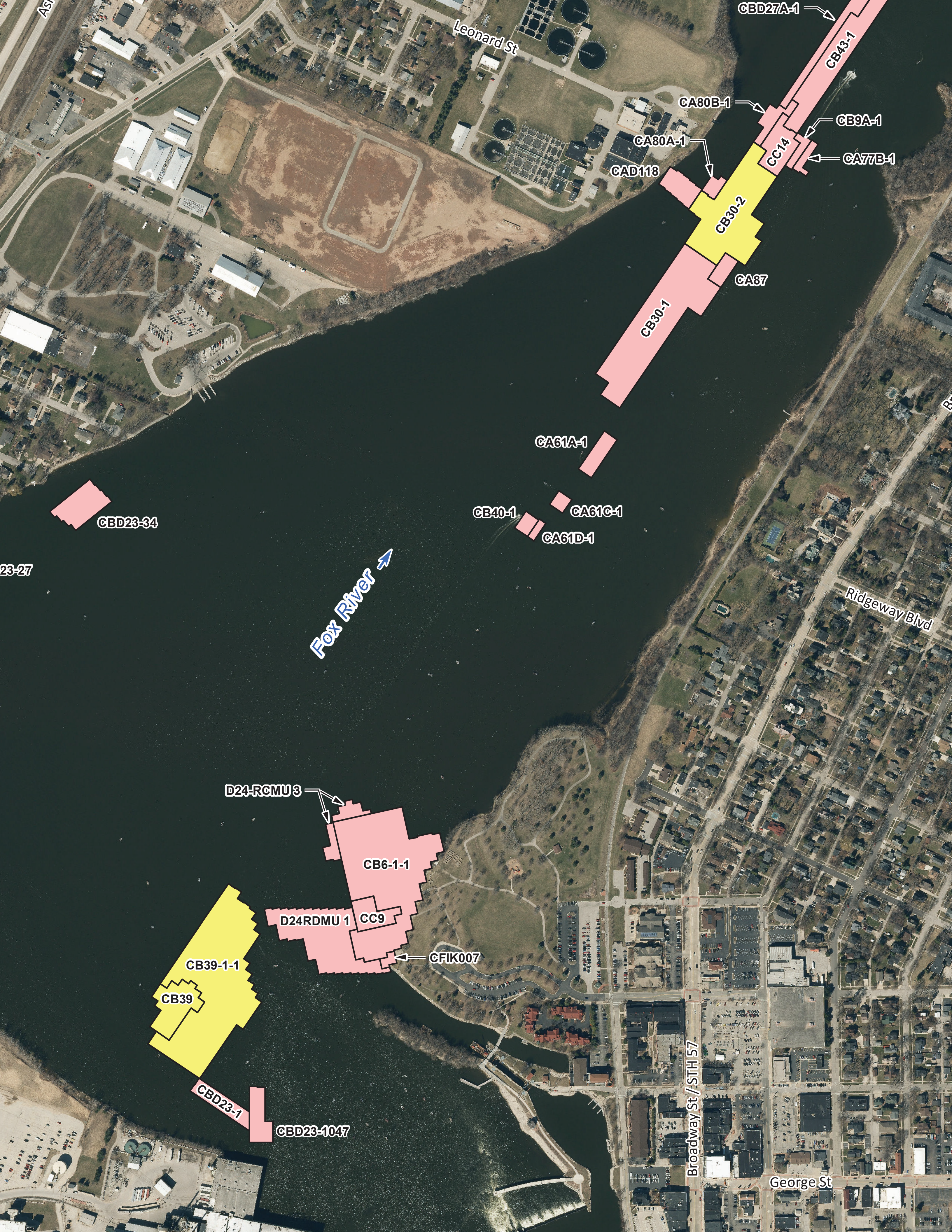
Total PCB Concentrations and Modeled Bed Shear Stress for OU4 Cap Areas

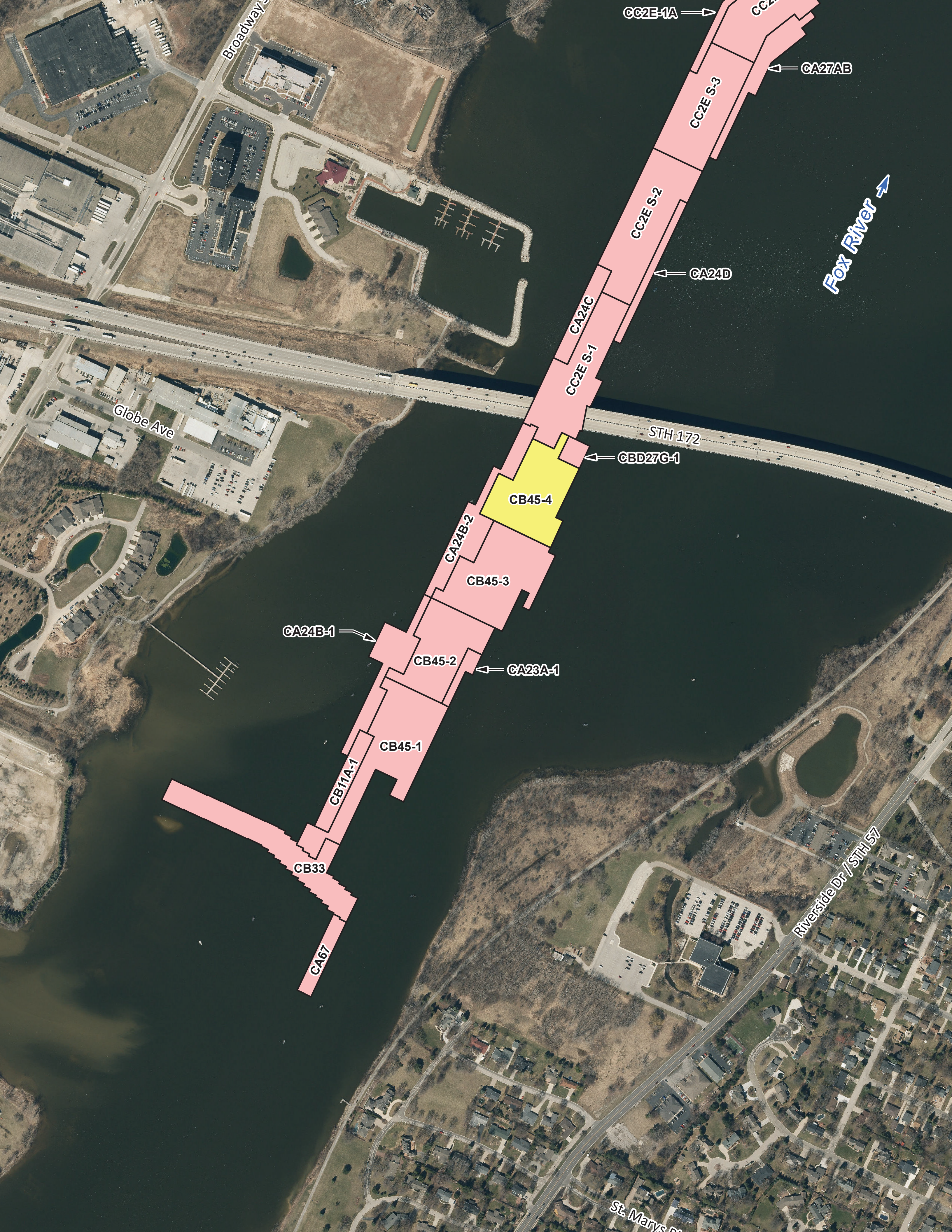
OU4 Cap Areas	Maximum Modeled Bed Shear Stress [N/m^2]	Location ID	Logged Interval Top	Logged Interval Bottom	Post Dredge Pre-Cap Elevation	Total PCB (mg/kg)
CB39	1.06	4001.5-101	556.11	555.61	556.02	10.40 ppm
CB39	1.06	4001.5-101	556.37	555.97	556.02	13.70 ppm
CB39-1-1	1.06	4002.5-116	558.31	557.81	559.61	29.80 ppm
CB39-1-1	1.06	4002.5-116	557.81	557.31	559.61	33.10 ppm
CB30-2	4.87	4012-106	563.71	563.21	563.62	42.40 ppm
CB45-4	4.59	4027-02	557.10	556.60	556.66	41.00 ppm
CC17	3.73	4045-128	560.23	559.73	563.76	6.26 ppm
CB60-1	2.27	5001-05	572.38	571.88	572.44	4.47 ppm
CB60-1	2.27	4092.5-62	574.35	573.85	574.42	8.40 ppm

N/m^2 = Newtons per square meter
PCB = Polychlorinated Biphenyls

Prepared by: TSW
Checked by: TMK1

Figures


Leonard St
CBD27A-1
CB43-1
CA80B-1
CB9A-1
CA80A-1
CC14
CA77B-1
CAD118
CB30-2
CA87
CB30-1
CA61A-1
CA61C-1
CB40-1
CA61D-1
CBD23-34
Fox River
Ridgeway Blvd
D24-RCMU 3
CB6-1-1
D24RDMU 1
CC9
CFIK007
CB39-1-1
CB39
CBD23-1
CBD23-1047
Broadway St / STH 57
George St

