LOWER FOX RIVER REMEDIAL DESIGN

CAP OPERATIONS, MAINTENANCE AND MONITORING PLAN

Prepared for

Lower Fox River Remediation LLC

Prepared by

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For Submittal to

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency

Revision 2

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AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
CCU	cap certification unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
CMU	cap management unit
COMMP	Cap Operations, Maintenance, and Monitoring Plan
CQAPP	Construction Quality Assurance Project Plan
cy	cubic yard
DOC	depth of contamination
Glatfelter	P.H. Glatfelter Company
GP	Georgia-Pacific Consumer Products LLC
IGLD85	International Great Lakes Datum of 1985
LTMP	Long Term Monitoring Plan
NAVD88	North American Vertical Datum of 1988
NCR	NCR Corporation
NOAA	National Oceanic and Atmospheric Administration
OU	Operable Unit
PCB	polychlorinated biphenyl
ppm	part per million
QAPP	Quality Assurance Project Plan
RA	remedial action
RAL	remedial action level
RAWP	Work Plan for Remedial Action
RD	remedial design
ROD	Record of Decision
Site	Operable Units 2 to 5 for the Lower Fox River and Green Bay Site
SOP	Standard Operating Procedure
SWAC	surface weighted average concentration
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources

1 INTRODUCTION

This document presents the Cap Operations, Maintenance, and Monitoring Plan (COMMP) for sediment remedial actions (RAs) involving capping in Operable Units (OUs) 2 to 5 for the Lower Fox River and Green Bay Site (Site; Figure 1-1). The OUs 2 to 4 portion of the Site includes approximately 32 miles of the Lower Fox River downstream of the Appleton Locks to the mouth of the Fox River at the City of Green Bay. The bay portion (OU 5) of the Site extends from the mouth of the Fox River at the City of Green Bay to the point where Green Bay enters Lake Michigan.

The original COMMP was prepared pursuant to the remedial design (RD) Administrative Order on Consent (AOC) for OUs 2 to 5, originally executed in March 2004 by Fort James Operating Company, Inc. and NCR Corporation and amended in October 2007. The U.S. Environmental Protection Agency (USEPA) and Wisconsin Department of Natural Resources (WDNR) (collectively the "Response Agencies") approved the COMMP on May 1, 2009. A revised COMMP was prepared in October 2012 and approved on October 26, 2012, as part of the Response Agencies' approval of the 100 Percent Design Report Volume 2. The remedial action (RA) for OUs 2 to 5 is currently underway, pursuant to an Administrative Order for Remedial Action, USEPA Docket Number V-W-08-C-885 (the "Order"). In the course of performing the RA, a need to revise the plans for cap operation, maintenance, and monitoring has arisen. This revision to the COMMP is prepared, as part of the RA work pursuant to the Order, to address this need. Implementation of this revised COMMP is a requirement of the Order, which was issued in 2007 to eight companies, including NCR, GP, and Glatfelter. NCR has entered into a consent decree with the government, in which the government agrees that the Response Agencies will, as an exercise of enforcement discretion, look first to GP and Glatfelter for implementation of the COMMP. In the consent decree, NCR agrees to implement the COMMP in response to a written demand by EPA.

The polychlorinated biphenyls (PCBs) cleanup remedy for the Lower Fox River was originally set forth in Records of Decision (RODs) for OUs 2 to 5 issued in December 2002 and June 2003 by the Response Agencies under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, 42 U.S.C. §§ 9601-9675 (USEPA and WDNR 2002 and 2003). In order to support detailed RD analyses consistent with the RODs, intensive data collection was performed between 2004 and 2007, resulting in collection and analysis of approximately 10,200 sediment samples from 1,900 locations at the Site. In June

2007, a ROD Amendment was issued by USEPA and WDNR that made changes to parts of the remedy described in the original RODs in response to new information collected since 2003, and also from experience with prior remediation activities at the Site (USEPA and WDNR 2007).

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N
W E
S

Operable Unit 5

Operable Unit 4

Operable Unit 3

Operable Unit 2

Green Bay
Ashwaubenon
Allouez
De Pere
Wrightstown
Little Chute
Kaukauna
Appleton
Kimberly
Combined Locks
Menasha
Neenah

0 2.5 5
Miles

Legend

- USACE Channel Definition
- American Transmission Company Line
- Transmission System
- Natural Gas Pipeline
- Fox River Boundary
- Municipal Boundary

Operable Unit Number

- 2
- 3
- 4

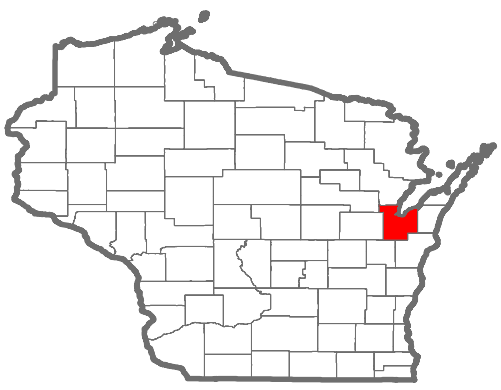


Figure 1-1
Lower Fox River
Area Location Map

Lower Fox River OU 2-OU 5

TETRA TECH

ANCHOR QEA

The 100 Percent Design Report Volume 1 (Tetra Tech et al. 2008) describes RA activities to be performed in 2009, and the 100 Percent Design Report Volume 2 (Tetra Tech et al. 2012) describes RA activities planned for 2010 and beyond. Between 2009 and 2019, more than 5 million cubic yards (cy) of sediments exceeding the 1.0 part per million (ppm) PCB remedial action level (RAL) specified in the RODs and ROD Amendment will be dredged from OUs 2 to 5 and the sediment will be dewatered and transported to permitted disposal facilities. Sand will be segregated from the sediments as practicable, and beneficially reused as approved by WDNR.

Engineered and bulkhead caps will be placed over approximately 183 acres of the river and shoreline area that exceed the 1.0 ppm RAL, and remedy sand covers will be placed over an additional approximate 106 acres to address thin sediment deposits containing relatively low PCB concentrations. In addition, sand covers will be used as a residuals management technique over an estimated 524 acres, depending on post-dredge concentrations of PCB in the sediment. Capping and sand covering of contaminated sediment is anticipated to be conducted over nine seasons, beginning in 2010 and continuing into 2019. The proposed sequence of capping and covering operations will generally proceed upstream to downstream following the completion of dredging in those areas. Completed and planned capping areas in OUs 2 to 5 are shown on Figure 1-5 of the 100 Percent Design Report Volume 2. Nearly all caps planned in OUs 2, 3 and some of OU4 have been installed at the time of this writing.

As described in the ROD Amendment, long-term monitoring of engineered caps installed in OUs 3 to 5 will be performed to ensure their long-term integrity and protectiveness. However, sand covers (placed as the primary remedy or as a post-dredge residuals management technique) will not require long-term monitoring or maintenance, consistent with the ROD Amendment. Baseline cap conditions will be established immediately following cap placement (i.e., during the season in which they are installed and designated as year zero) using pre- and post-cap bathymetric surveys and physical cap material thickness measurements. As described in more detail in Section 2, the long-term monitoring of engineered caps will include bathymetric surveys (primarily using hydrographic methods supplemented with manual survey or poling, as necessary), of the cap surface to monitor the integrity and surface elevation of the caps, beginning in Year 2 following construction, continuing at Year 4, and then approximately every 5 years thereafter unless monitoring indicates a reduced frequency is appropriate. If an area appears to be disturbed, geophysical surveying and/or diver-assisted

inspection may also be performed to better understand the mechanism(s) responsible for the disturbance and the extent of the disturbance. Given that completion of capping is anticipated to span approximately 10 years (beginning in 2010 and continuing into 2019), the initial (i.e., Year 2) monitoring will occur independently within groups of cap certification units (CCUs) completed within the same year of construction. However, subject to adaptive management and the Response Agencies' approval, follow-on monitoring of CCUs completed in different years may potentially be combined to more efficiently monitor the caps. If post-construction monitoring or other information indicates that the cap in an area no longer meets its original performance criteria and that degradation of the cap may result in an actual or threatened release of PCBs exceeding the 1.0 ppm RAL to the sediment surface, additional response activities, potentially including cap sampling where feasible, will be undertaken in the affected area. These additional response actions will be subject to collaborative workgroup discussion and the Response Agencies' approval.

1.1 Purpose and Scope

As discussed in the ROD Amendment and outlined above, certain elements of the OUs 2 to 5 RA will require long-term monitoring and/or maintenance. Long-term monitoring plans in engineered cap areas, along with cap maintenance and contingency measures, are presented in this COMMP.

