APPENDIX A

DREDGING AND MATERIALS HANDLING DESIGN SUPPORT DOCUMENTATION

Including

Attachment A-1 Remedial Action Area Delineation

Attachment A-2 In-Water Structure Transition Area Design "Ground Rules"

Attachment A-3 Shoreline Design Refinement "Ground Rules"

Attachment A-4 Dredged Cut and Capped Slope Stability Memo

Attachment A-5 Mass Balance Spreadsheet

Attachment A-6 Geotechnical Data for All Dredge Areas

ATTACHMENT A-1

REMEDIAL ACTION AREA DELINEATION

The following is a summary of the steps used to delineate the lateral extents of RA areas during the development of the dredge, cap, and cover plans.

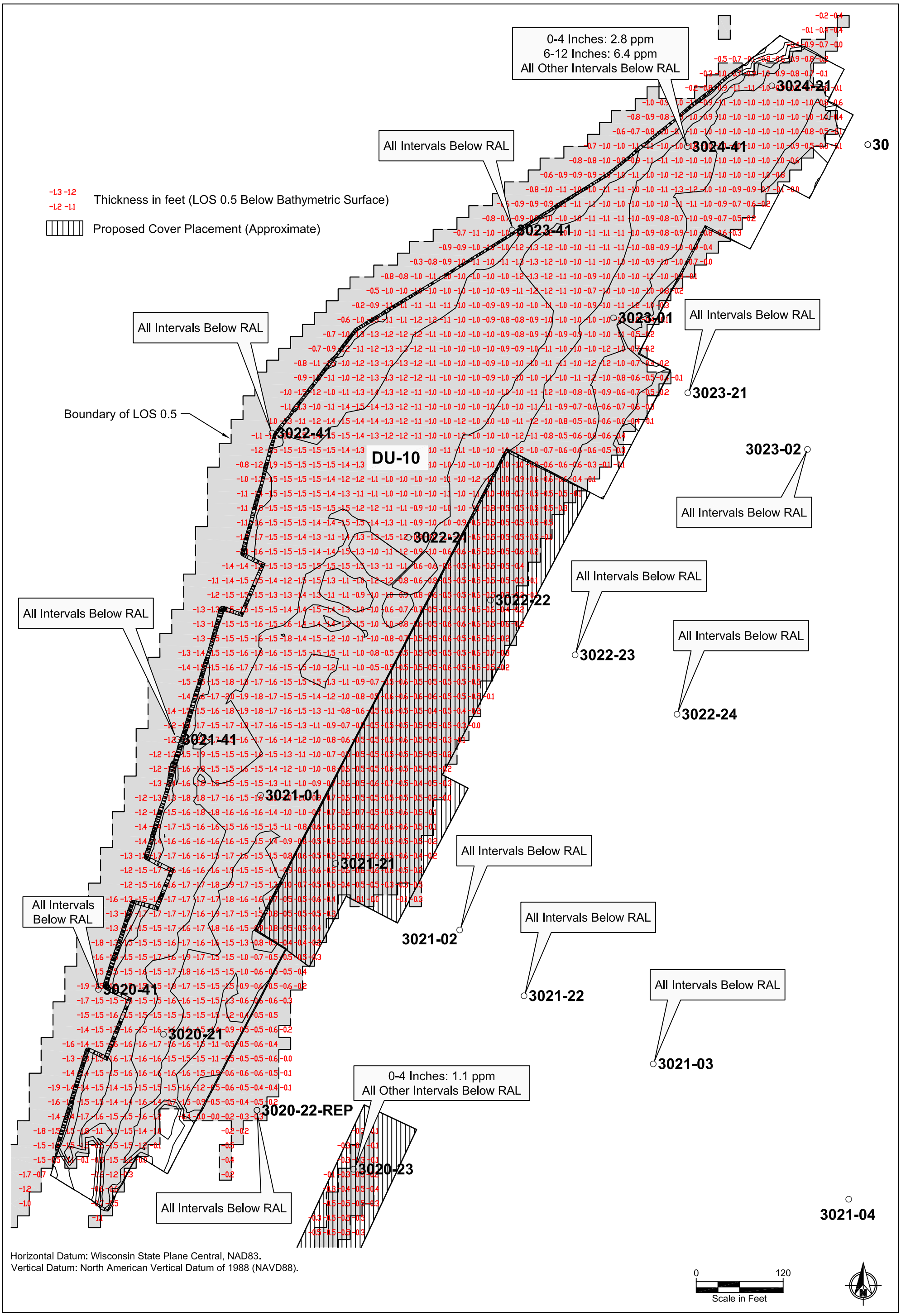
Steps to evaluate lateral extents:

1. RA areas were initially delineated based on a core-by-core analysis using a Thiessen polygon approach during the BODR phase. Each polygon represented a single RD sampling location and preliminary RAs were assigned to each polygon based on the PCB data from the RD sampling (see additional details in Section 4.4.1.1).
2. A geostatistical model, using full indicator kriging (FIK; see Section 2.4 of Volume 2) with RD data collected in 2004 and 2005 provided a three-dimensional surface representing the elevation of contamination above the RAL at various levels of significance (LOS). As discussed in the BODR and 30 Percent Design, the technical workgroups concluded that the LOS of 0.5 provides the optimum combination of maximum percent correct predictions and minimum overall bias and was therefore selected as the basis for delineating sediment with PCB concentrations exceeding the RAL.
3. The delineation of RA areas were refined from the Thiessen polygons developed in the BOD during the 30 Percent Design phase based on the FIK performed using the 2004 and 2005 RD sampling data. Geostatistical delineation of PCB contamination, discrete RD sampling data, and engineering judgment were used to refine the dredge prisms, as explained below:
    a. Cross-sections were generated every 100 to 200 feet along the alignment of the river and at various locations where additional detail was warranted (e.g., areas where the channel alignment and shoreline are not parallel).
    b. Each cross-section was analyzed individually and the lateral extents of remediation (dredging, capping, and sand cover) were delineated based on consideration of the following:
        - RA areas were delineated to address areas where the DOC was predicted to be in excess of approximately 2 to 4 inches (0.2 to 0.3 feet) by the FIK geostatistical model.

- PCB data from discrete core locations within and adjacent to the area were reviewed along with the FIK geostatistical model results. In some instances, the geostatistical model predicted the DOC upwards of 6 inches where the discrete core indicated all samples below the RAL. In these cases, the results of the discrete core samples were considered more accurate and RA areas were delineated accordingly.
- Engineering judgment was used to achieve a more efficient and constructable design. This involved creating minimum width and constant width "lanes" parallel to the channel centerline, bathymetry, or shoreline.

c. Plan view maps of the RA areas were reviewed along with predicted DOC from the geostatistical model shown on a regular grid spacing. Additional refinements were made to the lateral extents of the RA areas based on this review to ensure that the RA boundaries appropriately addressed areas where at least 2 to 4 inches of sediment above the RAL exist.

Figure 1 provides an example area that demonstrates the results of these steps.



Horizontal Datum: Wisconsin State Plane Central, NAD83.
Vertical Datum: North American Vertical Datum of 1988 (NAVD88).

May 29, 2008 10:45am evonckx C:\Documents and Settings\evonckx\Desktop\OU3 60% Dredge Plan WSPC USFT NAVD88 USFT - DH.dwg EXAMPLE

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Thickness of Sediment (in Feet) Between Bathymetric Surface and LOS 0.5
Fox River

ATTACHMENT A-2

IN-WATER STRUCTURE TRANSITION AREA DESIGN “GROUND RULES”

Remedial Design Technical Memorandum

To: Shoreline and Cap Design Sub-Group Coordinators: Tim Harrington (Hard Hat) and Rich Weber (NRT)

From: Matt Henderson, Paul LaRosa, Ram Mohan, and Clay Patmont (Anchor)
Gary Braun and Steve McGee (Tetra Tech)

cc: Jim Hahnenberg (U.S. Environmental Protection Agency), Greg Hill (Wisconsin Department of Natural Resources), and George Berken (Boldt)

Date: June 13, 2008

Re: 60 Percent Design – In-Water Structure Transition Area Design "Ground Rules"

This remedial design (RD) technical memorandum establishes the "ground rules" for the design process that will be used for transition areas between the proposed remedies (dredging and capping) and bridge crossings and utilities in Operable Units (OUs) 2 to 5 of the Lower Fox River (the River). This approach was discussed and agreed upon with the Agency/Oversight Team (A/OT) during the Workgroup 2 conference calls held on April 11, 2008, and April 18, 2008. The "ground rules" described below will be incorporated into the 60 Percent Design submittal and subsequently used to design the site-specific remedy for each bridge and utility crossing in the River with the final remedy for each area to be presented in the annual Remedial Action (RA) Work Plans. The example bridge and utility crossings discussed with the A/OT are also included in this memorandum for reference. This technical memorandum will be included as an appendix to the 60 Percent Remedial Design Report.

Bridge Crossings: Several logistical and safety concerns are associated with remedial construction in close proximity to in-water or nearshore structures such as a bridge piers including the potential to damage or compromise the integrity of a structure (due to settlement or loss of bearing support) and ultimately cause damage to the bridge (in the short or longer term) Therefore, to minimize this liability, the following ground rules were established through collaboration within Workgroup 2:

1. Dredging shall typically be conducted to within 25 feet of a bridge pier, dolphin, or fender, except as modified by site-specific conditions (i.e., a larger or smaller offset) during preparation of annual remedial action work plans..

2. The placement of a sand cover within 25 feet of a bridge pier may be performed if technically feasible and RD sampling results indicate elevated polychlorinated biphenyl (PCB) concentrations and environmental risk warranting special consideration.
3. The placement of capping materials around and under the bridge will be evaluated on a case-by-case basis depending on the vertical clearance under the bridge deck as well as horizontal distances between the piers and structures.

In addition, sand cover placement is currently being evaluated by J.F. Brennan during implementation of the remedy in OU 1. The results of this work will assist in the selection of the site-specific remedies for each bridge during the development of each of the annual RA Work Plans. The proposed remedy will be discussed and coordinated with the owner of each structure during the year prior to the planned RA in the vicinity of that bridge structure. For the purposes of the 60 Percent Design submittal, a 25-foot offset from the edge of bridge piers will be shown on the engineering plans as a general case.

Mason Street Bridge Crossing Example: Attachment A presents an example transition design for the Mason Street bridge crossing in OU 4B that was discussed with the A/OT during the April 11 and 18, 2008, Workgroup 2 meetings. Sheets E-1 and E-2 present the plan and cross-section for the Mason Street bridge, which is supported by concrete piers with a dolphin and fender system protecting the main piers from damage around the navigation channel. The remedy proposed in this area in the 30 Percent Design consists of both dredging and capping. As described above, a 25-foot offset is shown from the edge of the piers and fenders system within which no dredging or engineering capping would be performed. Instead, a 6-inch sand cover may be placed in these areas (as described above) subject to site specific logistical and safety considerations. In addition to the presence of the bridge piers in this area, a 16-inch water main extends across the river parallel to and south of the bridge. A 50-foot offset around this crossing is shown (consistent with the ground rules described below for utility crossings).

Utility Crossings: The primary concern in dredging or capping near buried utilities is that the utility could be damaged during (or following) the implementation of the remedy, potentially resulting in significant worker/public safety issues, environmental damage, as well as disruption of public service. Similar to the ground rules developed for bridge crossings, an

offset from the utility is planned to minimize the chance of damaging the utility during remedial construction. The width of the offset is based on several factors, including:

- The nature of the utility (water, electric, sewer, communication, petroleum, or natural gas, other)
- The availability (and reliability) of design drawings or construction (i.e., as-built) data
- PCB concentrations in the sediment surrounding the utility

In order to minimize the potential for environmental damage or safety concerns, the following ground rules were established through collaboration within Workgroup 2:

1. Dredging and/or capping shall be conducted to within 50 feet of each known or reported river utility crossing.
2. Dredging and/or capping may be conducted using a closer offset distance of 25 feet, if both of the following conditions are met:
    a. If the horizontal and vertical position of the utility or utilities is known with an accuracy of ± 6 inches vertically and ± 5 feet horizontally along the entire utility length as verified by physical surveys (e.g., manual probing)
    b. If RD sampling results indicate elevated PCB concentrations and environmental risk warranting special consideration
    c. If dredging and/or capping will not pose an adverse stability condition to the submerged utility crossing caused by undue stresses or excessive settlements

The proposed remedy and identification of the utility prior to construction will be discussed with the owner of each utility during the year prior to the planned RA in the vicinity of that utility and the design will be documented in the annual RA Work Plans. For the purposes of the 60 Percent Design, a 50-foot offset from the centerline of utility crossings will be shown on the engineering plans within which no dredging or engineering capping will be performed.

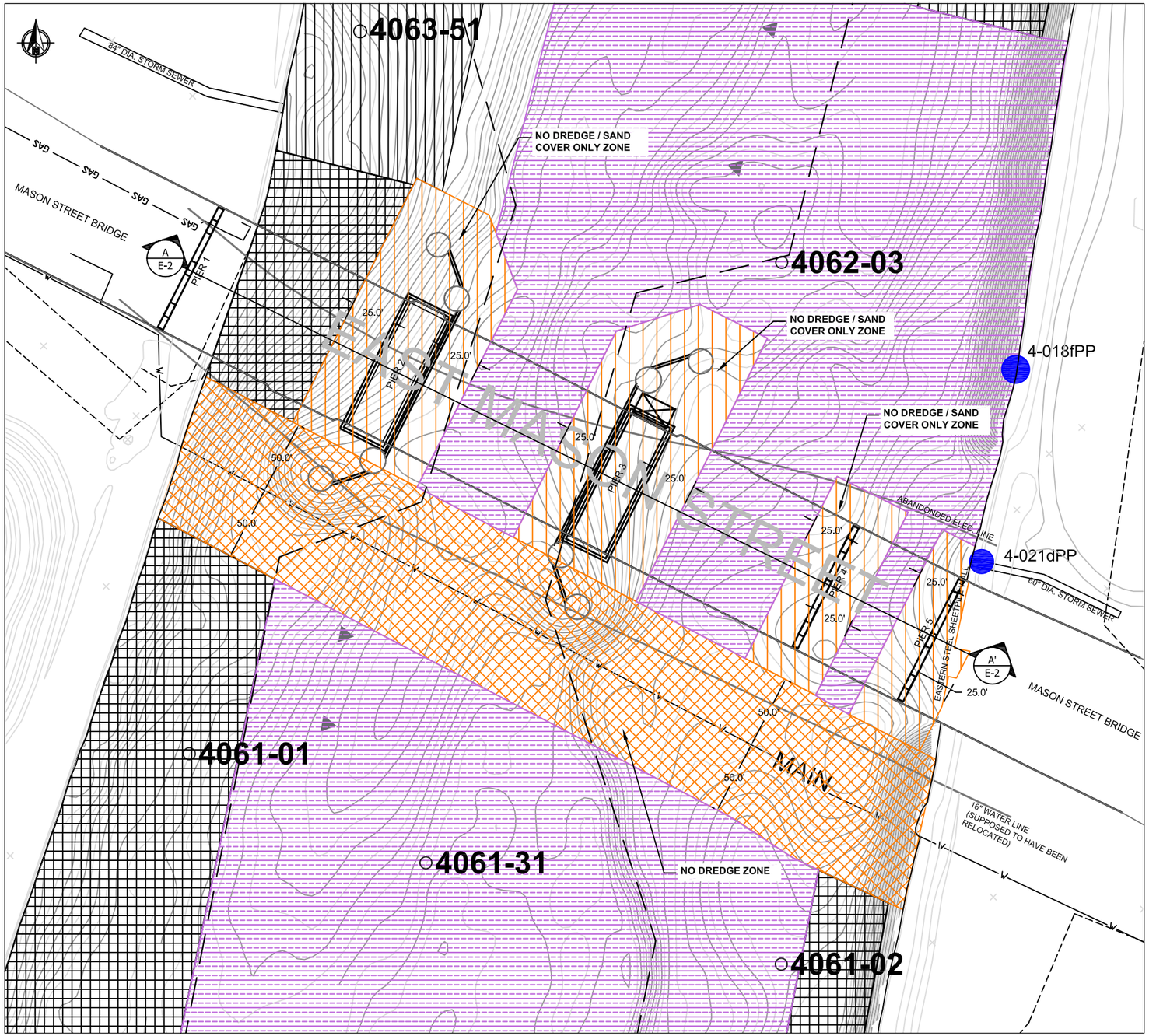
Reid Street and Scheuring Road Water Main Crossing Example: Attachment B presents example transition designs for two utility crossings (City of DePere water main crossings) in OU 3 that were discussed with the A/OT during the April 11 and 18, 2008, Workgroup 2 meetings. Sheets E-3 through E-6 present the plan and cross-sections for these two crossings. The Reid Street water main crossing consists of a 12-inch cast iron (C.I.) water main that extends across the River. The Scheuring Road crossing consists of a 16-inch C.I. water main that is supported by

wooden piles and concrete anchor blocks. To stabilize exposed portions of both water mains in 1997, the City of DePere covered approximately 680 linear feet of the Reid Street water main and 700 linear feet of the Scheuring Road water main with ¾-inch bedding stone, a geotextile fabric, and 2- to 5-inch cover stone. The cover stone features can be readily seen as a ridge (or mound) on the 2004 bathymetry maps (Sheets E-3 and E-5). It is important to note that for the Scheuring Road crossing, the cover stone mound observable on the 2004 bathymetry is approximately 100 feet south of the location of utility as documented in project basemaps developed in 2004 by RETEC. This underscores the uncertainty associated with working in the vicinity of buried utilities as well as the need to field locate these utilities (both horizontally and vertically) prior to actual construction work.

A 50-foot offset is shown on the example drawings in Attachment B from the centerline of each utility crossing. As can be seen on these examples, this 50-foot offset (where no dredging or capping will be performed) is intended to provide sufficient offset to prevent damage to the bedding and cover stone placed by the City of DePere.

ATTACHMENT A

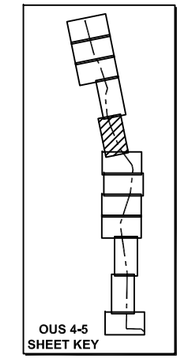
MASON STREET BRIDGE CROSSING EXAMPLE



STATION	Compaction Corrected Interval		Total PCB (mg/kg)
	Top of Core Interval (feet)	Bottom of Core Interval (feet)	
4061-01	0.00	0.54	0.72
4061-01	0.54	1.07	3.10
4061-01	1.07	1.61	2.00
4061-01	1.61	2.14	2.50
4061-01	2.14	2.68	0.44
4061-01	2.68	3.22	0.06
4061-02	0.00	0.67	0.56
4061-02	0.67	1.33	9.10
4061-02	1.33	2.00	10.05
4061-02	2.00	2.67	11.00
4061-02	2.67	3.33	14.00
4061-02	3.33	4.00	17.00
4061-02	4.00	4.67	1.20
4061-02	4.67	5.33	0.08
4061-02	5.33	6.00	0.03
4061-02	6.00	6.67	0.03
4061-02	6.67	7.33	0.03
4061-02	7.33	8.00	0.03
4061-31	0.00	0.52	2.00
4061-31	0.52	1.04	2.90
4061-31	1.04	1.56	2.50
4061-31	1.56	2.08	2.95
4061-31	2.08	2.60	3.10
4061-31	2.60	3.13	3.30
4061-31	3.13	3.65	0.85
4061-31	3.65	4.17	0.03
4061-31	4.17	4.69	0.03
4061-31	4.69	5.21	0.04
4061-31	5.21	5.73	0.03
4061-31	5.73	6.25	0.03
4063-51	0.00	1.43	0.67
4063-51	1.43	3.00	0.77

SAMPLE NOTES:

1. SAMPLE 4062-03 WAS NOT ANALYZED FOR PCB.



- 4089-10 — SAMPLE LOCATION
- 4-003bPP — OUTFALL LOCATION
- NO DREDGE / SAND COVER ONLY ZONES
- NO DREDGE / NO CAPPING ZONES
- COVER - 6" MIN. SAND CAP
- CAP A - 7"-9" MIN. THICK GRAVEL AND SAND CAP
- CAP C - 9" MIN THICK GRAVEL AND SAND CAP WITH 12" THICK ARMOR LAYER
- TRANSECT LOCATION FOR EXAMPLE DRAWINGS
- NAVIGATIONAL CHANNEL LINE
- NEATLINE DREDGING AREA

NOTES:

1. THIS DOCUMENT IS IN PREPARATION FOR REVIEW BY USEPA AND ITS FEDERAL AND STATE PARTNERS AND IS SUBJECT TO CHANGE.
2. ALL NOTES ON EXISTING CONDITIONS SHEETS APPLY.
3. ALL STRUCTURES, LOCATIONS, AND ALIGNMENTS NEED TO BE FIELD VERIFIED AND SHOULD BE CONSIDERED APPROXIMATE.
4. DREDGING SHALL TYPICALLY BE CONDUCTED TO WITHIN 25 FEET OF A BRIDGE PIER, DOLPHIN, OR FENDER, EXCEPT AS MODIFIED BY SITE-SPECIFIC CONDITIONS (I.E., A LARGER OR SMALLER OFFSET) DURING PREPARATION OF ANNUAL REMEDIAL ACTION WORK PLANS.
5. AN OFFSET OF LESS THAN 25-FEET MAY BE USED BASED ON THE FIELD VERIFICATION OF THE LOCATION OF THE BRIDGE PIERS AND FENDER SYSTEM, THE POTENTIAL FOR DAMAGING THE STRUCTURE AND/OR DREDGE EQUIPMENT, AND DISCUSSIONS WITH THE STRUCTURE'S OWNER (THE WISCONSIN DEPARTMENT OF TRANSPORTATION).

SOURCE:

1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL ZONE - NAD83, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
4. MASON STREET BRIDGE PLAN AND SECTION VIEWS DIGITIZED FROM DESIGN DRAWINGS BY THE STATE OF WISCONSIN DEPT. OF TRANSPORTATION, DIVISION OF HIGHWAYS ENTITLED "S.T.H. OVER FOX RIVER - STRUCTURE B-5-134, UNIT 13", SHEETS 1-13, DATED DEC. 1970. PLEASE NOTE THAT THESE ARE NOT AS-BUILT DRAWINGS.

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DESIGNED BY: D. BINKNEY/M. HENDERSON
DRAWN BY: D. BINKNEY/G. BOLIN
CHECKED BY: R. MOHAN/P. LAROSA
APPROVED BY: XX
FILE: AS SHOWN
DATE: MAY 2008

LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

EXAMPLE TRANSITION AREA DRAWINGS
BRIDGE EXAMPLES - PLAN VIEW

E-1

SHEET NO. 1 OF 6

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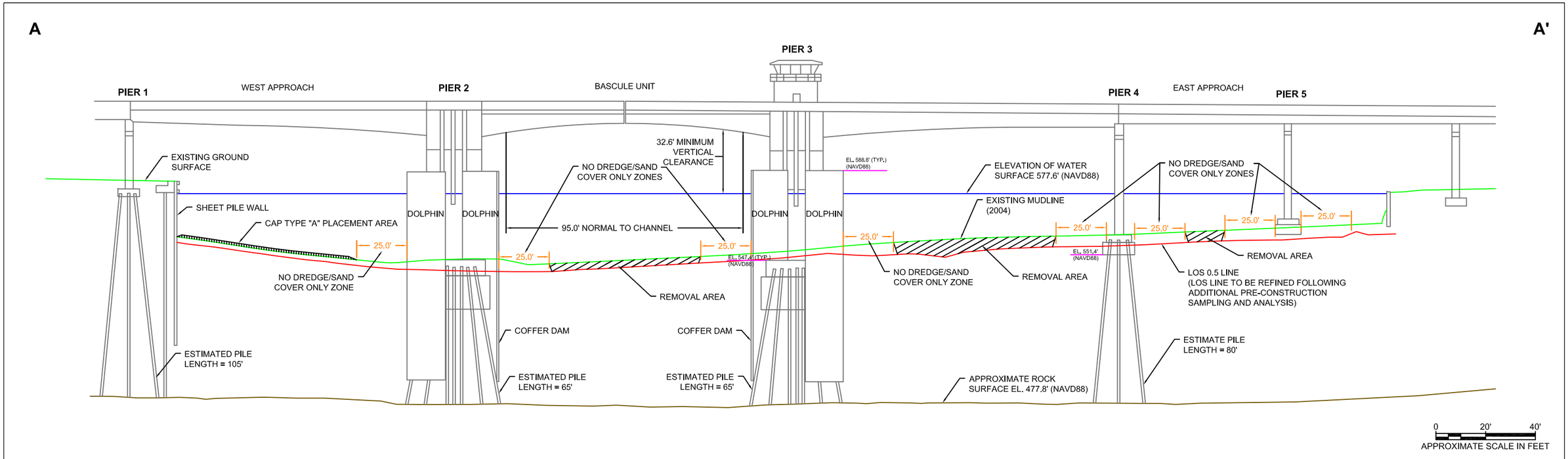
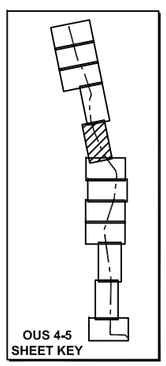


A MASON STREET BRIDGE

APPROXIMATE SCALE 1" = 20'



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- CAP C - 9" MIN THICK GRAVEL AND SAND CAP WITH 12" THICK ARMOR LAYER
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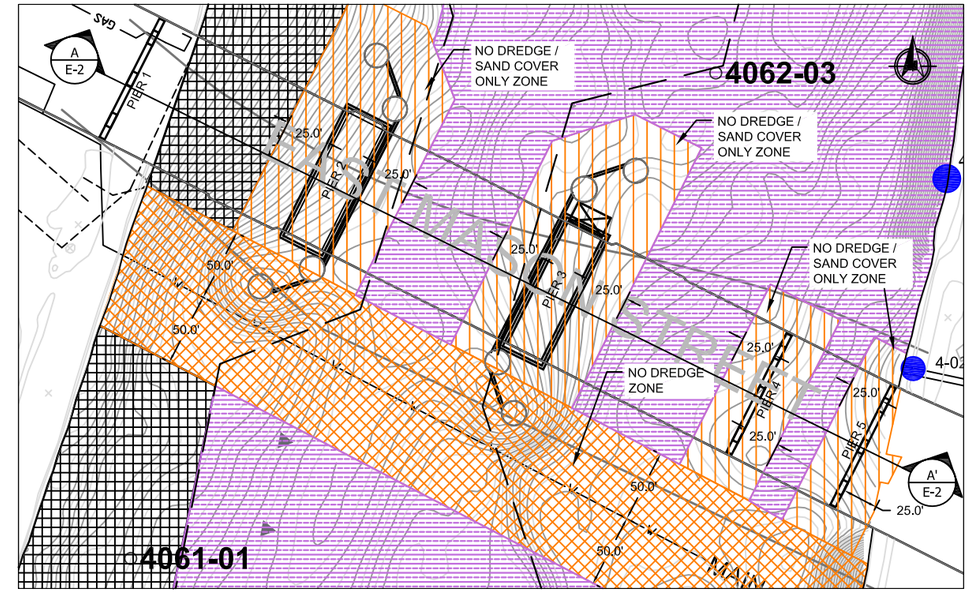
- NEATLINE DREDGING AREA



SECTION LOCATION
NOT TO SCALE

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DESIGNED BY: D. BINKNEY/M. HENDERSON
DRAWN BY: D. BINKNEY/G. BOLIN
CHECKED BY: R. MOHAN/P. LAROSA
APPROVED BY: XX
FILE: AS SHOWN
DATE: MAY 2008

LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

EXAMPLE TRANSITION AREA DRAWINGS
BRIDGE EXAMPLES

E-2

SHEET NO. 2 OF 6

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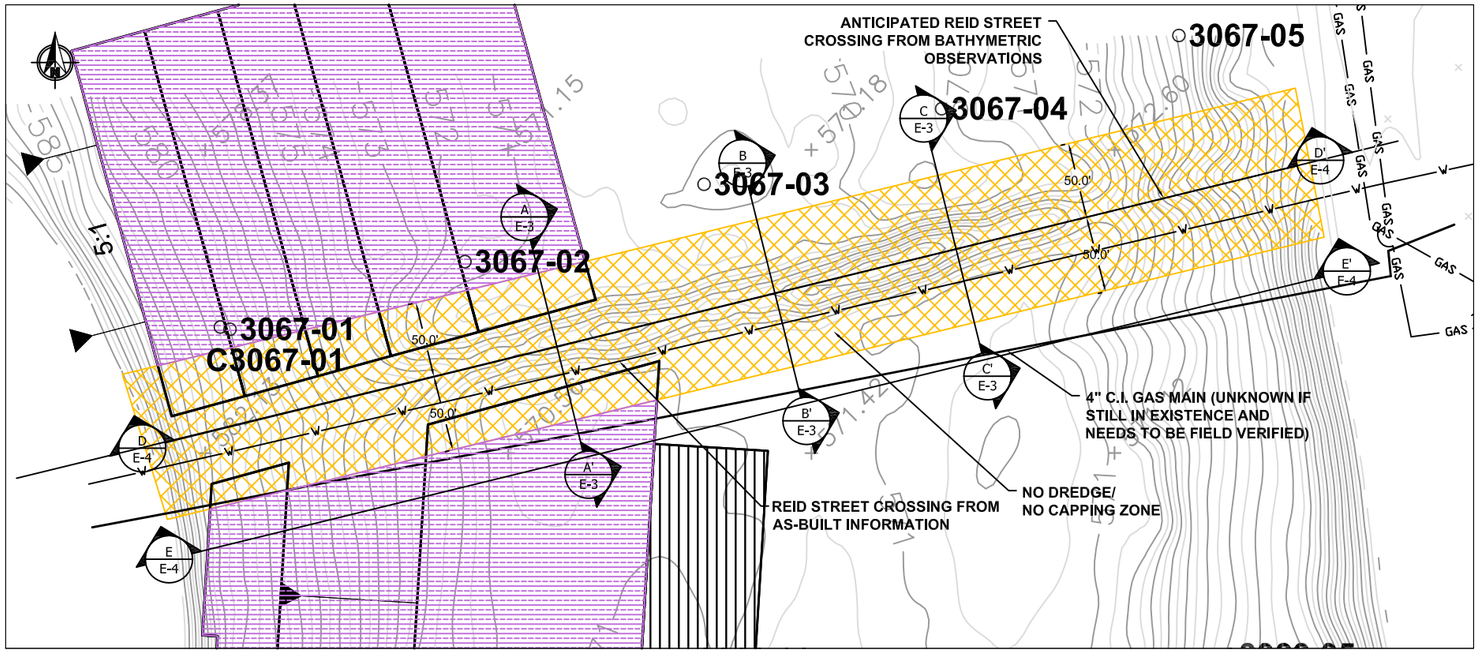
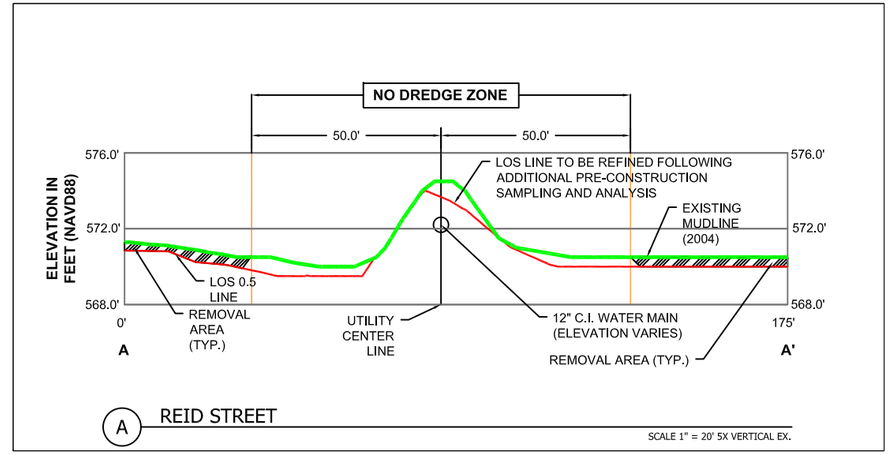
Jun 12, 2008 9:33am gbolin

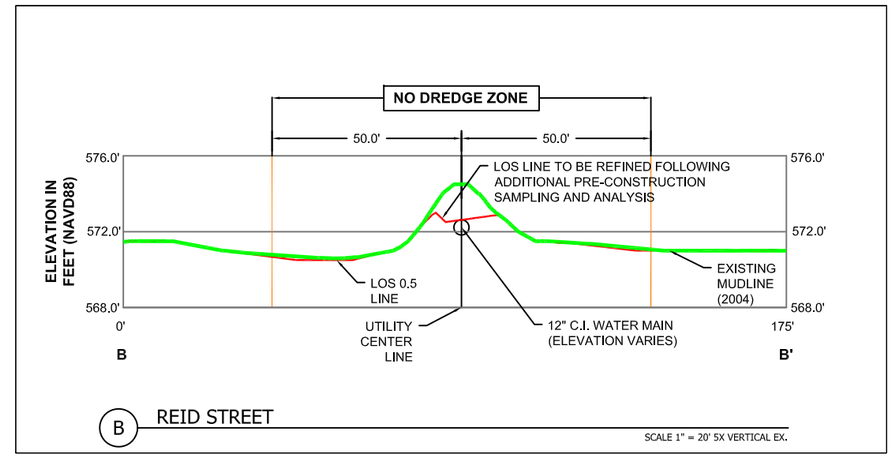
ATTACHMENT B

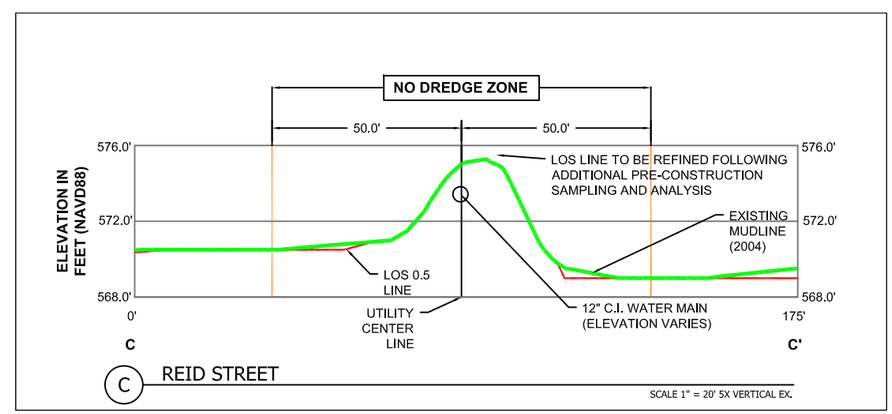
REID STREET AND SCHEURING ROAD WATER MAIN CROSSING EXAMPLE

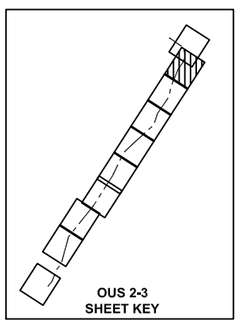


0 50' 100'
SCALE IN FEET
SCALE: 1" = 50'









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3067-01	1.13	1.69	25.00
3067-01	1.69	2.26	1.20
3067-01	2.26	2.82	0.30
3067-01	2.82	3.61	0.08
3067-02	0.00	0.57	28.00
3067-02	0.57	1.15	42.00
3067-02	1.15	1.72	21.01
3067-02	1.72	2.29	0.03
3067-02	2.29	2.87	0.03
3067-02	2.87	3.44	0.03
3067-02	3.44	3.90	0.03
3067-03	0.00	0.63	0.30
3067-03	0.63	1.50	1.20
3067-04	0.00	0.60	0.05
3067-04	0.60	0.96	0.03
3067-05	0.00	0.53	0.32
3067-05	0.53	1.05	0.03
3067-05	1.05	1.58	0.03

LEGEND

- 4089-10 SAMPLE LOCATION
- 4-003bPP OUTFALL LOCATION
- NO DREDGE / NO CAPPING ZONES
- HORIZONTAL:VERTICAL SLOPE IN DIRECTION OF ARROW
- COVER - 6" MIN. SAND CAP
- CAP A - 7"-9" MIN. THICK GRAVEL AND SAND CAP
- TRANSECT LOCATION FOR EXAMPLE DRAWINGS
- NEATLINE DREDGING AREA

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL ZONE, NAD83, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM (NAVD88), U.S. SURVEY FEET.
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DRAWN BY: D. BINKNEY/G. BOLIN
CHECKED BY: R. MOHAN/P. LAROSA
APPROVED BY: XX
FILE: AS SHOWN
DATE: MAY 2008

LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

UTILITY CROSSING EXAMPLES
REID STREET SECTIONS

E-3

SHEET NO. 3 OF 6

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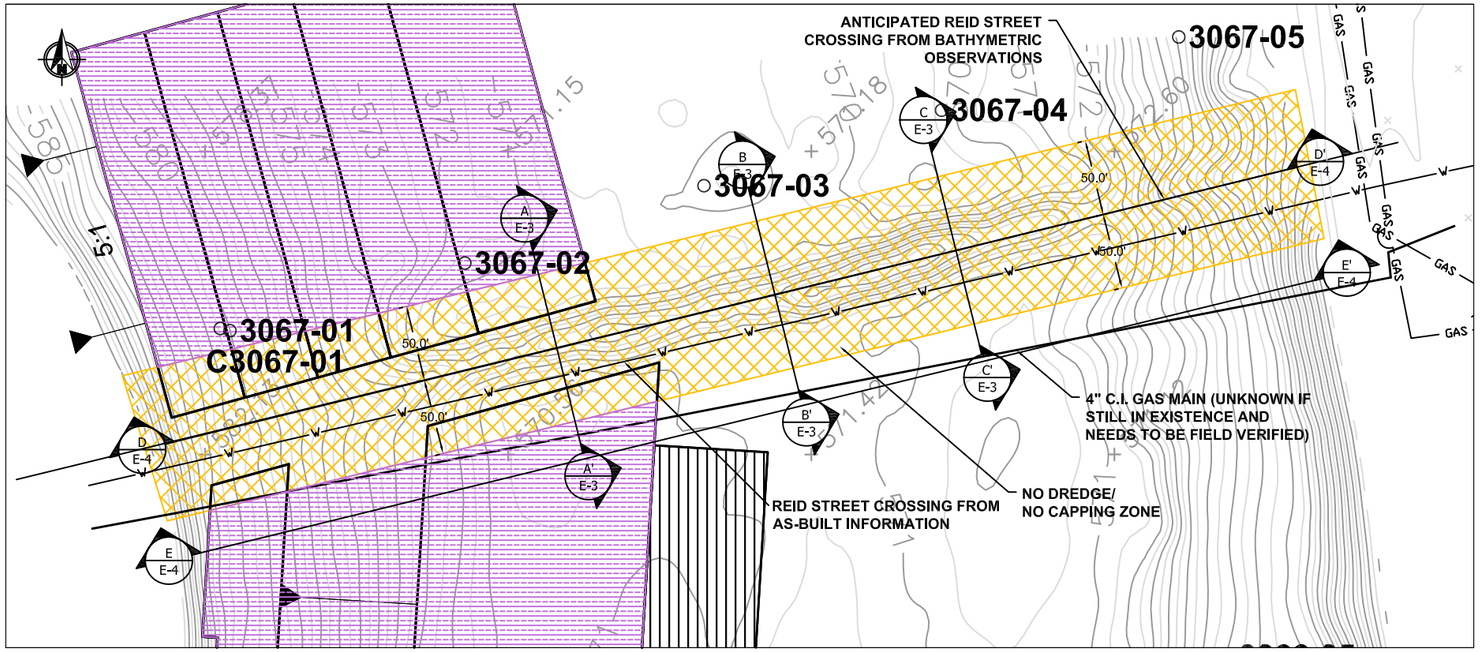

0 50' 100'

SCALE IN FEET

SCALE: 1" = 50'

LEGEND

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- 4-003bPP OUTFALL LOCATION
- NO DREDGE / NO CAPPING ZONES
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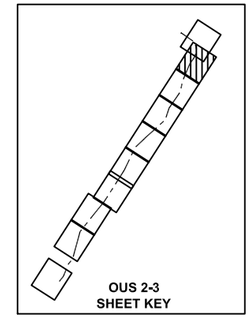
- TRANSECT LOCATION FOR EXAMPLE DRAWINGS
- NEATLINE DREDGING AREA



STATION	Compaction Corrected Interval		Total PCB (mg/kg)
	Top of Core Interval (feet)	Bottom of Core Interval (feet)	
3067-01	0.00	0.56	3.30
3067-01	0.56	1.13	36.00
3067-01	1.13	1.69	25.00
3067-01	1.69	2.26	1.20
3067-01	2.26	2.82	0.30
3067-01	2.82	3.61	0.08
3067-02	0.00	0.57	28.00
3067-02	0.57	1.15	42.00
3067-02	1.15	1.72	21.01
3067-02	1.72	2.29	0.03
3067-02	2.29	2.87	0.03
3067-02	2.87	3.44	0.03
3067-02	3.44	3.90	0.03
3067-03	0.00	0.63	0.30
3067-03	0.63	1.50	1.20
3067-04	0.00	0.60	0.05
3067-04	0.60	0.96	0.03
3067-05	0.00	0.53	0.32
3067-05	0.53	1.05	0.03
3067-05	1.05	1.58	0.03

NOTES:

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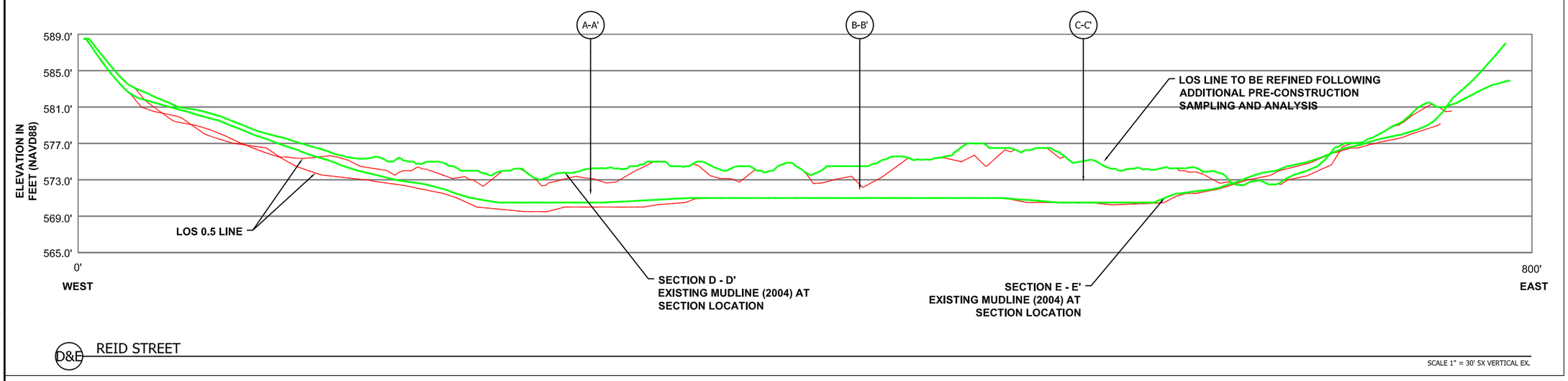

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LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

UTILITY CROSSING EXAMPLES
REID STREET SECTIONS

E-4

SHEET NO. 4 OF 6

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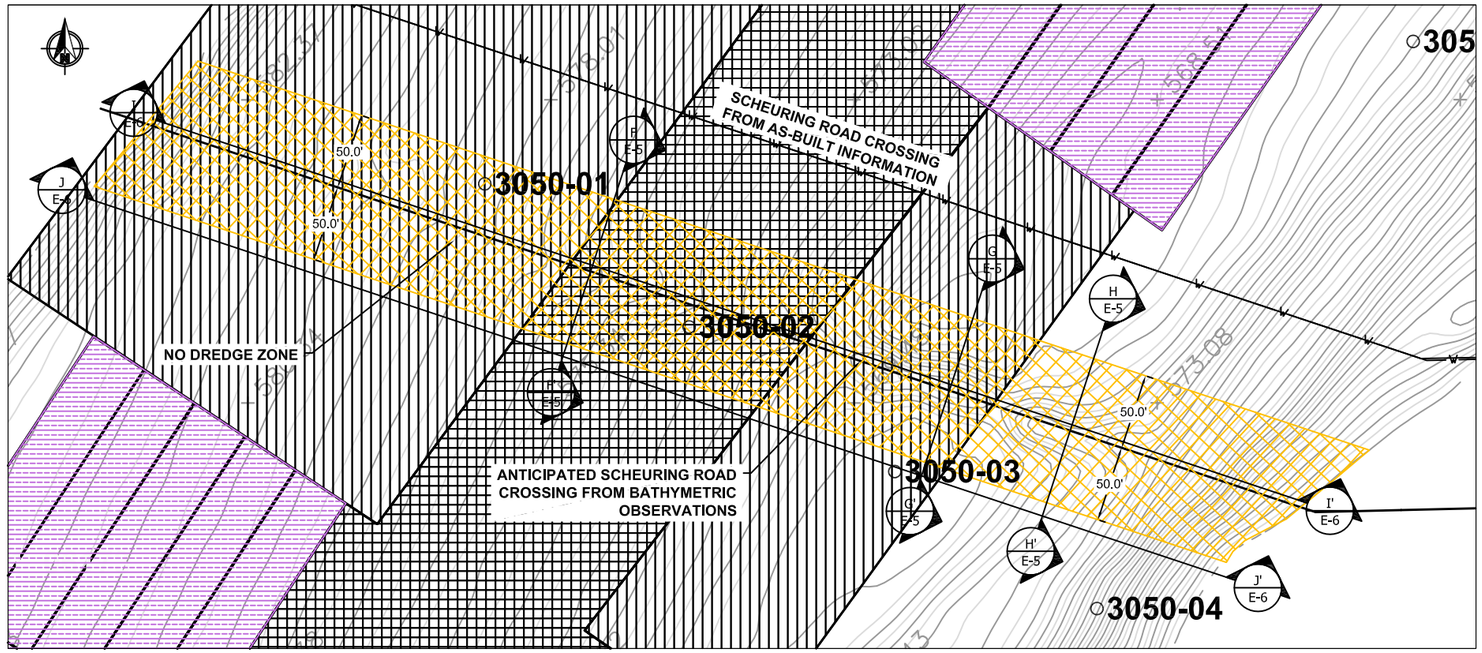

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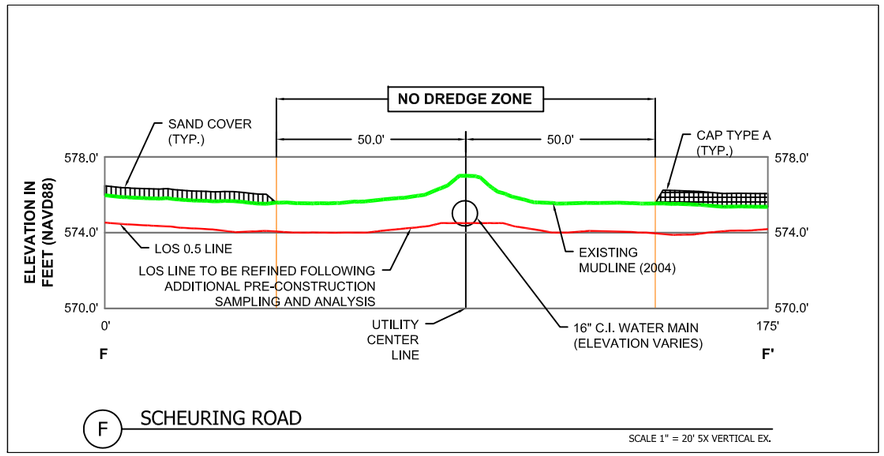
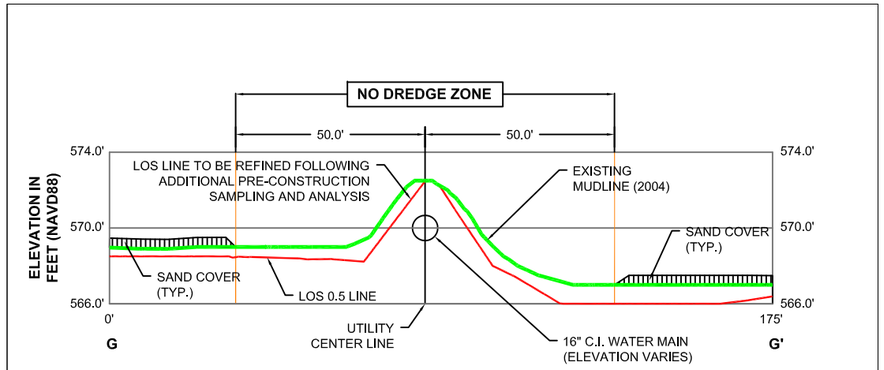
SCALE IN FEET
SCALE: 1" = 50'



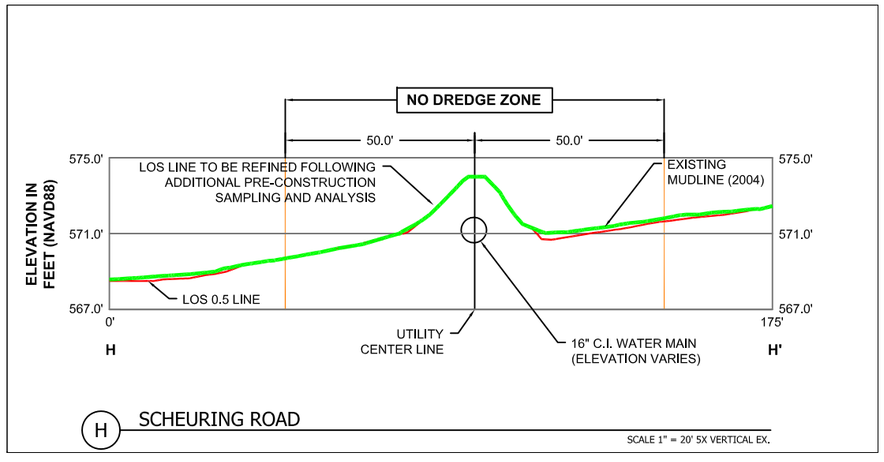
F SCHEURING ROAD

SCALE 1" = 20' 5X VERTICAL EX.



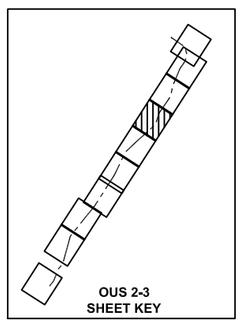
G SCHEURING ROAD

SCALE 1" = 20' 5X VERTICAL EX.



H SCHEURING ROAD

SCALE 1" = 20' 5X VERTICAL EX.



OUS 2-3
SHEET KEY

STATION	Compaction Corrected Interval		Total PCB (mg/kg)
	Top of Core Interval (feet)	Bottom of Core Interval (feet)	
3050-01	0.00	0.59	1.50
3050-01	0.59	1.18	0.82
3050-01	1.18	1.76	0.25
3050-02	0.00	0.65	7.50
3050-02	0.65	1.30	0.76
3050-03	0.00	0.55	1.50
3050-03	0.55	1.10	0.99
3050-03	1.10	1.65	0.34
3050-03	1.65	2.21	0.06
3050-03	2.21	2.76	0.03
3050-04	0.00	0.56	0.03
3050-04	0.56	1.13	0.03
3051-01	0.00	0.51	0.78
3051-01	0.51	1.02	0.37
3051-01	1.02	1.53	0.08
3051-02	0.00	0.58	5.90
3051-02	0.58	1.16	0.90
3051-02	1.16	1.73	1.10
3051-02	1.73	2.31	0.35
3051-02	2.31	2.89	0.06
3051-02	2.89	3.47	0.03
3051-03	0.00	0.63	18.00
3051-03	0.63	1.25	0.87
3051-03	1.25	1.88	0.46
3051-04	0.00	0.54	0.13
3051-04	0.54	1.07	0.03
3051-04	1.07	1.61	0.03
3051-05	0.00	0.56	0.18
3051-05	0.56	1.11	0.33
3051-05	1.11	1.67	0.03

SAMPLE NOTES:
1. SAMPLE 3051-01 LOCATED OUT OF THE PLAN VIEWPORT, APPROXIMATELY 424.8 FT NORTH EAST (DOWNSTREAM) OF SAMPLE 3050-01.
2. SAMPLE 3051-02 LOCATED OUT OF THE PLAN VIEWPORT, APPROXIMATELY 426.7 FT NORTH EAST (DOWNSTREAM) OF SAMPLE 3050-02.
3. SAMPLE 3051-03 LOCATED OUT OF THE PLAN VIEWPORT, APPROXIMATELY 428.2 FT NORTH EAST (DOWNSTREAM) OF SAMPLE 3050-03.
4. SAMPLE 3051-04 LOCATED OUT OF THE PLAN VIEWPORT, APPROXIMATELY 429.0 FT NORTH EAST (DOWNSTREAM) OF SAMPLE 3050-04.
5. SAMPLE 3051-05 LOCATED OUT OF THE PLAN VIEWPORT, APPROXIMATELY 443.6 FT EAST-NORTH EAST (DOWNSTREAM) OF SAMPLE 3050-04.