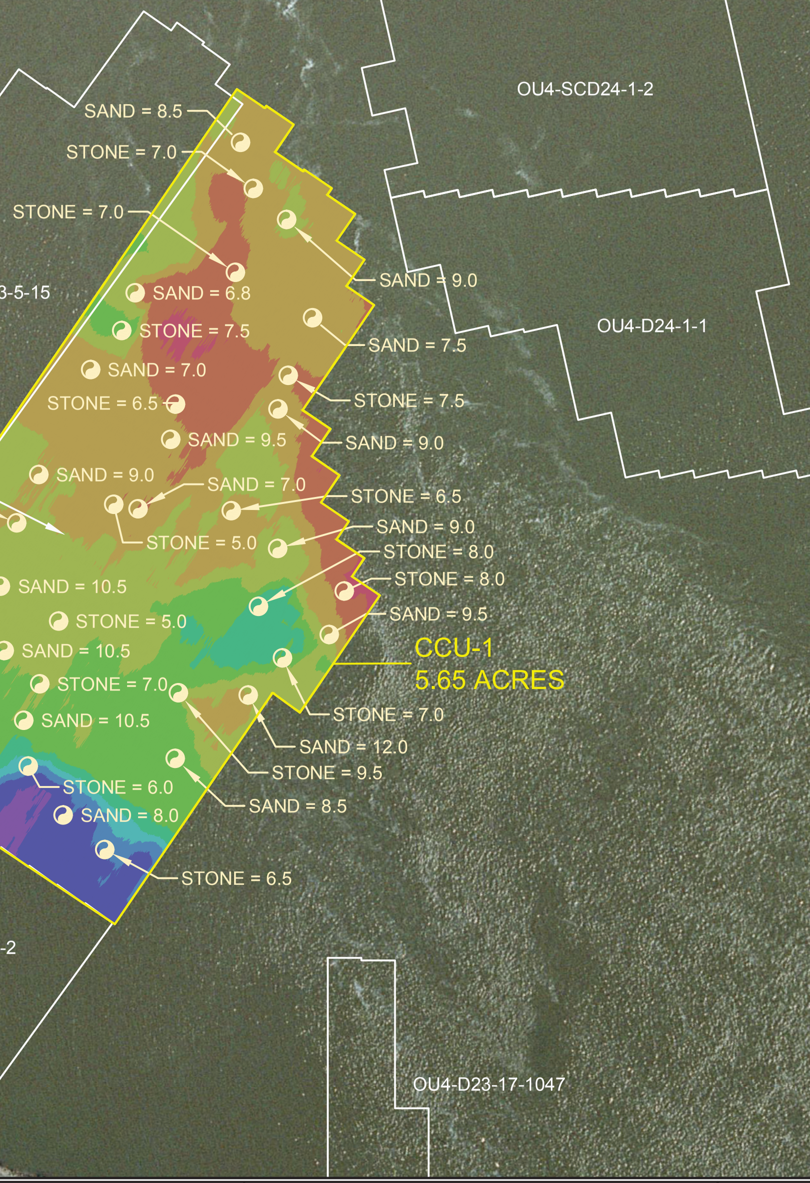


CC2E-1A
CA27AB
CC2E S-3
CC2E S-2
CA24D
Fox River
CA24C
CC2E S-1
Broadway
Globe Ave
STH 172
CBD27G-1
CB45-4
CA24B-2
CB45-3
CA24B-1
CB45-2
CA23A-1
CB45-1
CB11A-1
CB33
CA67
Riverside Dr / STH 57

CB3
SHC101
CC101(M)
CA34-2
CBD35U North Micro-102
SHC100
CA34-1
CC100
CB20-2
CBD35A-8B
CB20-1
CC17
CB33A
CA30C-2
CA
Broadway St
Ave
CBD35U South-3
CCD35U South-2
CBD35U South-2
CCD35U South-1
CBD35U South-1
CB50
CA30C-1
CCD34-2
CBD34-2
CC2E North-6
CC2E North-5
CA30A
CBD144
CBD148
CC2E North-4
CB52
CA30B
CB47
CB54
CA28C
CC2E North-3
CC2E North-2
CB46
CB28A
CC2E North-1
Fox River
Riverside Dr / STH 57
Allouez Ave


CA94-1
CA94-2
CB61
SRA-08-3
SRA-08-2
SRA-08-1
USH 141
Fox River
SRA-04
CBD35NOP-DCA45-7
STH 29
CBD157-3
STH 54/57
STH 32/54
SRA-05-07-1
SRA-05-07-2
STH 54
SRA-03-3
SRA-03-2
SRA-03-1
Fox River
CC22
CB58
SRA-06-1
SRA-06-2
STH 32
STH 57

Attachment 1



SITE INFORMATION

246,192 AREA (SQ. FT.)

DATE SAND PLACED = 8-21-13
DATE SAND SAMPLED = 8-23-13
DATE ARMOR PLACED = 10-26-13
DATE ARMOR SAMPLED = 10-29-13
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 STONE SIZE INSTALLED = 1.5"
DATE OF POST-COVER QA-BATHYMETRY = 8-22-13
DATE OF POST-CAP QA-BATHYMETRY = 10-29-13

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = B2
MAXIMUM DESIGN SURFICIAL CONCENTRATION = 50 PPM
PROJECT BASELINE ELEVATION = 576.6' (NAVD88)
MINIMUM DESIGN WATER DEPTH FOR CAP TYPE B2 D50 STONE INSTALLED = 4.0'
HIGHEST DESIGN CAP ELEVATION = 572.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 571.3'

PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP ABOVE HIGHEST DESIGN CAP ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST DESIGN CAP ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-13-04-CB39-1-1-COMP	<25.0 µg/kg (<0.025 ppm)

AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
550.00'	-	552.00'
552.00'	-	554.00'
554.00'	-	556.00'
556.00'	-	558.00'
558.00'	-	560.00'
560.00'	-	562.00'
562.00'	-	564.00'
564.00'	-	566.00'
566.00'	-	568.00'
568.00'	-	570.00'

400

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

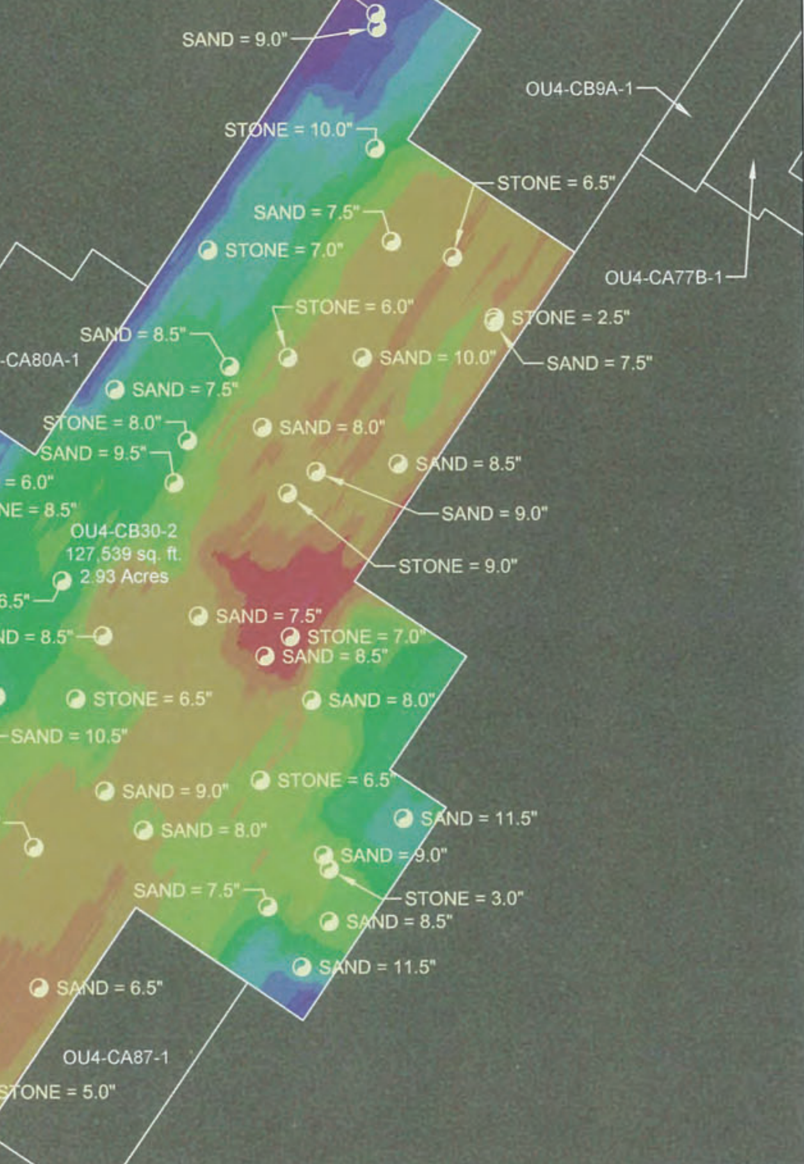
OU# - # - # - #
OPERABLE CAP/COVER CAP/COVER CAP/COVER

VARIANCE COLOR LEGEND

AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 573.6'(NAVD88)
0 sq. ft.	ABOVE HIGHEST DESIGN CAP ELEVATION 572.6'(NAVD88)
246,192 sq. ft.	BELOW HIGHEST DESIGN CAP ELEVATION 572.6'(NAVD88)

TETR
1611 STA
GREEN B
TEL: (920) 4

CAD FILE: OU4-CB39-1-
DRAWN BY: WALTER.B
DATE: December 13, 201
LAST REVISED: January



SITE INFORMATION

127,539 AREA (SQ. FT.)
DATE SAND PLACED = 6-20-14
DATE SAND SAMPLED = 6-25-14
DATE ARMOR PLACED = 8-19-14
DATE ARMOR SAMPLED = 8-20-14
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 STONE SIZE INSTALLED = 1.5"
DATE OF POST-COVER QA-BATHYMETRY = 6-24-14
DATE OF POST-CAP QA-BATHYMETRY = 8-22-14

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = B2
MAXIMUM DESIGN SURFICIAL CONCENTRATION = 50 PPM
PROJECT BASELINE ELEVATION = 576.6' (NAVD88)
MINIMUM DESIGN WATER DEPTH FOR CAP TYPE B2 D50 STONE INSTALLED = 4.0'
HIGHEST DESIGN CAP ELEVATION = 572.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 571.3'
PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP ABOVE HIGHEST DESIGN CAP ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST DESIGN CAP ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-14-04-CB30-2-COMP	25.0 µg/kg (0.025 ppm)

200

AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
555.00'	-	556.00'
556.00'	-	557.00'
557.00'	-	558.00'
558.00'	-	559.00'
559.00'	-	560.00'
560.00'	-	561.00'
561.00'	-	562.00'
562.00'	-	563.00'
563.00'	-	564.00'
564.00'	-	565.00'

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

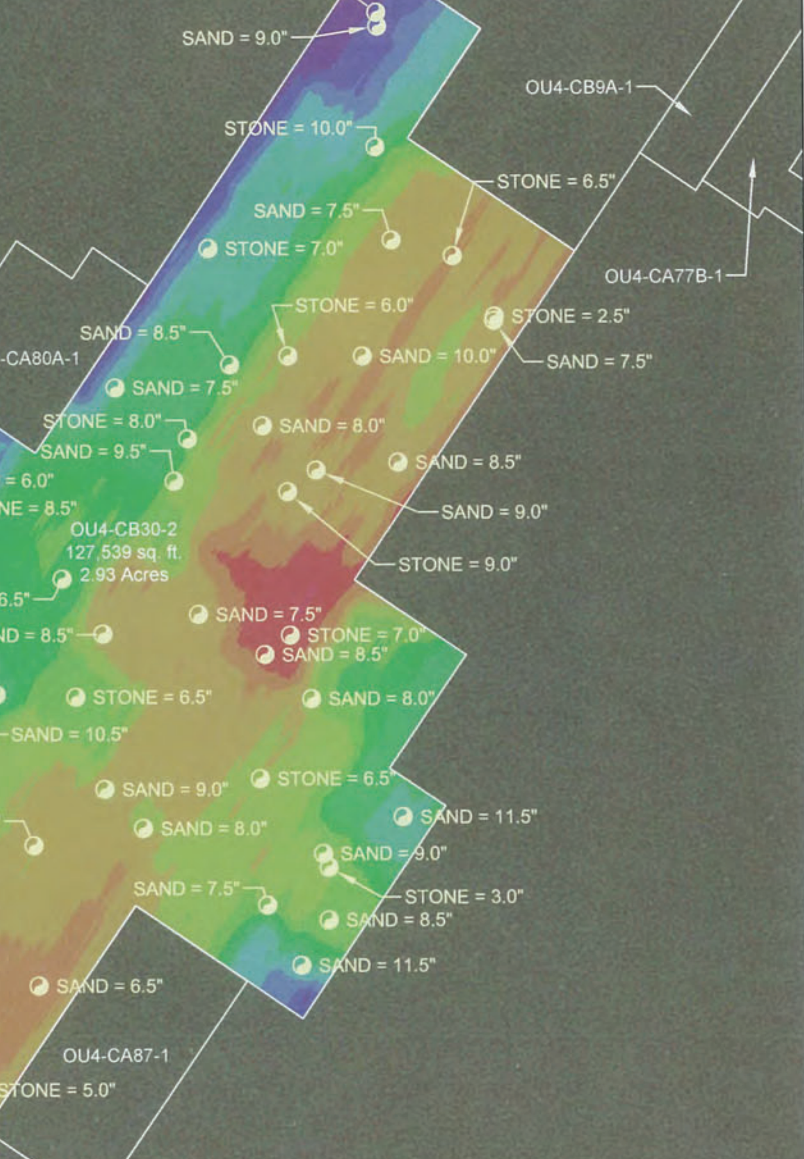
OU# - # - #
OPERABLE CAP/COVER CAP/COVER