This document describes post-RA environmental monitoring activities that will be performed in OUs 2 to 5, including post-construction monitoring and maintenance of capped areas to ensure the cap remains physically stable (i.e., does not erode) and chemically protective over time. The overall objective of the COMMP is to confirm that the OUs 2 to 5 RA activities achieve the performance standards specified in the ROD Amendment for verification of the effectiveness of engineered caps. This COMMP also identifies points of compliance for the RA and outlines contingency response actions that will be implemented in the event that engineered caps do not meet performance standards.

There are three types of compliance monitoring: protection, performance, and confirmation monitoring. The objectives of each type of compliance monitoring and associated data evaluations are as follows:

1. **Protection monitoring.** Confirm that human health and the environment are adequately protected during the construction period of the RA
2. **Performance monitoring.** Confirm that the RA has attained the RAL and/or surface weighted average concentration (SWAC), and demonstrate compliance with location-specific applicable or relevant and appropriate requirements (ARARs)
3. **Confirmation monitoring.** Confirm the long-term effectiveness of the RA once protection and performance monitoring is completed within a given OU

Protection and performance monitoring will be performed during implementation of the OUs 2 to 5 RA to verify the performance of dredging, capping, and sand cover placement relative to RD and ROD Amendment requirements. Protection and performance monitoring were initially detailed in the 2009 Construction Quality Assurance Project Plan (CQAPP) included as Appendix D of the 100 Percent Design Report Volume 1. The 2009 CQAPP was expanded to a Site-wide comprehensive CQAPP, which is presented in the 100 Percent Design Volume 2 (Tetra Tech et al. 2012) and will continue to be updated as needed and submitted as Appendix A of each annual Phase 2B Work Plan for Remedial Action (RAWP). The CQAPP plans and performance criteria were developed consistent with the ROD Amendment and built on similar plans and criteria that have been utilized for the Phase 1 and OU 1 projects. Detailed bathymetric surveying and sediment-sampling and -analysis procedures described in the CQAPP (see October 2012 version included as Appendix F of the 100 Percent Design Report Volume 2) are incorporated by reference into this COMMP.

This COMMP addresses confirmation monitoring elements as follows:

- Data quality objectives for post-construction monitoring of caps, including rationale for the type, location, and frequency of monitoring
- Monitoring techniques/methods to be used
- Response actions
- Reporting requirements

1.2 COMMP Organization

Section 2 of this COMMP presents a summary of the cap designs for OUs 2 to 5 and Section 3 presents plans for long-term monitoring and contingency responses should the results of monitoring the caps so indicate. Long-term monitoring of sediment, surface water, and biota will be performed as a separate, coordinated Site-wide activity as described in the Long Term Monitoring Plan (LTMP) (Anchor et al. 2009) and the *OU2-3 Long-Term Monitoring Sampling and Analysis Plan* (Foth. 2012).

1.3 COMMP Methods of Revision

The COMMP will be updated by NCR, once all in-river remedial action has been completed, to reflect final engineered and bulkhead cap quantities and locations. Thereafter, as part of implementation of the COMMP, the parties responsible for implementing the COMMP may propose to the Response Agencies revisions to the COMMP. If approved by the Response Agencies, any revisions to the COMMP will become enforceable requirements. Upon approval by the Response Agencies, the COMMP may also be revised on an as-needed basis, based on experience and field conditions.

2 CAP DESIGN SUMMARY

As discussed in detail in the 100 Percent Design Report Volume 2 for OUs 2 to 5, four different cap designs have been developed to address different capping requirements within the Lower Fox River, consistent with the ROD Amendment. In addition to these four cap designs, bulkheads and special remediation area (SRA) caps have been constructed with contaminated sediment above the RAL.

Bulkheads have RAL sediment remaining between the new bulkhead and the pre-existing bulkhead or remnants thereof. Currently there are two bulkheads that will be classified as caps (RGL and C. Reiss). The Response Agencies in their email of August 29, 2016, designated these bulkheads as engineered caps and subject to long term monitoring of their performance.

SRA caps are installed to provide limited chemical isolation and protective armoring near utilities. These caps are placed near utilities where it would be unsafe to dredge close to the utility. SRA caps will not satisfy all project capping criteria and are considered exceptions due to site-specific constraints.

Additional information regarding each type of cap is provided in the subsections below.

2.1 Caps Constructed of Aggregates

The four cap designs described in the 100 Percent Design Report Volume 2 for OUs 2 to 5, have specified target and minimum thickness criteria for the types of aggregates of which these caps are constructed, as summarized below:

- Cap A – Sand and gravel cap for PCBs ≤ 10 ppm in the underlying 6-inch sediment interval and ≤ 50 ppm in all underlying sediment intervals. Cap A consists of a targeted average thickness of 6 inches of clean sand overlain with a targeted average thickness of 7 inches of placed gravel, taking into consideration operational constraints and over-placement allowances. In areas where the post-cap water depth would be less than 4 feet, the targeted gravel layer thickness will be 12 inches. The placed thickness will be verified as described in the latest version of the Standard Operating Procedure (SOP) for Engineered Cap Verification Sampling and consistent with ROD Amendment requirements. The COMMP will assess long-term cap protectiveness relative to USEPA/U.S. Army Corps of Engineers (USACE) contaminated sediment cap design

criteria (Palermo et al. 1998; Shaw and Anchor 2007), which for Cap A includes a minimum 7 inches of in-place sand and gravel (minimum 9 inches in water depths less than 4 feet).

- Cap B – Sand and gravel cap for PCBs > 10 ppm in the underlying 6-inch sediment interval and ≤ 50 ppm in all underlying sediment intervals. Cap B consists of a targeted average thickness of 9 inches of clean sand overlain with a targeted average thickness of 7 inches of placed gravel, to be verified as described in the latest version of the SOP for Engineered Cap Verification Sampling and consistent with ROD Amendment requirements. In areas where the post-cap water depth would be less than 4 feet, the targeted gravel layer thickness will be 12 inches. The COMMP will assess long-term cap protectiveness criteria for Cap B relative to USEPA/USACE design criteria that specify a minimum 10 inches of in-place sand and gravel (minimum 12 inches in water depths less than 4 feet).
- **Cap C – Sand and quarry spall cap for PCBs > 50 ppm in any underlying sediment interval and for any caps placed in OU 4B federal navigation channels.** Cap C consists of a targeted average thickness of 9 inches of clean sand, overlain by a 6-inch filter layer of placed gravel (or an alternate filter layer design approved by the Response Agencies: e.g., geotextile), and finally overlain by a targeted average thickness of 18 inches of suitably sized armor stone. Within the OU 4B navigation channel, 4- to 9-inch quarry spall will be used for the armor layer. Placed thickness will be verified as described in the latest version of the SOP for Engineering Cap Verification Sampling and consistent with ROD Amendment requirements. The COMMP will assess long-term cap protectiveness criteria for Cap C relative to USEPA/USACE design criteria that specify a minimum 18 inches of in-place sand, gravel, and armor stone.
- **Shoreline Caps.** A range of shoreline cap designs have been developed in the collaborative RD workgroup. These shoreline caps are considered exceptional areas in accordance with the ROD Amendment. The RD workgroup established "ground rules" for appropriate transitions from offshore remedies into adjacent shoreline areas. Application of these ground rules will be performed as RA work progresses, and will be documented in annual Phase 2B RAWPs, also factoring in riparian landowner considerations. Shoreline caps may utilize Cap A, B, or C designs, depending on the

PCB concentrations and erosional conditions, as well as alternate designs approved by the Response Agencies (e.g., potentially incorporating geotextiles).

Further discussion of the designs for the four types of aggregate-constructed caps is presented in Table 6-6 of the 100 Percent Design Report Volume 2. As described in the CQAPP, engineered caps will be divided into CCUs for the purpose of verifying that cap--aggregate placement specifications have been met. Post-aggregate-cap placement bathymetric surveys, conducted during the year of cap completion (Year 0), will be used to establish the baseline condition for the subsequent (Year 2 and beyond) COMMP assessment of long-term changes in the aggregate cap surface elevations and thickness. This baseline condition will be developed on a CCU basis. During construction of the caps, the Tetra Tech Team will further subdivide each CCU into cap management units (CMUs) to facilitate efficient placement and quality control. The specific delineation of CCU and CMU areas will be based in part on the relative size and position of contiguous cap and adjacent cover areas, also considering production rates for engineered aggregate-cap placement, such that CCUs will likely consist of areas with consistent cap thicknesses (i.e., separate CCUs for Caps A, B, C, and shoreline caps). The specific size of CCUs and CMUs will be determined considering the Tetra Tech Team's operational plans and will be presented in the annual Phase 2B RAWP.