LEGEND

- 4089-10 SAMPLE LOCATION
- 4-003bPP OUTFALL LOCATION
- NO DREDGE / NO CAPPING ZONES
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LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

UTILITY CROSSING EXAMPLES
SCHEURING ROAD SECTIONS

E-5

SHEET NO. 5 OF 6

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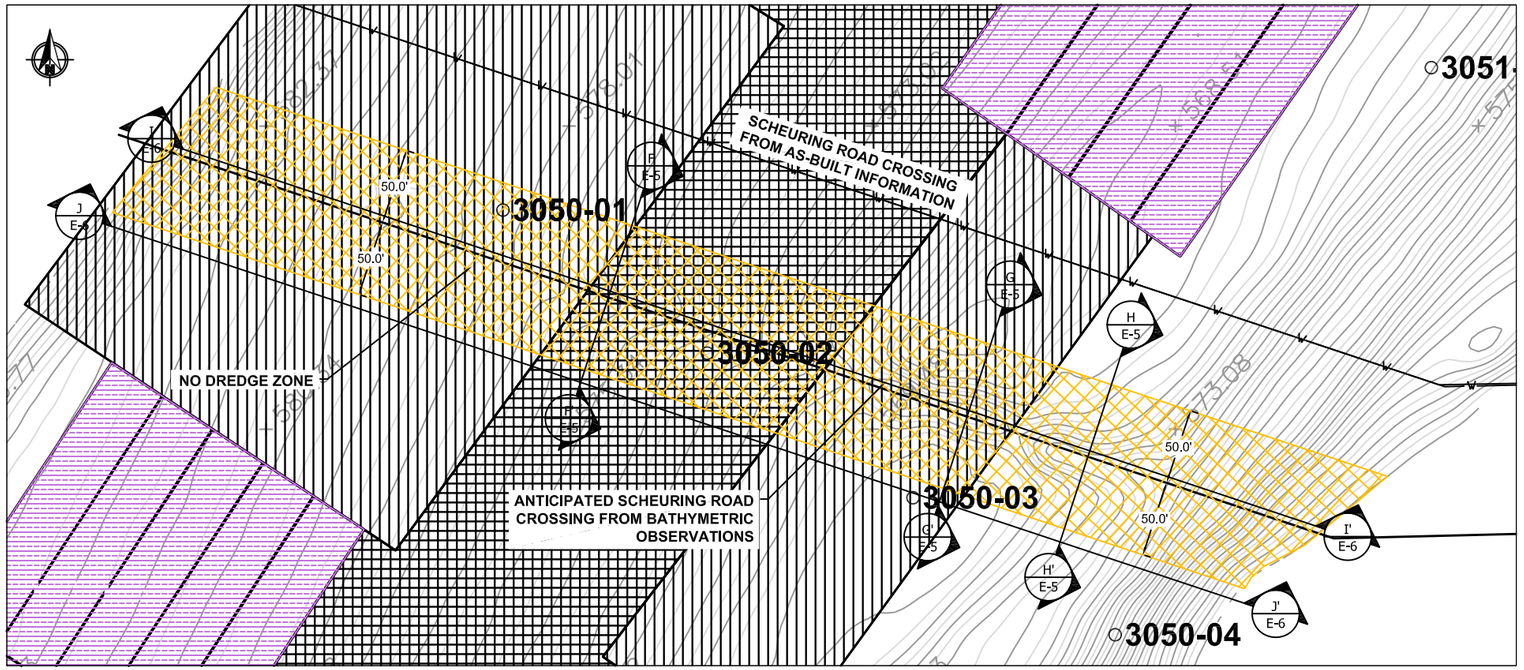

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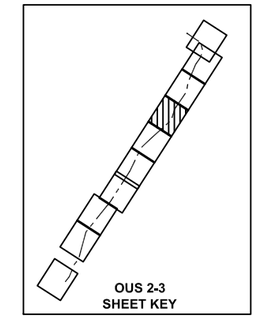

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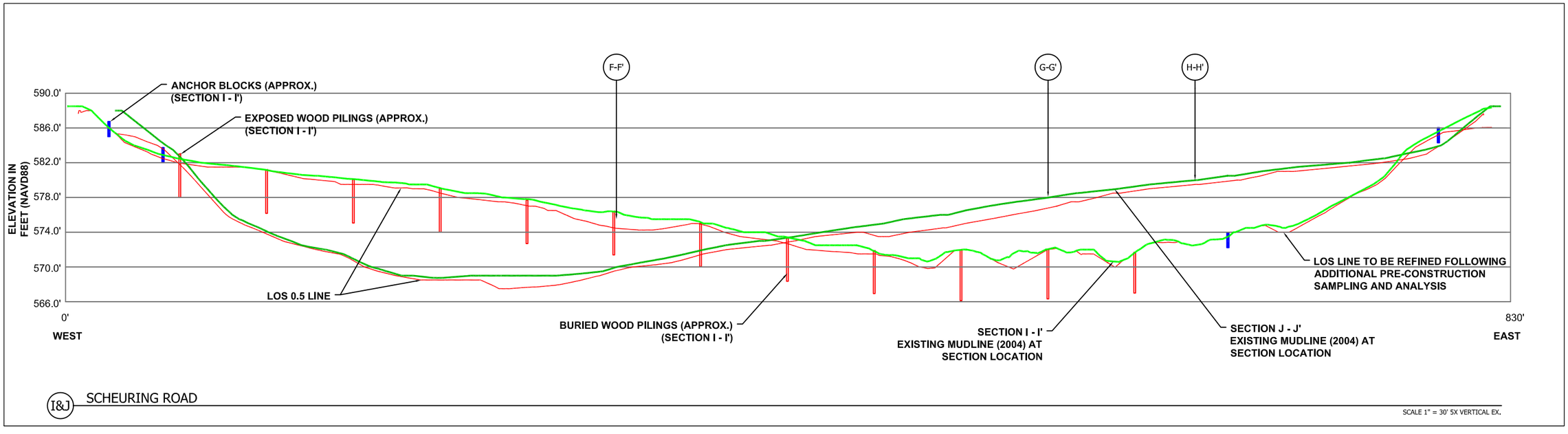

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E-6

SHEET NO. 6 OF 6

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Jun 12, 2008 9:58am gbolin

ATTACHMENT A-3

SHORELINE DESIGN REFINEMENT “GROUND RULES”

Remedial Design Technical Memorandum

To: Shoreline and Cap Design Sub-Group Coordinators: Tim Harrington (Hard Hat) and Rich Weber (NRT)

From: Matt Henderson, Paul LaRosa, Ram Mohan, and Clay Patmont (Anchor)
Steve McGee (Tetra Tech)

cc: Jim Hahnenberg (U.S. Environmental Protection Agency), Greg Hill (Wisconsin Department of Natural Resources), and George Berken (Boldt)

Date: June 6, 2008

Re: 60 Percent Design – Shoreline Design Refinement "Ground Rules"

This remedial design (RD) technical memorandum establishes the basis for design (or "ground rules") for developing appropriate transitions from offshore remedies into adjacent shoreline areas. The approach for local shoreline design refinements was discussed with the Agency/Oversight Team (A/OT) during the Workgroup 2 conference call held on April 28, 2008. The ground rules described herein will be incorporated into the 60 Percent Design submittal and subsequently used for the site-specific shoreline design in localized areas in the Fox River. Application of these ground rules will be performed as remedial action (RA) work progresses within the river, such that site-specific remedies are designed in the year prior to construction in that area and the final remedy for each area documented in the annual RA Work Plans.

As part of the 30 Percent Design (Appendix B, Attachment B-6), a 2-foot threshold was proposed as a minimum depth of contamination that would require detailed review and potential shoreline capping. Areas with less than 2 feet of contamination could be dredged without significant impact to the adjacent upland property; however, areas with predicted depth of contamination in excess of 2 feet would warrant additional engineering analysis. Additional site-specific engineering analysis involves consideration of existing slope angle and soil types/conditions, potentially supplemented by additional shoreline sampling/characterization. This RD technical memorandum builds upon the initial assessment and presents three design approaches for transitioning offshore remedies into adjacent shoreline areas. The approaches were developed in recognition of the following three sets of

conditions representing the general range of conditions anticipated throughout Operable Units (OUs) 2 to 5:

1) Transitioning from an offshore dredge area where the depth of contamination (DOC) (represented by the level of significance [LOS] of 0.5 surface) or site-specific shoreline samples indicate that sediments exceeding the 1.0 part per million (ppm) polychlorinated biphenyl (PCB) remedial action level (RAL) extend to a depth greater than 2 feet below the mudline and preliminary RA delineation included dredging
2) Transitioning from an offshore dredge area where the DOC (represented by the LOS 0.5 surface) or site-specific shoreline samples indicate that sediments exceeding the 1.0 ppm RAL extend to a depth less than 2 feet below the mudline and preliminary RA delineation included dredging
3) Transitioning from an offshore dredge and cap (or offshore cap) area into the shoreline where preliminary RA delineation included capping

These three design alternatives were discussed with the A/OT and are included in this memorandum for reference. This memorandum will be included as an appendix to the 60 Percent Remedial Design Report.

Shoreline Transition Case 1: This example case, illustrated in Attachment S-1, represents an area where the DOC (represented by the LOS 0.5 surface) or site-specific shoreline samples indicate that sediments exceeding the 1.0 ppm RAL extend to a depth greater than 2 feet below the mudline and the nearshore remedy delineated during preliminary RD involved dredging to remove all sediment exceeding the 1.0 ppm RAL. However, initial engineering analyses presented in the 30 Percent Design (Appendix B, Attachment B-6) indicate that dredging more than 2 feet immediately adjacent to the shoreline could destabilize the bank. Therefore, the dredge cut will be designed to daylight at the edge of the shoreline and slope down towards the river to the required dredge elevation at a 5 horizontal to 1 vertical (5H:1V) slope (maximum slope based on shoreline slope stability analysis). Flatter slopes will be considered on a case-by-case basis using site-specific physical/geotechnical and chemical information. The "edge of the shoreline", as it pertains to delineating the extent of in-water RA addressed by this RD, is defined as the shoreline identified during the November 2003 photogrammetric aerial survey performed by Jenkins Survey and Design, Inc. as part of the site survey work contracted by Wisconsin Department of Natural Resources (WDNR). Additional sampling, either as part of

annual infill sampling or following initial dredging, may be performed along shorelines to confirm the need for a shoreline cap. Sediments with PCB concentrations above the 1.0 ppm RAL that are left in place immediately adjacent to the shoreline will be capped following the dredging. Shoreline cap construction will be generally sequenced to follow shortly after dredging (typically within the same construction season). If site-specific conditions indicate a high potential for erosion (e.g., from wind waves, vessel wakes, propwash, or ice scour), shoreline cap construction may be sequenced immediately following dredging (e.g., within 1 to 3 months), to the extent practical. Evaluation of potential for post-dredge erosion will be a site-specific analysis considering fetch distance relative to potential for wind wave attack, vessel wake potential (e.g., OU 4B navigation channel versus OU 4A bench areas), etc. These site-specific evaluations will be included in the annual RA Work Plans.

Where shoreline capping is deemed necessary, appropriate armor stone sizes and thicknesses will be designed based on the results of wind wave, ice scour, propwash, and vessel wake analyses. Based on these analyses, vessel wakes are expected to be the dominant erosive force in most shoreline areas. Shoreline caps within OU 4B are expected to require larger armor stone (up to 1-foot median stone diameter) than those in OUs 4A and 3. Preliminary wave run-up calculations performed for the maximum predicted vessel wake and a 5H:1V slope using the Automated Coastal Engineering System (ACES) software indicate that shoreline caps should extend approximately 2 feet above the top of shoreline cap elevation to protect against scour during extreme wave events (Attachment S-1). The appropriate top of shoreline cap elevation will be determined based on the results of the hydrodynamic model generated by Sea Engineering for the RD, which incorporated a 100+ year flow event and a maximum seiche event. As the flood flow and seiche elevation will vary depending on the location within OU 4, this elevation will be site-specific. For the purpose of these examples, a top of cap elevation of approximately 581.6 feet North American Vertical Datum (NAVD) is shown, corresponding to a high water elevation including river stage, seiche, and wave run-up (subject to site-specific review and refinement as part of the annual RA Work Plans. The details of the wave run-up calculations will be included in the 60 Percent Design Report. The base of the shoreline slope cap will be designed with a toe berm (as necessary) to facilitate construction of the cap on the slope as well as provide long-term support by preventing undercutting. An example toe berm is depicted in Attachment S-1; further details of the toe berm configuration and associated design analysis will be presented in the 60 Percent Design Report.

Shoreline Transition Case 2: This design approach, illustrated in Attachment S-2, will apply to areas where the geostatistical modeling (LOS 0.5 surface) or site-specific shoreline samples indicate that sediments exceeding the 1.0 ppm RAL extend less than 2 feet below the existing mudline and the nearshore remedy delineated during preliminary RD involved dredging to remove all sediment exceeding the 1.0 ppm RAL. In addition, this case applies to shoreline areas where settlement-sensitive structures (e.g., docks, bulkhead walls, slope protection, etc.) are not positioned within approximately 10 feet of the slope. Based on initial engineering analyses presented in the 30 Percent Design (Appendix B, Attachment B-6), it is expected that essentially all of the sediment above the RAL under these conditions could be removed without destabilizing the bank. As in Case 1, the dredge cut will be designed to daylight at the edge of the shoreline and slope down towards the river to the required dredge elevation at a 5H:1V slope. Flatter slopes will be considered on a case-by-case basis using site-specific physical/geotechnical and chemical information. The "edge of the shoreline", as it pertains to delineating the extent of in-water RA addressed by this RD, is defined as the shoreline identified during the November 2003 photogrammetric aerial survey performed by Jenkins Survey and Design, Inc. as part of the site survey work contracted by WDNR. Since essentially all of the targeted sediment will be removed, a shoreline cap will not be placed in these areas.

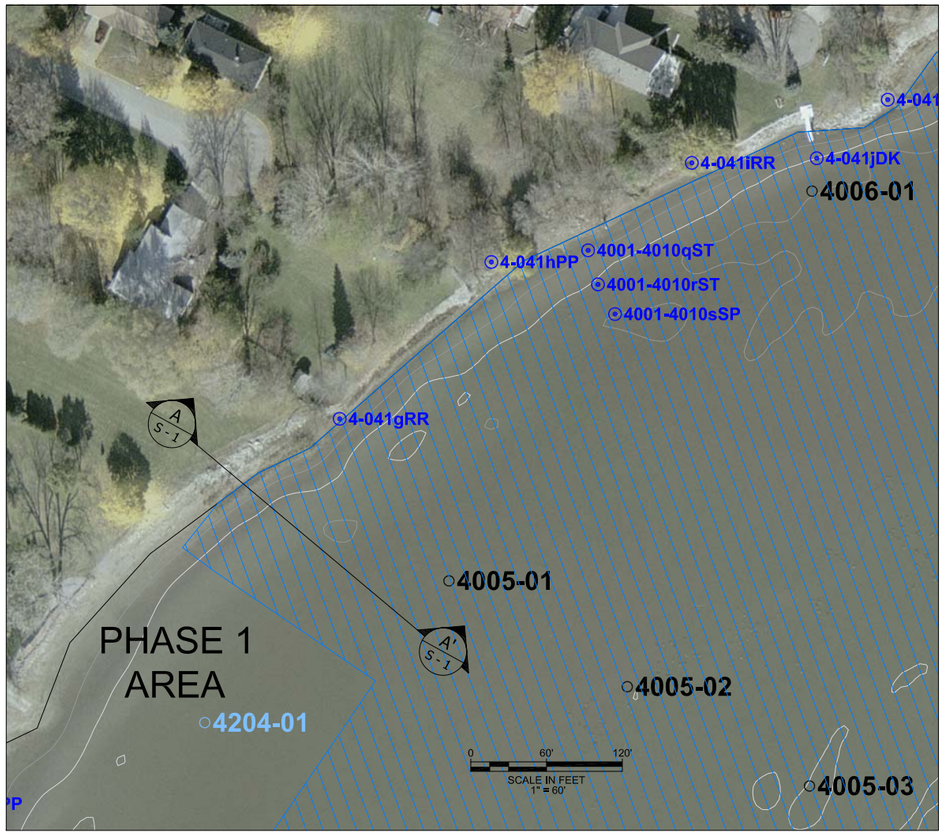
Shoreline Transition Case 3: This example case, illustrated in Attachment S-3, represents an area where the nearshore remedy delineated during preliminary RD involved capping (alone or more typically following initial dredging) to contain sediment exceeding the 1.0 ppm RAL at current depths in excess of 2 feet below the mudline. This design approach provides general design criteria for appropriate transition(s) between the nearshore cap (or dredge-and-cap) remedy and planned offshore remedy (dredge-only, dredge-and-cap, or cap). As with Cases 1 and 2, the dredge cut will be designed to daylight at the edge of the shoreline and slope down towards the river to the required dredge elevation at a 5H:1V slope. Sediments with PCB concentrations above the 1.0 ppm RAL left in place at the shoreline will be capped following dredging. Flatter slopes will be considered on a case-by-case basis using site-specific physical/geotechnical and chemical information. The "edge of the shoreline", as it pertains to delineating the extent of in-water RA addressed by this RD, is defined as the shoreline identified during the November 2003 photogrammetric aerial survey performed by Jenkins Survey and Design, Inc. as part of the site survey work contracted by WDNR. As with Case 1,

shoreline cap construction will be generally sequenced to follow shortly after dredging (typically within the same construction season). If site-specific conditions indicate a high potential for erosion (e.g., from wind waves, vessel wakes, propwash, or ice scour), shoreline cap construction may be sequenced immediately following dredging (e.g., within 1 to 3 months), to the extent practical. Evaluation of potential for post-dredge erosion will be a site-specific analysis considering fetch distance relative to potential for wind wave attack, vessel wake potential (e.g., OU 4B navigation channel versus OU 4A bench areas), etc. These site-specific evaluations will be included in the annual RA Work Plans.

Where shoreline capping is deemed necessary, appropriate armor stone sizes and thicknesses will be designed based on the results of wind wave, ice scour, propwash, and vessel wake analyses. Based on these analyses, vessel wakes are expected to be the dominant erosive force in most shoreline areas. Shoreline caps within OU 4B are expected to require larger armor stone (up to 1-foot median stone diameter) than those in OUs 4A and 3. Preliminary wave run-up calculations performed for the maximum predicted vessel wake and a 5H:1V slope using the ACES software indicate that shoreline caps should extend approximately 2 feet above the top of shoreline cap elevation to protect against scour during extreme wave events (Attachment S-3). The appropriate top of shoreline cap elevation will be determined based on the results of the hydrodynamic model generated by Sea Engineering, which incorporated a 100+ year flow event and a maximum seiche event. As the flood flow and seiche elevation will vary depending on the location within OU 4, this elevation will be site-specific. For the purpose of these examples, a top of cap elevation of approximately 581.6 feet NAVD is shown, corresponding to a high water elevation including river stage, seiche, and wave run-up (subject to site-specific review and refinement as part of the annual RA Work Plans. The details of the wave run-up calculations will be included in the 60 Percent Design Report. The base of the shoreline slope cap will be designed with a toe berm (as necessary) to facilitate construction of the cap on the slope as well as provide long-term support by preventing undercutting. An example toe berm is depicted in Attachment S-3; further details of the toe berm configuration and associated design analysis will be presented in the 60 Percent Design Report.

ATTACHMENT S-1

SHORELINE TRANSITION – EXAMPLE CASE 1



Chemistry

location	top (ft)	bott (ft)	[PCB]ppm
4005-01	0.0	0.6	5.4
	0.6	1.1	8.6
	1.1	1.7	18.8
	1.7	2.3	29.0
	2.3	2.9	19.0
	2.9	3.4	2.5
	3.4	4.0	0.7
	4.0	4.6	0.7
4005-02	0.0	0.6	4.5
	0.6	1.1	31.0
	1.1	1.7	16.4
	1.7	2.3	1.7
	2.3	2.8	1.4
	2.8	3.4	0.4
	3.4	3.9	0.3
	3.9	4.5	0.2
4005-03	0.0	0.5	4.0
	0.5	1.1	25.5
	1.1	1.6	21.0
	1.6	2.2	13.0
	2.2	2.7	0.8
	2.7	3.2	0.6
	3.2	3.8	0.6
	3.8	4.3	0.2
4006-01	0.0	0.5	4.5
	0.5	1.1	0.1
	1.1	1.6	0.0
	1.6	2.2	0.0
	2.2	2.7	0.0
	2.7	3.2	0.0

Taken from further offshore of point 4204-01, just outside Phase 1 area, facing north.

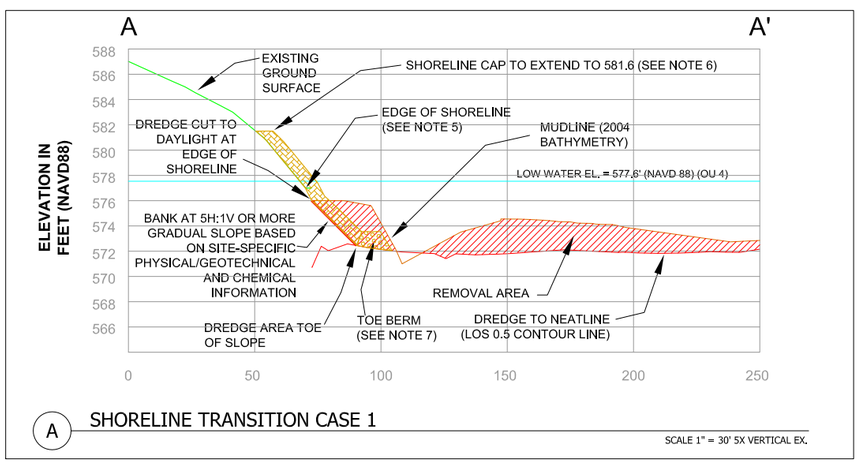
SECTION LOCATION

At point 4-041gRR (south edge of riprap embankment) facing northeast

At point 4001-4010qST, facing west.

Visual observations from 2006 and 2007 shoreline surveys
(Vertical Datum: NAVD88, U.S. survey feet)

Point Name	General Note	Specific feature	Water depth(ft)	Mudline elev.
4-041gRR	residential shoreline, riprap, and docks	riprap embankment at west; thin layer of gravel along riprap residential areas - soft underneath	0	578.6
4-041hPP	residential shoreline, riprap, and docks	N. edge of maintained embankment at outfall; thin layer of gravel along riprap residential areas - soft underneath	0	578.6
4-041iRR	residential shoreline, riprap, and docks	S. edge of residential riprap embankment; thin layer of gravel along riprap residential areas - soft underneath	0	578.6
4-041jDK	residential shoreline, riprap, and docks	east end of private dock	2	576.6
4001-4010qST	residential shoreline upstream of county fairgrounds	transition from hard sand to 6" of softer sand over hard sand	0.50	576.9
4001-4010rST	residential shoreline upstream of county fairgrounds	transition from 6" of soft sediment with hard bottom below to very soft deep sediment offshore	1.0	576.4
4001-4010sSP	residential shoreline upstream of county fairgrounds	6' of soft sediment above hard bottom, and very soft further offshore from this point.	1.5	575.9



A SHORELINE TRANSITION CASE 1

SCALE 1" = 30' 5X VERTICAL EX.

NEATLINE DREDGE AREA
MUDLINE (2004 BATHYMETRY)
SHORELINE CAP
TOE BERM
TRANSECT LOCATIONS
4005-01 SAMPLING POINT
4-041gRR SHORELINE SURVEY POINT

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88), U.S. SURVEY FEET.
4. ALL STRUCTURES, LOCATIONS, AND ALIGNMENTS NEED TO BE FIELD VERIFIED AND SHOULD BE CONSIDERED APPROXIMATE.
5. "EDGE OF SHORELINE" IS DEFINED AS THE ADMINISTRATIVE BOUNDARY OF THE OUs 2 TO 5 SITE AS DEFINED BY THE RETEC SURVEY COMPLETED IN 2004.
6. WAVE RUNUP ANALYSIS SHOWED A POTENTIAL FOR A 2-FOOT RUNUP WITH A 5:1 SLOPE; THEREFORE, THE SHORELINE CAP WILL EXTEND TO 581.6 FT (NAVD 88) TO ACCOUNT FOR A 2-FOOT SEICHE AND 2-FOOT RUNUP. THE TOP OF SHORELINE CAP ELEVATION WILL BE FURTHER REFINED BASED ON A SITE-SPECIFIC ANALYSIS OF THE RESULTS OF THE HYDRODYNAMIC MODEL GENERATED BY SEA ENGINEERING, WHICH INCORPORATED A 100+ YEAR FLOW EVENT AND A MAXIMUM SEICHE EVENT.
7. DETAILS ON THE TOE BERM DESIGN WILL BE INCLUDED IN THE 60% DESIGN DRAWINGS.

DRAFT

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: LIZ VONCKX
DRAWN BY: LIZ VONCKX
CHECKED BY: MATT HENDERSON
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
SHORELINE TRANSITION - CASE 1
PLAN AND SECTION VIEWS

S - 1

SHEET NO. 1 OF 3

Jun 06, 2008 11:30am evonckx C:\Documents and Settings\evonckx\Desktop\FOX\CAD\60% drawings\neatline dredging\OU4 neatline design 4005-01 case 1 v6.dwg SHORELINE CASE 1

ATTACHMENT S-2

SHORELINE TRANSITION – EXAMPLE CASE 2

Just inside mouth of inlet, facing SW toward south shore

At mouth of inlet, facing NW

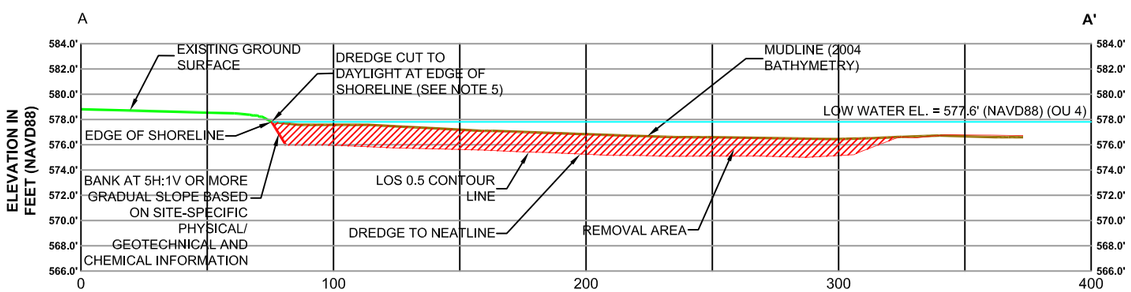
SECTION LOCATION

Just inside mouth of inlet facing directly south.

Taken near core location 4020-08, facing west.

Chemistry

location	top (ft)	bott (ft)	[PCB]ppm
4020-07	0.00	0.53	0.72
	0.53	1.06	0.37
	1.06	1.59	0.03
	1.59	2.12	0.03
	2.12	2.65	0.03
	2.65	3.18	0.03
	3.18	3.71	0.03
4020-08	0.00	0.57	0.51
	0.57	1.13	1.50
	1.13	1.70	3.20
	1.70	2.27	0.06
	2.27	2.83	0.03
	2.83	3.40	0.03
4020-09	0.00	0.51	4.40
	0.51	1.03	2.60
	1.03	1.54	0.03
	1.54	2.05	0.03
	2.05	2.56	0.03
4021-21	0.00	0.55	0.08
	0.55	1.10	0.03
	1.10	1.65	0.03
	1.65	2.20	0.03
	2.20	2.75	0.03
4019-21	0.00	0.56	0.17
	0.56	1.11	0.03
	1.11	1.67	0.03
	1.67	2.22	0.03



A SHORELINE TRANSITION CASE 2

SCALE 1" = 30' 5X VERTICAL EX.

NEATLINE DREDGING
MUDLINE (2004 BATHYMETRY)
COVER
TRANSECT LOCATIONS
4104-01 SAMPLING POINT

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM, 1988 (NAVD88), U.S. SURVEY FEET.
4. ALL STRUCTURES, LOCATIONS, AND ALIGNMENTS NEED TO BE FIELD VERIFIED AND SHOULD BE CONSIDERED APPROXIMATE.
5. "EDGE OF SHORELINE" IS DEFINED AS THE ADMINISTRATIVE BOUNDARY OF THE OUs 2 TO 5 SITE AS DEFINED BY THE RETEC SURVEY COMPLETED IN 2004.

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: GABE BOLIN
DRAWN BY: GABE BOLIN
CHECKED BY: MATT HENDERSON
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
SHORELINE TRANSITION - CASE 2
PLAN AND SECTION VIEWS

S - 2

SHEET NO. 2 OF 3

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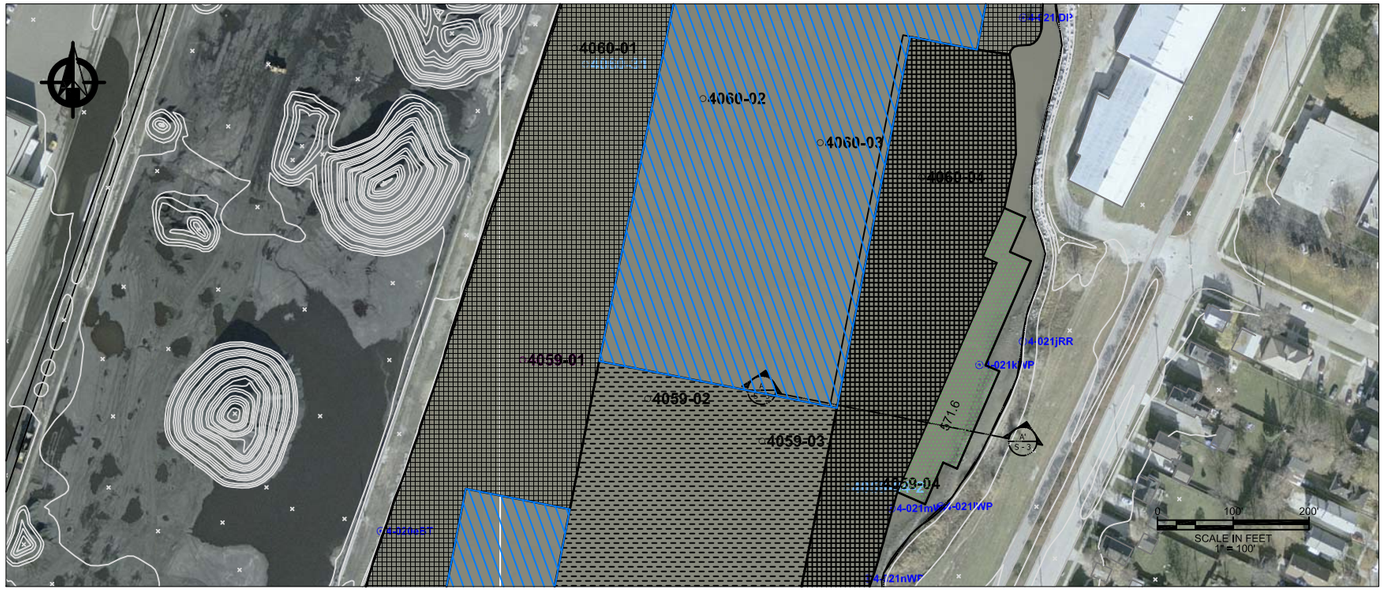
Jun 06, 2008 10:56am gbolin

ATTACHMENT S-3

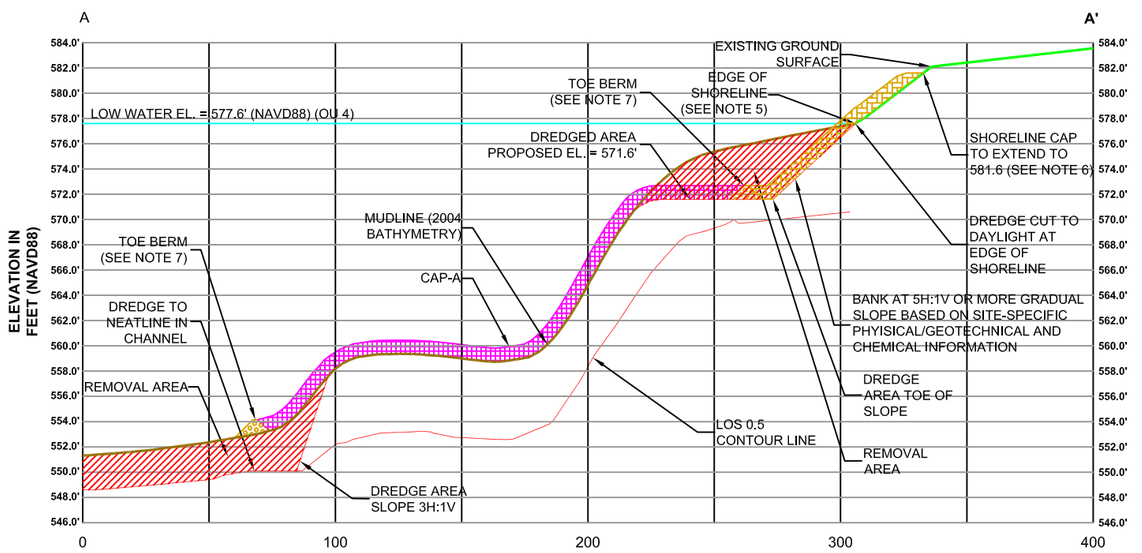
SHORELINE TRANSITION – EXAMPLE CASE 3



Chemistry

location	top (ft)	bott (ft)	[PCB]ppm
4059-03	0.0	0.5	2.2
	0.5	1.1	2.3
	1.1	1.6	2.4
	1.6	2.1	2.5
	2.1	2.6	0.0
	2.6	3.2	0.0
	3.2	3.7	0.0
	3.7	4.2	0.0
	4.2	4.8	0.0
4059R-04	0.0	0.7	2.1
	0.7	1.4	2.1
	1.4	2.1	2.1
	2.1	2.8	2.3
	2.8	3.4	2.3
	3.4	4.1	2.0
	4.1	4.8	1.7
	4.8	5.5	2.4
	5.5	6.2	1.5

SECTION LOCATION



A SHORELINE TRANSITION CASE 3

SCALE 1" = 30' 5X VERTICAL EX.