VARIANCE COLOR LEGEND

AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 573.6' (NAVD88)
0 sq. ft.	ABOVE HIGHEST DESIGN CAP ELEVATION 572.6' (NAVD88)
57,865 sq. ft.	BELOW HIGHEST DESIGN CAP ELEVATION 572.6' (NAVD88)

TETR
1611 STA
GREEN B
TEL: (920) 4

CAD FILE: OU4-CB30-2
DRAWN BY: SHANE.NE
DATE: October 3, 2014
LAST REVISED: October
CHECKED BY: REC



SITE INFORMATION

127,539 AREA (SQ. FT.)
DATE SAND PLACED = 6-20-14
DATE SAND SAMPLED = 6-25-14
DATE ARMOR PLACED = 8-19-14
DATE ARMOR SAMPLED = 8-20-14
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 STONE SIZE INSTALLED = 0.75"
DATE OF POST-COVER QA-BATHYMETRY = 6-24-14
DATE OF POST-CAP QA-BATHYMETRY = 8-22-14

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = B3
MAXIMUM DESIGN SURFICIAL CONCENTRATION = 50 PPM
PROJECT BASELINE ELEVATION = 576.6' (NAVD88)
MINIMUM DESIGN WATER DEPTH FOR CAP TYPE B3 D50 STONE INSTALLED = 6.0'
HIGHEST DESIGN CAP ELEVATION = 570.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 569.3'
PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP ABOVE HIGHEST DESIGN CAP ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST DESIGN CAP ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-14-04-CB30-2-COMP	25.0 μg/kg (0.025 ppm)

200

AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
555.00'	-	556.00'
556.00'	-	557.00'
557.00'	-	558.00'
558.00'	-	559.00'
559.00'	-	560.00'
560.00'	-	561.00'
561.00'	-	562.00'
562.00'	-	563.00'
563.00'	-	564.00'
564.00'	-	565.00'

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

OU# - # - #

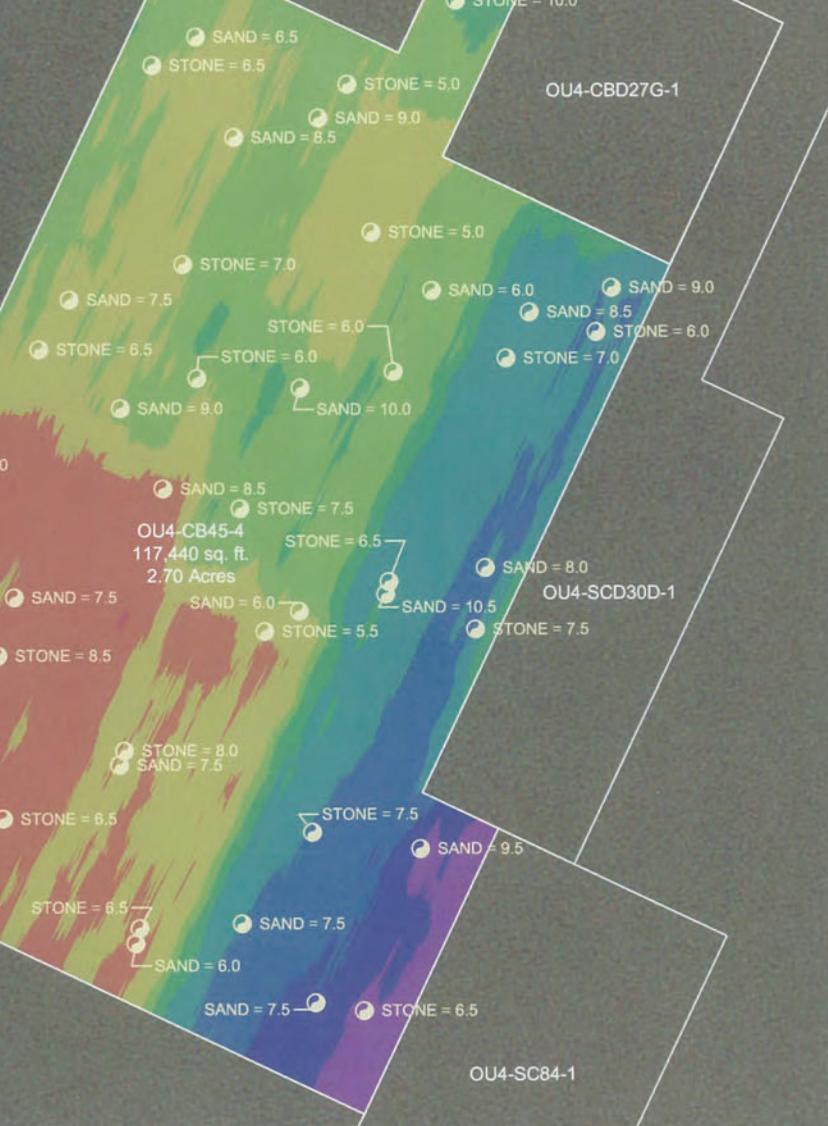
OPERABLE CAP/COVER CAP/COVER

VARIANCE COLOR LEGEND

AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 573.6'(NAVD88)
0 sq. ft.	ABOVE HIGHEST DESIGN CAP ELEVATION 570.6'(NAVD88)
69,674 sq. ft.	BELOW HIGHEST DESIGN CAP ELEVATION 570.6'(NAVD88)

TETR
1611 STA
GREEN B
TEL: (920) 4

CAD FILE: OU4-CB30-2
DRAWN BY: SHANE.NE
DATE: October 3, 2014
LAST REVISED: October
CHECKED BY: REG



SITE INFORMATION

117,440 AREA (SQ. FT.)

DATE SAND PLACED = 8-30-14
DATE SAND SAMPLED = 9-02-14
DATE ARMOR PLACED = 9-23-14
DATE ARMOR SAMPLED = 9-23-4
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 STONE SIZE INSTALLED = 1.50"
DATE OF POST-COVER QA-BATHYMETRY = 9-05-14
DATE OF POST-CAP QA-BATHYMETRY = 9-26-14

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = B2
MAXIMUM DESIGN SURFICIAL CONCENTRATION = 50 PPM
PROJECT BASELINE ELEVATION = 576.6' (NAVD88)
MINIMUM DESIGN WATER DEPTH FOR CAP TYPE B2 D50 STONE INSTALLED = 4.0'
HIGHEST DESIGN CAP ELEVATION = 572.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 571.3'

PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP ABOVE HIGHEST DESIGN CAP ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST DESIGN CAP ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-14-04-CB45-4-COMP	25.0 µg/kg (0.025 ppm)

0 160

AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
556.00'	-	557.00'
557.00'	-	558.00'
558.00'	-	559.00'
559.00'	-	560.00'
560.00'	-	561.00'
561.00'	-	562.00'
562.00'	-	563.00'
563.00'	-	564.00'
564.00'	-	565.00'

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

OU# - # - #

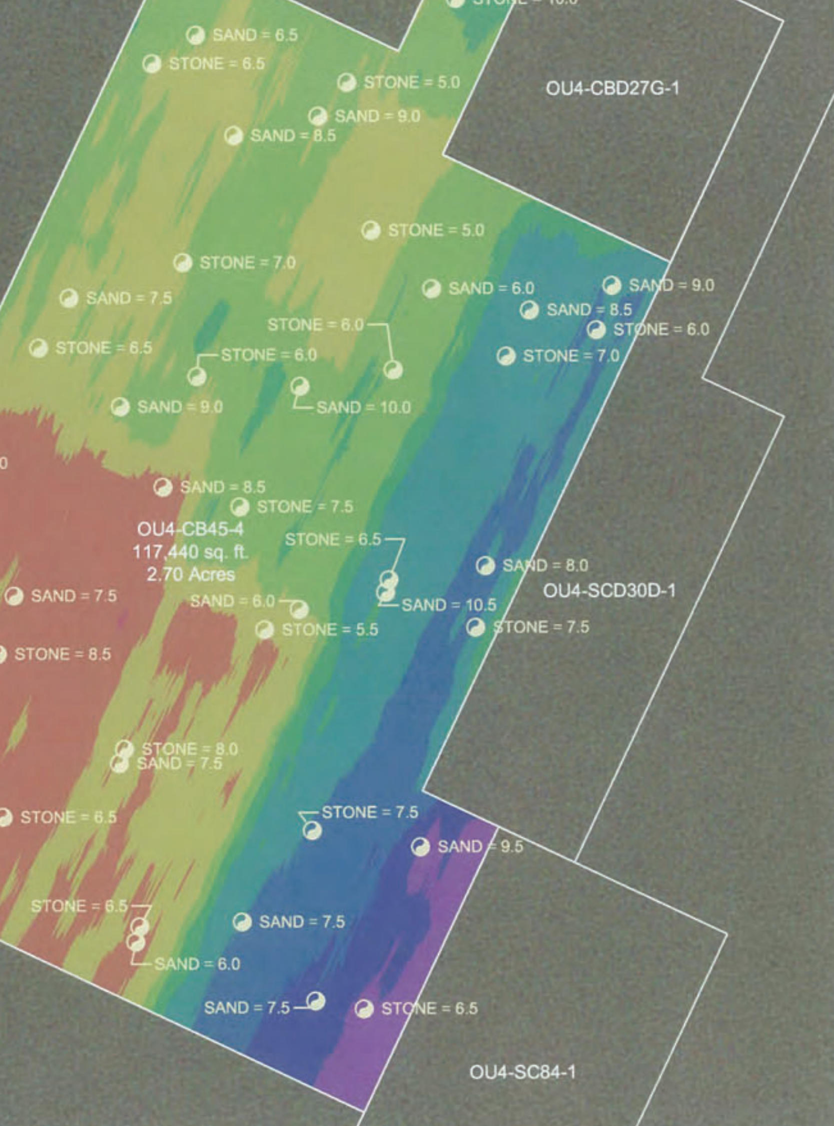
OPERABLE UNIT — CAP/COVER AREA — CAP/COVER MANAGEMENT UNIT

VARIANCE COLOR LEGEND

AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 573.6' (NAVD88)
0 sq. ft.	ABOVE HIGHEST DESIGN CAP ELEVATION 572.6' (NAVD88)
42,557 sq. ft.	BELOW HIGHEST DESIGN CAP ELEVATION 572.6' (NAVD88)