2.2 Bulkhead Caps

In some locations, bulkheads have been installed, repaired, or replaced to provide structural integrity of the shoreline adjacent to a dredge area. At the time of this revision, two of these bulkheads were installed with approximately 110 cubic yards (C. Reiss) and 220 cubic yards (RGL) of sediment above the 1 ppm PCB RAL (e.g., at the RGL bulkhead sample data indicated some concentrations exceeding 50 ppm PCBs) remaining between the new bulkhead and pre-existing bulkhead. These new bulkheads are designated as caps. These new bulkheads are designed to prevent the release of the contaminated sediment between the new and pre-existing bulkhead. As such, long term monitoring requirements for these new bulkheads are included in the COMMP.

2.3 Special Remedial Action (SRA) Caps Constructed of Aggregates

In some locations, special remedial action (SRA) caps will be installed to provide limited chemical isolation and protective armoring near utilities. These SRA caps will be placed

near utilities where it would be unsafe to dredge close to the utility. These SRA caps will not satisfy all project capping criteria and are considered exceptions due to site-specific constraints. However, these SRA caps are designed to prevent, as much as possible, the release of contaminated sediment near these utilities while still satisfying the required federally authorized navigational depths. Long term monitoring and maintenance will be performed for all SRA caps per Table 2-1. Once all in-river remedial action has been completed, Table 2-1 will be updated listing the monitoring and maintenance requirements for each SRA cap. Table 2-1 lists the SRA caps that are currently known and may be updated further pending additions or modifications.

Table 2-1
Summary of SRA Cap Monitoring and Maintenance Requirements

SRA Cap ID	Monitoring Required	Maintenance Required	Comment
SRA-03	Yes	Yes	Utility 023
SRA-04	Yes	Yes	D74 DMU-3 (GP Day Street Mill Water Intake Utility)
SRA-05	Yes	Yes	Utility 030
SRA-06	Yes	Yes	Utility 020
SRA-07	Yes	Yes	Utility 029
SRA-08	Yes	Yes	Utility 049

3 MONITORING AND MAINTENANCE OF CAPPING AREAS

The ROD Amendment requires long-term monitoring and maintenance of engineered caps that are installed in OUs 2 to 5 to ensure their long-term integrity and protectiveness. The long-term monitoring and maintenance will include:

- Routine monitoring in all capped areas using bathymetric surveys and other techniques (e.g., geophysical surveys, poling, probing, inspections), as appropriate
- Event-based monitoring in "sentinel" cap and bulkhead areas using bathymetric surveys, instrumentation and other techniques, as appropriate
- Additional cap monitoring and/or sampling based on the routine and event-based monitoring, if appropriate, as determined through collaborative workgroup discussion
- Cap maintenance, enhancement, or other contingency actions as necessary

The physical integrity of the caps constructed of aggregates or other armoring systems/materials such as armored mats will be monitored to verify that the cap meets the ROD Amendment construction requirements, and remains effective in accordance with the ROD standards. Bulkhead caps will be monitored to verify physical integrity by comparing conditions at the time of monitoring to baseline conditions established on the as-built drawings. The physical integrity of the SRA caps constructed of aggregates will be monitored to determine if the SRA caps remain effective. Given that completion of capping is anticipated to span approximately 10 years (beginning in 2010 and continuing through 2019), monitoring will be initiated independently within groupings of CCUs where construction is completed within the same year. The schedule for initiating COMMP-related activities is presented on the schedule for long-term monitoring presented in Appendix A, and outlined in the sections below. Through adaptive management the schedule may be modified to allow more efficient monitoring relative to actual construction completion dates.

The CQAPP and SOP for Engineered Cap Thickness Verification describe the use of sediment cores, "catch pans," or other techniques for measuring the thickness of placed aggregates with consideration of armor stone size. Cap thickness is initially measured by collecting a core sample through the chemical isolation layer, and measuring the thickness of the armor layer of the cap during and immediately following construction. These thickness measurements are used to correlate the cap thickness with aggregate placement records and pre- and post-

placement bathymetric surveys. Measurements of the amount of aggregate placed, verified with post-construction (Year 0) surveys and core and catch-pan thickness measurements, will be performed as necessary to verify that aggregate placement specifications (e.g., thickness and extent) have been met, and also to establish the baseline (Year 0) cap condition for the subsequent assessment of long-term changes in cap thickness.

Post-construction bathymetric surveys of the capped area will be performed during Years 2, 6, and every 5 years thereafter for groups of CCUs completed within the same year of construction. However, subject to adaptive management and Response Agencies' approval, follow-on post-construction physical monitoring of CCUs completed in different years may potentially be combined to monitor more efficiently. Furthermore, the frequency of monitoring outlined above, which is consistent with the ROD, may be reduced, subject to Response Agencies' approval if multiple events show cap areas to be stable. In addition to the planned monitoring events, bathymetric surveys of capped areas 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. Table 3-1 presents a summary of Fox River flow rates.

Table 3-1
Summary of Lower Fox River Flow Rates

Recurrence Interval	Flows at Rapide Croche, Appleton, Wi USGS station 04084445 (cfs)	Flows at Oil Tank Depot at Green Bay, WI USGS station 040851385 (cfs)
2	12,600	15,000
5	15,100	19,700
10	16,500	22,900
20	17,500	25,700
25	18,000	27,100
50	19,000	30,200
100	19,900	33,400

1. The computed recurrence interval flow for the Fox River at Rapide Croche, Appleton, WI USGS station 04084445 is from Walker J.F., and W.R Krug, 2003. "Flood-Frequency Characteristics of Wisconsin Streams". USGS in cooperation with the Wisconsin Department of Transportation. Water-Resources Investigation Report 03-4250. The 20-year recurrence interval was interpolated from the computed recurrence intervals.
2. cfs = cubic feet per second

Supplemental bathymetric surveys will also be performed within 1 year following major river construction events (e.g., new bridge construction), which occur within or adjacent to aggregate

caps, and/or within 1 year following the occurrence of low-water elevations (defined as the lowest monthly average within a given water year, April to March) that are more than 1 foot below the low-water elevations used to develop the cap designs (see table 3.2). 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. Similarly, if cap integrity and performance are verified following water level conditions that are more than 1 foot below the design low-water elevation, follow-on event-based cap monitoring will occur for every additional one-foot drop in elevation.

Table 3-2
Summary of Baseline and Design Low-Water Elevations

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

As discussed in more detail below, if bathymetric surveys show evidence of disruption or erosion of the armor layer, the collaborative workgroups will evaluate the need for additional assessment of affected cap areas, potentially including sampling, poling, and/or sub-bottom profiling. If cap erosion is confirmed by additional assessment such that the minimum cap isolation or armor/bioturbation layer thicknesses are no longer present in more than a minor area of the cap (defined in Section 3.3), then possible response actions can include:

- Armor or otherwise repair the identified area of erosion (e.g., reestablish cap thickness) if the ROD and Response Agencies-approved RD performance standards (i.e., minimum design thickness criteria provided by the 100 Percent Design Report Volume 2) are no longer being met
- Enact managerial or institutional controls, such as changes to vessel operations in specific berthing areas, to help control any further cap erosion

- Removal of the cap and underlying contaminated sediment if monitoring or other information shows a pattern of cap degradation in multiple areas, and pending the results of engineering evaluations

Bulkheads will be monitored for deflection, movement, and corrosion. Deflection or movement of a bulkhead may cause the seal created between sheet piles to open, resulting in loss of contained contaminated sediment from behind the bulkhead. Similarly, corrosion of the steel sheet piles may open a pathway for the contaminated sediment to escape. For this reason, corrosion and thickness of the sheet piles should also be monitored. These two criteria, deflection and corrosion, should be compared to the initial position and thickness established in the as-built drawings as a baseline.

The results of all cap monitoring will be summarized in interim technical memoranda to be submitted to the Response Agencies, and will be used as input to the cap monitoring decision framework discussed in Section 3.3. Consistent with CERCLA requirements, the Response Agencies and the LLC will evaluate cap performance and the need for and scope of continued cap monitoring and contingency response actions as part of the 5-year review process.

The following sections present the cap monitoring plan and contingency response decision framework.

3.1 Routine Monitoring of Caps Constructed of Aggregates or Other Armoring Systems/Materials such as Armored Mats

Following the initial post-construction bathymetric surveying of the capped areas as described in the CQAPP (Year 0), long-term COMMP monitoring of the capping areas will be performed, including bathymetric surveying in all cap areas.