Visual observations from shoreline survey, June 14, 2006
(Vertical Datum: NAVD88, U.S. Survey Feet)

Point Name	Specific feature	Water depth(ft)	Mudline elev.
4-021jRR	south end of riprap	0.5	577.8
4-021kWP	north end of abandoned piles	3	575.3
4-021lWP	south end of piles	0.7	577.7
4-021mWP	north end of abandoned pile group	5.0	573.3
4-021nWP	south end of piles	1.5	576.8

Taken near sample location 4060-04, facing southeast

NEATLINE DREDGING
MUDLINE (2004 BATHYMETRY)
571.6 DREDGE AND CAP
CAP A
CAP C
SHORELINE CAP
TOE BERM
TRANSECT LOCATIONS
4059-02 SAMPLING POINT
4-021jRR SHORELINE SURVEY POINT

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
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6. WAVE RUNUP ANALYSIS SHOWED A POTENTIAL FOR A 2-FOOT RUNUP WITH A 5:1 SLOPE; THEREFORE, THE SHORELINE CAP WILL EXTEND TO 581.6 FT (NAVD 88) TO ACCOUNT FOR A 2-FOOT SEICHE AND 2-FOOT RUNUP. THE TOP OF SHORELINE CAP ELEVATION WILL BE FURTHER REFINED BASED ON A SITE-SPECIFIC ANALYSIS OF THE RESULTS OF THE HYDRODYNAMIC MODEL GENERATED BY SEA ENGINEERING, WHICH INCORPORATED A 100+ YEAR FLOW EVENT AND A MAXIMUM SEICHE EVENT.
7. DETAILS ON THE TOE BERM DESIGN WILL BE INCLUDED IN THE 60% DESIGN DRAWINGS.

DRAFT

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: GABE BOLIN
DRAWN BY: GABE BOLIN
CHECKED BY: MATT HENDERSON
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
SHORELINE TRANSITION - CASE 3
PLAN AND SECTION VIEWS

S - 3

SHEET NO. 3 OF 3

C:\Documents and Settings\gbolin\My Documents\Fox River Temp Files\CAD Files transferred from FUJI\08029503 EXAMPLES CAP REFINEMENTS RECOVERED.dwg SHORELINE CASE 3
Jun 06, 2008 10:54am gbolin

ATTACHMENT A-4

DREDGED CUT AND CAPPED SLOPE STABILITY MEMO

ANCHOR ENVIRONMENTAL, L.L.C.

Memorandum

To: Basis of Design Report File

From: John Laplante, Paul LaRosa, and John Verduin

cc: George Hicks (Shaw), Paul Montney, Chip Hilarides, Richard Moser, (Georgia Pacific) Roger McCready (NCR), John Heyde (Sidley)

Date: February 14, 2006

Re: Dredged Cut and Capped Slope Stability

This memorandum provides details and background on the dredge cut slope and cap stability analyses. The analyses described herein were performed during development of the Basis of Design for the Fox River.

Details of the slope stability analyses performed for the design of dredge cut slopes are provided below using data generated during the 2004 and 2005 Remedial Design (RD) geotechnical investigation program (Shaw/Anchor 2004 and 2005). Three (3) horizontal to 1 vertical (3H:1V) slopes were selected for the dredge prism design based on review of vane shear and triaxial strength data collected as part of the RD and previous investigations. These data indicate that a 3H:1V slope will have a factor of safety of at least 1.3 for the vast majority of the data reviewed. Slopes cut at 3H:1V are expected to remain stable throughout construction.

Moreover, under the ROD Remedy (and areas handled in a similar fashion under the Optimized Remedy), any long-term sloughing of adjacent slopes is expected to involve clean material (less than 1 ppm PCBs), since the dredge prism in these areas was designed to remove the deepest contamination between adjacent cuts. Slight adjustment of the slopes is expected in some areas over time due to the dynamic nature of hydrodynamic conditions. However, adjustments in these dredge slopes will not expose contaminated sediments in the future.

Based on detailed stability analyses outlined below, capped areas are predicted to be stable on existing slopes as steep as 2.75H:1V, as generally discussed in Appendix H. While the cap will be stable on these steeper slopes, only one very localized section of the capped area has a slope of this angle. The vast majority of capped areas proposed under the Optimized Remedy have slopes of 10H:1V or flatter.

STABILITY OF DREDGE CUT SLOPES

For purposes of the Basis of Design Report (BODR), the stability of cut slopes was evaluated for a range of slope angles and a range of cut depths. For purely cohesive sediments, the stability of the cut is a function of the height of the cut. For sediments with appreciable sand, the stability is also a function of the slope angle.

Lambe and Whitman (1969) present methods to evaluate the stability of slopes using infinite slope theory, for both cohesive and granular materials. These methods were used to compute the factor of safety for slopes based on the existing site strength data, which includes the following:

- Vane Shear Test (VST) data collected in 2004 and 2005
- Laboratory Unconsolidated Undrained (UU) shear strength test data collected by the Johnson Company as well as the Shaw/Anchor team
- Laboratory Consolidated Undrained (CU) shear strength test data collected by the Shaw/Anchor team

Using the methods presented by Lambe and Whitman, a graph was prepared to show the required sediment shear strength for a given slope, and a given depth of cut, at a selected factor of safety. Figure 1 presents these curves, which are linear plots of cut depth vs. required shear strength, for slopes of 3H:1V, 4H:1V, 5H:1V and 10H:1V, assuming a factor of safety of 1.3 for these slopes.

Also plotted on Figure 1 are the available laboratory UU and CU shear strength data from the sources listed above. The UU data are plotted as discrete shear strengths for each undisturbed sample, at the depth from which the sample was collected. The CU data are plotted as strength versus depth, using the cohesion and friction angle measured during the laboratory CU test on each sample.

Evaluations made using the VST shear strength data (corrected based on plasticity index after Bjerrum, 1972) indicate that more than 95 percent of the time, a factor of safety of 1.3 or better is achieved using a 3H:1V cut slope. Most importantly, the CU data, which are among the highest quality of the tests, all show adequate strength to achieve the target factor of safety.

The preliminary limit equilibrium slope stability analyses demonstrate that the Lambe and Whitman methods provide a conservative estimate of the strength required to achieve the target factor of safety. More detailed computer modeling limit equilibrium analyses will be performed during later stages of design (30 or 60 Percent Design).

Based on this evaluation, the 3H:1V cut slope was selected for design. This represents the slope that the Contractor will be required to achieve, and will likely be the basis for measurement of pay volumes during construction.

STABILITY OF CAPS ON SLOPES

To evaluate the stability of caps on slopes, areas of interest were identified in the river, and a representative section was selected that included a steep slope and capping as part of the remedy. The selected section, 112+00, is located in OU 4. The east bank of the river in this area has an average slope of 4.7H:1V, with localized steeper areas up to 2.75H:1V, and a proposed cap thickness of 13 inches.

Slide 5.0 is a two-dimensional slope stability analysis software, complete with sensitivity, probabilistic and back analysis capabilities. The Slide software offers various vertical slice limit equilibrium methods (Bishop, Janbu, Spencer, Corps of Engineers #1 and #2, and more) for stability modeling. Slope stability evaluations are conducted by inputting the geometry and subsurface stratigraphy of an existing or proposed slope as well as various parameters describing the sediment and water conditions (sediment and water densities, cohesion, friction angle, soil model, groundwater/surface water elevations, etc.). The software output includes graphical solutions of the factor of safety associated with various failure surfaces and well as numerous other tabular and graphical outputs useful for data analyses.

In situ sediment properties for the slope stability evaluations were obtained from laboratory measurements on samples collected during the 2004 and 2005 pre-design sampling and analysis program. In addition, physical properties of the capping materials were estimated based on the nature of the cap materials proposed (sand and gravel) and the method of cap placement (mechanical clamshell). The following input assumptions were used in the model:

- Cap unit weight = 120 pcf (this is a conservative value; the unit weight will likely be lower), friction angle = 32 degrees and cohesion = 0 psf.

- Sediment unit weight= 92 pcf, friction angle = 0, and cohesion varying as a function of depth from 50 to 750 psf, based on results of the vane shear and laboratory strength testing.

Both circular and non-circular surfaces were evaluated, and the software performed a search for the critical (i.e. lowest factor of safety) slip surface. Generalized Limit Equilibrium and Spencer methods were used to compute the factor of safety.

Based on the results of the static stability analysis, caps on slopes similar to the conditions modeled for river section 112+00 (average slope of 4.7H:1V, with localized steeper areas up to 2.75H:1V) are expected to have a static factor of safety of 1.3 or better, which meets the criteria presented by Hammer and Blackburn (1977) for the long term stability condition. Results of the static slope stability evaluation are presented on Figure 2. Future phases of the design will include evaluation of the slope stability during seismic events.

Appropriate construction techniques will be required to ensure proper cap placement thereby limiting the potential for slope stability failures during or shortly after construction. This will involve the placement of materials in a "bottom up" fashion, whereby materials are first placed at the toe of a slope and construction produces towards to top of slope. In this way, cap materials will be continually placed against a firm toe support and are not allowed to slump towards the base.

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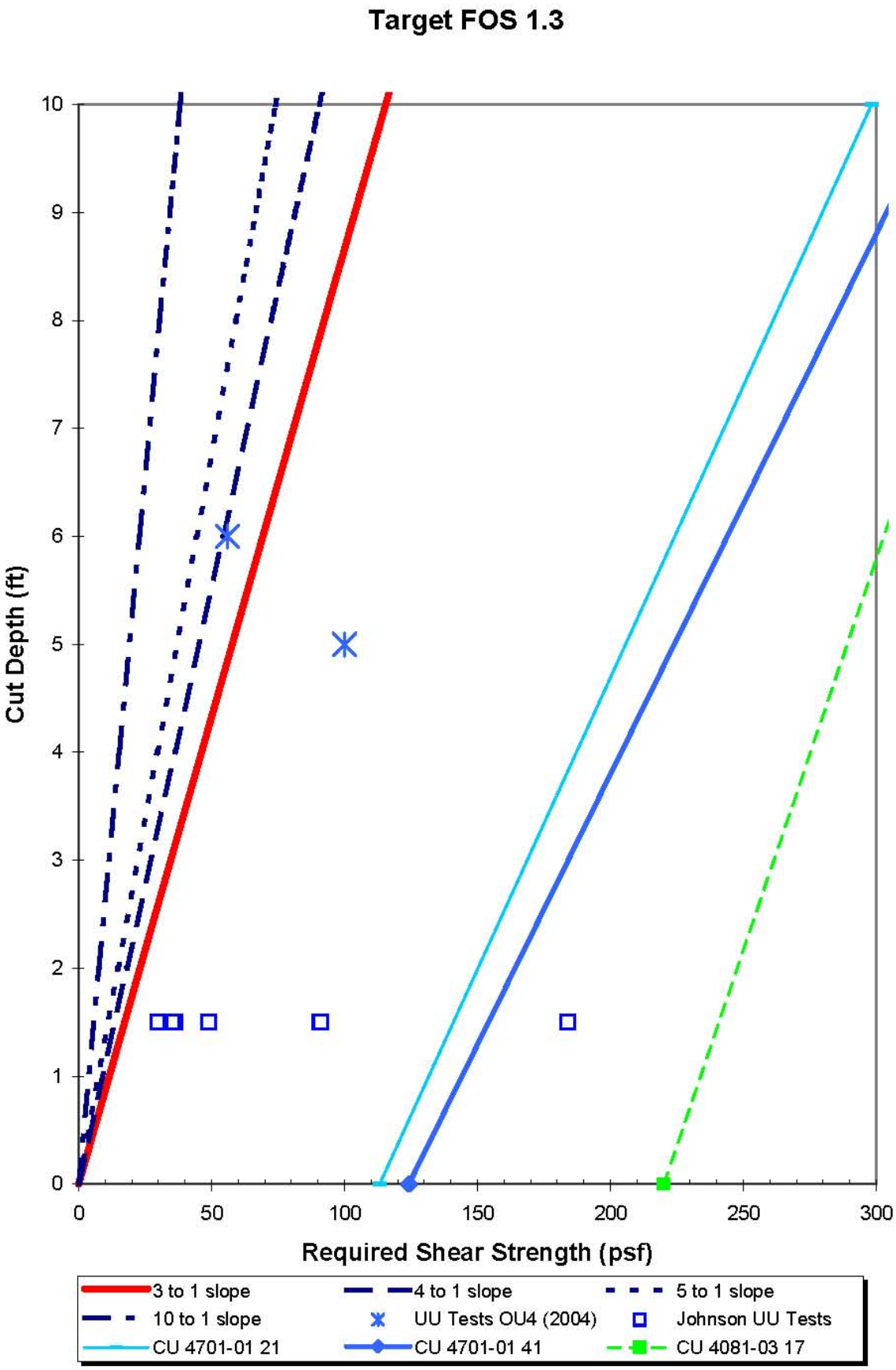


Figure 1
Selection of Cut Slope Angle
Fox River

ANCHOR ENVIRONMENTAL, L.L.C.

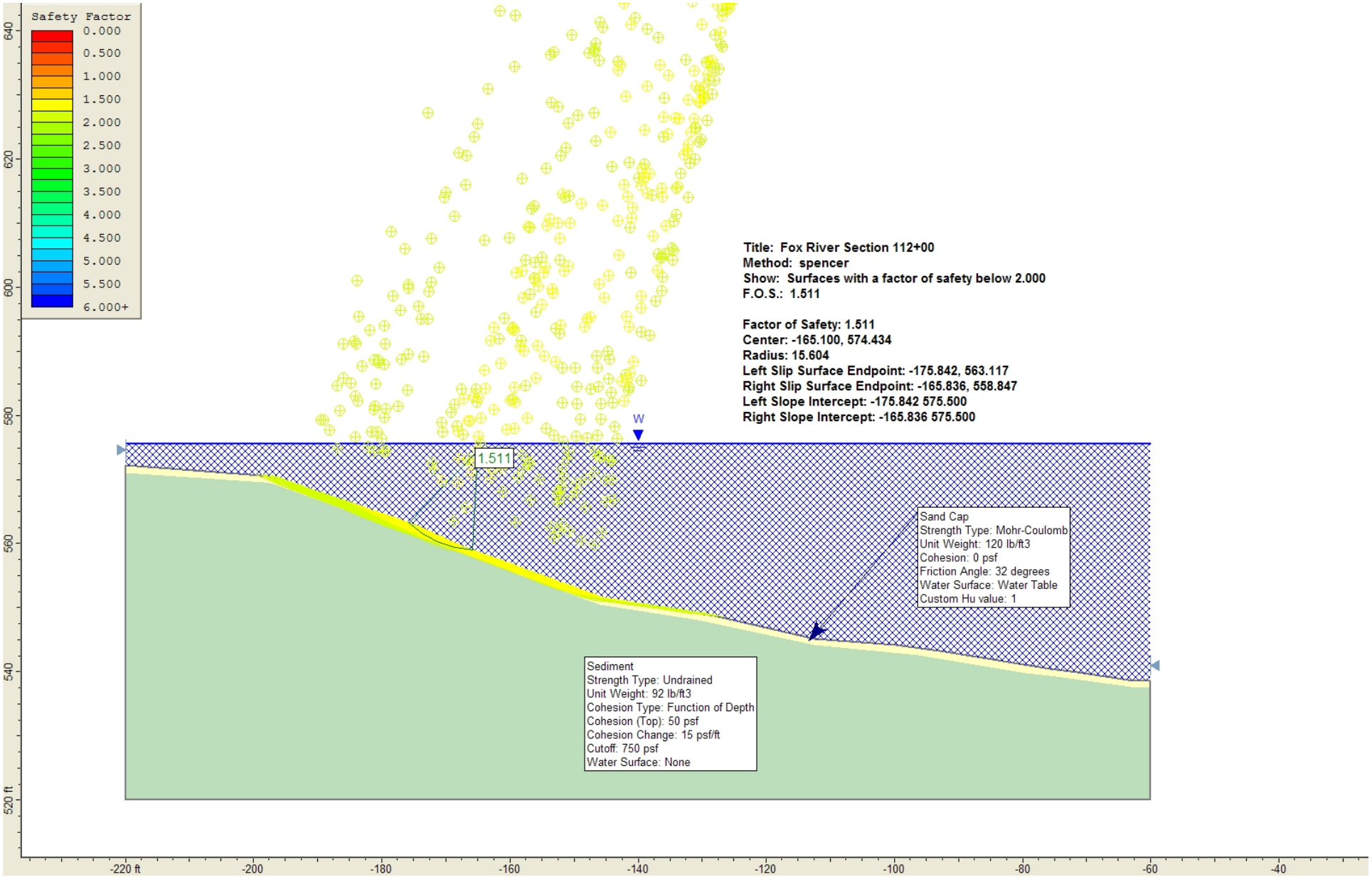


Figure 2
Cap Slope Stability
Lower Fox River

ATTACHMENT A-5

MASS BALANCE SPREADSHEET

Preliminary Mass Balance Calculations for OUs 2 to 5

Boskalis Dolman COMPOSITE NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Total estimated volume per composite in m3 situ sediment	106,000	70,000	500,000	430,000	1,150,000	317,000	2,573,000
In situ Material Characteristics							
Dry solids, %, in situ	45.7%	31.9%	57.1%	59.9%	40.8%	69.0%	
Organics, % of dry solids, in situ	9.8%	15.7%	9.1%	6.2%	12.8%	5.7%	
Specific Gravity, mtons/m3	2.52	2.45	2.53	2.57	2.48	2.58	
Density, mtons/m3 in situ	1.37	1.22	1.51	1.56	1.31	1.71	
Particle size distribution conform BRAUN 2007							
Total Sand (+63 micron)	58.6%	31.4%	66.1%	81.8%	42.6%	89.6%	
Coarse Sand (+150 micron)	30.8%	18.6%	27.8%	51.5%	11.6%	52.7%	
Fine Sand (+63 - 150 micron)	27.8%	12.8%	38.3%	30.3%	31.0%	36.9%	
Process Design Characteristics Dredging and Desanding							
Design capacity, cyard/hr in situ	250	250	250	250	250	250	
Design capacity, m3/hr in situ	191	191	191	191	191	191	
Total Volume Inpute in gpm	6,000	6,000	6,000	6,000	6,000	6,000	
Total Volume Input in m3 per hour	1368	1368	1368	1368	1368	1368	
Process Input Characteristics							
Input solids per hour in mtds/hr	119	74	165	179	102	226	
Input organics in mtds/hr	12	12	15	11	13	13	
Input minerals in mtds/hr	108	63	150	168	89	213	
Total Sand Load (+63 micron) in mtds/hr	63	20	99	137	38	191	
Coarse Sand Load (+150 micron) in mtds/hr	33	12	42	86	10	112	
Fine Sand Load (+63 - 150 micron) in mtds/hr	30	8	57	51	28	78	
Fine minerals Load in mtds/hr	45	43	51	31	51	22	
Organics in mtds/hr	12	12	15	11	13	13	
Total Residue Load (Fine + Organics) in mtds/hr	56	55	66	42	64	35	
Total Process Volumes (maximized)							
Total Flow in m3/hr	1368	1368	1368	1368	1368	1368	
Total Flow Solids in mtds/hr	119	74	165	179	102	226	
Total Flow Solids Volume in m3/hr	47	30	65	70	41	88	
Total Flow Water Volume in m3/hr	1,321	1,338	1,303	1,298	1,327	1,280	
Total Flow Mixture Density in mton/m3	1.053	1.032	1.073	1.080	1.045	1.101	
Simplified Process calculations Desanding							
Load De-sander Coarse Sand, mtds/hr	119	74	165	179	102	226	
Load De-sander Coarse Sand, m3/hr	1,321	1,338	1,303	1,298	1,327	1,280	
Coarse Sand Removal, mtds/hr	33	12	42	86	10	112	
Gravity drained solids	82.5%	82.5%	82.5%	82.5%	82.5%	82.5%	
Coarse Sand Removal, wet mtons/hr	40	14	50	105	12	136	
Process Water addition, estimated, m3/hr	100	100	100	100	100	100	
Load De-sander Fine Sand, mtds/hr	86	63	123	92	92	113	
Load De-sander Fine Sand, m3/hr	1,334	1,407	1,295	1,174	1,400	1,089	
Fine Sand Removal, mtds/hr	30	8	57	51	28	78	
Gravity drained solids	82.5%	82.5%	82.5%	82.5%	82.5%	82.5%	
Fine Sand Removal, wet mtons/hr	36	10	69	62	33	95	
Process Water addition, estimated, m3/hr	100	100	100	100	100	100	
Simplified Process calculations Dewatering							
Dewatering Load Total Residue, mtds/hr	56	55	66	42	64	35	
Dewatering Load Total Residue, m3/hr	1,356	1,486	1,245	1,142	1,428	985	
Total Residue Removal in mtds/hr	56	55	66	42	64	35	
Filter cake dry solids after pressing	52.5%	52.5%	52.5%	52.5%	52.5%	52.5%	
Filter Cake Removal, wet mtons/hr	107	104	125	79	122	67	
Process Water addition, estimated, m3/hr	250	250	250	250	250	250	
Simplified Water Balance							
Water Flow to Process Water Tank, m3/hr	1,420	1,555	1,279	1,255	1,466	1,120	
Process Water to Desanding and dewatering, m3/hr	450	450	450	450	450	450	
Total Excess Water at maximized productions, m3/hr	970	1,105	829	805	1,016	670	
Extra water addition for cleaning works etc, m3/hr (?)	100	100	100	100	100	100	
Uptime Factor	75%	75%	75%	75%	75%	75%	
Daily Excess Water to Water Treatment, m3	19,265	21,685	16,714	16,284	20,088	13,853	
Average hourly Excess Water to Water Treatment, m3/hr	803	904	696	678	837	577	
Average hourly Excess Water to Water Treatment, GPM	3,521	3,963	3,055	2,976	3,671	2,532	
Filter press sizing							
Process Design Characteristics Filter Presses							
Design capacity, cyard/hr in situ	180	180	180	180	180	180	
Design capacity, m3/hr in situ	138	138	138	138	138	138	
Filter Press Inputs							
Filter cake dry solids, %	52.5%	52.5%	52.5%	52.5%	52.5%	52.5%	
Cake density, mtons/m3	1.417	1.417	1.417	1.417	1.417	1.417	
Dewatering Load Total Residue, mtds/hr	41	39	47	30	46	25	
Dewatering Load Total Residue, mtons/hr	77	75	90	57	88	48	
Dewatering Load Total Residue, m3/hr	54	53	64	40	62	34	
Cycle time, minutes	75	75	75	75	75	75	
Press size, m3	17.7	17.7	17.7	17.7	17.7	17.7	
Compression factor membrane press	1.3	1.3	1.3	1.3	1.3	1.3	
Capacity per press in m3 per drop	13.6	13.6	13.6	13.6	13.6	13.6	
Nr of Drops per press per hour	0.8	0.8	0.8	0.8	0.8	0.8	
Capacity per press in m3 per hour	10.9	10.9	10.9	10.9	10.9	10.9	
Uptime factor	75%	75%	75%	75%	75%	75%	
Nett Capacity per press in m3 per hour	8.2	8.2	8.2	8.2	8.2	8.2	
Number of Presses needed	6.7	6.5	7.8	4.9	7.6	4.1	

ATTACHMENT A-6

GEOTECHNICAL DATA FOR ALL DREDGE AREAS

Appendix A - Attachment A-7
Geotechnical Data for All Dredge Areas (2009 and Beyond)