TET
1611 S
GREEN
TEL: (92

CAD FILE: OU4-CB45
DRAWN BY: SHANE.
DATE: October 16, 20
LAST REVISED: Octo
CHECKED BY: REG



SITE INFORMATION

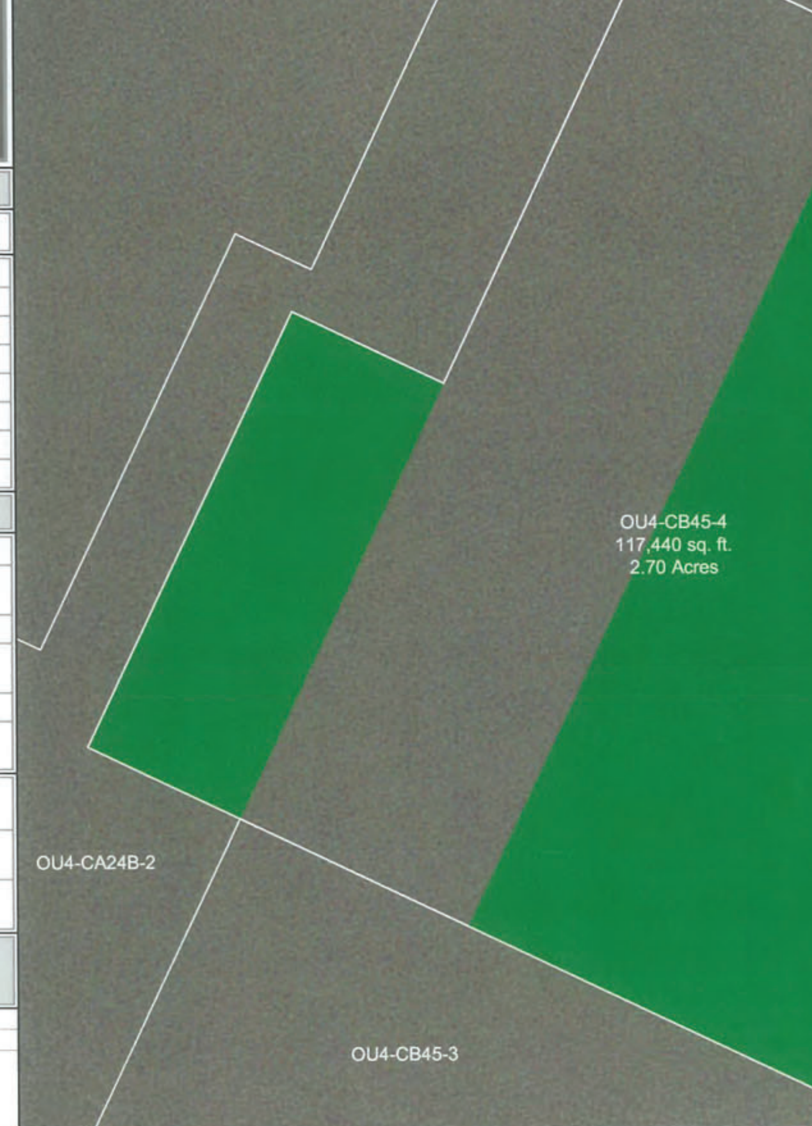
117,440 AREA (SQ. FT.)
DATE SAND PLACED = 8-30-14
DATE SAND SAMPLED = 9-02-14
DATE ARMOR PLACED = 9-23-14
DATE ARMOR SAMPLED = 9-23-14
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 STONE SIZE INSTALLED = 0.75"
DATE OF POST-COVER QA-BATHYMETRY = 9-05-14
DATE OF POST-CAP QA-BATHYMETRY = 9-26-14

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = B3
MAXIMUM DESIGN SURFICIAL CONCENTRATION = 50 PPM
PROJECT BASELINE ELEVATION = 576.6' (NAVD88)
MINIMUM DESIGN WATER DEPTH FOR CAP TYPE B3 D50 STONE INSTALLED = 6.0'
HIGHEST DESIGN CAP ELEVATION = 570.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 569.3'
PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP ABOVE HIGHEST DESIGN CAP ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST DESIGN CAP ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-14-04-CB45-4-COMP	25.0 µg/kg (0.025 ppm)



AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
556.00'	-	557.00'
557.00'	-	558.00'
558.00'	-	559.00'
559.00'	-	560.00'
560.00'	-	561.00'
561.00'	-	562.00'
562.00'	-	563.00'
563.00'	-	564.00'
564.00'	-	565.00'

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

OU# - # - #

OPERABLE UNIT | CAP/COVER AREA | CAP/COVER MANAGEMENT UNIT

VARIANCE COLOR LEGEND

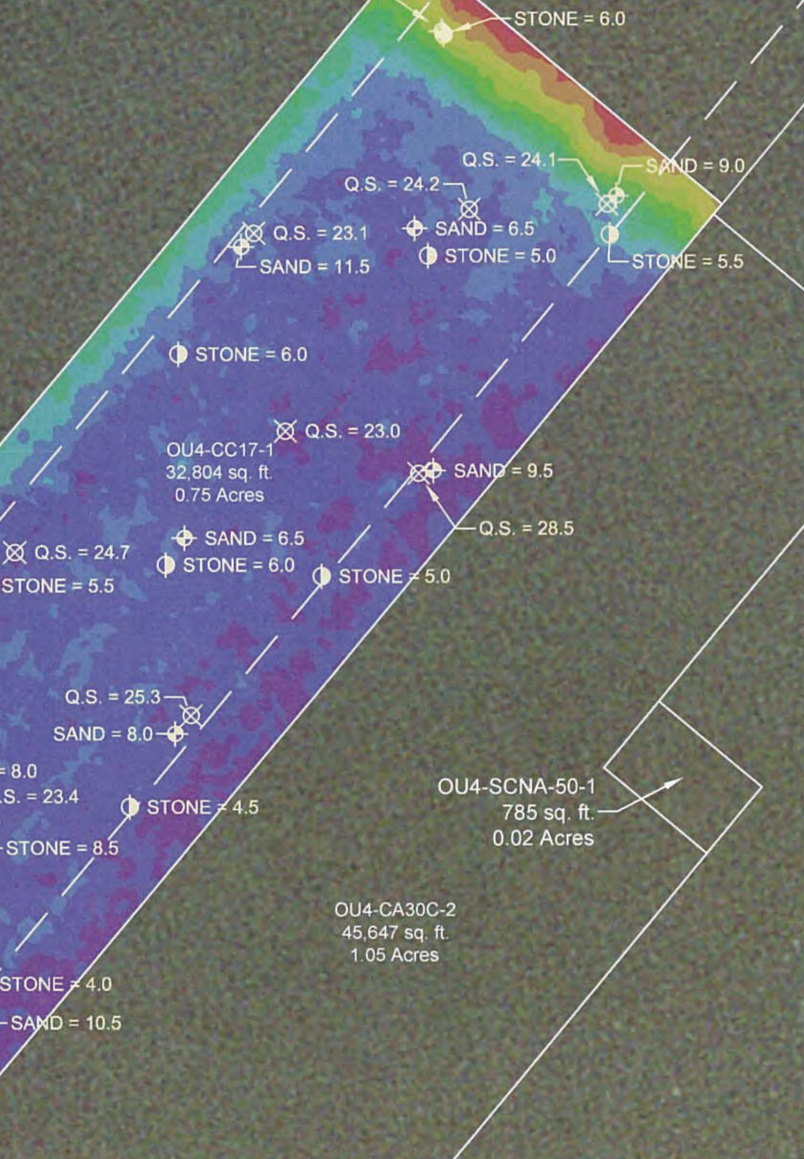
AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 573.6' (NAVD88)
0 sq. ft.	ABOVE HIGHEST DESIGN CAP ELEVATION 570.6' (NAVD88)
74,883 sq. ft.	BELOW HIGHEST DESIGN CAP ELEVATION 570.6' (NAVD88)

0 160

...E NAD83 WISCONSIN...

TET...
1611 S...
GREEN...
TEL: (92...