Post-construction bathymetric surveys of the CCUs within all capped areas will be completed during Years 2, 6, 11, etc. within groups of CCUs completed within the same year of construction. Capping in OU 2 and upper OU 3 was completed in 2011. The OU 3 Year 0 post-construction bathymetric survey was completed in November 2011 and an assessment of baseline cap conditions in OU 3 was completed as documented in a Foth Memorandum regarding, *Lower Fox River OU3 COMMP Hydrographic Survey*, dated April 26, 2012. By agreement with the A/OT, the OU 3 "Year 2" cap monitoring event was

performed in 2014 (see Foth 2015, "Lower Fox River OU4 *COMMP* Hydrographic Survey – Year Zero"), with follow-on monitoring to occur in 2018, 2023, etc. Also by agreement with A/OT, the small area of caps placed in OU 2 are considered an exception area, being in slack water and being part of a habitat improvement plan, and are therefore not subject to COMMP requirements.

Year 2 COMMP monitoring within downstream (OU4/5) groups of CCUs will be initiated each subsequent year from 2015 to 2019, or as modified through adaptive management discussions to create efficiencies (Reference Appendix A "*Lower Fox River EPA Guidelines - Long Term Monitoring Schedules*" for details). Capping in OU 4 is scheduled to be completed in 2019, and will constitute the last series of COMMP monitoring events. Cap monitoring in these final areas is, therefore, anticipated to be conducted with Year 0 work in 2019, Year 1 in 2020, and Year 3 in 2022, etc. Cap monitoring after 2019 will be coordinated to combine monitoring events as practicable to take place during the same year, potentially rescheduling the Years 6 and 11 (and beyond) surveys ahead or behind by 1 year to improve monitoring efficiencies, subject to Response Agency approval.

The long-term monitoring hydrographic surveys will be performed using multi-beam acoustical systems that conform to guidelines set forth by the USACE guidance (EM 1110-2-1003, Engineering and Design - Hydrographic Surveying dated January 2002). Details of the survey position and control equipment are presented in the CQAPP and in Section 4 of the 100 Percent Design Report Volume 1. Details of the field instrument calibration and preventative maintenance techniques are presented in the most recent version of the Fox River Quality Assurance Project Plan (QAPP). To the extent possible, survey data will be collected along the same transects in each CCU from year to year (including pre- and post-cap surveys) to ensure comparable data are collected.

3.2 Routine Monitoring of Bulkheads

Two bulkhead caps exist at the time of this revision, the first of which is located along the north shoreline of the RGL slip. The second bulkhead cap is located along the south end of the C. Reiss Coal Company property. The routine monitoring plan for the RGL and C. Reiss bulkheads is presented in Appendix B.

3.3 Event-Based Monitoring of Caps Constructed of Aggregate

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 PCB concentrations. Such sentinel cap monitoring locations will be in areas potentially subjected to the upper 10 percent of predicted peak bottom shear stresses within capping areas (based on project-specific hydrodynamic modeling. As described above, selection of sentinel cap areas for each cap type will include the following considerations:

- Peak shear stress resulting from river flows and seiches
- Near-surface PCB concentration – Cap (especially Cap B) areas with relatively high PCB concentrations in the 6 inches of sediment immediately below the cap were included in the set of sentinel cap areas.
- Areas of high recreational use such as marinas, boat launches, etc. that may be subject to elevated erosional forces from propwash or anchor drag.

Specific sentinel monitoring locations will be refined to correspond with final CMUs, which will be documented as appropriate.

Sentinel cap 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. Table 3-1 presents the flow rates in the Fox River for various return-interval flow events. The 20-year return interval flow at the Rapide Croche gaging station (U.S. Geological

Survey [USGS] Station No. 04084500) was based on linear interpolation using data from Walker and Krug (2003).

Supplemental bathymetric surveys will also be performed in sentinel cap areas 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 Table 3-2. Long-term monitoring modifications will be documented in a revision to this COMMP.

Flows near the mouth of the Fox River (including the combined effects of upstream floods and seiches) are measured approximately every 15 minutes at the Oil Tank Depot gaging station (Station No. 040851385 http://waterdata.usgs.gov/nwis/). The Oil Tank Depot gage is currently operated and supported by the USGS and the Green Bay Metropolitan Sewerage District, respectively, who plan to continue operation of the gage into the future. Hourly average flows exceeding the 20-year return-interval flow rate listed in Table 3-1 (i.e., 25,700 cfs) will be used to trigger the supplemental bathymetric surveys. Updated return-interval flow rates developed by USGS and/or the Tetra Tech Team will also be monitored to refine the appropriate triggers for event-based cap monitoring activities. 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 (e.g., 33,400 cfs; see Table 3-1; subject to future updates).

Lake Michigan water levels are currently measured at the National Oceanic and Atmospheric Administration (NOAA) gaging station near the mouth of Green Bay (Station No. 9087079). Annual low-water elevations (defined as the lowest monthly average within a given water year) from the NOAA gaging station 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 RD baseline water elevation (576.6 feet NAVD88 in OU 4), supplemental bathymetric surveying will be triggered for the following fall after the spring flood season and summer recreational boating season. Follow-up 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:

- Field reconnaissance for evidence of erosional features (e.g., presence of gullies, escarpments, slumps, etc.);
- Monitoring elevation changes using stakes embedded in the cap; and/or
- Follow-up land surveying as necessary to verify elevation changes.

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

3.4 Event-Based Monitoring of Bulkheads

In addition to low water elevation, bulkheads experience a unique set of potential events that may require action. Should one of the events outlined below occur, a dive team certified by the Associations of Diving Contractors International (ADCI) standard will be hired to perform an inspection of the bulkhead for structural integrity and breaches in the bulkhead seal (e.g., puncture, seam separation, etc.) In addition to the dive team inspection, a land survey of the bulkhead will be performed to determine if significant movement occurred from the event. Similar to routine monitoring criteria, significant movement would be considered any deflection greater than the threshold determined by the engineer of record or a Wisconsin licensed structural engineer. Events requiring an inspection include:

- Impact from a vessel.
- Significant new construction by the riparian property owner that results in an increase in loading conditions from those assumed for the bulkhead.
- Excessive upland surcharge greater than the design specifications indicated in the as-built drawings.

The dive team will perform an inspection as soon as available after an event, as described above. The dive team will inspect bulkhead seam integrity and search for any openings in the bulkhead that could lead to potential release of contaminated sediment. The dive team will report its findings to the engineer of record or to a Wisconsin licensed structural engineer, who will provide recommendations on a path forward based on the event and any

damage sustained that might compromise the bulkhead's ability to contain the sediment. In the event of a low water elevation that is more than one foot below the annual mean level, additional inspections of bulkheads may be conducted while there is a greater amount of exposed surface.

3.5 Cap Monitoring Decision Framework Summary

As discussed in the sections above, monitoring of the cap areas will primarily involve routine evaluation of the cap's physical integrity as well as periodic monitoring in sentinel cap areas triggered by high flows, periods of low water, or major in-river construction projects.

The cap monitoring decision tree to be used in OUs 3 to 5 is summarized in Figure 3-1. The bathymetric survey results as well as bulkhead monitoring results will be summarized in interim technical memoranda to be submitted to the Response Agencies. Potential erosion within aggregate cap areas will be identified based on comparison of the most recent bathymetric surveys with the Year 0 bathymetric surveys as the baseline. Potential deterioration of bulkheads will be identified based on comparison of the as-built drawings established as the baseline measurement.

3.5.1 Caps Constructed of Aggregates Monitoring Responses

If bathymetric surveying indicates that the cap armor layer remains intact over 95 percent or more of a CCU area based on a comparison to the baseline survey, no maintenance will be required at that location. Given natural hydrodynamic fluctuations, small (less than 5 percent by area) regions of the cap would be expected to self-level over time, such that the cap armor stone will continue to be maintained. In the event that long-term bathymetric surveying indicates a decrease in the top of cap elevation, but sub-bottom profiling or physical poling confirms the armor stone remains intact, it will be determined that consolidation of the underlying sediment has occurred rather than erosion of cap thickness. In this event, there will be no need for further cap maintenance.