COMPACTION CORRECTE DATA								30% Design Dredge Plan				Compaction Corrected Percent		Atterberg Limits[b]			Grain Size[c]									Grain size Parameters														
Sample ID	Date Sampled	Depth Interval (Letter)	Top Sample Depth (ft)	Bottom Sample Depth (ft)	Average Sample Depth (ft)	Corr. Top Sample Depth (ft)	Existing Elev. (2004 Survey) (ft.) [IGLD 85]	Optimized Remedial Action	Target Dredge Depth (ft)	Sample w/in Dredge Prism (yes/no)	Moisture Content[a] (%)	Compaction Corrected Moisture Content[a] (%)	Percent Solids (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Gravel (%)	Sand (%) Coarse	Sand (%) Medium	Sand (%) Fine	Silt (%)	Clay (%)	Sand (%)	Gravel/ Sand (%)	Silt/Clay (%)	D_{10} (eff. gs)	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{100}	Cu (uniformity)	Cc (gradation)	USCS	USCS Description	Organic Content[d] (%)	Specific Gravity[e]	Corrected Bulk Density (Calc'd) (pcf)	Corrected Dry Density (Calc'd) (pcf)
2005-01	8/9/04	CDEF	1.0	3.0	2.0	1.1	589.8	Dredge or D&C	1.3	yes	222.8	246.7	29%	210.2	46.7	163.5																			OH	ORGANIC CLAY, ORGANIC SILT			75.15	21.67
2006-01	5/17/05	BC	0.5	1.0	0.8	1.1	590.2	Dredge or D&C	1.7	yes	273.2	648.3	13%	189.6	45.2	144.4	0.0	0.0	0.4	7.6	48.0	44.0	8.0	8.0	92.0	<0.001	<0.001	0.0022	0.0053	0.01	0.052	2			OH	ORGANIC CLAY, ORGANIC SILT		2.353	67.59	9.03
3021-01	8/10/04	BCDE	0.5	2.5	1.5	0.6	584.7	Dredge or D&C	1.2	yes	235.9	314.1	24%	207.5	52.3	155.2																			OH	ORGANIC CLAY, ORGANIC SILT			72.73	17.56
3045-04	8/19/04	BCDE	0.5	2.5	1.5	0.5	580.5	Dredge or D&C	3.0	yes	197.6	219.2	31%	172.1	40.7	131.4	0.0	0.0	3.8	7.5	43.6	45.0	11.3	11.3	88.6	<0.001	<0.001	0.0024	0.006	0.009	0.055	2			OH	ORGANIC CLAY, ORGANIC SILT			76.49	23.96
3046-02	8/19/04	BCDE	0.5	2.5	1.5	0.6	577.8	Dredge or D&C	2.3	yes	41.0	64.0	61%	199.1	21.7	177.4																			OH	ORGANIC CLAY, ORGANIC SILT		2.378	96.49	58.83
3049-01	8/20/04	EFGH	2.0	4.0	3.0	2.4	580.8	Dredge or D&C	3.3	yes	169.4	206.6	33%	157.0	53.0	104.0																			OH	ORGANIC CLAY, ORGANIC SILT			77.21	25.19
3053-02	8/21/04	BCDE	0.5	2.5	1.5	0.5	571.8	Dredge or D&C	2.3	yes	211.2	231.7	30%	161.6	61.2	100.4	0.0	0.0	3.3	30.9	45.3	20.5	34.2	34.2	65.8	0.002	0.0032	0.0084	0.04	0.06	0.26	2	30.00	0.59	OH	ORGANIC CLAY, ORGANIC SILT			75.85	22.87
3061-03	8/22/04	BCDE	0.5	2.5	1.5	0.5	570.9	Dredge or D&C	1.9	yes	248.9	272.1	27%	203.9	50.1	153.8	0.0	1.5	5.9	12.0	47.1	33.5	19.4	19.4	80.6	<0.001	<0.001	0.0042	0.0091	0.016	0.15	4.9			OH	ORGANIC CLAY, ORGANIC SILT			74.11	19.92
3062-03	8/22/04	A-H	0.0	4.0	2.0	0.0	571.2	Dredge or D&C	1.7	yes	248.6	321.0	24%	158.0	62.1	95.9	0.0	0.6	0.3	29.3	48.3	21.5	30.2	30.2	69.8	0.0022	0.0033	0.007	0.011	0.015	0.24	4.9	6.82	1.48	OH	ORGANIC CLAY, ORGANIC SILT			72.53	17.23
3067-02	8/22/04	AB	0.0	1.0	0.5	0.0	572.9	Dredge or D&C	2.9	yes	301.4	351.7	22%	190.2	63.5	126.7	0.0	0.0	0.0	17.6	65.4	17.0	17.6	17.6	82.4	0.0018	0.0024	0.0074	0.0089	0.0095	0.17	0.41	5.28	3.20	OH	ORGANIC CLAY, ORGANIC SILT			71.74	15.88
3067-02	8/23/04	DE	1.5	2.5	2.0	1.7	572.9	Dredge or D&C	2.9	yes	15.5	23.8	81%				8.9	6.0	41.4	40.8	0.9	2.0	88.2	97.1	2.9	0.21	0.26	0.38	0.48	0.6	2	12.7	2.86	1.15	SP	POORLY-GRADED SAND			118.83	95.97
4001-05	6/28/04	ABCDE	0.0	2.5	1.3	0.0	575.4	Dredge or D&C	1.4	yes	196.3	222.7	31%	143.6	45.5	98.1																			OH	ORGANIC CLAY, ORGANIC SILT	9.1		76.30	23.65
4001-08	6/28/04	BC	0.5	1.5	1.0	0.7	575.7	Dredge or D&C	1.7	yes	277.7	384.1	21%	192.5	53.1	139.4																			OH	ORGANIC CLAY, ORGANIC SILT		2.408	70.97	14.66
4002-05	6/29/04	BCDE	0.5	2.5	1.5	0.6	575.6	Dredge or D&C	2.1	yes	254.8	307.0	25%	202.6	48.5	154.1																			OH	ORGANIC CLAY, ORGANIC SILT			72.94	17.92
4002-08	6/29/04	EFGH	2.0	4.0	3.0	2.0	574.8	Dredge or D&C	14.8	yes	229.3	229.3	30%	166.5	44.3	122.2																			OH	ORGANIC CLAY, ORGANIC SILT			75.96	23.07
4002R-22	5/6/05	FGH	2.5	4.0	3.3	3.7	574.8	Dredge or D&C	16.8	yes	223.4	350.8	22%	209.1	47.9	161.2	0.0	0.0	2.5	16.0	49.5	32.0	18.5	18.5	81.5	<0.001	<0.001	0.043	0.011	0.015	0.095	2			OH	ORGANIC CLAY, ORGANIC SILT			71.76	15.92
4003-08	6/30/04	EFGH	2.0	4.0	3.0	2.4	570.7	Dredge or D&C	10.7	yes	276.1	335.2	23%	232.6	50.1	182.5																			OH	ORGANIC CLAY, ORGANIC SILT			72.15	16.58
4004-06	6/30/04	CDEF	1.5	3.5	2.5	1.6	576.1	Dredge or D&C	2.1	yes	203.9	213.3	32%	179.3	135.2	44.1																			OH	ORGANIC CLAY, ORGANIC SILT			76.82	24.52
4004-12	7/11/04	GHJK	3.0	5.0	4.0	5.0	569.4	Dredge or D&C	10.4	yes	230.7	412.0	20%	196.6	46.4	150.2																			OH	ORGANIC CLAY, ORGANIC SILT			70.50	13.77
4004R-12	10/8/04	HJKL	3.5	5.5	4.5	5.8	569.4	Dredge or D&C	10.5	yes	212.2	381.1	21%	216.1	48.6	167.5																			OH	ORGANIC CLAY, ORGANIC SILT			71.09	14.78
4005-02	7/1/04	BCDE	0.5	2.5	1.5	0.6	576.3	Dredge or D&C	2.8	yes	204.6	235.6	30%	200.9	48.0	152.9																			OH	ORGANIC CLAY, ORGANIC SILT			75.66	22.54
4005-05	7/1/04	A	0.0	0.5	0.3	0.0	576.0	Dredge or D&C	2.0	yes	281.6	286.2	26%																						OH	ORGANIC CLAY, ORGANIC SILT			73.61	19.06
4005-05	7/1/04	BCDE	0.5	2.5	1.5	0.5	576.0	Dredge or D&C	2.0	yes	187.7	191.0	34%	199.7	62.1	137.6																			OH	ORGANIC CLAY, ORGANIC SILT	10.7		78.21	26.88
4005-12	7/11/04	CDEF	1.0	3.0	2.0	1.1	573.3	Dredge or D&C	1.3	yes	60.5	70.4	59%				0.7	0.0	0.8	57.3	30.7	10.5	58.1	58.8	41.2	0.0049	0.0078	0.045	0.0095	0.11	0.18	9.6	22.45	3.76	SC	CLAYEY SAND			95.27	55.90
4006-01	7/6/04	BC	0.5	1.5	1.0	0.5	576.1	Dredge or D&C	0.6	yes	44.1	51.0	66%	101.1	17.9	83.2																			CH	CLAY OF HIGH PLASTICITY, FAT CLAY			102.19	67.67
4006-05	7/7/04	BCD	0.5	2.0	1.3	0.6	575.6	Dredge or D&C	1.6	yes	226.6	298.6	25%	204.6	42.0	162.6	0.0	0.0	0.5	10.3	44.2	45.0	10.8	10.8	89.2	<0.001	<0.001	0.003	0.006	0.01	0.03	2			OH	ORGANIC CLAY, ORGANIC SILT			73.20	18.36
4006R-12	5/7/05	HJ	3.5	4.5	4.0	4.3	564.8	Dredge or D&C	10.3	yes	253.8	321.2	24%				0.0	0.2	11.1	25.9	26.8	36.0	37.2	37.2	62.8	<0.001	<0.001	0.0034	0.009	0.03	0.3	4.8			OH	ORGANIC CLAY, ORGANIC SILT		2.219	71.76	17.04
4006R-12	5/7/05	QR	7.0	8.0	7.5	8.6	564.8	Dredge or D&C	10.3	yes	234.6	297.5	25%				0.0	0.2	17.2	24.9	27.8	30.0	42.3	42.3	57.8	<0.001	0.0015	0.005	0.015	0.085	0.54	4.8			OH	ORGANIC CLAY, ORGANIC SILT		2.258	72.57	18.26
4007-03	7/7/04	EFGH	2.0	4.0	3.0	2.2	575.8	Dredge or D&C	2.8	yes	210.5	241.9	29%	166.9	47.7	119.2																			OH	ORGANIC CLAY, ORGANIC SILT			75.36	22.04
4007-11	7/9/04	CDEF	1.0	3.0	2.0	1.3	561.2	Dredge or D&C	7.2	yes	256.6	331.0	23%		NP																				OL	ORGANIC SILT, ORGANIC CLAY	26.8		72.26	16.76
4008-01	7/7/04	BC	0.5	1.5	1.0	0.6	575.1	Dredge or D&C	1.1	yes	60.4	71.7	58%				6.3	1.9	3.4	69.4	11.0	8.0	74.7	81.0	19.0	0.0065	0.023	0.14	0.17	0.19	0.37	13	29.23	15.87	SC	CLAYEY SAND			94.90	55.28
4008-06	7/8/04	BC	0.5	1.5	1.0	0.6	573.4	Dredge or D&C	0.9	yes	187.2	238.4	30%	203.0	43.9	159.1	0.5	3.8	11.6	31.2	28.0	25.0	46.6	47.1	53.0	0.0015	0.0019	0.0068	0.06	0.1	0.43	9.6	66.67	0.31	OH	ORGANIC CLAY, ORGANIC SILT			75.53	22.32
4009-02	7/8/04	BC	0.5	1.5	1.0	0.5	574.8	Dredge or D&C	1.8	yes	269.4	291.7	26%	226.2	51.7	174.5																			OH	ORGANIC CLAY, ORGANIC SILT			73.42	18.74
4009-05	7/8/04	BC	0.5	1.5	1.0	0.6	571.6	Dredge or D&C	1.6	yes	209.2	243.3	29%	192.7	46.7	146.0																			OH	ORGANIC CLAY, ORGANIC SILT			75.30	21.93
4009-08	7/8/04	CDEF	1.0	3.0	2.0	1.1	572.5	Dredge or D&C	1.5	yes	72.6	89.5	53%	86.8	17.5	69.3	1.3	1.2	7.4	53.8	13.8	22.5	62.4	63.7	36.3	<0.001	0.0024	0.01	0.13	0.18	0.35	13			SC	CLAYEY SAND			90.48	47.76
4010-01	7/10/04	CDEF	1.0	3.0	2.0	1.3	573.6	Dredge or D&C	3.0	yes	184.9	262.3	28%	178.9	45.3	133.6	0.0	0.4	13.2	30.0	36.9	19.5	43.6	43.6	56.4	0.0016	0.0031	0.009	0.02	0.095	0.38	4.9	59.38	0.53	OH	ORGANIC CLAY, ORGANIC SILT			74.49	20.56
4010-04	7/10/04	CD	1.0	2.0	1.5	1.2	570.9	Dredge or D&C	2.4	yes	246.3	299.8	25%	219.7	50.8	168.9																			OH	ORGANIC CLAY, ORGANIC SILT			73.16	18.30
4011-04	7/10/04	CDEF	1.0	3.0	2.0	1.3	559.7	Dredge or D&C	2.2	yes	229.3	296.9	25%	231.9	52.6	179.3																			OH	ORGANIC CLAY, ORGANIC SILT			73.25	18.45
4012-02	7/12/04	CDEF	1.0	3.0	2.0	1.2	569.4	Dredge or D&C	5.4	yes	259.6	328.3	23%	237.2	53.4	183.8	0.0	0.0	0.8	15.1	58.1	26.0	15.9	15.9	84.1	0.0013	0.002	0.0064	0.02	0.035	0.08	2	26.92	0.90	OH	ORGANIC CLAY, ORGANIC SILT			72.33	16.89
4012-03	5/18/05	ABCD	0.0	2.0	1.0	0.0	561.9	Dredge or D&C	4.4	yes	288.3	378.8	21%	226.4	61.2	165.2	0.0	0.4	1.7	19.9	53.0	25.0	22.0	22.0	78.0	0.001	0.002	0.066	0.025	0.041	0.13	4.9			OH	ORGANIC CLAY, ORGANIC SILT	14.6	2.365	70.95	14.82
4013-02	7/20/04	EFGH	2.0	4.0	3.0	2.5	561.5	Dredge or D&C	4.0	yes	237.6	307.2	25%	224.4	50.9	173.5	0.3	1.4	20.6	26.4	21.8	29.5	48.4	48.7	51.3	<0.001	0.0014	0.005	0.019	0.17	0.6	9.6			OH	ORGANIC CLAY, ORGANIC SILT		2.44	72.98	17.92
4018-02	7/13/04	BCDE	0.5	2.5	1.5	0.6	574.4	Dredge or D&C	2.9	yes	150.0	193.7	34%	145.2	41.9	103.3																			OH	ORGANIC CLAY, ORGANIC SILT			78.02	26.57
4020-08	7/14/04	BCD	0.5	2.0	1.3	0.6	576.9	Dredge or D&C	1.4	yes	65.0	79.1	56%	64.7	34.1	30.6																			CH-OH	CLAY OF HIGH PLASTICITY, FAT CLAY			92.91	51.88
4021-01	7/21/04	BCDE	0.5	2.5	1.5	0.5	566.3	Dredge or D&C	5.4	yes	140.4	146.6	41%	119.3	29.3	90.0																			OH	ORGANIC CLAY, ORGANIC SILT			81.94	33.23
4021-01	7/21/04	JKL	4.0	5.5	4.8	4.1	566.3	Dredge or D&C	5.4	yes	24.7	26.9	79%				4.4	4.1	15.3	68.2	5.0	3.0	87.6	92.0	8.0	0.09	0.15	0.19	0.26	0.3	0.7	19	3.33	1.34	SM	SILTY SAND			116.24	91.57
4023-02	7/19/04	CDEF	1.0	3.0	2.0	1.1	575.4	Dredge or D&C	1.2	yes	43.6	51.8	66%				0.5	1.2	3.4	64.3	7.1	23.5	68.9	69.4	30.6	<0.001	0.0017	0.013	0.16	0.18	0.28	13			SC	CLAYEY SAND			101.86	67.11
4023-05	7/21/04	DEFG	1.5	3.5	2.5	1.8	572.7	Dredge or D&C	2.2	yes	39.0	55.8	64%				0.0	1.2	4.1	77.7	11.0	6.0	83.0	83.0	17.0	0.011	0.035	0.12	0.17	0.18	0.25	4.9	16.36	7.27	SC	CLAYEY SAND			100.24	64.35
4024-03	7/19/04	CDEF	1.0	3.0	2.0	1.0	575.2	Dredge or D&C	1.2	yes	65.0	67.9	60%	76.6	18.1	58.5	0.0	0.4	2.0	38.4	35.7	23.5	40.8	40.8	59.2	<0.001	0.0016	0.008	0.05	0.077	0.18	4.9			CH-OH	CLAY OF HIGH PLASTICITY, FAT CLAY			96.02	57.17
4025-02	7/19/04	EFGH	2.0	4.0	3.0	2.1	573.4	Dredge or D&C	4.4	yes	182.4	197.2	34%	182.5	37.1	145.4	0.0	1.2	10.8	25.9	29.1	33.0	37.9	37.9	62.1	<0.001	<0.001	0.0043	0.012	0.021	0.33	4.9			OH	ORGANIC CLAY, ORGANIC SILT			77.79	26.18
4026-02	7/22/04	EFGH	2.0	4.0	3.0	2.2	574.5	Dredge or D&C	2.5	yes	153.3	171.6	37%	123.4	32.4	91.0										<0.001		0.002	0.006	0.009					OH	ORGANIC CLAY, ORGANIC SILT			79.64	29.32
4030-08	7/23/04	CD	1.0	2.0	1.5	1.1	573.0	Dredge or D&C	2.5	yes	182.2	211.8	32%	186.0	40.5	145.5	0.0	0.1	29.1	19.0	43.3	8.5	48.2	48.2	51.8	0.006	0.008	0.013	0.064	0.19	0.88	4.9	31.67	0.15	OH-SC	ORGANIC CLAY, ORGANIC SILT			76.90	24.66
4032-10	7/24/04	CD	1.0	2.0	1.5	1.2	573.3	Dredge or D&C	2.8	yes	242.9	308.7	24%	220.0	56.4	163.6																			OH	ORGANIC CLAY, ORGANIC SILT			72.89	17.84
4033-06	7/25/04	CDEF	1.0	3.0	2.0	1.2	571.5	Dredge or D&C	3.5	yes	218.1	270.1	27%	214.2	53.4	160.8	0.0	0.0	0.5	18.8	50.7	30.0	19.3	19.3	80.7	<0.001	0.002	0.005	0.014	0.031	0.1	2			OH	ORGANIC CLAY, ORGANIC SILT			74.19	20.05
4034-03	7/26/04	GHJK	3.0	5.0	4.0	3.1	572.2	Dredge or D&C	3.2	yes	117.8	124.4	45%	169.1	38.3	130.8																			OH	ORGANIC CLAY, ORGANIC SILT			84.55	37.68
4034-07	7/26/04	CDEF	1.0	3.0	2.0	1.1	573.0	Dredge or D&C	2.5	yes	129.8	143.5	41%	153.6	33.8	119.8																			OH	ORGANIC CLAY, ORGANIC SILT			82.27	33.79
4034-08	7/26/04	EF	2.0	3.0	2.5	2.4	573.4	Dredge or D&C	4.9	yes	195.1	242.8	29%	186.3	55.5	130.8	0.6	8.5	20.1	29.4	18.9	22.5	58.0	58.6	41.4	0.0014	0.0022	0.0076	0.17	0.26	1.2	9.6	185.71	0.16	SC	CLAYEY SAND			75.32	21.97
4036-01	7/27/04	CDEF	1.0	3.0	2.0	1.0	575.8	Dredge or D&C	1.8	yes	91.8	95.1	51%	96.5	24.3	72.2	0.0	0.0	0.7	8.0	38.8	52.5	8.7	8.7	91.3	<0.001	<0.001	0.0017	0.0045	0.0075	0.046	2			OH	ORGANIC CLAY, ORGANIC SILT			89.33	45.79
4036-08	7/27/04	GHJK	3.0	5.0	4.0	3.3	573.3	Dredge or D&C	4.8	yes	203.0	228.6	30%	203.5	58.1	145.4																			OH	ORGANIC CLAY, ORGANIC SILT			76.00	23.13
4036-09	7/27/04	BCDE	0.5	2.5	1.5	0.6	572.9	Dredge or D&C	4.9	yes	238.3	286.5	26%	198.3	54.4	143.9	0.0	0.0	7.5	18.7	50.3	23.5	26.2	26.2	73.8	<0.001	0.0027	0.007	0.027	0.042	0.17	2			OH	ORGANIC CLAY, ORGANIC SILT			73.60	19.04
4036-09	7/27/04	B-K	0.5	5.0	2.8	0.6	572.9	Dredge or D&C	4.9	yes	229.0	275.6	27%	150.6	60.2	90.4	0.0	0.0	0.0	26.3	54.7	19.0	26.3	26.3	73.7	0.0025	0.004	0.01	0.035	0.049	0.2	0.425	19.60	0.82	OH	ORGANIC CLAY, ORGANIC SILT			73.98	19.70
4037-23	5/18/05	ABCD	0.0	2.0	1.0	0.0	572.9	Dredge or D&C	6.9	yes	184.6	224.8	31%	137.3	38.5	98.8	0.1	0.9	5.9	27.8	41.8	23.5	34.6	34.7	65.3	0.0012	0.0023	0.08	0.04	0.06	0.16	9.6			OH	ORGANIC CLAY, ORGANIC SILT	13.3	2.319	75.65	23.29
4038-01	7/27/04	BCDE	0.5	2.5	1.5	0.6	575.1	Dredge or D&C	2.6	yes	190.4	229.0	30%	179.6	42.7	136.9	0.0	0.1	0.6	4.2	53.1	42.0	4.9	4.9	95.1	<0.001	<0.001	0.002	0.0064	0.0093	0.035	2			OH	ORGANIC CLAY, ORGANIC SILT			75.98	23.09
4038-03	7/27/04	BCDE	0.5	2.5	1.5	0.5	572.9	Dredge or D&C	2.9	yes	234.1	252.3	28%	196.0	46.3	149.7																			OH	ORGANIC CLAY, ORGANIC SILT			74.90	21.26
4038-06	7/28/04	CD	1.0	2.0	1.5	1.1	570.9	Dredge or D&C	2.9	yes	219.8	254.0	28%	205.5	47.1	158.4	0.0	0.0	2.6	17.7	55.7	24.0	20.3	20.3	79.7	0.0016	0.0022	0.0071	0.019	0.031	0.14	2	19.38	1.02	OH	ORGANIC CLAY, ORGANIC SILT			74.83	21.13
4038-07	7/28/04	EFGH	2.0	4.0	3.0	2.1	572.1	Dredge or D&C	4.1	yes	220.4	237.7	30%	200.9	48.0	152.9																			OH	ORGANIC CLAY, ORGANIC SILT			75.56	22.37
4040-04	7/28/04	BCD	0.5	2.0	1.3	0.6	568.4	Dredge or D&C	0.9	yes	60.6	75.7	57%				1.0	0.7	4.8	68.3	10.1	15.0	73.8	74.8	25.1	0.002	0.0055	0.11	0.17	0.18	0.28	13	90.00	33.61	SC	CLAYEY SAND			93.80	53.39
4042-01	7/28/04	CDE	1.0	2.5	1.8	1.1	571.1	Dredge or D&C	2.5	yes	208.3	236.0	30%	175.6	43.7	131.9																			OH	ORGANIC CLAY, ORGANIC SILT			75.64	22.51
4044-01	8/3/04	CD	1.0	2.0	1.5	1.1	570.9	Dredge or D&C	4.9	yes	204.1	227.2	31%	161.2	48.2	113.0																			OH	ORGANIC CLAY, ORGANIC SILT			76.07	23.25
4044-01	8/3/04	HJK	3.5	5.0	4.3	3.8	570.9	Dredge or D&C	4.9	yes	40.3	48.0	68%				0.0	0.1	0.7	66.2	25.0	8.0	67.0	67.0	33.0	0.0071	0.019	0.06	0.13	0.16	0.25	2	22.54	3.17	SC	CLAYEY SAND			103.55	69.98
4045-03	8/3/04	BCD	0.5	2.0	1.3	0.6	566.1	Dredge or D&C	3.1	yes	241.7	273.1	27%	196.4	43.6	152.8																			OH	ORGANIC CLAY, ORGANIC SILT			74.07	19.85
4046-02	8/3/04	A-M	0.0	6.0	3.0	0.0	568.3	Dredge or D&C	4.3	yes	248.9	332.3	23%	188.4	54.7	133.7	0.0	0.0	0.3	29.4	56.3	14.0	29.7	29.7	70.3	0.004	0.0052	0.0099	0.017	0.025	0.24	0.5	6.25	0.98	OH	ORGANIC CLAY, ORGANIC SILT		2.31	71.82	16.61
4047-01	8/31/04	BCDE	0.5	2.5	1.5	0.6	565.3	Dredge or D&C	5.8	yes	189.2	239.2	29%	148.9	40.4	108.5																			OH	ORGANIC CLAY, ORGANIC SILT	9.2	2.396	75.34	22.21
4048-02	8/31/04	GHJK	3.0	5.0	4.0	3.1	572.7	Dredge or D&C	7.2	yes	239.2	251.5	28%	204.4	55.7	148.7	2.8	16.6	25.9	20.3	21.9	12.5	62.8	65.6	34.4	0.003	0.008	0.015	0.3	0.7	2.6	9.6	233.33	0.11	SC	CLAYEY SAND			74.94	21.32
4048-05	8/24/04	BCDE	0.5	2.5	1.5	0.6	556.0	Dredge or D&C	3.5	yes	206.6	260.6	28%	170.5	57.2	113.3																			OH	ORGANIC CLAY, ORGANIC SILT			74.56	20.67
4048R-03	5/10/05	EF	2.0	3.0	2.5	2.6	557.7	Dredge or D&C	5.2	yes	230.9	312.6	24%				0.0	0.0	1.7	11.9	56.4	30.0	13.6	13.6	86.4	<0.001	<0.001	0.005	0.011	0.035	0.075	2			OH	ORGANIC CLAY, ORGANIC SILT			72.77	17.64
4049-08	10/4/04	EFGH	2.0	4.0	3.0	2.5	563.5	Dredge or D&C	6.4	yes	213.3	276.9	27%	189.1	40.8	148.3																			OH	ORGANIC CLAY, ORGANIC SILT			73.93	19.62
4050-03	8/24/04	CDEF	1.0	3.0	2.0	1.2	570.8	Dredge or D&C	10.1	yes	207.1	265.0	27%	165.8	65.7	100.1	0.0	0.0	0.0	19.8	63.2	17.0	19.8	19.8	80.2	0.003	0.0043	0.0095	0.031	0.044	0.13	0.425	14.67	0.68	OH	ORGANIC CLAY, ORGANIC SILT			74.38	20.38
4051-05	8/31/04	GHJK	3.0	5.0	4.0	6.3	567.1	Dredge or D&C	10.9	yes	168.6	402.3	20%	185.4	56.4	129.0																			SC	CLAYEY SAND			70.67	14.07
4051R-04	5/10/05	BCDE	0.5	2.5	1.5	0.8	569.4	Dredge or D&C	12.6	yes	181.1	334.3	23%	161.7	43.5	118.2	0.0	0.0	1.9	9.9	52.7	35.5	11.8	11.8	88.2	<0.001	<0.001	0.003	0.011	0.017	0.055	2			OH	ORGANIC CLAY, ORGANIC SILT			72.17	16.62
4052-02	8/25/04	BCDE	0.5	2.5	1.5	0.5	565.8	Dredge or D&C	12.2	yes	222.0	236.7	30%	185.0	76.7	108.3	0.0	0.0	0.2	24.4	59.4	16.0	24.6	24.6	75.4	0.0031	0.005	0.012	0.043	0.05	0.15	0.425	16.13	0.93	OH	ORGANIC CLAY, ORGANIC SILT			75.60	22.45
4053-03	9/3/04	BCDE	0.5	2.5	1.5	0.5	571.0	Dredge or D&C	12.6	yes	22.7	25.7	80%																						SM	SILTY SAND			117.24	93.26
4053-03	9/3/04	EFGH	2.0	4.0	3.0	2.1	571.0	Dredge or D&C	12.6	yes	171.4	181.4	36%	169.8	32.7	137.1																			OH	ORGANIC CLAY, ORGANIC SILT			78.88	28.03
4055-02	9/3/04	JKLM	4.0	6.0	5.0	4.4	575.6	Dredge or D&C	6.1	yes	159.6	181.9	35%	155.1	41.0	114.1																			OH	ORGANIC CLAY, ORGANIC SILT			78.85	27.97
4055-06	5/18/05	ABCD	0.0	2.0	1.0	0.0	563.6	Dredge or D&C	2.1	yes	229.1	236.1	30%	172.8	41.2	131.6	0.0	0.0	1.9	24.5	43.6	30.0	26.4	26.4	73.6	0.001	0.0017	0.005	0.016	0.039	0.14	2			OH	ORGANIC CLAY, ORGANIC SILT	9.4	2.319	75.11	22.35
4055-06	9/3/04	CDEF	1.0	3.0	2.0	1.0	563.6	Dredge or D&C	2.1	yes	207.6	214.0	32%	209.5	42.5	167.0	0.0	0.0	0.6	24.3	39.6	35.5	24.9	24.9	75.1	<0.001	<0.001	0.004	0.01	0.018	0.13	2			OH	ORGANIC CLAY, ORGANIC SILT			76.78	24.45
4056-01	9/1/04	BCDE	0.5	2.5	1.5	0.5	575.3	Dredge or D&C	0.8	yes	162.6	165.7	38%	148.3	36.9	111.4																			OH	ORGANIC CLAY, ORGANIC SILT	6.8		80.13	30.16
4056-04	9/1/04	GHJK	3.0	5.0	4.0	3.6	554.9	Dredge or D&C	6.4	yes	235.9	292.3	25%	212.0	53.6	158.4																			OH	ORGANIC CLAY, ORGANIC SILT		2.407	73.33	18.69
4058-02	8/25/04	BCD	0.5	2.0	1.3	0.5	558.8	Dredge or D&C	5.8	yes	61.6	62.8	61%				14.6	12.7	0.7	46.1	22.9	3.0	59.5	74.1	25.9	0.012	0.016	0.012	0.23	0.28	4.75	9.5	23.33	0.04	SM	SILTY SAND			97.67	59.97
4058-02	8/25/04	LMNP	5.0	7.0	6.0	5.1	558.8	Dredge or D&C	5.8	yes	87.0	88.6	53%	78.2	30.5	47.7																			SC-OH	CLAYEY SAND			90.68	48.09
4060-02	8/25/04	CDEF	1.0	3.0	2.0	1.1	551.1	Dredge or D&C	3.1	yes	178.4	198.5	33%	156.0	48.8	107.2	0.8	0.6	0.2	27.0	52.9	18.5	27.8	28.6	71.4	0.0026	0.004	0.01	0.041	0.055	0.23	9.5	21.15	0.70	OH	ORGANIC CLAY, ORGANIC SILT			77.71	26.03
4062-03	5/18/05	DEFG	2.0	4.0	3.0	2.2	552.0	Dredge or D&C	3.5	yes	87.5	99.8	50%	87.3	23.8	63.5	0.0	0.0	0.2	5.5	36.3	58.0	5.7	5.7	94.3	<0.001	<0.001	0.0011	0.0032	0.0055	0.026	2			OH	ORGANIC CLAY, ORGANIC SILT	4.2	2.482	88.99	44.53
4063-02	9/2/04	CDEF	1.0	3.0	2.0	1.2	548.2	Dredge or D&C	6.6	yes	122.6	161.0	38%	93.4	29.3	64.1																			SC-OH	CLAYEY SAND			80.55	30.86
4064-32	5/11/05	BCDE	0.5	2.5	1.5	0.6	550.2	Dredge or D&C	3.4	yes	103.2	123.5	45%				1.2	7.4	11.9	37.7	14.1	27.5	57.0	58.2	41.6	<0.001	0.0018	0.006	0.1	0.15	0.85	9.5			SC	CLAYEY SAND			84.69	37.90
4066-32	5/8/05	BCDE	0.5	2.5	1.5	0.6	550.0	Dredge or D&C	1.5	yes	128.1	150.5	40%				0.3	1.0	8.6	36.2	21.8	32.0	45.8	46.1	53.8	<0.001	<0.001	0.0041	0.01	0.094	0.29	9.7			OH	ORGANIC CLAY, ORGANIC SILT			81.54	32.55
4077-04	9/9/04	EFGH	2.0	4.0	3.0	2.1	572.0	Dredge or D&C	7.0	yes	45.8	52.0	66%	39.0	23.7	15.3																			SC	CLAYEY SAND			101.75	66.92
4085-03	10/5/04	BCDE	0.5	2.5	1.5	0.5	574.9	Dredge or D&C	5.9	yes	159.6	174.7	36%	110.0	33.1	76.9	0.3	1.0	3.5	37.5	44.8	13.0	42.0	42.3	57.8	0.0036	0.0065	0.029	0.06	0.08	0.22	4.9	22.22	2.92	OH	ORGANIC CLAY, ORGANIC SILT			79.39	28.90
4089-01	5/17/05	BCDE	0.5	2.5	1.5	0.5	578.3	Dredge or D&C	6.8	yes	241.8	241.8	29%				0.0	0.0	1.3	23.2	43.0	32.5	24.5	24.5	75.5	0.001	<0.001	0.043	0.013	0.04	0.12	2			OH	ORGANIC CLAY, ORGANIC SILT			75.37	22.05
4091-03	9/14/04	CDE	1.0	2.5	1.8	1.0	550.0	Dredge or D&C	1.5	yes	137.4	146.2	41%	121.5	29.1	92.4																			OH	ORGANIC CLAY, ORGANIC SILT			81.98	33.30
4107-32	5/8/05	BC	0.5	1.5	1.0	0.5	548.3	Dredge or D&C	4.1	yes	166.6	182.4	35%	151.4	38.8	112.6	0.4	1.1	5.2	31.2	31.6	30.5	37.5	37.9	62.1	<0.001	0.0016	0.048	0.013	0.03	0.24	13			OH	ORGANIC CLAY, ORGANIC SILT		2.315	78.11	27.66