CAD FILE: OU4-CB45...
DRAWN BY: SHANE...
DATE: October 16, 20...
LAST REVISED: Octo...
CHECKED BY: REG



SITE INFORMATION

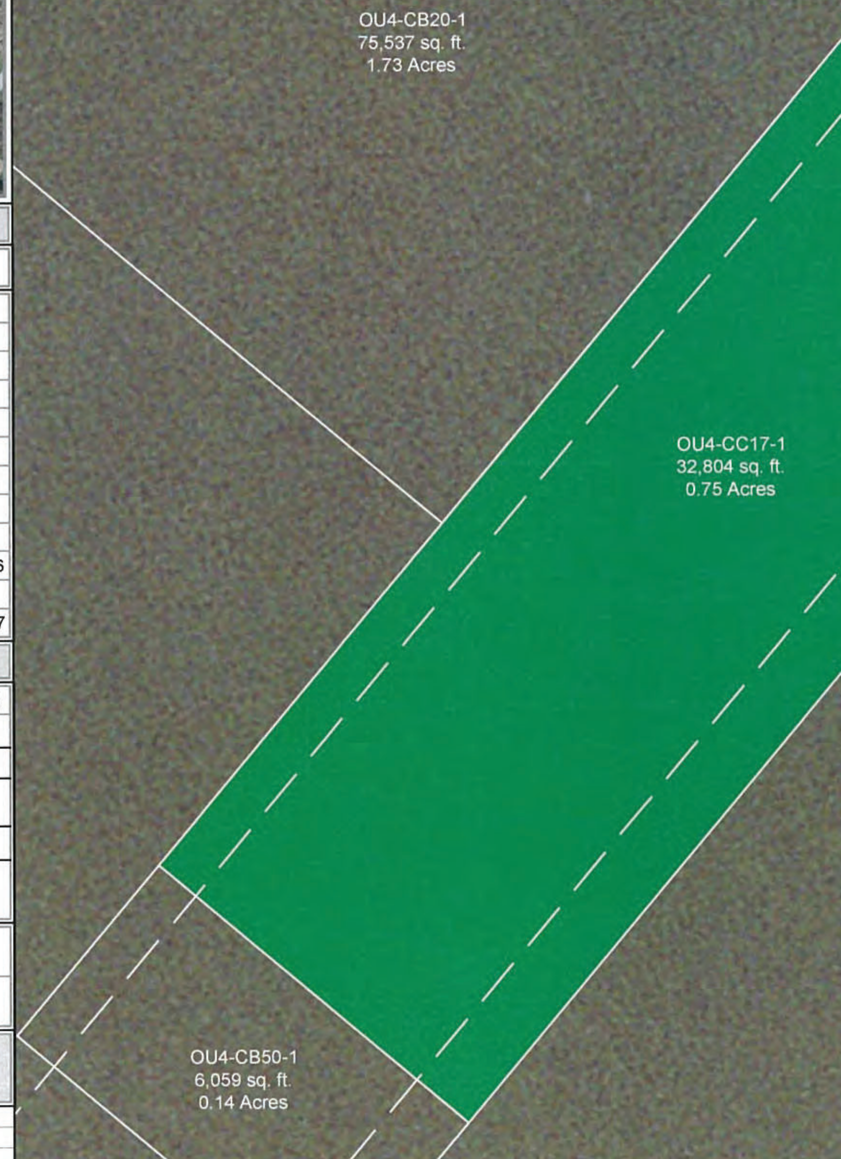
32,804 AREA (SQ. FT.)
DATE SAND PLACED = 10-25-2016
DATE SAND SAMPLED = 10-27-2016
DATE ARMOR PLACED = 10-30-2016
DATE ARMOR SAMPLED = 10-31-2016
DATE QUARRY SPALL PLACED = 5-23-2017
DATE QUARRY SPALL SAMPLED = 6-1-2017
ARMOR TYPE = BANK RUN GLACIAL DEPOSIT
D50 ARMOR STONE SIZE INSTALLED = 0.75"
D50 QUARRY SPALL SIZE INSTALLED = 8.0"
DATE OF POST-COVER QA-BATHYMETRY = 10-26-2016
DATE OF POST-CAP QA-BATHYMETRY = 11-2-2016
DATE OF POST-QUARRY SPALL QA-BATHY = 6-27-2017

CAP AND SEDIMENT DATA

ENGINEERED CAP TYPE = C(M1) (Inside Navigation Channel)
AUTHORIZED NAVIGATION CHANNEL DEPTH = 6'
LOW WATER POOL ELEVATION = 577.6' (NAVD88)
NAVIGATION CHANNEL CAP PROTECTION INSTITUTIONAL CONTROL BUFFER = 2.0'
HIGHEST DESIGN CAP ELEVATION = 569.6'
HIGHEST DESIGN SEDIMENT STARTING ELEVATION = 566.4'
PERCENT OF CAP ABOVE HIGHEST ALLOWED ROD ELEVATION = 0 %
PERCENT OF CAP BELOW HIGHEST ALLOWED ROD ELEVATION = 100 %

CHEMICAL ISOLATION LAYER SAMPLE RESULTS

SAMPLE ID	CONCENTRATION
TTFR-16-04-CC17-1-C6(2-4)	25.0 µg/kg (0.025 ppm)



100

AS-BUILT COLOR LEGEND

MIN. EL.		MAX. EL.
553.00'	-	554.00'
554.00'	-	555.00'
555.00'	-	556.00'
556.00'	-	557.00'
557.00'	-	558.00'
558.00'	-	559.00'
559.00'	-	560.00'
560.00'	-	561.00'
561.00'	-	562.00'
562.00'	-	563.00'

DRAWING NOTES

1. PROJECT BASELINE ELEVATION IS THE NOAA LOW WATER DATUM FOR OU4
2. POST-CAP WATER DEPTH MUST BE NO LESS THAN 3.0' BELOW THE PROJECT BASELINE ELEVATION
3. ROD ELEVATION IS 3.0' BELOW THE PROJECT BASELINE ELEVATION FOR AN OPERABLE UNIT
4. ALL SAND AND STONE MEASUREMENTS ARE IN INCHES (UNLESS OTHERWISE NOTED)
5. NM = NOT MEASURED

OU# - # - #
OPERABLE CAP/COVER CAP/COVER

VARIANCE COLOR LEGEND

AREA	
0 sq. ft.	ABOVE HIGHEST ALLOWED ROD ELEVATION 569.6' (NAVD88)
32,804 sq. ft.	BELOW HIGHEST ALLOWED ROD ELEVATION 569.6' (NAVD88)

TETR
1611 STAT
GREEN BA
TEL: (920) 44

CAD FILE: OU4-CC17-1.
DRAWN BY: SHANE.NEL
DATE: November 7, 2017
LAST REVISED: Novemb

Appendix F

OU5 MNR and OU4 CIL Locations Technical Memorandum

Technical Memorandum

Foth Infrastructure & Environment, LLC

2121 Innovation Court, Suite 300
P.O. Box 5126 • De Pere, WI 54115-5126
(920) 497-2500 • Fax: (920) 497-8516
www.foth.com

March 15, 2021

TO: Jim Saric - Remedial Project Manager – USEPA, Chicago, IL
Beth Olson - Project Coordinator – WDNR, Green Bay, WI

CC: Bill Hartman - P.H. Glatfelter
Paul Montney - Georgia-Pacific
George Berken - Boldt Technical Services
Gary Kincaid - Wisconsin Department of Natural Resources
Denis Roznowski - Foth Infrastructure & Environment, LLC

FR: Tara Van Hoof and Sharon Kozicki - Foth Infrastructure & Environment, LLC

RE: Lower Fox River OU4-5 Long-Term Monitoring
Proposed Sediment MNR and CIL Locations

1 Introduction

Foth Infrastructure & Environment, LLC (Foth) has prepared this Technical Memorandum (Memo) to present the design and rationale to be used for elements of the long-term monitoring (LTM) in Operable Units (OU) 4 and 5 within the Lower Fox River (LFR) in preparation for the Year 0 monitoring, expected to occur in 2021.

LFR LTM is being performed to assess progress toward achieving the remedial action objectives (RAOs) specified in the *Record of Decision: Operable Units 3, 4, and 5, Lower Fox River and Green Bay Wisconsin* (USEPA and WDNR, 2003); and the *Record of Decision Amendment: Operable Unit 2 (Deposit DD), Operable Unit 3, Operable Unit 4, and Operable Unit 5)* (USEPA and WDNR, 2007) issued under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended; and the LFR *Long-Term Monitoring Plan* (*FR-LTMP*) (Anchor QEA et al., 2009).

The purpose of this Memo is to:

1. Present historical surficial sediment data collected in Green Bay, Lake Michigan (Bay) and propose LTM locations with rationale for sediment monitored natural recovery (MNR) sampling in the Bay.

2. Present the rationale and proposed locations for chemical isolation layer (CIL) sampling of engineered caps placed in OU4.

There are no planned changes to the OU4 or OU5 LTM surface water sampling or fish collection sampling programs. Foth is seeking Agencies Oversight Team (A/OT) acceptance for the sediment MNR locations in the Bay and the CIL locations in OU4 and OU5 presented in this Memo. Upon approval of the activities, the *OU1-3 Long Term Monitoring Sampling and Analysis Plan - Revision 2* (*SAP*) (Foth, 2018) will be updated as an addendum to the *Long Term Monitoring Plan (LTMP)* (Anchor, 2009) to incorporate these activities and the other LTM activities in OU4 and OU5.

2 Chemical Isolation Layer Monitoring

In accordance with the *FR-LTMP*, cap chemical isolation monitoring is performed in representative areas with "Type B" caps to verify basic cap design assumptions (i.e., proper installation of the cap and resistance to chemical diffusion through the cap from underlying contaminated sediments). "Type B" caps contain a basal layer of mixed cap material and sediment overlain by a clean sand CIL and a final armor layer; these types of caps are typically located in OU2-5 over mid-range sediment polychlorinated biphenyls (PCB) concentrations (between 10 and 49.99 milligrams per kilogram [mg/kg]).

The *FR-LTMP* specifies collecting CIL samples at approximately 15 to 20 representative locations in OUs 2-5. Three sample locations were established in OU3, Foth is proposing 15 CIL sample locations from 11 caps in OU4, presented on Figures 2-1 and 2-2.
CIL sample locations were selected using on the following rationale:

- Co-located with previous CIL sample locations collected immediately after placement of the caps, providing a basis of comparison for future sampling events.

- Caps containing little to no deposition, as to minimize the amount of sediment requiring removal prior to a sampling event.

- Outside of the turning basin and navigation channel, which are typically depositional areas with greater water depths that are logistically difficult to obtain and have more potential hazards that may interfere with the safety of the divers.

- With consideration for the representative range of sediment PCB concentrations below the caps.

Note that sample locations were not selected in modified Type B caps which have additional armoring. Table 2-1 provides information pertaining to the previous CIL samples collected immediately after placement of the caps, estimated average PCB concentrations in the sediment underlying the caps, range of deposition measured to date, and location with respect to turning basins and the navigation channel. This table highlights the caps that were selected for CIL sampling in OU4, as well as those that were not considered, based on the rationale above. The 15 proposed CIL sample locations have a representative range of average PCB concentrations in the surface sediments below the cap, are primarily outside of the turning basins and navigation channel, have little to no deposition based on poling performed in 2018, and are co- located with previous CIL sample locations.

3 Monitored Natural Recovery Monitoring

Sediment monitoring will be conducted in representative MNR areas of OU5. Sediment monitoring of MNR areas provides a secondary line of evidence to document natural recovery success, with the primary line of evidence being PCB concentrations in fish tissue and surface water. The *FR-LTMP* specifies that "approximately 15 to 20 sampling stations in OU5 will be monitored, focusing on those areas that were reported in the Remedial Investigation/Feasibility Study as containing surface sediment PCB concentrations above 1 mg/kg. To the extent possible, sediment MNR sampling locations have been co-located with surface water and fish monitoring stations. At each sampling station, a five-point composite sediment sample will be collected from the top 6 inches (15 centimeters) of the sediment to track reductions in average PCB concentrations over time.

Figures 3-1 and 3-2 depict the 21 selected sediment MNR sample locations. Figure 3-1 shows proposed locations in the overall extent of OU5, and Figure 3-2 provides additional detail for the proposed locations beyond, but near, the river mouth arc boundary (Arc). Note that on December 10, 2019, the A/OT confirmed that "the area of OU5 that is inside the Arc will not be categorized as part of OU5's MNR area. The area of OU5 inside the Arc is included within the ROD-defined OU4/5 remedial action area." Also note that the dredge limits in the navigation channel beyond the arc, as shown on Figure 3-2, are also excluded from the OU5 MNR area.