In the event that the bathymetric surveys, physical poling, and/or geophysical surveys (e.g., sub-bottom profiling) identify a contiguous area totaling more than 5 percent of a CCU with no discernable armor layer, the collaborative workgroup will evaluate the need for additional assessment, potentially including:

- Poling of the area(s) preliminarily determined to have undergone erosion to delineate the extent of the area(s); a visual characterization of the cap thickness and physical composition of the cap layer(s) in the suspect area as determined by divers
- Diver inspection to evaluate the need for follow-on cap monitoring/assessment, subject to technical workgroup discussions and Response Agencies' approval:
  - If an intact armor layer is encountered during the visual characterization, the diver will document the thickness of recently deposited sediment that may have accumulated above the armor layer. No additional sampling will be performed (e.g., coring)
  - If the diver determines that the armor layer has been eroded and is not present at the location, the diver will collect a manual measurement and/or push core of the remaining cap layer(s). The technical workgroup will recommend an appropriate analysis technique for the recovered measurement data based on the Site-specific conditions and results of the physical monitoring

In the event that core sampling and chemical analyses are recommended by the collaborative workgroup, such will be performed in accordance with the QAPP. As part of the adaptive management process, alternative methods to monitor the physical and/or chemical integrity of the caps may be identified.

The sampling and analysis techniques discussed above may be revised as necessary as part of the Adaptive Management Plan (see Appendix E of the 100 Percent Design Report, Volume 2). They can be viewed as individual "tools" that are part of a larger "toolbox" of potential responses and strategies following initial indications from geophysical surveying of cap erosion.

If cap erosion, to the point that the cap thickness no longer meets ROD or Response Agencies'-approved performance standards, is confirmed by bathymetric surveys and verified by follow-up monitoring/sampling, possible response actions can include:

- Repairing or augmentation of the thickness of the cap to ensure cap integrity
- Increasing the frequency and intensity of cap monitoring
- Armoring the area of erosion with larger stone

- Enacting managerial or institutional controls, such as changes to vessel operations in specific berthing areas, to help control any further cap erosion
- Removal of the cap and underlying contaminated sediment if monitoring or other information shows a pattern of cap degradation in multiple areas, and pending the results of engineering evaluations

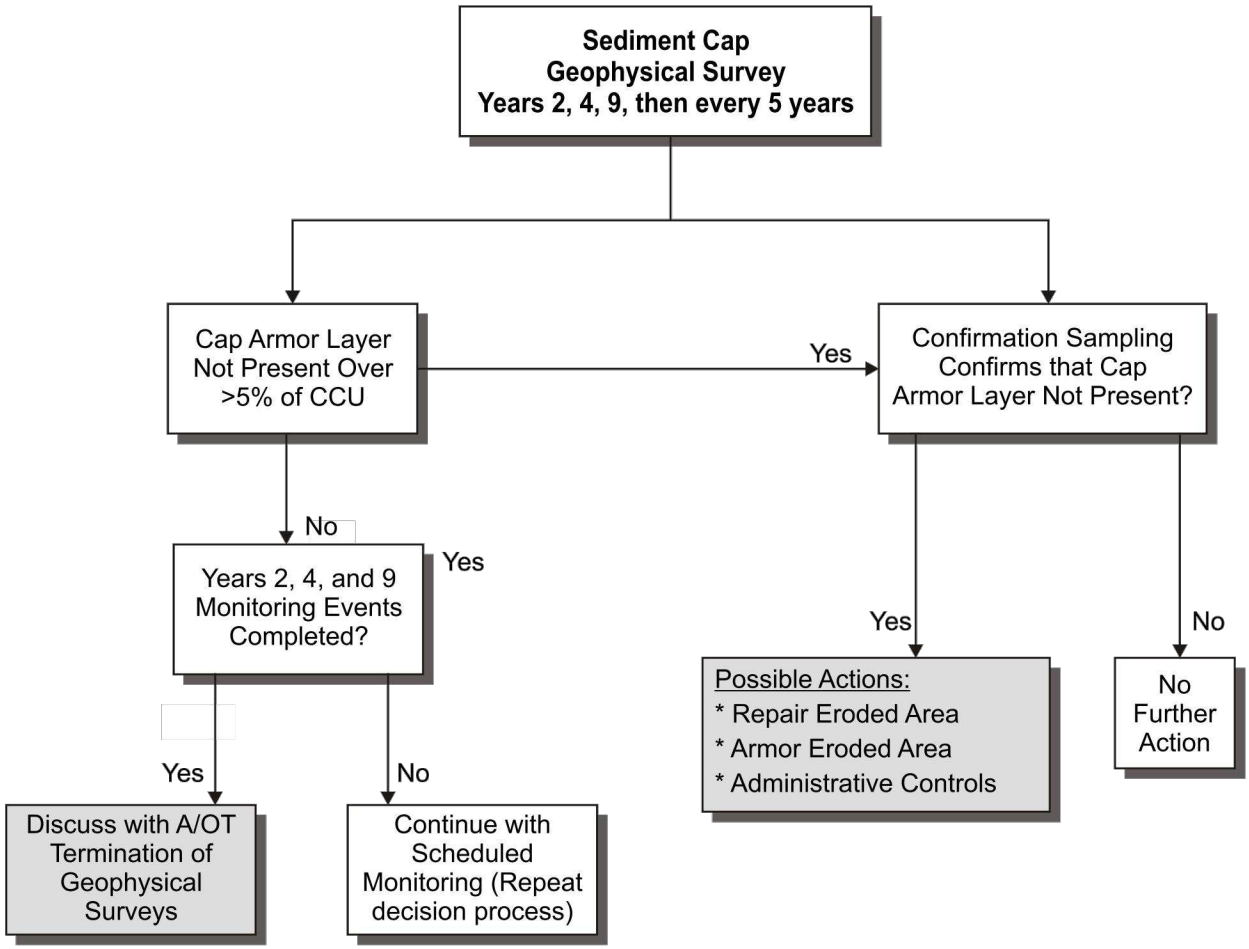
Maintenance records from the caps that have been in place for more than 15 years (e.g., a number of estuarine and river caps constructed in the Pacific Northwest; e.g., Sumeri 1996) indicate that maintenance of up to approximately 5 percent of the total cap area, typically within areas of relatively high peak shear stress, may be needed within the first 5 years following cap construction. After appropriate modifications to the armor stone size, further cap maintenance has not been required at any of these capping sites (up to 20 years after construction) following initial maintenance. Therefore, maintenance of engineered caps to be placed in OUs 3 to 5 may be expected within up to 5 percent of the total cap area within several years following construction.

If monitoring data indicate that a cap placed in an area no longer meets its original design criteria and that degradation of significant areas of the cap may result in an actual or threatened release of PCBs at or from the area, additional supplemental evaluations will be performed to identify additional response activities that may be appropriate for consideration in the area. If monitoring or other information shows a pattern of cap degradation in multiple areas, then additional response activities may be considered, including cap enhancement (e.g., application of a thicker sand layer or stone layer or use of larger armor stone) or cap and underlying contaminated sediment removal. Consistent with CERCLA requirements, the Response Agencies and the LLC will evaluate cap performance and the need for and scope of continued cap monitoring as part of the 5-year review process.

Alternatively, if cap monitoring results, after event-based monitoring and/or scheduled monitoring or inspection, indicate that the cap has consistently maintained integrity over at least 95% of the area (by CCU), the Respondents responsible for implementation of the COMMP may request those CCUs be removed from the requirements of the COMMP.

3.5.2 Bulkhead Cap Monitoring Responses

The engineer of record (preferably) or a Wisconsin licensed structural engineer (if the engineer of record is not available) and the Respondents responsible for implementation of the COMMP will be notified by the party executing the monitoring activity and response activities will be determined in coordination with the Respondents responsible for implementation of the COMMP if the survey results of a bulkhead indicate movement of greater than the allowable measurements as established by the engineers of record, or threaten to release contaminated sediment from behind the bulkhead. The Agencies will be notified verbally within 48 hours of an event as outlined above, such as a vessel being known to have struck a bulkhead and believed to have caused damage to it. A survey and dive team inspection will be conducted within 30 days of the event. Annual reminder letters will be sent to riparian property owners to ensure communication of such an event is documented and GP, Glatfelter and NCR are informed timely to meet these requirements.



Oct 22, 2012 6:16pm tgriga K:\Projects\0295-TetraTech\Lower Fox River OU 2 to 5\0295-RP-001.dwg Figure 3-1

ANCHOR QEA

TETRA TECH

Figure 3-1
Decision Framework for Sediment Cap Monitoring
Lower Fox River OUs 2 to 5

4 REFERENCES

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APPENDIX A

Lower Fox River EPA Guidelines
Long Term Monitoring Schedules
REVISED March 12, 2018

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

Calendar Year	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 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2009	Yes					
2010		Fish Tissue-OU1-Year 0 Water-OU1-Year 0				
2011						
2012		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		
2013						
2014	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		
2015						
2016						
2017						
2018		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		
2019	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
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Calendar Year	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 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2020					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
2021						
2022		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 2 Water-OU4-Year 2 Isolation-Layer-OU4-Year 2	Fish Tissue-OU5-Year 2 Water-OU5-Year 2 MNR Sediment-OU5-Year 2
2023						
2024	Yes					
2025						
2026						
2027		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 7 Water-OU4-Year 7 Isolation-Layer-OU4-Year 7	Fish Tissue-OU5-Year 7 Water-OU5-Year 7 MNR Sediment-OU5-Year 7
2028						
2029	Yes					
2030						
2031						
2032		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 12 Water-OU4-Year 12 Isolation-Layer-OU4-Year 12	Fish Tissue-OU5-Year 12 Water-OU5-Year 12 MNR Sediment-OU5-Year 12
2033						
2034	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Chemical Monitoring Schedule
March 12, 2018

This table identifies the USEPA/WDNR requirements regarding when monitoring functions are to be completed e.g., caps, fish tissue, etc.
If an Operable Unit is completed earlier or later than expected then the USEPA/WDNR will revise this monitoring schedule.