COMPACTION CORRECTE DATA								30% Design Dredge Plan						Atterberg Limits [b]			Grain Size [c]									Grain size Parameters													
Sample ID	Date Sampled	Depth Interval	Top Sample Depth	Bottom Sample Depth	Average Sample Depth	Corr. Top Sample Depth	Existing Elev. (2004 Survey)	Optimized Remedial Action	Target Dredge Depth	Sample w/in Dredge Prism	Moisture Content [a]	Compaction Corrected Moisture Content [a]	Compaction Corrected Percent Percent Solids	Liquid Limit	Plastic Limit	Plasticity Index	Gravel	Sand (%)			Silt	Clay	Sand	Gravel/ Sand	Silt/Clay	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{100}	Cu	Cc	USCS	USCS Description	Organic Content[d]	Specific Gravity [e]	Corrected Bulk Density (Calc'd)	Corrected Dry Density (Calc'd)
		(Letter)	(ft)	(ft)	(ft)	(ft)	(ft.) [IGLD 85]		(ft)	(yes/no)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	Coarse	Medium	Fine	(%)	(%)	(%)	(%)	(%)	(eff. gs)							(uniformity)	(gradation)			(%)		(pcf)	(pcf)
4201-04	5/6/05	EFGH	2.0	4.0	3.0	2.6	575.5	Dredge or D&C	9.5	yes	300.9	400.2	20%				0.0	0.0	3.3	25.5	43.2	28.0	28.8	28.8	71.2	<0.001	0.0014	0.0053	0.011	0.021	0.19	2			OH	ORGANIC CLAY, ORGANIC SILT			70.71	14.14
4201-06	5/6/05	DEF	1.5	3.0	2.3	2.0	575.6	Dredge or D&C	11.6	yes	220.0	301.6	25%				0.0	0.0	2.9	24.5	46.6	26.0	27.4	27.4	72.6	<0.001	<0.001	0.0063	0.02	0.03	0.16	2			OH	ORGANIC CLAY, ORGANIC SILT			73.10	18.20
4201-06	5/6/05	QRS	7.0	8.5	7.8	9.2	575.6	Dredge or D&C	11.6	yes	239.4	327.0	23%				0.0	0.0	3.9	26.3	41.8	28.0	30.2	30.2	69.8	<0.001	0.0017	0.0057	0.01	0.013	0.21	2			OH	ORGANIC CLAY, ORGANIC SILT			72.36	16.95
4202-07	5/6/05	EFGH	2.0	4.0	3.0	2.8	565.6	Dredge or D&C	10.6	yes	295.0	422.5	19%	239.1	56.5	182.6	0.0	0.0	0.2	8.0	59.8	32.0	8.2	8.2	91.8	<0.001	<0.001	0.0043	0.013	0.026	0.065	2			OH	ORGANIC CLAY, ORGANIC SILT			70.31	13.46
4203-07	5/7/05	B-H	0.5	4.0	2.3	0.6	557.4	Dredge or D&C	2.4	yes	77.4	111.3	47%	64.7	22.5	42.2	5.3	2.1	13.1	50.5	15.5	13.5	65.7	71.0	29.0	0.0025	0.006	0.08	0.16	0.21	0.66	13	84.00	12.19	SC	CLAYEY SAND		2.587	87.93	41.62
4232-01	5/8/05	EFGH	2.0	4.0	3.0	2.4	572.1	Dredge or D&C	3.7	yes	196.2	239.4	29%				3.1	3.4	4.0	16.2	42.8	30.5	23.6	26.7	73.3	<0.001	<0.001	0.0047	0.01	0.019	0.24	13			OH	ORGANIC CLAY, ORGANIC SILT			75.48	22.24
4242-01	5/8/05	BCD	0.5	2.0	1.3	0.6	571.3	Dredge or D&C	4.3	yes	224.8	295.9	25%				0.0	0.8	6.0	19.7	41.5	32.0	26.5	26.5	73.5	<0.001	<0.001	0.0045	0.012	0.021	0.19	4.8			OH	ORGANIC CLAY, ORGANIC SILT			73.28	18.51
4242-01	5/8/05	FGHJ	2.5	4.5	3.5	3.2	571.3	Dredge or D&C	4.3	yes	35.3	55.8	64%				5.5	3.9	7.9	71.1	6.6	5.0	82.9	88.4	11.6	0.021	0.081	0.11	0.17	0.22	0.5	13	10.48	2.62	SP-SM	POORLY-GRADED SAND			100.25	64.36
4245-05	5/10/05	GHJK	3.0	5.0	4.0	3.8	561.9	Dredge or D&C	6.7	yes	210.7	280.5	26%				0.0	0.0	1.8	19.9	46.3	33.0	21.7	21.7	78.3	<0.001	0.0015	0.004	0.013	0.027	0.12	2			OH	ORGANIC CLAY, ORGANIC SILT			73.81	19.40
4245R-01	5/10/05	BCDE	0.5	2.5	1.5	0.6	571.0	Dredge or D&C	4.0	yes	207.8	233.0	30%				0.0	0.0	1.0	15.6	50.4	33.0	16.6	16.6	83.4	<0.001	0.0015	0.004	0.011	0.026	0.085	2			OH	ORGANIC CLAY, ORGANIC SILT			75.78	22.75
4246-01	5/10/05	BCDE	0.5	2.5	1.5	0.6	565.0	Dredge or D&C	3.3	yes	198.1	241.7	29%	150.6	42.3	108.3	0.2	8.8	16.6	33.0	14.6	27.0	58.4	58.6	41.6	<0.001	0.0016	0.0071	0.013	0.2	1	13			OH	ORGANIC CLAY, ORGANIC SILT			75.37	22.06
4247-01	5/10/05	GHJK	3.0	5.0	4.0	3.9	561.1	Dredge or D&C	8.6	yes	200.9	270.8	27%				0.0	0.0	1.2	6.8	26.0	66.0	8.0	8.0	92.0	<0.001	<0.001	0.0034	0.0095	0.013	0.06	2			OH	ORGANIC CLAY, ORGANIC SILT			74.16	20.00
4249-02	5/10/05	BCDE	0.5	2.5	1.5	0.7	571.8	Dredge or D&C	3.6	yes	220.8	300.3	25%				0.3	0.5	3.2	20.0	46.0	30.0	23.7	24.0	76.0	<0.001	0.0018	0.005	0.012	0.023	0.14	9			OH	ORGANIC CLAY, ORGANIC SILT		2.365	72.91	18.22
4251-02	5/10/05	EFGH	2.0	4.0	3.0	2.5	556.8	Dredge or D&C	8.3	yes	222.8	282.7	26%				0.0	0.0	0.7	18.6	44.7	36.0	19.3	19.3	80.7	<0.001	<0.001	0.0037	0.0093	0.014	0.09	2			OH	ORGANIC CLAY, ORGANIC SILT			73.73	19.26
5002-06	9/13/04	CD	1.0	2.0	1.5	1.2	573.4	Dredge or D&C	1.9	yes	118.4	146.6	41%	126.7	28.7	98.0																			OH	ORGANIC CLAY, ORGANIC SILT			81.94	33.23
5002-08	9/14/04	FGH	2.5	4.0	3.3	2.6	551.5	Dredge or D&C	4.5	yes	174.8	182.2	35%	185.3	49.4	135.9																			OH	ORGANIC CLAY, ORGANIC SILT			78.83	27.94
																								16	47														

DATA SUMMARY

OU 2-5	Count	115	115	115	86	86	86	65	65	65	65	65	65	65	65	65	65	26	26				9	16	115	115
	Max	301	648	81%	239	135	184	15	17	41	78	65	66	88	97	95		233	34				27	2.59	118.8	96.0
	Average	182	227	35%	171	46	125	1	1	6	29	37	26	36	37	63		41	4				12	2.37	79.5	29.1
	Min	16	24	13%	39	18	15	0	0	0	4	1	2	5	5	3		3	0				4	2.22	67.6	9.0
	St. Dev.	72	105	14%	44	15	38	2	3	8	18	16	13	22	24	24		55	7				7	0.09	10.4	17.6
OU 2-3	Count	8	8	8	8	8	8	4	4	4	4	4	4	4	4	4		1	1					2	8	8
	Max	273	648	61%	210	61	177	0	2	6	31	48	45	34	34	92		30	1					2.38	96.5	58.8
	Average	200	275	31%	188	46	141	0	0	3	15	46	36	18	18	82		30	1					2.37	77.0	24.9
	Min	41	64	13%	157	22	100	0	0	0	8	44	21	8	8	66		30	1					2.35	67.6	9.0
	St. Dev.	72	167	14%	21	12	28	0	1	2	11	2	11	12	12	12		#DIV/0!	#DIV/0!						8.5	14.6
OU 4-5	Count	104	104	104	76	76	76	60	60	60	60	60	60	60	60	60		25	25				9	14	104	104
	Max	301	423	81%	239	135	184	15	17	41	78	65	66	88	97	95		233	34				27	2.59	118.8	96.0
	Average	181	224	35%	170	46	124	1	2	6	30	36	25	38	39	61		42	4				12	2.37	79.7	29.5
	Min	16	24	19%	39	18	15	0	0	0	4	1	2	5	5	3		3	0				4	2.22	70.3	13.5
	St. Dev.	73	100	15%	46	16	39	3	3	8	18	17	13	23	24	24		56	7				7	0.09	10.6	18.1

APPENDIX B

CAP DESIGN SUPPORT DOCUMENTATION

Including

Attachment B-1 Cap Design Tech Memo

Attachment B-2 Vessel Wakes Modeling

Attachment B-3 Propwash Evaluation on Navigation Channel Side Slopes

Attachment B-4 Slope Stability Analysis for Capped Side Slopes

Attachment B-5 Cap Design Refinement "Ground Rules" Memo

Attachment B-6 Cap Design Type Summary Table

ATTACHMENT B-1

CAP DESIGN TECH MEMO

Memorandum

To: 60 Percent Design File

From: Paul LaRosa, Clay Patmont, and Kim Powell (Anchor Environmental)

cc:

Date: June 10, 2008

Re: Lower Fox River OUs 2 to 5 - Engineered Cap Design Technical Memo

1 INTRODUCTION

This memorandum presents a summary of engineering evaluations necessary to complete the remedial design (RD) of engineered sediment caps as part of the remedial action for Operable Units (OUs) 2 through 5 of the Lower Fox River, consistent with the June 2007 Record of Decision [ROD] Amendment for OUs 2-5. This memorandum builds upon and incorporates by reference, preliminary cap designs presented in the OUs 2-5 Basis of Design Report [BODR] (Shaw and Anchor 2006), approved in July 2006 by the U.S. Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR). In addition, this memorandum presents a summary of additional cap design evaluations that have been conducted subsequent to the BODR which will be integrated into the final remedial design for OUs 2-5.

Additional engineering evaluations will be performed during subsequent stages of RD, including standardized actions for post-dredge management of undisturbed and generated residuals, considering feasibility and cost-effectiveness. Further design details will be developed as part of the Construction Quality Assurance Project Plan (CQAPP) and Adaptive Management Plan.

2 REFINEMENTS TO TECHNICAL DESIGN OF IN SITU CAP

As described in the BODR, preliminary designs for engineered sediment caps in OUs 2-5 followed detailed guidance for in situ capping developed by USEPA and the U.S. Army Corps of Engineers (USACE):

- Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (USEPA 2005a)
- Guidance for Subaqueous Dredged Material Capping (Palermo et al. 1998a)
- Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In Situ Subaqueous Capping of Contaminated Sediments (Palermo et al. 1998b)

These documents provide detailed procedures for site and sediment characterization, cap design, cap placement operations, and monitoring for subaqueous capping. Caps designed according to the USEPA and USACE guidance have been demonstrated to be protective of human health and the environment (USEPA 2005a).

The thickness and other design specifications for in situ engineered caps in OUs 2-5 consider the following five components:

- Chemical isolation of contaminants (Ti)
- Bioturbation (Tb)
- Consolidation (Tc)
- Erosion (Te)
- Operational considerations (i.e., gas generation, placement inaccuracies, and other pertinent processes) (T_o)

As discussed in the BODR, an appropriate thickness of cap was determined individually for each component based on site-specific design parameters. The total cap thickness that satisfies all design components is equal to the summation of the individual component thicknesses listed above. Note however, that the technical Workgroup concluded that the erosion component and the bioturbation component may be a concurrent thickness and not independent thickness requirements, consistent with White Paper 6B (Palermo et al. 2002). Therefore, a set thickness of an armor layer can serve to resist erosion as well as accommodate bioturbation. Given the variability of site conditions (PCB concentrations, erosion potential, etc.) throughout OUs 2-5, several cap designs were developed for the Optimized Remedy, as listed below and described in detail in Appendix D of the BODR:

- **Cap A - 13-inch sand and gravel cap** – consisting of a minimum 3 inches of placed sand (equivalent to a targeted average thickness of 6 inches within the placement area

considering normal overplacement allowances), overlain by a minimum 4 inches of placed gravel (7 inches with overplacement allowances)

- **Cap B - 16-inch sand and gravel cap** – consisting of a minimum 6 inches of placed sand (9 inches with overplacement allowances) overlain by a minimum 4 inches of placed gravel (7 inches with overplacement allowances)
- **Cap C - 33-inch sand and gravel/quarry spall cap** – consisting of a minimum 12 inches of placed sand (15 inches with overplacement allowances) overlain by a minimum 12-inch-thick placed layer of suitably sized armor material (18 inches with overplacement allowances). Within the active portions of the OU 4B navigation channel, four to nine-inch quarry spall material may be required for the armor layer; smaller material could potentially be used in other areas of the OU 4 that are subject to lower erosional forces.

The sections below present the design of each cap component including refinements to and additional considerations regarding specific cap components from the BODR through the 60 Percent design. Note that the design considerations for certain cap components have remained the consistent since the development of the BODR (e.g., bioturbation).

2.1 Chemical Isolation

As described in the BODR, a series of calculations were performed using location-specific conditions (PCB concentrations, vertical groundwater velocity, sediment total organic carbon [TOC], consolidation-induced porewater flux, etc.) to evaluate the chemical isolation component of a subaqueous cap for PCB containment. Specifically, chemical isolation modeling included the use of a transient model described in Appendix B of the *ARCS Program Guidance for In Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1988b) to estimate contaminant flux through the chemical isolation layer and the time to achieve steady state chemical flux conditions in the isolation layer of the cap. In addition, the steady state model of Reible et al. (2004) was used to estimate chemical concentrations in the surficial (bioturbation) sediment layers of the cap once steady state conditions are achieved. The results of the steady state model indicated that, with the cap designs incorporated into the Optimized Remedy, once steady state conditions are achieved, there is greater than a 99 percent probability that sediment PCB concentrations in the cap bioturbation zone would be maintained (in perpetuity) below the 1 ppm remedial action level (RAL).

As described in the BODR, proposed cap thicknesses with respect to chemical isolation of PCBs were preliminarily based on the average sediment PCB concentration in the top 1.5 feet of sediment immediately underlying the prospective cap layer for a given core location. As such, cap designs were developed with varying chemical isolation thicknesses to contain sediment with between 1 and 10 ppm, 10 and 50 ppm, and greater than 50 ppm in the top 1.5 feet of sediment. For areas outside of the federally authorized navigation channel, a 13-inch cap was proposed for areas with PCB concentrations less than 10 parts per million (ppm) and a 16-inch cap was proposed for areas with PCB concentrations between 10 and 50 ppm in the top 1.5 feet of sediment.

Subsequent to the BODR, the delineation of caps with the appropriate chemical isolation layer thickness was refined based on the PCB concentration in the top 6 inches of sediment immediately underlying the cap, consistent with the criteria specified in the ROD Amendment (USEPA and WDNR 2007):

- **Engineered caps of at least 6 inches of sand for chemical isolation:** PCB concentrations will not exceed 50 ppm within the sediment profile and PCBs in the top six inches of sediment immediately beneath the cap will be less than 10 ppm.
- **Engineered caps of at least 9 inches of sand for chemical isolation:** PCB concentrations will not exceed 50 ppm within the sediment profile.
- **Engineered caps of at least 15 inches of sand (and filter material) for chemical isolation:** PCB concentrations exceeding 50 ppm buried within the sediment profile or in shoreline areas where dredging would result in instability.

For dredge-and-cap ("hybrid") areas of OUs 2-5, appropriate sand layer thicknesses for chemical isolation of PCBs (i.e., 6-, 9-, or 15-inch-thick layers)) were determined based on estimates of the maximum PCB concentration anticipated in the top six inches of sediment immediately beneath the cap, considering the following:

a) The upper-bound generated residual PCB concentration and thickness/density anticipated following dredging (e.g., assuming a range of generated residual releases using the framework outlined by Patmont and Palermo 2007); and

b) The upper-bound undisturbed residual PCB concentration in the 6-inch interval immediately beneath the dredge elevation.

Field verification of designed cap thicknesses will include the collection of samples for PCB analysis in dredge-and-cap areas following dredging but prior to cap placement, in order to verify RD forecasts and confirm the appropriate cap thickness is applied based on the measured concentration of residuals. The CQAPP Addendum provides additional details of PCB analysis in dredge-and-cap areas. Sampling densities and frequencies for this purpose may be reduced over time if the RD forecasts are consistently verified.

2.2 Bioturbation Component

The BODR stated that the bioturbation depth is expected to be limited to the upper 5 to 10 cm (2 to 4 inches). As mentioned above and as discussed in the BODR, the cap designs developed in the 30 Percent Design and summarized herein provide an erosion protection layer component (Te) of the cap that is sufficient for protection against both physical isolation and bioturbation (Tb).

2.3 Consolidation Component

The cap material itself will be granular and is expected to undergo minimal elastic settlement within the period of construction. Therefore, no additional cap thickness is included to account for cap consolidation. However, as discussed in the BODR, cap-induced consolidation of existing sediments resulting in porewater expulsion was considered in the chemical isolation thickness design discussed in Section 2.1.

2.4 Erosion Protection Component

The erosion protection component of an in situ cap prevents external forces from disturbing the cap or the underlying contaminated sediments. Several potential forms of erosion including hydrodynamic flows, ice scour, wind-induced waves, and vessel-induced propeller wash and vessel wakes were evaluated for the preliminary cap design, as detailed in Appendix D in the BODR. Refinements to and additional considerations regarding the erosion component of the cap design have been conducted since the submittal of the BODR,

specifically related to hydrodynamic flows, vessel-induced propeller wash, and vessel wakes. These evaluations are described in the sections below.

2.4.1 Hydrodynamic Flows

Sea Engineering Inc. (SEI) developed and calibrated a detailed 2-dimensional hydrodynamic model using an extensive data set from USGS in OUs 3 and 4 to predict bottom shear stresses during a design level flow event (24,200 cfs [685 m^3/s]) with a recurrence interval of approximately 100 years. Initial model runs were conducted using existing bathymetry and results were used to evaluate the applicability of various cap designs under the Optimized Remedy. Following initial design of the Optimized Remedy, the detailed hydrodynamic model was run again using post-remedy design bathymetry and the remedial actions refined as necessary to accommodate predicted hydrodynamic erosion forces. These analyses are described in detail in Appendix D of the BODR. In summary, relative to existing conditions, the hydrodynamic model predicted only minor changes from existing conditions in shear stresses throughout OUs 3 and 4 under the Optimized Remedy bathymetric conditions and corresponding to the reasonable worst-case hydrodynamic design condition (i.e., simultaneous 100-year flows, historical low water levels, and maximum seiche amplitude). A conservative maximum bottom shear stress of 100 dynes/cm^2 was selected for design and was correlated to minimum thickness of 4 inches of 1.5-inch armor stone, consistent with USEPA and USACE guidance.

Subsequent reviews of the hydrodynamic information available for the Lower Fox River suggest that local runoff (e.g., from the East River) may discharge into OU 4 at rates higher than the values assumed during the BODR hydrodynamic modeling. To further inform sensitivity analyses of RD parameters, SEI performed additional supplemental model simulations in March 2007 using a range of extreme flow assumptions, including hindcasting from a record rainfall event that occurred on June 22-23, 1990 (Shaw and Anchor 2007). The results of this sensitivity analysis modeling further confirmed that the engineered cap designs presented in the BODR will adequately protect against disturbance from extreme river flows.

To supplement previous modeling of extreme river flows and to further ensure that appropriately conservative cap design are specified for localized areas of OU 4, the 2-dimensional hydrodynamic model was revised in October 2007 as part of the 30 Percent Design to evaluate the localized effects of tributary inflows at their specific geographic location during the peak discharges measured during the June 22-23, 1990 event discussed above. Tributary flow contributions to the Lower Fox River during the extreme rainfall event were determined using the Soil and Water Assessment Tool (SWAT) model, a physically-based river basin scale model developed for the USDA Agricultural Research Service (ARS) to quantify the impact of land management practices in large, complex watersheds (Technical Memorandum 2a, 1998). These tributary loadings were then applied to the hydrodynamic model developed for OUs 3 and 4 to simulate the June 22-23, 1990 flow conditions.

For both OUs 3 and 4, resulting shear stresses in the majority of the reaches were predicted to be significantly less than the maximum bottom stress of 100 dynes/cm2 selected for armor stone design in the BODR. Localized shear stresses in excess of the original design shear stress (100 dynes/cm^2) were observed in only two areas: in OU 3 immediately below the Little Rapids Dam, and in OU 4 just downstream of the East River. However, these areas have not been targeted for capping as part of the OUs 2 to 5 remedial action. Therefore, this supplemental modeling further confirms that the engineered cap designs presented in the BODR will adequately protect against disturbance from extreme river flows.

2.4.2 Vessel-Induced Propeller Wash

As part of the BODR, the potential impacts of vessel-induced propeller wash were evaluated consistent with USEPA/USACE guidance documents (USACE 1998a) and technical literature (Verhey 1983, Blaauw and van de Kaa, 1978). Certain components of the available guidance and technical literature are based on large ocean-going vessels operating at very slow speeds (e.g., maneuvering operations), and therefore are not applicable to much smaller recreational vessels operating in portions of the Lower Fox River. Therefore, to evaluate these recreational vessels as part of the BODR, the predictive equations developed for the larger vessels were adapted to address smaller recreational vessels under moving conditions based on a field study conducted in

October 2005 where bottom-mounted current meters were used to measure actual bottom velocities of maneuvering and passing recreational vessels in the Fox River. Based on engineering evaluations performed for the BODR, a median stone size of 1.5 inches (i.e., gravel) was shown to resist the reasonable worst-case hydrodynamic condition in all areas of OU 3 and 4 and to also resist erosion expected when subjected to the propeller wash of a range of characteristic vessels (e.g., *Foxy Lady* Tour boat or recreational boats) passing over an in situ cap under relatively shallow water conditions.

Since submittal of the BODR in May 2006, more detailed analyses of the propwash from recreational vessels was performed to inform the 30 Percent Design phase to refine and optimize cap designs to further ensure long-term stability and performance. As part of these more detailed analyses, available site-specific vessel information was reviewed to develop a refined propwash modeling framework specifically for evaluating recreational propwash on the Lower Fox River.

The refined recreational propwash evaluation was aimed at developing recommendations for the size of armor stone that would be necessary to resist the erosive forces from the propeller wash generated by recreational boats operating on the Lower Fox River. The evaluation consisted of an engineering evaluation utilizing the following general considerations:

- Modeling results based on the technical framework discussed below
- Engineering considerations including material gradations, implementability, cost, etc.
- Best professional judgment (e.g., consideration of other natural and engineered aquatic sites)

The JETWASH model used for the OUs 2-5 cap armor design is very similar to that recommended in the USEPA/USACE guidance, but includes additive velocities to account for the propeller shaft pitch relative to the bottom (critical factor for recreational boats) and the reflection of the propeller jet with the bottom. The OUs 2-5 modeling framework utilizes a momentum-based particle stability evaluation to account for the transient nature of the recreational propwash. A series of technical memoranda were submitted summarizing the technical basis for the Fox River propwash modeling

framework and illustrating an example computation. The technical memoranda were reviewed and accepted by USEPA and WDNR on September 10, 2007.