In general, the sediment MNR sample locations were selected based on co-location with a historical surficial sediment sample (with the exception of two locations chosen by the A/OT), focus on the eastern side of the bay, relatively higher PCB concentration (few historical surface concentrations remaining in OU5 are above 1 mg/kg), and water depth (less than around 80 feet). Figures 3-1 and 3-2 present water depth and PCB concentration for historical sediment sample locations provided in the following datasets:

- WDNR Fox River Database (WDNR, 2006) - 1989/90 Green Bay Mass Balance Study (GLNPO), 1998 BBL Sediment/Tissue Data Collection, 1995 WDNR Sediment Data Collection.

- White Paper No. 19 (WDNR, 2003) – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach, June 2003 (data collected 2002).

- Core Chemistry Data Base provided by Tetra Tech (Tetra Tech, 2019) from the following subcategories:
    - Basis of Design Report 2004-2005 predesign sediment samples
    - 2017 Beyond the Arc data
    - May 2019 sampling in the Bay near the outlet of the Lower Fox for remedial design

Table 3-1 summarizes information pertaining to the selected MNR locations, including coordinates, PCB concentration, approximate water depth, and data source.

Substrate information was not evaluated as it was not readily available and was not found to be relevant in selection of MNR sample locations.

Sample locations in the navigation channel and at depths greater than 80 feet were avoided. Excessive water depth is a limitation for common sediment sampling methodology used historically for the LFR project.

4 Conclusions

Based on the requirements of the *FR-LTMP* and taking into account existing conditions, including historical sample locations, PCB concentrations, water depth, and deposition, Foth proposes to collect CIL samples at 15 representative locations in OU4 and MNR samples at 21 representative locations in OU5, as presented on Figures 2-1 and 2-2 and Figures 3-1 and 3-2, respectively.

5 References

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The RETEC Group, Inc. 2002. *Final Feasibility Study - Lower Fox River and Green Bay, Wisconsin Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources. December 2002.

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Tables

13	231112.0882	2472802.512	578.3927	19.7	10.6	8.0	TTFR-13-04-CB39-1-1-COMP	8/30/2013	9/6/2013	<	25.0	0.025	U	11.00 (CB39) / 4.53 (CB39-1-1)	1. a
13	231224.8256	2472624.692	578.323	20.9	11.0	8.0									
13	231290.2699	2472620	578.32	21.6	22.6	11.0									
13	231331.063	2472907.469	578.1218	22.3	21.6	7.0									
13	231570.8141	2472944.411	578.2129	23.0	20.0	11.0									
13	232119.56	2473422.34	578.26	18.1	11.0	7.5	TTFR-13-04-CB-D24-3-COMP	9/24/2013	9/27/2013	<	25.0	0.025	U	3.7	Li ov a
13	231979.35	2473342.73	578.23	19.8	13.0	9.5									
13	231457.77	2473512.05	578.08	14.7	17.0	10.0	TTFR-13-04-CB-D24-1-COMP	10/8/2013	10/10/2013	<	25.1	0.0251	U	1.41	Li ov are
13	231672.75	2473389.93	577.85	21.2	11.0	7.0									
13	231549.47	2473293.67	577.82	21.8	10.5	7.5									
13	231613.57	2473197.85	577.80	20.9	13.5	7.0									
13	231685.92	2473085.73	577.72	22.4	12.5	7.0									
13	232010.84	2473551.81	578.16	8.7	13.0	8.0	TTFR-13-04-CB6-1-1-COMP	10/8/2013	10/10/2013	<	25.0	0.025	U	9.62	Li ov
13	231844.67	2473574.79	577.99	8.5	10.5	7.0									
13	232004.54	2473462.98	577.99	8.7	13.0	8.5									
13	231608.45	2473628.37	578.00	13.0	8.0	7.0									
13	231493.37	2473579.11	578.05	11.8	22.5	8.5									
14	235124.64	2475458.36	579.88	20.9	14.5	9.0	TTFR-14-04-CB9A-1-COMP	6/18/2014	6/23/2014	<	25.0	0.025	U	11.00	Lit
14	235063.24	2475395.13	579.82	20.6	18.0	13.0									
14	235351.6019	2475457.19	579.5346	20.9	17	8.5	TTFR-14-04-CB43-1-COMP	6/19/2014	6/23/2014	<	25.1	0.0251	U	21.28	Lit
14	235585.37	2475615.91	579.46	18.5	12.0	7.5									
14	235236.89	2475406.14	579.22	20.3	22.5	14.5									
14	235686.71	2475650.53	579.44	18.5	15.0	8.5									
14	235813.46	2475832.28	579.22	20.6	13.0	7.5									
14	236435.1592	2476225.066	579.3517	22.3	14.5	9.5	TTFR-14-04-CB43-2-COMP	6/23/2014	6/26/2014	<	25.0	0.025	U	22.02	Lit
14	236460.85	2476363.06	579.94	21.3	16.0	8.5									
14	235963.48	2475963.76	579.61	20.9	16.0	9.5									
14	236294.66	2476244.46	579.80	21.8	14.0	8.0									
14	236140.89	2476090.72	579.66	21.3	15.0	7.5									
14	234153.21	2474647.15	579.16	21.2	20.0	9.5	TTFR-14-04-CB30-1-COMP	6/24/2014	6/26/2014	<	25.0	0.025	U	11.87	Lit
14	234320.99	2474752.90	580.30	21.9	15.0	8.0									
14	234264.55	2474822.08	579.65	21.9	14.0	8.0									
14	234426.05	2474930.85	579.74	21.9	17.0	8.5									
14	234488.89	2474807.43	579.66	16.7	13.5	6.0									
14	234851.23	2474980.38	579.40	14.6	30.5	8.5	TTFR-14-04-CB30-2-COMP	6/19/2014	6/23/2014	<	25.0	0.025	U	17.17	Lit
14	234855.71	2475181.34	579.37	22.4	18.0	6.0									
14	234970.78	2475217.01	579.51	21.5	19.0	9.5									
14	234739.42	2475013.72	579.55	17.8	18.5	10.5									
14	234617.02	2475186.08	579.32	19.9	18.0	9.0									
14	233307.64	2471741.11	579.46	7.3	20.0	14.5	TTFR-14-04-SCD23-27-COMP	6/24/2014	6/26/2014		54.7	0.0547		0.58	Lit
14	233202.26	2471621.61	579.56	7.5	18.0	11.5									
14	233510.36	2472270.65	579.24	5.0	20.0	10.5	TTFR-14-04-SCD23-34-COMP	6/24/2014	6/26/2014	<	25.0	0.025	U	0.04	Lit
14	233456.06	2472147.03	579.16	4.9	19.5	8.5									
14	235364.78	2475386.96	579.24	11.8	16.5	6.5	TTFR-14-04-CBD27A-1-COMP	6/24/2014	6/26/2014	<	25.0	0.025	U	0.84	Lit
14	235482.88	2475484.78	579.29	14.3	15.5	7.5									
14	235704.50	2475675.53	579.45	20.2	16.5	10.0									
14	235903.01	2475798.14	579.74	20.1	16.5	6.0	TTFR-14-04-CBD27A-2-COMP	6/24/2014	6/26/2014	<	25.0	0.025	U	0.84	Lit
14	235855.39	2475767.50	579.64	20.0	14.5	7.0									
14	230806.24	2472837.34	579.45	8.90	21.0	7.0	TTFR-14-04-SCD23-1-COMP	6/25/2014	6/30/2014	<	25.0	0.025	U	0.14	Li ov are
14	230773.89	2472894.21	579.48	9.7	20.0	6.0									
14	233449.55	2474205.80	578.98	24.3	17.0	10.5	TTFR-14-04-CB40-1-COMP	7/15/2014	7/18/2014	<	25.0	0.025	U	1.63	Lit
14	233397.54	2474174.89	579.03	24.2	19.0	11.0									
14	238338.04	2477187.02	579.24	19.6	13.0	7.0	TTFR-14-04-CB33-1-COMP	7/28/2014	7/31/2014	<	25	0.025	U	10.3	Lit
14	238398.62	2477022.23	579.36	11.2	10.5	8.5									
14	238592.92	2476862.35	579.50	4.2	13.0	8.0									

14	239101.63	2477555.84	579.58	20.5	13.5	12.5	TTFR-14-04-CB45-1-COMP	9/5/2014	9/9/2014	<	25	0.025	U	17.98
14	238771.79	2477352.76	579.47	22.0	15.0	8.5								
14	238473.44	2477131.49	579.63	17.4	12.5	7.5								
14	238972.32	2477431.35	579.47	19.4	6.5	14.0								
14	239201.35	2477468.52	579.76	20.1	17.5	12.5								
14	239529.98	2477643.43	580.47	21.5	18.0	11.5	TTFR-14-04-CB45-2-COMP	9/5/2014	9/9/2014	<	25	0.025	U	25.41
14	239270.98	2477644.51	580.36	23.3	15.0	8.5								
14	239442.25	2477605.19	580.49	21.8	16.0	7.5								
14	239418.19	2477750.27	579.60	23.5	15.0	6.0								
14	239551.55	2477963.84	579.20	20.0	16.0	7.5	TTFR-14-04-CB45-2-COMP	9/5/2014	9/9/2014	<	25	0.025	U	16.62
14	239752.47	2477981.73	579.44	22.6	11.5	11.0								
14	239864.06	2478038.51	579.50	22.0	16.0	7.5								
14	239609.7429	2477688.91	580.3678	20.5	13.5	7.5								
14	239652.0652	2477786.422	580.2235	23.9	15.5	8								
14	240307.88	2478248.29	579.67	20.8	15.5	12.0	TTFR-14-04-CB45-4-COMP	9/3/2014	9/8/2014	<	25	0.025	U	19.41
14	239997.98	2477945.02	579.37	19.3	16.0	8.0								
14	239962.55	2478086.73	579.29	21.9	16.0	7.5								
14	240150.765	2478258.04	579.687	18.7	17	8.5								
14	238613.90	2477172.68	579.57	18.0	19.0	8.0	TTFR-14-04-CB11A-1-COMP	8/27/2014	8/29/2014	<	25	0.025	U	12.93
14	238924.02	2477357.28	579.87	20.4	15.0	6.5								
14	238790.70	2477274.41	579.52	19.2	22.5	13.0								
14	240261.29	2478299.94	579.69	18.7	18.5	8.5	TTFR-14-04-CBD27G-1-COMP	8/28/2014	9/3/2014	<	25	0.025	U	3.25
14	240219.06	2478243.01	579.41	20.9	15.0	6.0								
14	242656.33	2479829.42	579.34	10.2	14.0	8.0	TTFR-14-04-CB53-1-C3(2-4)	10/8/2014	10/13/2014	<	25	0.025	U	24.2
14	242423.93	2479530.96	579.22	9.5	15.0	6.0	TTFR-14-04-CB89A-1-COMP	10/8/2014	10/13/2014	<	25	0.025	U	8.35
14	242505.17	2479632.43	579.26	9.5	14.0	7.0								
15	243001.93	2479805.04	579.86	10.3	15.0	6.5	TTFR-15-04-CB28A-1-COMP	5/18/2015	5/20/2015	<	25.0	0.025	U	16.84
15	243164.82	2480009.36	579.76	9.7	17.5	7.0								
15	243269.94	2480084.76	579.64	10.1	17.0	6.0								
15	243282.30	2480157.52	579.80	10.3	20.0	8.0	TTFR-15-04-CB46-1-COMP	5/19/2015	5/22/2015	<	25.0	0.025	U	34.25
15	243207.87	2480064.19	579.84	10.4	23.5	6.0								
15	244033.19	2481091.72	580.11	13.3	18.5	7.5	TTFR-15-04-CBD148-1-COMP	6/1/2015	6/3/2015	<	25.0	0.025	U	18.00
15	243922.09	2480955.95	579.96	13.0	17.5	6.0								
15	243892.31	2480918.82	579.99	11.7	17.5	7.0	TTFR-15-04-CB54-1-C3(2-4)	6/1/2015	6/3/2015	<	25.0	0.025	U	18.75
15	243748.00	2480561.82	580.12	10.2	18.0	7.0	TTFR-15-04-CB47-1-C2(2-4)	6/1/2015	6/3/2015	<	25.0	0.025	U	13.64
15	243907.03	2481778.75	580.01	12.2	16.5	8.0	TTFR-15-04-CB52-1-COMP	8/24/2015	8/27/2015	<	25.0	0.025	U	9.85
15	243930.28	2481686.57	578.98	10.2	19.0	10.0								
15	244004.16	2481726.37	580.09	11.6	17.0	6.5								
15	244039.78	2481822.11	579.29	13.4	17.0	6.0	TTFR-15-04-CBD144-1-COMP	8/24/2015	8/27/2015	<	25.0	0.025	U	5.27
15	244072.53	2481809.40	580.06	13.1	12.0	6.5								
15	244870.69	2482402.92	580.09	21.4	13.5	6.0	TTFR-15-04-CB50-1-COMP	10/12/2015	10/14/2015	<	25.0	0.025	U	9.99
15	245170.00	2482605.77	580.10	20.7	15.5	7.0								
15	245477.09	2482818.34	579.83	19.4	13.5	8.5								
15	245131.01	2482441.78	579.70	18.1	12.0	7.5								