Calendar Year	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 2019)	OU5 Fish, Water, and MNR Sediment (Construction Completed Upstream 2019)
2035						
2036						
2037		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 17 Water-OU4-Year 17 Isolation-Layer-OU4-Year 17	Fish Tissue-OU5-Year 17 Water-OU5-Year 17 MNR Sediment-OU5-Year 17
2038						
2039	Yes					
2040						
2041						
2042		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 22 Water-OU4-Year 22 Isolation-Layer-OU4-Year 22	Fish Tissue-OU5-Year 22 Water-OU5-Year 22 MNR Sediment-OU5-Year 22
2043						
2044	Yes					
2045						
2046						
2047		**Repeat year 2042 monitoring for fish tissue, water, chemical isolation-layer, and monitored natural recovery sediment every five (5) years in perpetuity.**				
2048						
2049	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

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

Calendar Year	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 2019 (Construction Completed 2019)
2009	Yes					
2010		Caps-OU1-Year 0 Note: Year zero for OU1 is the year after construction is completed.				
2011		Caps-OU1-Year 1 Note: Bathymetric Survey Triggered by 5 year recurrence flow rate.	Caps-OU3-Year 0			
2012		Caps-OU1-Year 2 Note: Bathymetric Survey of cap waived because of the 2011 Bathymetric Survey results for 5 year recurrence flow rate.				
2013						
2014	Yes		Caps-OU3-Year 3	Caps-OU4-Year 0 (2013-2014)		
2015						
2016				Caps-OU4-Year 2 (2013-2014)		
2017					Caps-OU4-Year 0 (2015-2017)	
2018		Caps-OU1-Year 8	Caps-OU3-Year 7	Caps-OU4-Year 4 (2013-2014)	Caps-OU4-Year 1 (2015-2017)	
2019	Yes					Caps-OU4/OU5-Year 0 (2019)

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

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

Calendar Year	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 2019 (Construction Completed 2019)
2020						Caps-OU4/OU5-Year 1 (2019)
2021						
2022		Caps-OU1-Year 12	Caps-OU3-Year 11	Caps-OU4-Year 8 (2013-2014)	Caps-OU4-Year 5 (2015-2017)	Caps-OU4/OU5-Year 3 (2019)
2023						
2024	Yes					
2025						
2026						
2027		Caps-OU1-Year 17	Caps-OU3-Year 16	Caps-OU4-Year 13 (2013-2014)	Caps-OU4-Year 10 (2015-2017)	Caps-OU4/OU5-Year 8 (2019)
2028						
2029	Yes					
2030						
2031						
2032		Caps-OU1-Year 22	Caps-OU3-Year 21	Caps-OU4-Year 18 (2013-2014)	Caps-OU4-Year 15 (2015-2017)	Caps-OU4/OU5-Year 13 (2019)
2033						
2034	Yes					

USEPA/WDNR Lower Fox River PCB Project
Long Term Cap Monitoring Schedule
March 12, 2018

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

Calendar Year	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 2019 (Construction Completed 2019)
2035						
2036						
2037		Caps-OU1-Year 27	Caps-OU3-Year 26	Caps-OU4-Year 23 (2013-2014)	Caps-OU4-Year 20 (2015-2017)	Caps-OU4/OU5-Year 18 (2019)
2038						
2039	Yes					
2040						
2041						
2042		Caps-OU1-Year 32	Caps-OU3-Year 31	Caps-OU4-Year 28 (2013-2014)	Caps-OU4-Year 25 (2015-2017)	Caps-OU4/OU5-Year 23 (2019)
2043						
2044	Yes					
2045						
2046						
2047		**Repeat year 2042 monitoring for Caps every five (5) years in perpetuity.**				
2048						
2049	Yes					

APPENDIX B

Monitoring Plan for Bulkhead Caps

RGL, C. Reiss Bulkhead Monitoring Program Outline

Introduction

This monitoring program outlines the procedures for long term monitoring of the RGL Holdings bulkhead and the C. Reiss bulkhead, both of which had improvements completed in 2016. This plan contains input from both GEI Consultants and AECOM, engineers of record for the design of these improvements (RGL Holdings bulkhead and C. Reiss bulkhead respectively). Any additional walls that may be constructed will be monitored using these same procedures.

The monitoring program concept has been developed following guidelines set forth in the U. S. Army Corps of Engineers (USACE) "Inspection, Evaluation and Repair of Hydraulic Steel Structures" (EM 1110-2-6054) and "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures" (ER 1110-2100). General guidance is provided in these documents for the establishment of a sound observation program and reporting on results of the monitoring, noting that each project will have unique requirements to suit the size, age, configuration, and usage of the constructed infrastructure.

The monitoring program will consist of three major elements:

- Visual monitoring with date-stamped photographs
- Top of wall monitoring using topographical survey
- Full depth monitoring through use of geotechnical remote sensing inclinometers

Frequency of the instrumentation monitoring program is proposed to be as follows:

- Monthly for first six months following establishment of the monitoring devices
- Quarterly for the following 18 months
- Annually for the next 3 years
- Every 5 years for the balance of the program

Additional observations may be necessary due to flood, ice, impacts or other potential causes of damage to the wall system. These observations will be added at the discretion of the Response Agencies in collaboration with the party responsible for managing the monitoring program. An annual letter (see Attachment 1) will be sent to riparian property owners reminding them to notify the responsible parties if an event occurs.

The monitoring program frequency will be modified if observation data indicate movement meeting or exceeding the criterion of $^1/_2$-inch per year, in any direction. Further action will be triggered if continued movement is observed and/or if the rate of movement is accelerating, based on observation of the measurement curves.

Proposed Monitoring Program Summary

The bulkhead monitoring program will include the following elements:

- Visual observation of the steel sheets for:

  - Horizontal and vertical alignment
  - Cracks in concrete cap
  - Subsidence behind the bulkhead
- Top of wall alignment topographical surveys using:
  - Four locally installed benchmarks for instrument trilateration, constructed following procedures developed by the National Geodetic Survey
    - Baseline monuments will be constructed in a 12-inch diameter excavation, six feet in depth. A 24-inch thick compacted sand base supports the 6-foot reference rod, encased in 4 feet thickness of concrete over the compacted sand base. The surface of the monument is contoured dome, with a 2-inch domed aluminum concrete survey marker set in the center of the concrete, flush with the surface.
  - Establishment of local control via:
    - Fox River Control Network
    - Multiple transects to ensure accuracy of data.
    - Transect anomalies of ±1/4 inch horizontal and/or ±1/8 inch vertical or greater will be discarded and the transect re-surveyed.
  - Measurement of top of bulkhead observation points (18 points), 15 feet on center, along the length of the bulkhead concrete cap, using:
    - Robotic total station, with accuracy of 2 mm +2 ppm or better
    - Monitoring points - set 2" domed bronze concrete survey markers with 2 1/4" stem. These will be counter sunk and grouted in place to be flush with the concrete cap
    - Target baseline x, y, z coordinates established via multiple series of direct face and reverse face readings, with reference control based on the newly constructed local benchmarks.
- Depth of bulkhead alignment monitoring. For full depth of bulkhead deflection/movement monitoring, a series of three inclinometers will be installed along the length of the bulkhead alignment. General locations are shown on the attached diagrams. Observations of slide and tilt of the bulkhead will be completed using:
  - Remote sensing, in-place instruments for maximum measurement accuracy and repeatability:
    - Durham Geoslope Serial HD IPI
    - Repeatability of ± 22 arc seconds or ±0.1 mm/m.

These instruments will:

- Be socketed into bedrock a minimum of two feet for highly reliable reference through the life of the monitoring program
- Have a setback distance 1.5 times top of wall to dredge depth (28x1.5.42 feet)
- Have flush-mounted protection (i.e., cast in place concrete mass and manhole cover casting) at the surface.