Due to the wide variety of recreational vessels and modes of operation on the Lower Fox River, the refined propwash computations utilized a Monte Carlo simulation for a range of appropriately conservative input variables based on site-specific data. The Monte Carlo simulations were used to generate a probability of occurrence for each particular combination of input parameters. Furthermore, the cap armor design framework utilized five levels of conservatism, as follows:

- Model conservatism – In addition to the additive velocities (prop pitch and bottom reflection) discussed above, several other components of the model are conservative, including the use of a maximum static thrust, the definition of particle instability (i.e., threshold of motion), and computation of a theoretical maximum particle displacement.
- Conservative input parameters – The Agency/Respondent propwash technical Subgroup selected a range of appropriately conservative modeling parameters (e.g., limited to vessels with engines larger than 25 horsepower (HP) when a significant percentage of the vessels operating on the Fox River are below 25 HP).
- Low probability of occurrence – The Subgroup evaluated the results of the Monte Carlo simulations through cumulative frequency (i.e., probability of occurrence of particular combinations of input parameters) and based the armor size recommendations on a very low probability of occurrence (generally less than 5 to 10 percent) prior to considering cap-induced consolidation (see below).
- Conservative cap gradation (i.e., D_{50}) – Consistent with USEPA/USACE guidance, the results of the modeling were used to recommend a median stone size (D_{50}) for cap armor. However, aggregate materials obtained from natural sources are typically comprised of graded materials and not a single uniform particle size. Therefore, by definition, 50 percent of the material (by weight) used for cap armor material, will have a particle size that exceeds the median stone size.
- Self-armoring – The process of self armoring occurs when the larger particles within a gradation form a relatively thin layer near the top of the cap for which the median stone size exceeds that recommended for design. This self-armoring

response to extreme propwash events exceeding the recommended design value further ensures the protectiveness of the overall cap armor design.

A total of 10,000 combinations of parameters for several representative water depths (3, 5, 7, and 10 feet) were generated through the Monte Carlo simulation. As part of the modeling inputs, constraints were developed to prevent unrealistic combinations (e.g., limiting the depth of the propeller shaft relative to the water depth to avoid scenarios in which the boat would be expected to contact the bottom). Approximately 2,500 combinations that met all constraints were used as input to the JETWASH model. The JETWASH model and particle stability evaluation were then performed for each of the combinations. Figure 1 presents the number of times a stable particle diameter was computed in the JETWASH model (shown as a cumulative frequency) for 3-, 5-, 7-, and 10-foot water depths as part of the Monte Carlo simulation.

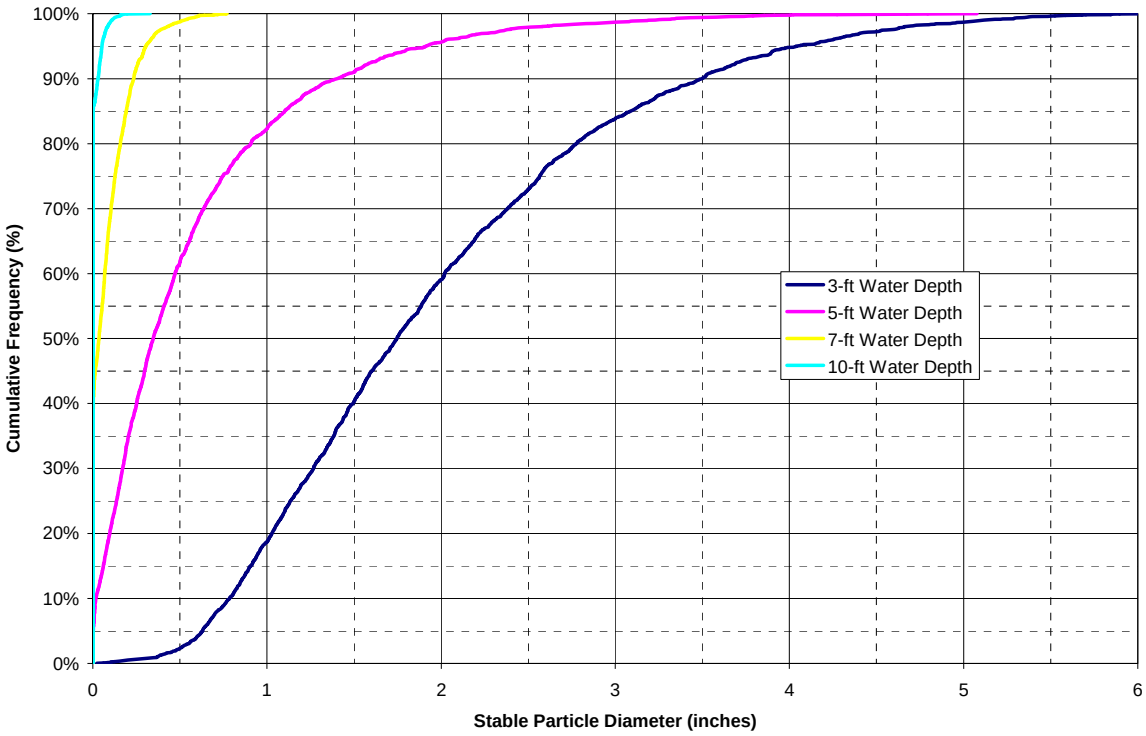


Figure 1 – Cumulative Frequency of Stable Particle Diameters Predicted from Monte Carlo Analysis

Table 1 summarizes the general cap armor recommendations necessary to resist the erosive forces expected to be generated by recreational vessels on the Lower Fox River, as developed by the technical Subgroup based on the engineering evaluation described above (i.e., utilizing Monte Carlo model output [see Figure 1], engineering considerations, and best professional judgment).

Table 1
Summary of Cap Armor Recommendations for Propwash

Water Depth	Median Stone Size, D_{50} [inches]	Maximum Stone Size, D_{100} [inches]	Classification
3 to 4 feet	3	6	Gravel/Cobble
4 to 6 feet	1.5	3	Gravel
>6 feet	0.25	1	Sand/Gravel

In general, the selected median stone size correlated with at least the 90 percent cumulative frequency predicted by the Monte Carlo simulation (Figure 2, Table 2); however, this analysis did not account for the estimated consolidation of the cap which would result in deepening of the water depth after placement.

In order to evaluate the magnitude of the cap-induced consolidation, several samples were collected for seepage-induced consolidation testing (SICT) as part of the 2004 and 2005 pre-design sampling and analysis effort. The SICT is a specialized consolidation test for very soft sediments, through which 5 dimensionless parameters are determined that describe the consolidation characteristics as a function of void ratio, stress, and permeability. These relationships were then used to estimate cap-induced consolidation which, for placement of 13-inch-thick cap, ranged from 5 to 11 inches with an average of 8 inches. This average cap-induced settlement of 8 inches was applied to the capping areas to evaluate the post-consolidation water depth and specifically the associated propwash cumulative frequency that will be achieved after consolidation.

When incorporating the estimated cap-induced consolidation (i.e., 8 inches average), the selected median stone sizes listed in Table 1 correspond to greater than the 95th percent cumulative frequency for a majority of the post-consolidation water depths in capping areas. Figure 2 illustrates this evaluation. For example, the Monte Carlo simulation

predicted a stable particle diameter of 1.5 inches or less in 5 feet of water for 91 percent of the input combinations. When the additional 8 inches of cap-induced consolidation is considered (approximate water depth of 5 feet, 8 inches), the stable particle diameter of 1.5 inches corresponds to approximately the 98th percent cumulative frequency.

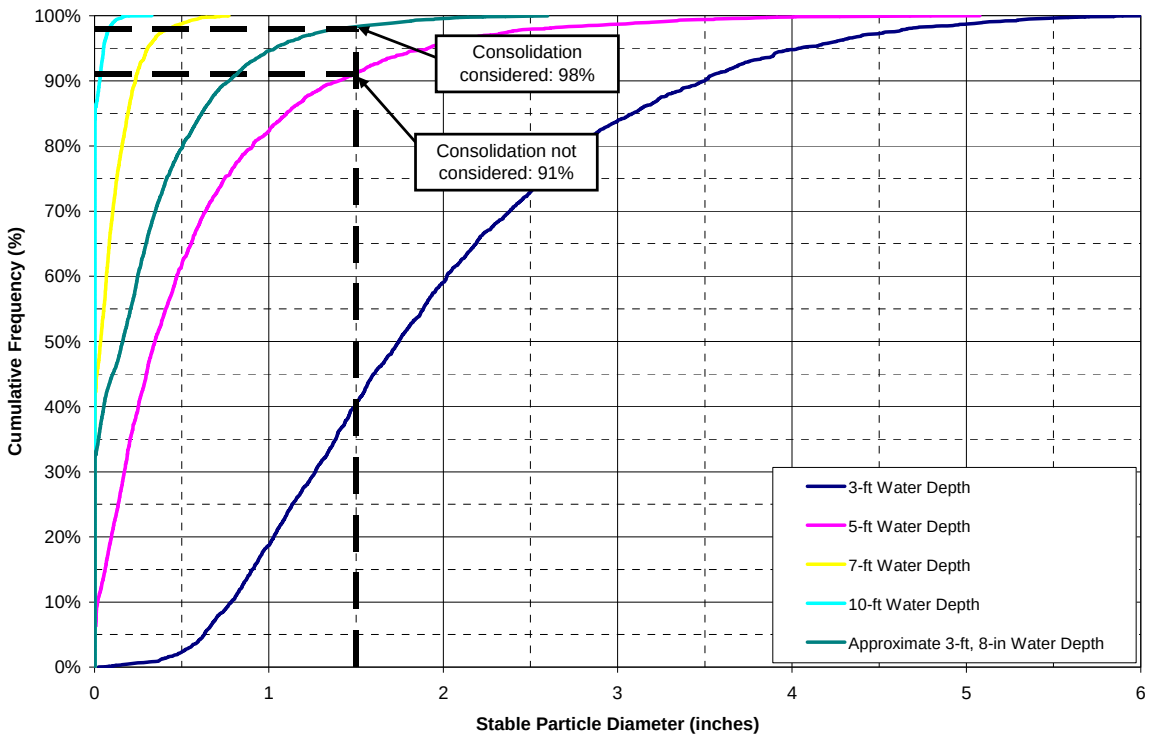
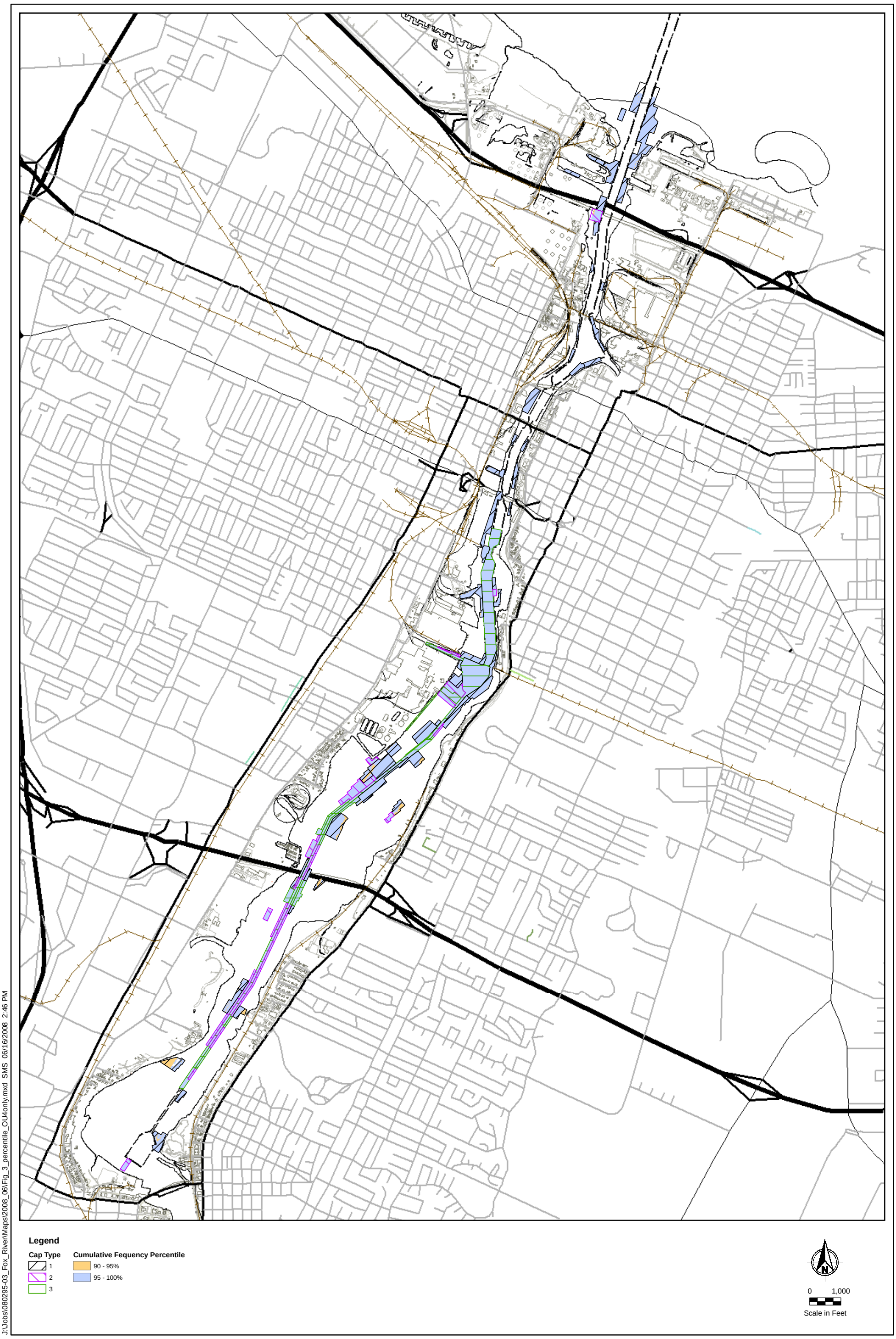


Figure 2 – Consideration of Consolidation in Selecting a Stable Particle Diameter from Monte Carlo Analysis

Table 2 summarizes the estimated cumulative frequency for pre- and post-consolidation water depth intervals as well as the acreage of each post-consolidation water depth interval in OU 4. Figure 3 presents the areal coverage of these post-consolidation cumulative frequencies.



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ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
Cumulative Fequency Percentiles of Post-cosolidation
Water Depths in Proposed Capping Areas

Table 2
Summary of Estimated Cumulative Frequencies of Pre- and Post-Consolidation Water Depths in Proposed Capping Areas in OU 4

Water Depth Range above Capping Areas	Cumulative Frequency Percentage (Pre-Consolidation)	Cumulative Frequency Percentage (Post-Consolidation)	Cap (acreage)
3-3.5 ft	85	95	1.2
3.5-4 ft	90	97	1.7
4-4.5 ft	80	90	0.7
4.5-5 ft	85	95	10.2
5-5.5 ft	91	98	7.5
5.5-6 ft	95	99	9.1
6-6.5 ft	80	90	7.6
6.5-7 ft	85	95	10.7
7-7.5 ft	90	97	7.0
7.5-8 ft	93	99	6.1
8+ ft	95	99+	223.7
		Total Cap Acreage:	*285.5*
		Percentage of Cap with >95% Cumulative Frequency (post-consolidation):	*97%*

Although certain water depth ranges at the "transition depths" (i.e., 4 and 6 feet) result in a cumulative frequency less than 95 percent, the proposed median grain sizes were chosen based on a reasonably conservative evaluation. Depending on availability, the final materials used in construction of the cap will meet or exceed the recommended gradations (adding additional protection).

2.4.3 Vessel Wake Analysis

Since the BODR, additional engineering analyses were performed to further evaluate the erosive forces in shoreline areas designated for capping (i.e., engineered caps or dredge-and-cap). Specifically, impacts from vessel-generated waves were evaluated for designated cap areas in OUs 3 and 4 including the following primary considerations:

- Classification of typical (design) vessels passing through proposed capping areas in OU 3 and OU 4.
- Comparative evaluation of empirical techniques available and appropriate for estimating vessel wake impacts for the design vessels.
- Estimation (prediction) of an appropriately conservative design wave from a typical vessel sailing line to the shoreline.

- Subsequent design of a shoreline cap and revetment capable of resisting the predicted design wave.
- Estimation of wave run-up on the shoreline cap to determine top of cap elevation

Classification of design vessels for this analysis was based on a comprehensive evaluation of data compiled from various resources including ship arrival information recorded by the Port of Green Bay, reported bridge openings on the Lower Fox River within OU 4, and information compiled for the propeller wash analysis discussed above in Section 2.2.2. Vessel information including vessel length, beam width, weight, draft, engine power, entrance length, and typical cruising speed were also obtained and estimated based on available data.

A comprehensive evaluation and summary of available empirical models for vessel wave prediction was developed by the USACE Coastal and Hydraulics Laboratory (CHL) as part of the Upper Mississippi River-Illinois Water (UMR-IWW) System Navigation Study (Sorensen 1997). This report also discusses the applicability of these models for various vessel types. Preliminary evaluations of the models presented in this document and correspondence with Dr. Robert Sorensen led to the selection of four models that are likely applicable for predicting vessel wakes generated by the vessels characteristic of the Fox River remediation areas:

- **Sorensen and Weggel (1984, 1986):** Empirical model developed based on available laboratory and field model data on vessel-generated waves, to predict maximum wave height as a function of vessel speed, vessel geometry, water depth, and distance from sailing line. Applicable for various vessel types (ranging from small recreational boats to large tankers), vessel speeds, and water depths.
- **Permanent International Association of Navigation Congresses (PIANC) (1987):** The PIANC model was developed for the design of revetments for inland waterways and is based on field (primarily canal) and laboratory measurements. Vessel generated wave heights are predicted as a function of vessel speed, water depth, and distance from the sailing line to the point of interest. The PIANC model is valid for tugs and conventional inland motor vessels at various water depths and vessel speeds.

- K**riebel and Seelig (2005):** This is the most recent model available for the prediction of vessel-generated wave heights based on an empirical analysis of over 1,200 data points from small-scale model tests reported in literature. The model was validated via a series of physical model tests in a towing tank for deep and shallow water depths at the US Naval Academy (USNA) and in the field using a training vessel owned by the USNA in the Chesapeake Bay near Annapolis, Maryland. The model is essentially an improvement of the widely used Sorensen and Weggel (1984, 1986) method.
- **Bhowmik (1991):** Predictive model based on measurements of waves generated by 12 different recreational boats ranging in length from approximately 11 to 45 feet with a maximum draft of 2.4 feet in the Illinois and Mississippi Rivers. Vessels included a flat bottom johnboat, a pontoon, a tri-hull, and various V-hulls. Two wave gages were deployed at each of four distances from the sailing line and 246 test runs were conducted. The empirical model relates maximum vessel-generated wave height as a function of vessel speed, draft, length, and distance from the sailing line and is applicable to recreational vessels, also typical of the Lower Fox River.

These models were used to determine the critical wave height generated by a design vessel passing through a typical section of the Lower Fox River where dredging and/or shoreline capping are anticipated along the river bank. Since vessel wave characteristics change as they propagate nearshore (i.e., interact with the bottom in shallower water depths), the critical wave height was transformed to account for these effects and to design an appropriate shoreline revetment using the USACE Automated Coastal Engineering System (ACES 1992). The armoring of submerged offshore areas was designed in accordance with the USEPA/USACE guidelines for sub-aqueous capping of contaminated sediments (USEPA 2006). Design guidelines for rock riprap specified by the Federal Highway Administration (FHWA 1989) and the USACE (Corps 1971, 1991, 1994) were also considered. Finally, the top of shoreline cap elevation was determined by computing the wave run-up in ACES.

The critical wave heights (i.e., "design wave") were generated by a recreational vessel (tour boat), the *Foxy Lady*. Based on the results of the vessel-generated waves analysis

using the critical wave height, the recommended armor and filter layers to protect engineered caps from scour from vessel-generated waves is presented in Table 3. The top of shoreline cap elevation will account for the predicted 2 foot wave run-up when using a 5H:1V slope.

Table 3
Summary of Preliminary Cap Armor Recommendations for Vessel Wakes

Representative Capping Area	Critical Design Wave Height (feet)	Cap Design					
		Armor Layer			Filter Layer		
		D_{50}	D_{100}	Thickness	D_{50}	D_{100}	Thickness
		Cap Armor within Surf Zone[a]					
OU 3/OU 4A (Transect 4044)	3.22	0.68 ft.	1.08 ft.	1.36 ft.	0.08 ft.	0.15 ft.	1.0 ft.
OU 4B (Transect 4061)	3.30	0.60 ft.	0.96 ft.	1.20 ft.	0.07 ft.	0.13 ft.	1.0 ft.
		Capping Armor below Surf Zone[a] D_{50} (inches)					
OU 3/OU 4A (Transect 4044)	3.22	0.95 inches (Coarse Gravel)					
OU 4B (Transect 4061)	3.30	0.81 inches (Coarse Gravel)					

Notes:

a. Surf zone defined herein as water depth range subject to breaking waves, which may extend from the top of bank to approximately 1 to 2 times the wave breaking depth (4.2 to 8.4 feet)

b. D_{50} = median particle diameter in gradation

c. D_{100} = maximum particle diameter in gradation

2.4.4 Summary of Erosion Protection Components

The general recommendations of cap armor materials for each erosion protection component (i.e., wind wave, vessel wake, river flows, etc.) were used to preliminarily delineate the extents of various cap armor designs within OUs 2-5 for the 60 Percent Design. Following this preliminary delineation, the appropriateness of the general cap armor designs in specific localized areas of the river will be reviewed, and refined as necessary based on site-specific conditions including, but not limited to, the following:

- Proximity to in-water infrastructure (e.g., utilities, bridges, boat launch, stormwater outfalls, marine facilities)
- Proximity to tributaries (in reference to hydrodynamic analyses)

- Frequency and probability of actual vessel use (in reference to vessel-induced propeller wash and wave analyses)
- Location within the federal navigation channel (e.g., protection of side slopes against propwash)
- Geotechnical stability of sediments (e.g., slope stability)

General "ground rules" and design considerations for determining the cap delineation and armor based on the site-specific conditions are presented in the 60 Percent Design Report. Site-specific remedies will be designed in the year prior to construction in that area and the final remedy for each area will be documented in the annual RA Work Plans.

2.5 Operational Component

As discussed in the BODR, given the inherent difficulties in achieving accurate placement tolerances for in-water construction, an additional thickness ("over-placement allowance") is typically specified in the capping contract. For OUs 2 to 5 the over-placement amount is expected to vary between 0 to 6 inches with an average of less than 3 inches for sand and gravel layers and an average of 6 inches for quarry spall armor layers. This is based on anticipated cap placement equipment, experience at other similar capping projects, and considerations of likely contractor incentives to limit the amount of excess thickness. Therefore, for subsequent engineering evaluations (e.g., evaluation of post-cap water depth, geotechnical stability, construction schedule, etc.), the following additional thickness have been assumed:

- Sand cap material: 3 inches
- Gravel armor material (up to D_{50} of 1.5 inches): 3 inches
- Large gravel (D_{50} of 3 inches) and quarry spall armor material (where applicable): 6 inches

The method to be used to verify that minimum cap thicknesses have been achieved over a certain area with a specified level of confidence will be presented in the CQAPP.

3 SUMMARY

The cap components and design criteria presented herein describe the general cap design from the BODR through the 60 Percent Design Report. Three types of caps were developed based on chemical concentration of existing or residual materials; however, the final cap design may change is select locations based on site-specific conditions (e.g., in-water structure, proximity to the shoreline).

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ATTACHMENT B-2

VESSEL WAKES MODELING

Memorandum

To: 60 Percent Design Report File

From: Matt Henderson, Kim Powell, Felix Kristanovich, and Paul LaRosa (Anchor Environmental)

cc:

Date: June 10, 2008

Re: Armor Layer Design for Vessel-Generated Waves

1 INTRODUCTION

The Record of Decision (ROD) Amendment (USEPA and WDNR 2007) requires that the engineered caps in the Lower Fox River Operable Units (OUs) 2 through 5 be durable and effective over the long term. As part of the design process, several forces have been identified that could potentially compromise the integrity and protectiveness of a cap. These forces include scour from hydrodynamic flows (including seiches), disruption from bioturbation (i.e., biological activity), ice scour, scour from propeller wash, and scour from vessel-generated waves. This appendix presents the evaluation and design of an armoring layer for the engineered caps to resist the erosive forces from vessel-generated waves in the Lower Fox River OUs 2 through 5. The evaluation presented herein focuses on the generation of waves created by passing vessels and the propagation of these waves to portions of the shoreline that have been targeted for capping as a part of the OUs 2 through 5 remediation project. The steps in the design of the armor layer for the engineered caps were as follows:

- Classification of typical (design) vessels passing through proposed capping areas in OU 3 and OU 4 (A and B)
- Comparative evaluation of empirical techniques available and appropriate for estimating vessel wake impacts for these typical vessels
- Estimation of representative design waves generated at the vessel sailing line and propagated to the shoreline
- Subsequent design of an appropriately conservative shoreline cap and armor layer capable of resisting the predicted design waves
- Estimation of wave run-up on the shoreline cap to determine top of cap elevation

The steps and results of this evaluation are presented in detail in the sections below.

2 VESSEL CLASSIFICATION ON THE LOWER FOX RIVER

Several different types of vessels, ranging from recreational boats to tugboats, transit the Lower Fox River. These vessels are of different sizes and travel at different speeds and, therefore, generate different wave heights and periods. The classification of design vessels for this analysis was based on an evaluation of data compiled from various resources such as ship arrival records from the Port of Green Bay (the Port), reported bridge openings on the Lower Fox River within OU 4, and information compiled for the propeller wash analysis discussed in Appendix B-1 of the 30 Percent Design Report.

Based on a review of available data and discussions with local marinas, it is evident that the number of recreational boats using the Lower Fox River outnumbers commercial vessels. The Port records indicate that 185 cargo vessels arrived in 2003, 139 vessels in 2004, and 217 vessels in 2005 (Port of Green Bay 2007). In 2004, the Port recorded 15 tugboats, estimated to be at most 2.7 percent of the total boat traffic. However, recreational vessels, including motor boats and yachts, are not included in the Port records. The Port does record the number of bridge openings for all vessels traveling up the Lower Fox River, and these bridge openings were evaluated to estimate the number of recreational vessels using the Lower Fox River. In 2004, the Port recorded 227 openings of the Don A. Tilleman (Tilleman) Bridge (which has a vertical clearance of 32.6 feet), and 1,116 openings of the Walnut Street Bridge (which has a vertical clearance of 11.8 feet). Assuming the Walnut Street Bridge opened twice for each cargo vessel in 2004 (once each way going into and out of their port of call; totaling 278 openings), at least 419 non-cargo boats (totaling 838 openings), such as yachts, tug boats, or large recreational vessels, passed under the bridge heading either upstream or downstream on the river. Therefore, the recreational boats outnumber cargo boats and tugboats by an estimate of at least 2:1. It should be noted that the number on non-cargo boats actually exceeds the cargo boats by more than the 2:1 margin estimated above since not all cargo ships using the river travel as far upstream as the Walnut Street Bridge.

The vessels that are typically found in OU 3 and OU 4 (A and B) are presented in Table 1. Table 1 also includes the design parameters for the typical vessels, including the vessel length,

beam, draft, engine power, and typical speed. For some vessels, length and beam were obtained by estimating vessel dimensions from plans or photographs of a typical vessel. Specific information was available for the following vessels: *Alpena*, *J.A.W. Inglehart*, *Paul H. Townsend*, *Foxy Lady*, *Foxy Lady II* (scheduled to replace the Foxy Lady during the summer 2008), *Gopher*, *Badger*, and *Mary Jane*. Because the vessel draft was unknown for certain cargo vessels, the draft was estimated using the regression relationship between the draft and the vessel capacity or the vessel gross tonnage (Draft [feet] = 0.0001*Capacity [metric tons] + 25.85).

These different classifications of vessels were carried forward in the analysis of vessel-generated waves. It should be noted that cargo vessels are limited to reach OU 4B due to draft limitations in the upper reaches of the river; recreational vessels and tugboats navigate in all reaches of OU 3 and OU 4 (A and B).