015	245032.75	2481563.33	580.72	12.8	19.0	6.5	TTFR-15-04-CBD35U-SOUTH-1-COMP	11/16/2015	11/18/2015		51.6	0.0516		5.8	Li
016	245469.58	2482758.86	579.83	17.8	14.5	9.5	TTFR-16-04-CB33A-1-COMP	10/12/2016	10/17/2016	<	25.0	0.0250	U	11.87	Lit
016	245642.00	2482915.24	579.95	18.4	13.5	6.0									
016	245724.85	2482927.47	579.91	18.2	12.5	6.5									
016	245926.99	2483055.48	580.80	21.7	14.5	7.0	TTFR-16-04-CB20-1-C9(2-4)	10/28/2016	11/3/2016		7330.0	7.3300		18.57	Li ove a
016	245807.58	2482957.60	580.53	18.4	18.0	8.5	TTFR-16-04-CB20-1-COMP	10/28/2016	11/3/2016	<	25.1	0.0251	U		
016	246152.24	2483018.85	579.86	25.4	20.0	15.5									
016	245975.65	2482869.08	579.33	14.1	16.5	7.5									
016	246003.76	2482756.79	579.84	13.5	11.5	9.0	TTFR-16-04-CB20-2-COMP	10/19/2016	10/26/2016	<	25.0	0.0250	U	22.52	
016	246182.95	2482904.70	580.10	18.4	11.0	7.0									
016	246065.90	2482726.68	580.10	15.7	16.0	13.0									
016	246208.83	2482702.06	580.22	23.1	10.5	6.5									
016	246208.85	2482607.11	580.49	23.9	17.5	8.0	TTFR-16-04-CBD35A-8B-COMP	10/19/2016	10/26/2016	<	25.0	0.0250	U	8.53	D o wi
016	246163.93	2482667.08	580.27	25.6	14.5	7.0									
016	246114.86	2482671.58	580.21	22.9	14.0	6.5									
016	246326.36	2482656.88	580.60	15.4	12.0	6.0	TTFR-16-04-CBD35U N MICRO-102-C1(2-4)	10/19/2016	10/26/2016	<	25.0	0.0250	U	11.2	Li ove are
16	246646.39	2482876.54	580.31	14.3	28.0	6.0	TTFR-16-04-CB34-1-COMP	11/8/2016	11/11/2016	<	25.0	0.0250	U	6.45	Lit
16	246676.50	2482906.73	580.20	14.6	19.0	10.0									
16	246740.46	2482955.83	580.33	16.9	19.0	7.0									
19	250245.64	2483579.57	581.02	10.7	15.0	8.5	TTFR-18-04-CB58-1-COMP	9/27/2018	10/2/2018	<	25	0.025	U	10.26	
19	250200.36	2483602.84	581.21	11.6	11.5	6.0									

ocations.

Table 3-1
OU5 MNR Data for Selected Locations

OU	Sample ID	Northing As-built (ft.)	Easting As-built (ft.)	Approximate Water Depth (ft.)	Sample Interval Depth (in)	PCB Concentration (mg/kg)	Data Source (See Notes)
OU5A	GB02-05	267399	2491618	10	0-6	0.300	2003 WDNR White Paper No. 19
	5008-12	267402.66	2489701.24	10	0-6	0.909	2017 Beyond the Arc data
	S00040	271951.67	2512717.12	9	0-3.94	0.460	1998 BBL Sediment/Tissue Data Collection
	5021.5-01	272672.15	2491599.41	10	0-6	0.531	2017 Beyond the Arc data
	MNR02	301280	2511265	20	N/A	N/A	No historical data available
	MNR01	284642	2500836	10	N/A	N/A	No historical data available
	E339B04A	290267.16	2503308.84	14	0-3.94	0.289	1989/90 Green Bay Mass Balance Study (GLNPO)
OU5B	E165B02A	307926.18	2523425.28	22	0-3.94	0.427	1989/90 Green Bay Mass Balance Study (GLNPO)
	E323B05A	308244.04	2535390.80	23	0-3.94	0.586	1989/90 Green Bay Mass Balance Study (GLNPO)
	E323B06A	325736.79	2534921.05	28	0-1.97	0.727	1989/90 Green Bay Mass Balance Study (GLNPO)
	E326B04A	326182.72	2551294.66	28	0-3.94	0.719	1989/90 Green Bay Mass Balance Study (GLNPO)
	E169B03A	342260.57	2552409.73	35	0-3.15	0.936	1989/90 Green Bay Mass Balance Study (GLNPO)
	E240B07A	358252.03	2550408.54	45	0-3.94	0.760	1989/90 Green Bay Mass Balance Study (GLNPO)
	E323B07A	358702.81	2566497.31	36	0-3.94	0.964	1989/90 Green Bay Mass Balance Study (GLNPO)
	E323B08A	357806.82	2534059.96	38	0-3.94	0.388	1989/90 Green Bay Mass Balance Study (GLNPO)
	AA87GB0022a	374708.52	2552029.83	48	0-3.94	0.534	1989/90 Green Bay Mass Balance Study (GLNPO)
OU5C	AA88GB0020a	375571.80	2582366.78	50	0-3.94	0.737	1989/90 Green Bay Mass Balance Study (GLNPO)
	E010B02A	391605.83	2581898.98	69	0-3.94	0.697	1989/90 Green Bay Mass Balance Study (GLNPO)
	GC0378	393611.85	2569967.16	48	0-3.15	1.020	1998 BBL Sediment/Tissue Data Collection
	E080B02A	392575.63	2614284.05	60	0-3.94	0.621	1989/90 Green Bay Mass Balance Study (GLNPO)
	E240B06A	405586.86	2633839.91	66	0-3.15	0.653	1989/90 Green Bay Mass Balance Study (GLNPO)

Notes:

Data Sources:

• WDNR Fox River Database (WDNR, 2006) - 1989/90 Green Bay Mass Balance Study (GLNPO), 1998 BBL Sediment/Tissue Data Collection, 1995 WDNR Sediment Data Collection.

• White Paper No. 19 (WDNR, 2003) – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach, June 2003 (data collected 2002).

• Core Chemistry Data Base provided by Tetra Tech (Tetra Tech, 2019) from the following subcategories:
- Basis of Design Report 2004-2005 predesign sediment samples
- 2017 Beyond the Arc data
- May 2019 sampling in the Bay near the outlet of the Lower Fox for remedial design

Coordinates in Wisconsin State Plane Central.
N/A = Not available

Prepared by: TMK1
Checked by: TRN

Figures

& "C" CAP DESIGN LOCATION
IDENTIFICATION

CAP DESIGN LOCATION
IDENTIFICATION

CAP DESIGN LOCATION
IDENTIFICATION
NOTE 4)

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE). THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.
2. ORTHO PHOTO SUPPLIED BY BROWN COUNTY LAND INFORMATION OFFICE. COMPILED IN NOVEMBER 2010.

GEORGIA-PAC

LO

C" CAP DESIGN LOCATION
NTIFICATION

DESIGN LOCATION
NTIFICATION

DESIGN LOCATION
NTIFICATION

NOTES:

1. THE HORIZONTAL CONTROL IS REFERENCED TO THE NAD83 WISCONSIN STATE PLANE COORDINATE SYSTEM (WISCONSIN CENTRAL ZONE). THE VERTICAL CONTROL IS REFERENCED TO NAVD 88.
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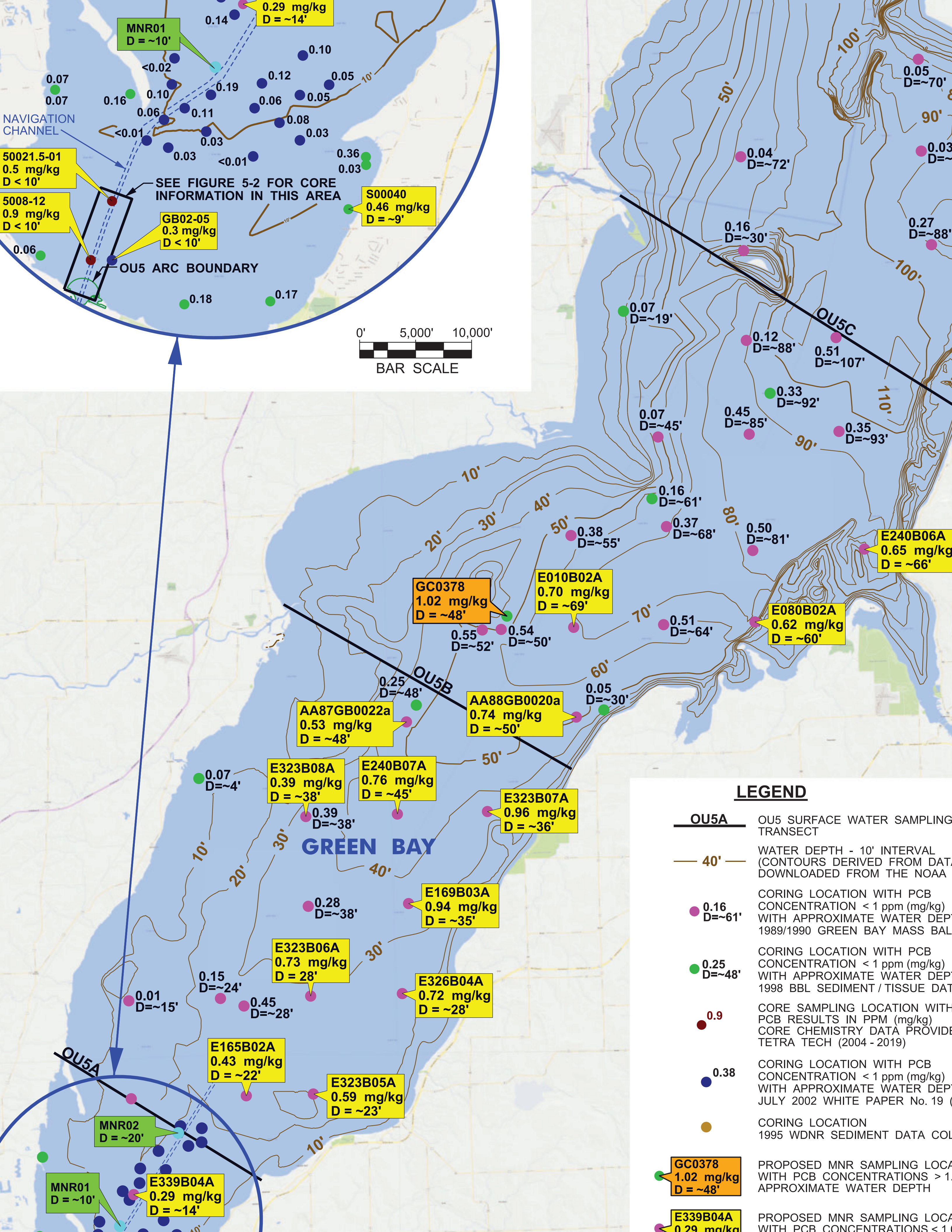
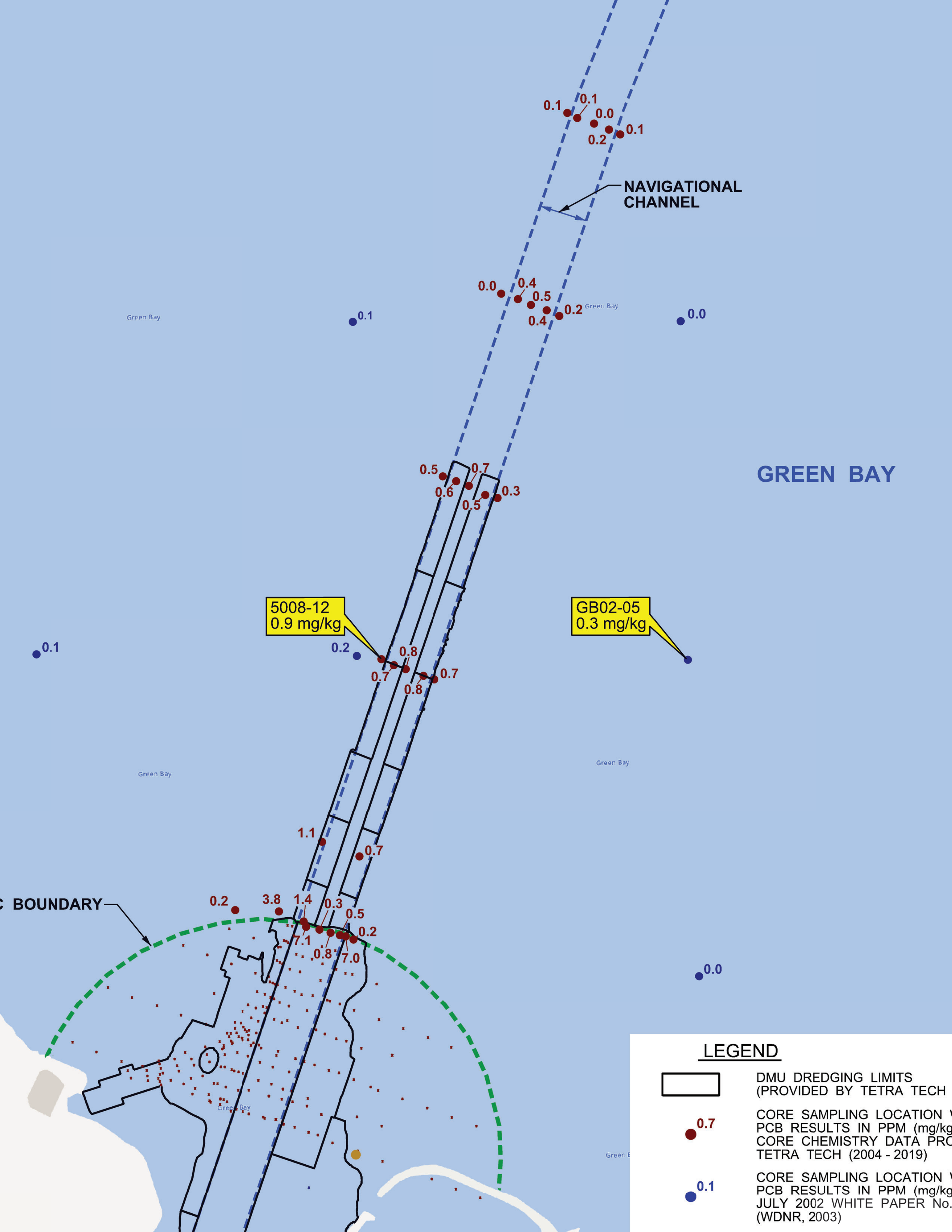
GEORGIA-PAC


MNR01
D = ~10'
0.29 mg/kg
D = ~14'
0.14
0.10
<0.02
0.12
0.05
0.07
0.07
0.16
0.10
0.19
0.06
0.05
0.06
0.11
0.08
NAVIGATION CHANNEL
<0.01
0.03
0.03
0.03
<0.01
0.36
0.03
50021.5-01
0.5 mg/kg
D < 10'
SEE FIGURE 5-2 FOR CORE INFORMATION IN THIS AREA
5008-12
0.9 mg/kg
D < 10'
S00040
0.46 mg/kg
D = ~9'
GB02-05
0.3 mg/kg
D < 10'
0.06
OU5 ARC BOUNDARY
0.18
0.17
0' 5,000' 10,000'
BAR SCALE
0.05
D=~70'
90'
0.04
D=~72'
0.16
D=~30'
0.27
D=~88'
100'
0.07
D=~19'
OU5C
0.12
D=~88'
0.51
D=~107'
0.33
D=~92'
0.07
D=~45'
0.45
D=~85'
0.35
D=~93'
0.16
D=~61'
0.38
D=~55'
0.37
D=~68'
0.50
D=~81'
E240B06A
0.65 mg/kg
D = ~66'
GC0378
1.02 mg/kg
D = ~48'
E010B02A
0.70 mg/kg
D = ~69'
0.55
D=~52'
0.54
D=~50'
0.51
D=~64'
E080B02A
0.62 mg/kg
D = ~60'
0.25
D=~48'
OU5B
0.05
D=~30'
AA87GB0022a
0.53 mg/kg
D = ~48'
AA88GB0020a
0.74 mg/kg
D = ~50'
0.07
D=~4'
E323B08A
0.39 mg/kg
D = ~38'
E240B07A
0.76 mg/kg
D = ~45'
E323B07A
0.96 mg/kg
D = ~36'
0.39
D=~38'
GREEN BAY
0.28
D=~38'
E169B03A
0.94 mg/kg
D = ~35'
E323B06A
0.73 mg/kg
D = 28'
E326B04A
0.72 mg/kg
D = ~28'
0.15
D=~24'
0.01
D=~15'
0.45
D=~28'
OU5A
E165B02A
0.43 mg/kg
D = ~22'
E323B05A
0.59 mg/kg
D = ~23'
MNR02
D = ~20'
MNR01
D = ~10'
E339B04A
0.29 mg/kg
D = ~14'
LEGEND
OU5A
OU5 SURFACE WATER SAMPLING
TRANSECT
40'
WATER DEPTH - 10' INTERVAL
(CONTOURS DERIVED FROM DATA
DOWNLOADED FROM THE NOAA
0.16
D=~61'
CORING LOCATION WITH PCB
CONCENTRATION < 1 ppm (mg/kg)
WITH APPROXIMATE WATER DEPT
1989/1990 GREEN BAY MASS BAL
0.25
D=~48'
CORING LOCATION WITH PCB
CONCENTRATION < 1 ppm (mg/kg)
WITH APPROXIMATE WATER DEPT
1998 BBL SEDIMENT / TISSUE DAT
0.9
CORE SAMPLING LOCATION WITH
PCB RESULTS IN PPM (mg/kg)
CORE CHEMISTRY DATA PROVIDE
TETRA TECH (2004 - 2019)
0.38
CORING LOCATION WITH PCB
CONCENTRATION < 1 ppm (mg/kg)
WITH APPROXIMATE WATER DEPT
JULY 2002 WHITE PAPER No. 19 (
CORING LOCATION
1995 WDNR SEDIMENT DATA COL
GC0378
1.02 mg/kg
D = ~48'
PROPOSED MNR SAMPLING LOCA
WITH PCB CONCENTRATIONS > 1.
APPROXIMATE WATER DEPTH
E339B04A
0.29 mg/kg
PROPOSED MNR SAMPLING LOCA
WITH PCB CONCENTRATIONS < 1



NAVIGATIONAL
CHANNEL
GREEN BAY
Green Bay
5008-12
0.9 mg/kg
GB02-05
0.3 mg/kg
C BOUNDARY
0.1
0.1
0.0
0.1
0.2
0.0
0.4
0.5
0.2
0.4
0.1
0.0
0.5
0.7
0.6
0.5
0.3
0.2
0.8
0.7
0.8
0.7
0.1
1.1
0.7
0.2
3.8
1.4
0.3
0.5
0.2
7.1
0.8
7.0
0.0
LEGEND
DMU DREDGING LIMITS
(PROVIDED BY TETRA TECH
0.7
CORE SAMPLING LOCATION
PCB RESULTS IN PPM
CORE CHEMISTRY DATA
TETRA TECH (2004 - 2019)
0.1
CORE SAMPLING LOCATION
PCB RESULTS IN PPM
JULY 2002 WHITE PAPER
(WDNR, 2003)