Periodic Inspection Reporting

The Respondents responsible for implementing the COMMP shall prepare a summary report after each inspection to become part of the permanent record, and to provide a basis for increased observation or repair work should any be indicated. Periodic Inspection Reports will be completed within 30 days of the observations.

Steel Sheet Member Thickness Monitoring

Physical measurement of steel sheet thickness is to be completed on a frequency schedule of every 15 years and may be adjusted to align with the long term cap monitoring schedule. The anticipated rate of steel sheet-pile section loss is calculated to be 60-170 micro-meters/year due to oxidation or corrosion caused by environmental factors. This equates to an average of approximately 0.09 inches in 20 years. The PZ40 sheets installed at C. Reiss have a nominal flange and web thicknesses of 0.5 to 0.6 inches, respectively. The PZC 28 sheets installed at RGL have a nominal flange and web thicknesses of 0.645 and 0.57 inches, respectively.

Verifying residual thickness of the members will be accomplished by ultrasonic testing. There are currently a variety of ultrasonic thickness gauges commercially available, and they are relatively easy to use. The Association for Standards Testing of Materials has developed "Standard Practice for Ultrasonic Testing of Wrought Products — E2375", which will be followed for accuracy and consistency of the thickness testing.

A dive team will be needed to collect the underwater measurement data. The dive team shall be licensed/certified to perform supplied air industrial diving in the State of Wisconsin, and resumes must be provided indicating comparable work experience for the firm and the diver.

Scour Monitoring

Movement of vessels into and out of the areas near bulkheads may result in scouring. Monitoring by hydrographic survey will be performed to ensure that the sediment at the toe of the wall does not scour below the level shown on the design drawings. This monitoring will be performed annually for the first 3 years, and then every 5 years for the balance of the program.

ATTACHMENT 1
DRAFT ANNUAL REMINDER LETTER to RIPARIAN PROPERTY OWNERS with BULKHEAD CAPS

[Addressed to RGL or C. Reiss]

Subject: Annual Reminder from Fox River Cleanup Project Regarding Bulkheads

Dear Property Owner:

We are writing to provide an annual reminder from the Fox River cleanup project regarding a bulkhead on your property at [address] that was installed during construction of the Fox River cleanup. In addition to providing structural support for your property, your bulkhead functions as an engineered cap for the Fox River cleanup. That is, the bulkhead isolates a small amount of contaminated river sediment that is located between the current bulkhead and the pre-existing bulkhead structure (110 cubic yards C. Reiss / 220 cubic yards RGL with some sediment concentrations greater than 50 ppm PCBs at RGL). The Fox River cleanup project was undertaken to remove or isolate river sediments that were contaminated with polychlorinated biphenyls (PCBs). While most of the contaminated sediments adjacent to your property were removed from the river, a small amount of sediment was unavoidably located between the new and old bulkheads. Your bulkhead (see attached drawing, as applicable) is expected to prevent PCBs in this sediment from migrating into the river.

In order to perform this function, it is important that the bulkhead remain in good condition. The Fox River cleanup project includes a regular monitoring program that will inspect your bulkhead (from the river) at regular intervals. However, if an event occurs that may compromise the bulkhead's ability to isolate PCBs, it is important for you to let us know right away so that the bulkhead can be inspected promptly.

Please let us know if either of the following occurs or is planned:

- An impact from a vessel against the bulkhead occurs; or any other known or suspected damage to the bulkhead.

- Significant new construction or a change in activities occurs or is planned on your property that results in an increase in loading (especially near the shoreline) above the amount assumed in the design for the bulkhead. We particularly ask that you notify us in advance of any significant increase in loading. The design loads assumed for each bulkhead are as follows:

    - RGL: uniform loads of up to 500 pounds per square foot within 120 feet from the front of the wall. The toe of any surcharge load exceeding this load must be at least 120 feet behind the front sheet pile wall. The maximum crest height of a sand stockpile (if present) is 30 feet, and the maximum base width of the stockpile at grade cannot exceed 150 feet in the north-south direction. The sand is assumed to have a unit weight of 125 pounds per cubic foot (pcf).

- C. Reiss: a maximum surcharge load of 500 psf was assumed for up to 40 feet from the wall.

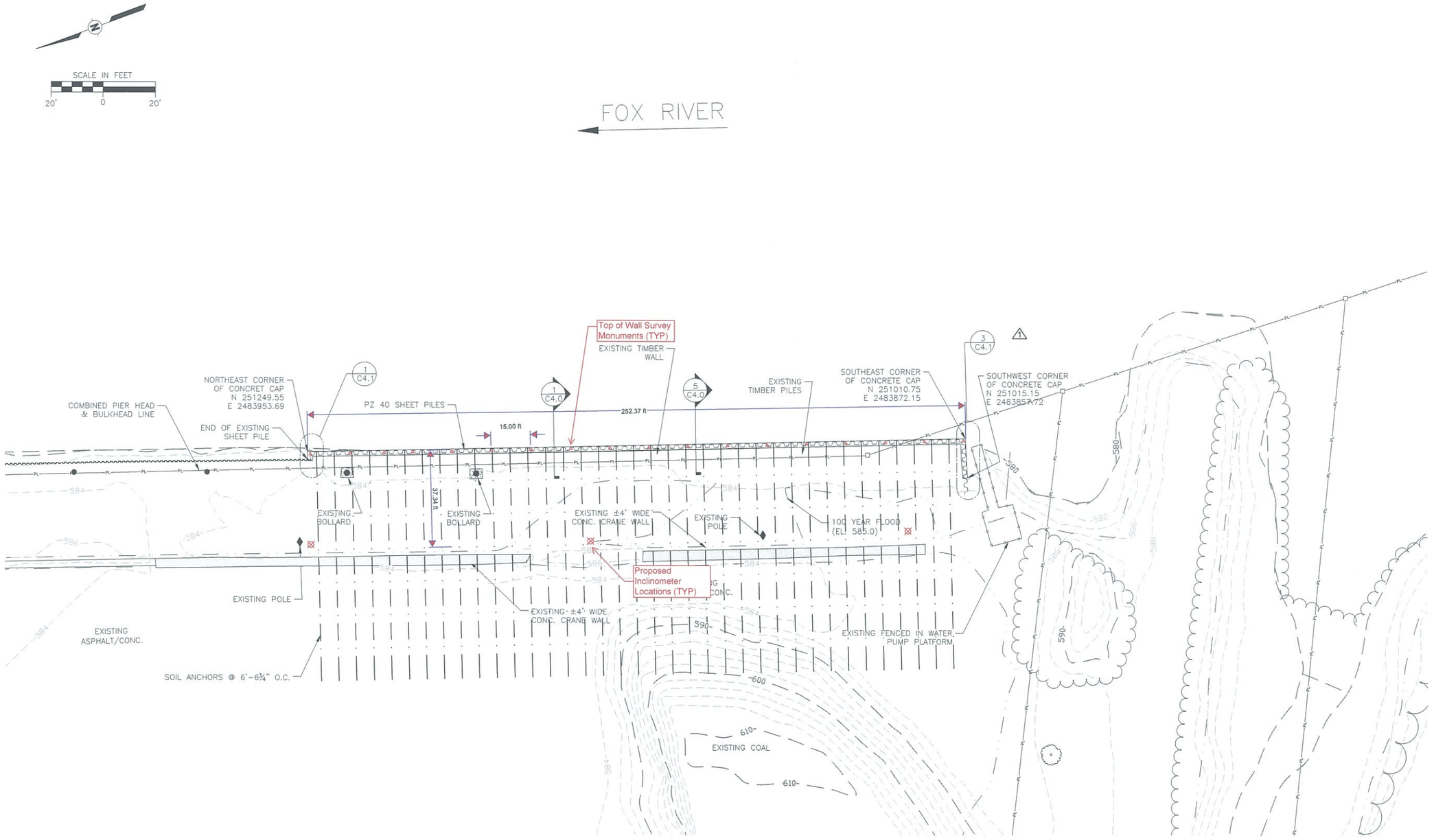
In addition, we ask that you let us know promptly of any change in property ownership or contact person so that we can ensure that future annual reminder letters are sent to the proper, on-site person in charge of the property.

Finally, please note that any inspection that the Fox River cleanup project performs of your bulkhead is for purposes of the cleanup project only. These inspections are not intended to identify structural issues, and none of the U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, nor any of the private entities participating in the cleanup project offer any representation or warranty as to the condition of the bulkhead for structural purposes.

Sincerely,

[WDNR representative]

Last saved by: DESROCHERSR Last Plotted: 2016-12-20 Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI D 22" x 34"
Filename: K:\PROJECTS\60516441_REISS SOUTH BULKHEAD\900-WORKINGDOCS-CAD\AS RECORD DRAWINGS\60488660_C-3.0 SITE PLAN_AR.DWG



NOTES:

1. COORDINATES DENOTE THE LAND SIDE OF THE PZ 40 SHEEET PILES ARE REFERENCED TO WISCONSIN STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE.
2. INACCORDANCE WITH WISCONSIN STATE STATUES, CAHPTER 30, THE SMALL VARIATIONS IN ALIGHMENT ARE INTENDED TO MAINTAIN A NOMINAL 2' OR LESS SPACING BETWEEN THE LAND SIDE OF THE PZ 40 SHEET PILES AND THE EDGE OF THE EXOSTING TIMBER PILES, TO THE EXTENT PRACITICABLE.
3. MATERIAL LAYDOWN AREA WILL BE DETERMINED BY OWNER PRIOR TO CONSTRUCTION.
4. AS CONSTRUCTED SURVEY DATA WAS PROVIDED BY J.F. BRENNAN COMPANY.

"THE INFORMATION SHOWN ON THIS DRAWING CONCERNING TYPE AND LOCATION OF UNDER-GROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING HIS OWN DETERMINA-TIONS AS TO THE TYPE AND LOCATION OF UNDER-GROUND UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO."

TO OBTAIN LOCATIONS OF PARTICIPANTS UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

CALL DIGGERS HOTLINE
1-800-242-8511
TOLL FREE

WIS STATUTE 182.0175(1974) REQUIRES NOW 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE

AECOM

PROJECT

C. Reiss Coal Company
South Bulkhead Improvements
111 W. Mason Street
Green Bay, WI 54303

CLIENT

Tetra Tech
1611 State Street
Green Bay, WI 54304

CONSULTANT

AECOM
2985 South Ridge Road
Suite B
Green Bay, WI 54304
(920) 468-1978 tel
(920) 468-3312 fax
www.aecom.com

REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION
5	12/20/2016	AS-RECORD
4	08/16/2016	ISSUED FOR CONSTRUCTION
3	08/08/2016	BIDDING ADDENDUM 1
2	08/01/2016	ISSUED FOR BID
1	07/22/2016	95% SUBMITTAL

KEY PLAN

PROJECT NUMBER

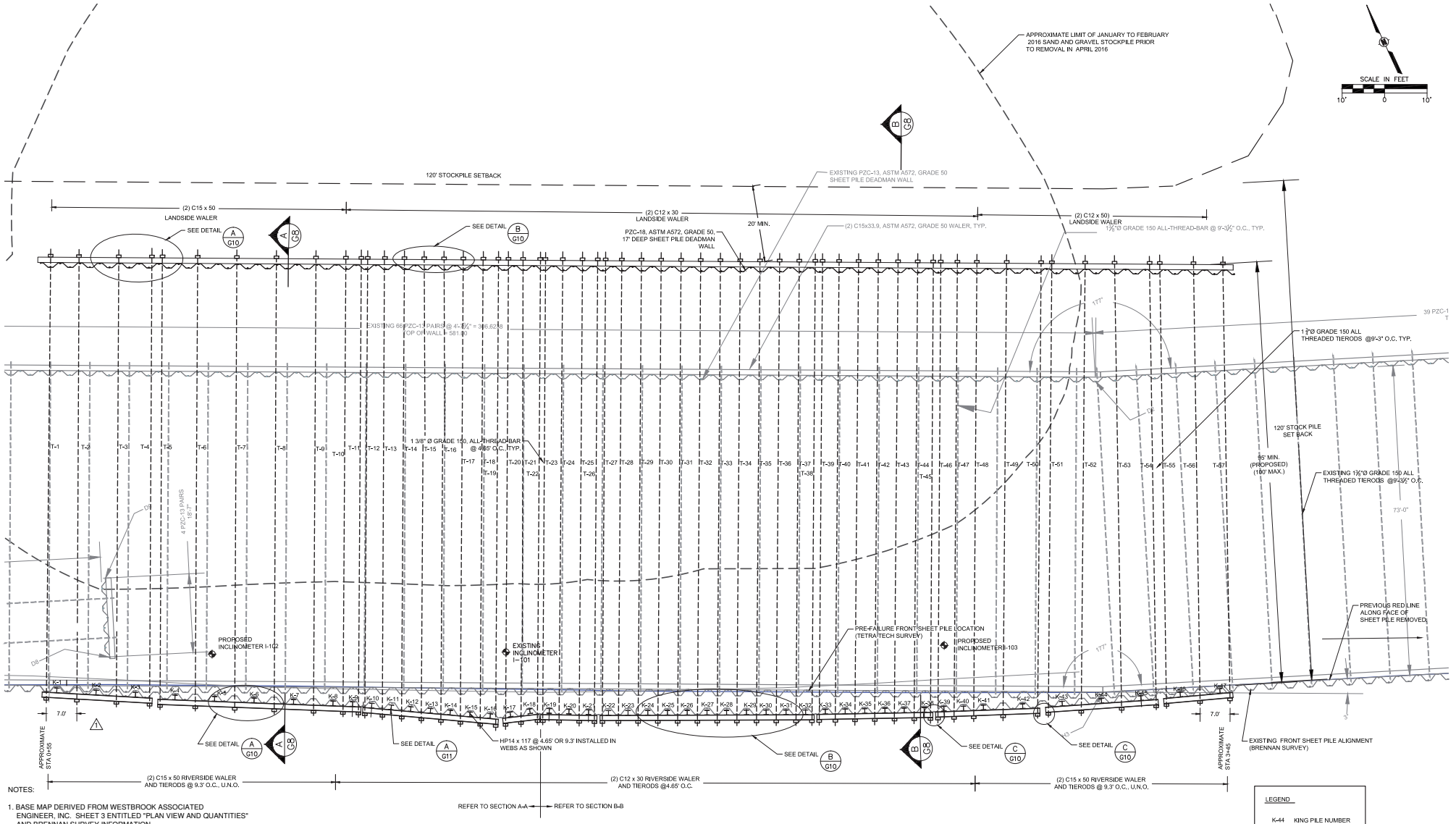
60488660

SHEET TITLE

SITE PLAN

SHEET NUMBER

C-3.0 9 OF 11



NOTES:

1. BASE MAP DERIVED FROM WESTBROOK ASSOCIATED ENGINEER, INC. SHEET 3 ENTITLED "PLAN VIEW AND QUANTITIES" AND BRENNAN SURVEY INFORMATION.
2. FIELD VERIFY ALL DIMENSIONS AND ELEVATIONS.
3. DOCUMENT ALL UNCOVERED OR NEW DISTRESS TIERODS, SHEETING AND CONNECTIONS AND NOTIFY ENGINEER.
4. WALER SPLICE LOCATIONS NOT SHOWN, TO BE DETERMINED BY CONTRACTOR MINIMUM OF TWO TIERODS PER WALER. REFER TO DETAIL C ON G-9.
5. WALER SEGMENTS AND BREAKS SHOWN SCHEMATICALLY. ACTUAL SEGMENT LENGTHS AND BREAK LOCATIONS TO BE DETERMINED IN THE FIELD BASED ON ACTUAL SHEET PILE ALIGNMENT.
6. FIELD VERIFY NEW ANCHOR SHEET PILE WALL ALIGNMENT. LOCATE EXISTING RAILROAD TRACKS, BURIED TIMBER PLATFORMS AND OTHER OBSTRUCTIONS BEFORE DRIVING ANCHOR SHEET PILES.

PARTIAL PLAN

2 SEE DRAWING G-12 FOR AS-BUILT LOCATIONS OF TIERODS, WALERS, AND HP14 x 117 KING PILES

Attention:

0 1"

If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
2	3/8/2017	2016 AS-BUILT DRAWINGS	WHW
1	6/21/2016	FIELD REVISIONS AND CLARIFICATIONS	WHW
0	05/27/16	100% DESIGN FOR CONSTRUCTION	WHW

Designed:	S. NICOSON/ C. TAN
Checked:	C. TAN
Drawn:	J. LEMMENS
Approved By:	W. WALTON
P.E. Number:	30270
Submittal Date:	03/08/2017

GEI Consultants
3159 Voyager Drive
Green Bay, Wisconsin 54311
920-455-8200

J.F. Brennan Company, Inc.
818 Bainbridge Street
LaCrosse, WI 54603

GEI Project 1604210

RGL Holdings Bulkhead Wall Rehabilitation
Green Bay, WI

SHEET. NO. G-7

HEAD SHEET PILE WALL REPAIR PLAN VIEW

REV 2