3 COMPARATIVE EVALUATION OF EXISTING METHODOLOGIES

There have been several methods and models reported in the literature to estimate vessel-generated wave heights and periods. A comprehensive evaluation and summary of available empirical models for vessel-generated wave prediction was developed by the U.S. Army Corps of Engineers' (Corps') Coastal and Hydraulics Laboratory (CHL) as part of the Upper Mississippi River-Illinois Water (UMR-IWW) System Navigation Study (Sorensen 1997). This report also discusses the applicability of these models for various vessel types. Preliminary evaluations of the models presented in the CHL document and correspondence with Dr. Robert Sorensen led to the selection of four models that are applicable for predicting vessel wakes generated by the vessels that are characteristic of the ones navigating the Lower Fox River remediation areas:

- **Sorensen and Weggel (1984)/Weggel and Sorensen (1986):** This is an empirical model (developed from available laboratory and field data on vessel-generated waves) to predict maximum wave height as a function of vessel speed, vessel geometry, water depth, and distance from sailing line. This model is applicable for various vessel types (ranging from small recreational boats to large tankers), vessel speeds, and water depths.
- **Permanent International Association of Navigation Congresses (PIANC) (1987):** The PIANC model was developed for the design of revetments for inland waterways and is based on field (primarily canal) and laboratory measurements. Vessel-generated wave

heights are predicted as a function of vessel speed, water depth, and distance from the sailing line to the point of interest. The PIANC model is valid for tugboats and conventional inland motor vessels at various water depths and vessel speeds.

- **Kriebel and Seelig (2005):** This is the most recent model available for the prediction of vessel-generated wave heights based on an empirical analysis of over 1,200 data points from small-scale model tests reported in literature. The model was validated via a series of physical model tests in a towing tank for deep- and shallow-water depths at the U.S. Naval Academy (USNA) and in the field, using a training vessel owned by the USNA in the Chesapeake Bay near Annapolis, Maryland. The model is essentially an improvement of the widely used Sorensen and Weggel (1984, 1986) method.
- **Bhowmik (1991):** This predictive model is based on measurements of waves generated by 12 different recreational boats ranging in length from approximately 11 to 45 feet, with a maximum draft of 2.4 feet in the Illinois and Mississippi Rivers. Vessels included a flat-bottom johnboat, a pontoon, a tri-hull, and various V-hulls. Two wave gages were deployed at each of four distances from the sailing line and 246 test runs were conducted. The empirical model relates maximum vessel-generated wave height as a function of vessel speed, draft, length, and distance from the sailing line, and is applicable to recreational vessels also typical of the Lower Fox River.

4 DETERMINATION OF VESSEL-GENERATED WAVES AND WAVE PROPAGATION ON SHORELINE CAP AREAS

The four methods described above were used to estimate the design wave height generated by a typical vessel passing through a typical transect for each of the OUs. Table 2 presents the applicability of these methods for the various vessels analyzed herein. Typical transects used in this analysis include remedial design (RD) sampling transect 4044 for OU 4A, and transect 4061 for OU 4B. For this design level, the capping areas of OU 3 were represented by the analysis and results for the capping areas of OU 4A, as the same types of vessels travel in these OUs.

Once the vessel-generated design wave height was determined, the design wave was then propagated into the shallow water towards the shoreline to determine the breaking wave height. This breaking wave was then used to design the cap armor layer in the shoreline cap area in accordance with the Corps' Automated Coastal Engineering System (ACES) program (Corps 1992). Cap areas that extend into the submerged offshore areas will be subject to vessel-

generated waves (not the breaking waves along the shoreline) and were designed according to the Corps guidelines for sub-aqueous capping of contaminated sediments (EPA 2006). Finally, the top of shoreline cap elevation was determined by computing the wave run-up.

4.1 General Input Parameters for All Models

4.1.1 Bathymetry and Shoreline Slopes

As described above, representative transects for each OU are used for the calculations. At transect 4044 in OU 4A, the nearshore dredge cut will likely be designed with a 5 horizontal to 1 vertical (5H:1V) slope prior to cap placement, in accordance with the 60 Percent Design, subject to additional site-specific analyses prior to construction. For transect 4061 at OU 4B, the shoreline is already protected with an existing revetment (e.g., riprap); therefore the cap design near the shoreline will be tied into the existing 3H:1V slope. The shoreline protection design presented herein was designed for a 5H:1V slope, based on the results of a slope stability analysis that was performed for the unprotected shorelines as part of the 60 Percent Design (see Appendix B-4 of Volume 2). Site-specific remedies will be designed in the year prior to construction in that area and the final remedy for each area will be documented in the annual RA Work Plans. Alternate (flatter or steeper) slopes may be considered on a case-by-case basis for these locations using site-specific physical/geotechnical and chemical information.

4.1.2 Vessel Operational Characteristics

4.1.2.1 Cargo Vessels

Cargo vessels are confined to reach OU 4B. According to the Port (Haen 2007), cargo ships typically move between 0.9 to 2.6 knots (1 to 3 miles per hour [mph]); however, ships sometimes move as fast as 4.3 to 8.7 knots (5 to 10 mph). Vessel wakes for these ships were computed assuming an average vessel speed of 1.7 knots (2 mph) and a maximum speed of 8.7 knots (10 mph). The drafts of the some of these cargo vessels that operated in the OU 4B navigation channel have drafts in excess of 30.5 feet, which is equal to (or slightly greater) than the depth of the navigation channel in places. These vessels still use the navigation channel while "rubbing" their hull along the channel thalweg. Typical cargo vessels observed in this reach are the *MV American Integrity*, the *MV American Republic*, the *MV Mark Hannah*, the Hannah 2902

(barge), and the steamer *Herbert Jackson*. At transect 4061, only the *MV American Integrity* (with a draft of 34 feet) moves its hull through the bottom of the channel and is confined to lower vessel speeds. Other cargo vessels have smaller drafts than the 30.5-foot estimated water depth during low flows.

4.1.2.2 Tugboats

Although most tugboats travel on OU 4B, because of their small draft (3 to 3.5 feet), they could also travel upstream in OU 3 and OU 4A. For OU 4B (transect 4061), vessel wake was computed for an average vessel speed of 1.7 knots (2 mph) and the maximum vessel speed of 8.7 knots (10 mph). The maximum vessel speed was increased to 13 knots (15 mph) in the upper navigational units OU 3 and OU 4A.

4.1.2.3 Recreational Vessels

Recreational vessels travel on reaches OU 3, OU 4A, and OU 4B. The vessel wake was computed for an average vessel speed of 7 knots (8 mph) and the maximum vessel speed of 21.7 knots (25 mph). A typical motorized vessel is a Monterey-type boat, ranging in size from the small Monterey 180 FS sports boat to a large Monterey 350 SX cruiser. A recreational vessel (yacht) frequently traversing the river from OU 3 to OU 4B is the *Foxy Lady,* with an observed average travel speed of 7 knots (8 mph). Based on conversations with the owner, the *Foxy Lady* will be replaced by the *Foxy Lady II* during the summer of 2008. Analyses for both yachts are presented herein.

4.2 Sorensen and Weggel Method

4.2.1 Method Description

The Sorensen-Weggel method (Sorensen and Weggel 1984, Weggel and Sorensen 1986) calculates the wave height generated at a vessel bow as a function of the vessel speed, distance from the sailing line, water depth, vessel displacement volume, and vessel hull geometry (i.e., vessel length, beam, and draft). The method has been widely tested on different vessels, and is recommended for use with vessels having a Froude number between 0.2 and 0.8. The Froude number, Fr, is defined as:

$$Fr = \frac{\text{vessel speed}}{\sqrt{32.2 \times \text{water depth}}}$$

4.2.2 Applicability of the Sorensen-Weggel Method

The Sorensen-Weggel method is valid for:

- Cargo vessels with lengths between 128 and 1,000 feet, beams between 32 and 105 feet, drafts between 10 and 34 feet, and speeds up to 13 knots (15 mph)
- Tugboats with lengths between 30 and 32 feet, beams between 9 and 30 feet, drafts between 3 and 4 feet, and speeds up to 13 knots (15 mph)
- Various sized yachts with small drafts and typical speeds of 7 knots (8 mph) in the shallower parts of OU 4A and up to 13 knots (15 mph) in the deeper parts of OU 4B

This method is not applicable for vessels moving with higher speeds at smaller water depths because the Sorensen-Weggel Froude number is outside the recommended range (0.2 to 0.8). For the same reason, the method is not applicable for recreational vessels moving faster than 13 knots (15 mph) at the 26-foot depth, or 8.7 knots (10 mph) at the 16-foot depth.

4.2.3 Calculated Design Wave Heights Using the Sorensen-Weggel Method

Design vessel waves generated by this method for the different vessel types (i.e., cargo, tugboats, and recreational) and traveling speeds are presented in Tables 3 and 4 for reaches OU 4A (transect 4044) and OU 4B (transect 4061), respectively. Details are presented below:

- **Cargo Vessels:** For cargo vessels, such as the *MV American Integrity*, the *MV American Republic*, the *MV Mark Hannah*, a Hannah 2902 barge, and the steamer *Herbert Jackson,* traveling at 1.7 knots (2 mph) at a depth of 30.5 feet, the vessel-generated waves could not be determined because the Froude number was outside the recommended range. In addition, the vessel-generated waves could not be determined for the *MV American Integrity* because the keel of the ship would drag along the mudline when traveling at a speed of 8.7 knots (10 mph). Other cargo ships generated wave heights between 0.2 and 3.1 feet as shown in Table 4 (OU 4B).

- **Tugboats:** For tugboats (such as the *Gopher*, the *Badger*, and the *Mary Jane*) traveling at 1.7 knots (2 mph) in OU 4A or OU 4B at a depth of 30.5 feet (transect 4061) or at a depth of 20.5 feet (transect 4044), the Froude number was also outside the recommended range (between 0.2 and 0.8). In OU 4B, this method predicted vessel-generated waves ranging from 2.0 to 2.1 feet tugboats traveling at 8.7 knots (10 mph) (Table 4). The method predicted wave heights of 2.1 feet for the same tugboats in OU 4A at shallower depths (20.5 feet).
- **Recreational Vessels:** For the *Foxy Lady* and *Foxy Lady II*, this method estimated wave heights of 0.9 feet (both vessels) (OU 4A) and 1.6 feet (both vessels) (OU 4B) for the vessel traveling at a speed of 8.7 knots (10 mph), and wave heights of 3.2 feet and 3.1 feet, respectively (OU 4A) and 3.1 feet and 3.0 feet, respectively (OU 4B) for the vessel traveling at a speed of 11.3 knots (13 mph). At higher traveling speeds, the vessel speed is outside the tested range on which the model was developed. Therefore, wave heights are over-estimated using this model when the recreational vessel travels at higher speeds.

4.3 PIANC Method

4.3.1 Method Description

PIANC (1987) summarized the state of knowledge on predicting vessel-generated wave heights in their guidelines for the design of construction revetments for inland waterways. The PIANC method relates the wave height to the vessel depth, distance from the sailing line, and the vessel speed. The method is applicable for tugboats, patrol boats, and loaded conventional inland motor boats. Verhey and Bogaerts (1989) extended the PIANC method to include empty European barges and empty conventional motor vessels.

4.3.2 Applicability of the PIANC Method

This method is applicable for a wide range of conditions, similar to the Sorensen-Weggel method. However its application is limited to:

- Cargo vessels, tugboats, and yachts in deeper water depths, such as 20 feet or greater in OU 4B

- Cargo vessels, tugboats, and yachts in water depths deeper than 16.5 feet for OU 3 and OU 4A
- Recreational boats at speeds lower than 8.7 knots (10 mph) in deeper water depths, such as 20 feet or greater in OU 4B

It should be noted that the PIANC method is not applicable for recreational vessels traveling at high speeds and for some tugboats traveling at shallow depths (when the Froude number is greater than 0.7, the recommended upper limit for this method).

4.3.3 Calculated Design Wave Heights Using the PIANC Method

Critical vessel-generated waves computed by this method for the different vessel types and traveling speeds are presented in Tables 3 and 4 for reaches OU 4A (transect 4044) and OU 4B (transect 4061), respectively.. Details are presented below:

- **Cargo Vessels:** For cargo vessels, such as the *MV American Integrity*, the *MV American Republic*, the *MV Mark Hannah*, the Hannah 2902 barge, and the steamer *Herbert Jackson*, traveling at 1.7 knots (2 mph) at water depths of 30.5 feet, the vessel-generated waves are extremely small, consistent with the no-wake zone requirement for this area. The PIANC method estimated wave heights of 1.6 to 2.1 feet for these cargo vessels traveling at 8.7 knots (10 mph).
- **Tugboats:** For tugboats (such as the *Gopher, the Badger,* and the *Mary Jane*), traveling at speeds of 1.7 knots (2 mph) in reach OU 4 (A and B) at water depths of 30.5 feet (transect 4061) or 20.5 feet (transect 4044), the vessel wave heights were computed to be extremely small, consistent with the no-wake zone. Wave heights of 2 feet for the tugboats traveling at 8.7 knots (10 mph) in OU 4B, and 2.3 to 2.8 feet in OU 4A (at the shallower water depth of 20.5 feet) were determined using this model. Tugboats could travel faster in the upper reaches of OU 3 and OU 4A, generating waves over 3 feet in height.
- **Recreational Vessels:** For the *Foxy Lady* and *Foxy Lady II*, this model predicted wave heights of 1.0 and 1.1 feet, respectively, in OUs 4A and 4B for the vessels traveling at speeds of 7 knots (8 mph). In OU 4A, the *Foxy Lady* and *Foxy Lady II* predicted wave heights of 2.4 and 2.7 feet, respectively for the vessels traveling at speeds of 8.7 knots (10 mph). In OU 4B, the *Foxy Lady* and *Foxy Lady II* predicted wave heights of 2.7 and 3.1 feet, respectively for the vessels traveling at speeds of

9 knots (10.4 mph). Similar to the Sorenson-Weggel method, the wave heights were over-estimated by this method for the recreational vessels traveling at higher speeds. The vessel speed for use in the model is limited and outside the tested range on which the PIANC method was developed. Therefore, wave heights are over-estimated using this model when the sailing vessel travels at speeds higher than 9 knots (10.4 mph).

4.4 Kriebel and Seelig Method

4.4.1 Method Description

Kriebel and Seelig developed this model in 2005 (Kriebel and Seelig 2005) and based it on small-scale field studies from 16 previous reports. This model was tested using real field trials in Chesapeake Bay with ship speeds between 7 and 10 knots (8 and 11.5 mph). The model relates vessel wave height to vessel speed, ship hull form, modified Froude number, and distance from the ship sailing line. The dimensionless Froude number incorporates ship speed and the relative water-depth-to-ship-draft ratio and was tested only in the 0.1 to 0.5 range. The modified Froude number was related to the normalized wave height, and no data obtained from the field studies exceeded $gH/V^2 = 0.4$ (where "g" is acceleration of gravity, "H" is maximum wave height, and "V" is the ship speed).

4.4.2 Applicability of the Kriebel and Seelig Method

While this method claims to provide more accurate results than the Sorensen-Weggel method, its applicability is more restricted. The restrictions of the dimensionless Froude number and the normalized wave height limit the application of this method to:

- Large cargo vessels traveling in OU 4B
- Recreational vessels traveling in OU 4 at speeds less than 7 knots (8 mph)

The method is not applicable for smaller cargo ships (i.e., the *MV Mark Hannah*), because the hull geometry is likely to be significantly different than the hulls of the ships tested during the development of the model. In addition, the model is not applicable for any of the tugboats.

4.4.3 Calculated Design Wave Heights Using the Kriebel and Seelig Method

Critical vessel-generated waves computed by this method for different vessel types and different vessel speeds are presented in Tables 3 and 4 for reaches OU 4A (transect 4044) and OU 4B (transect 4061), respectively. Details are presented below:

- **Cargo Vessels:** For cargo vessels, such as the *MV American Integrity*, the *MV American Republic*, the Hannah 2902 barge, and the steamer *Herbert Jackson*, traveling at 1.7 knots (2 mph) in water depths of 30.5 feet, the dimensionless Froude number was below the recommended range (between 0.1 and 0.5). Vessel-generated waves of 0.22 and 0.45 feet for the *MV American Integrity* and the Hannah 2902 barge, respectively, traveling at 8.7 knots (10 mph) were determined using this method. This method estimated a 1-foot wave for the *MV American Republic* and a 2-foot wave for the steamer *Herbert Jackson* traveling at 8.7 knots (10 mph).
- **Recreational Vessels:** For the *Foxy Lady*, this method estimated a wave height of 1.3 feet for the vessel traveling at 7 knots (8 mph), and a wave height of 2.5 feet for the vessel traveling at 8 knots (9.2 mph) in reach OU 4A. The method also estimated wave heights of 1.1 feet and 3.3 feet for the vessel traveling at 7 knots (8 mph) and 8.7 knots (10 mph) in reach OU 4B. For the *Foxy Lady II*, the wave heights were over-estimated for all speeds in OU 4A. The method estimated a wave height of 1.6 feet in OU 4B. Similar to the previous methods, the wave heights were over-estimated for both vessels traveling at speeds higher than 8.7 knots (10 mph) in both reaches.

4.5 Bhowmik et al. Method

4.5.1 Method Description

Bhowmik, Soong, Reichelt, and Seddick (1991) developed an empirical equation for waves generated by 12 different recreational-type vessels for various vessel lengths and drafts, with vessel speeds up to 39 knots (45 mph). The maximum wave height was found proportional to the vessel length and vessel draft, and inversely and weakly proportional to the vessel speed. Even though the Froude number for many of the tested vessels exceeded 0.7, the water depth was not found to be significant in the

regression analysis, so it was not included in the empirical equation. The method did not incorporate the influence of various hull forms on the generated wave heights.

4.5.2 Applicability of the Bhowmik et al. Method

This method was only used for recreational vessels traveling at various speeds. In determining the design wave, the wave height generated at a vessel speed of 7 knots (8 mph) was used since the wave height decreases with an increase in the ship speed (keeping all other variables same). This approach is consistent with the lower speed boundary of the boats tested in the development of the model. Monterey-type boats, with different ship lengths and drafts as observed in navigation units OU 3 and OU 4A, were used to determine the maximum (or design) wave height.

4.5.3 Design Wave Heights Using the Bhowmik et al. Method

The wave heights obtained by the Kriebel and Seelig method were compared with the wave heights obtained using the Sorensen-Weggel method at the minimum water depth (16 feet) and the maximum vessel speed (10.4 knots [12 mph]) as allowed by the Froude number criterion for each method. The Bhowmik et al. model resulted in higher wave heights for the large Monterey vessels and the Sorensen-Weggel model resulted in higher wave heights for only the smallest Monterey vessel (180 FS).

4.6 Frequency Analysis

A frequency analysis was conducted using the number of vessels recorded and estimated in 2004, and the wave height generated by each category of vessels. For each category of vessels (i.e., cargo boat, tugboat, yacht, and recreational motor boat), the design wave was assumed to be equal to the highest wave generated in each category. The results are illustrated in Figure 1 for transect 4061 in reach OU 4B and in Figure 2 for transect 4044 in reach OU 4A. As shown on the figures, recreational boats generate waves comparable to tugboats and cargo boats, particularly when traveling at high speeds in shallow water.

Figure 1 – Wave Height Frequency Analysis in OU 4B

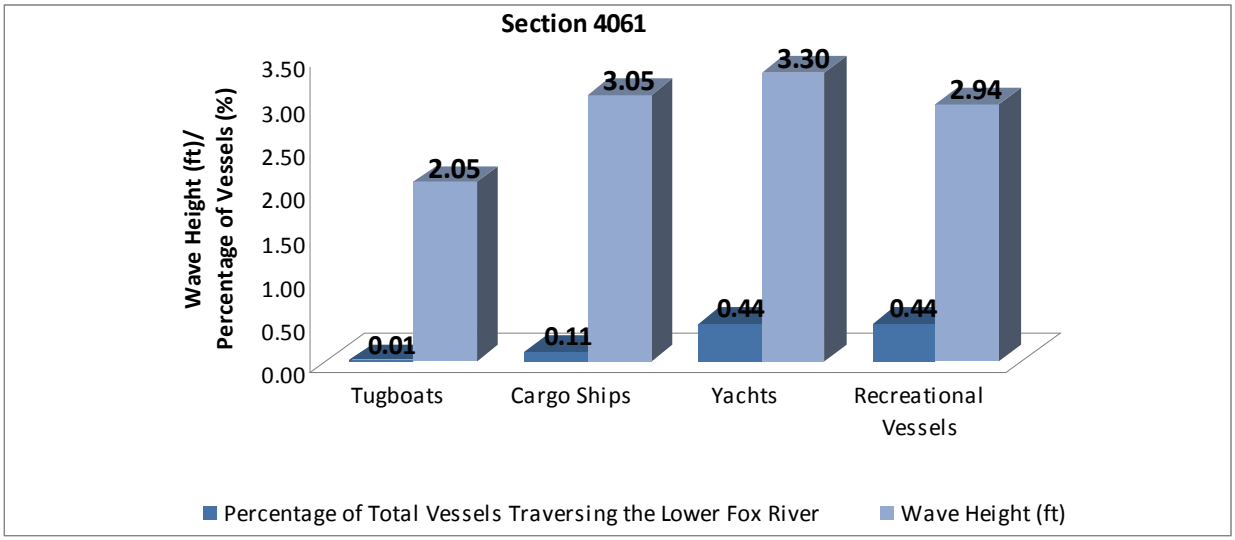
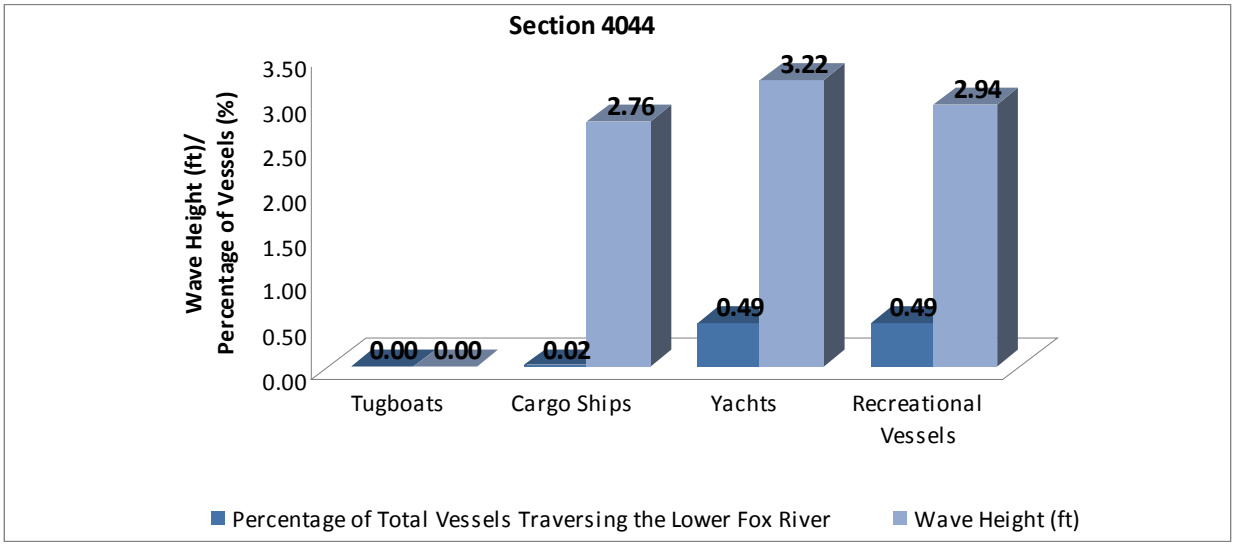


Figure 2 – Wave Height Frequency Analysis in OU 4A



4.7 Results of the Vessel-Generated Wave Analysis

Computed wave heights and periods obtained using the four methods discussed above are summarized in Table 3 for reach OU 4A and in Table 4 for reach OU 4B. For each vessel, only the waves calculated using successful methods were included in the tables. For example, for recreational Monterey boats, only Bhowmik et al. and Sorensen-Weggel methods are applicable. For each method, the minimum distance from the sailing line and two representative vessel speeds (the average vessel speed and the estimated maximum speed) are included. The maximum speed is either the maximum speed anticipated for that vessel in a particular reach, or the speed at which the maximum wave height is generated using a certain method (whichever is less). For example, the maximum speed using the Sorensen-Weggel method for the Monterey boats is 10.4 knots (12 mph) because the model is not applicable at higher speeds. The maximum vessel speed for the *Foxy Lady* was 8.7 knots (10 mph), based on reported speeds for that vessel. If a particular method was unable to calculate any wave parameters for a particular vessel speed because the operating conditions were outside the range applicable to the particular model, a "failed to compute" statement is presented on the table. An example is the Sorensen-Weggel method for vessels traveling at 1.7 knots (2 mph).

5 DESIGN FOR SHORELINE CAP

Vessel-generated waves computed from the previously described transects diverge from the vessel's sailing line and propagate towards both shorelines. The ACES program was used to calculate wave shoaling and refraction using Snell's law with wave properties predicted by linear wave theory. For each transect, new wave characteristics (wave height and crest angle) were computed for each break-point on the slope. The wave was calculated at the toe of the shoreline slope (i.e., "the design wave") and was then used to design the shoreline cap armor and the submerged shoreline cap.

The extent of the shoreline cap encompasses the aquatic, or submerged, shoreline cap, as well as the armor/revetment cap along the slope. As the waves generated by the vessels approach the shore, the waves increase in steepness as the water depth decreases. When the wave steepness reaches a limiting value, the wave breaks. In general, waves break in a water depth approximately equal to the wave height. The "surf zone" is the region extending from the boundary of wave breaking to the limit of wave run-up on the shoreline slope. Within the surf

zone, wave breaking is the dominant hydrodynamic process. The delineation between the shoreline armor cap and the submerged shoreline cap was estimated as the location on the shoreline slope at one to two times the wave breaking depth.

Calculations for the shoreline armor cap design and the submerged shoreline cap were performed using the largest critical wave height predicted from the vessel-generated waves analysis (Section 4). For OU 4A, the largest critical wave height (i.e., 3.2 feet) was computed for the *Foxy Lady* using the Sorenson-Weggel method. Similarly, the largest critical wave height (i.e., 3.3 feet) was computed for the *Foxy Lady* using the Kriebel and Seelig method in OU 4B. As previously discussed, the results of critical wave analysis for OU 4A was applied to OU 3. Note that the *Foxy Lady* will be replaced by the *Foxy Lady II* during the summer of 2008; however, the results of the Foxy Lady are conservatively used as the basis for the shoreline armor cap and submerged shoreline cap design.

5.1 Shoreline Armor Cap Design

5.1.1 Methodology

The ACES program was used to size the shoreline armor cap by using the rubble-mound revetment module of the program. The design of the revetment generally follows the engineering guidelines provided in the Corps' *Hydraulic Design of Flood Control Channels*, EM 1110-2-1601 (Corps 1994). The revetment is composed of a top rock layer and an intermediate filter layer (or layers) placed on top of the capped sediment layer. The riprap stone sizes and stone gradation are based on the Corps' *General Design and Construction Considerations for Earth and Rock Fill Dams*, EM-1110-2-2300 (Corps 2004). The filter material is sized using the Ahrens relationship between the armoring and filtering layers (Ahrens 1981).

The minimum and maximum weight of the riprap stone was computed as:

$$W_{max} = 4W_{50} \text{ and } W_{min} = (1/8)\, W_{50}$$

Where, W_{max} is the weight of the largest stone, W_{min} is the weight of the smallest stone, and W_{50} is the medium stone weight. The filter layer stone size was computed from:

$$D_{15(armor)} / D_{85(filter)} = 4.0$$

Where, D_{15} and D_{85} represent diameters of a filter particle where 15 and 85 percent of the filter layer material is finer by weight, respectively.

The filter material recommended by ACES does not consider the stability of the filter layer. Therefore, three additional resources will be used during future designs to verify the stability between the filter and the riprap layers and the filter and the underlying sand isolation layer: the *Design of Riprap Revetment - HEC-11* guidelines for rock riprap (FHWA 1989); the Hydraulic Design of Flood Control Channels (Corps 1994) requirements for rock riprap; and the *Additional Guidance for Riprap Channel Protection*, ETL 1110-2-120 (Corps 1971).

The revetment calculations were performed using a maximum slope of 5H:1V based on a shoreline slope stability analysis. Alternate (flatter or steeper) slopes will be considered on a case-by-case basis using site-specific physical/geotechnical and chemical information. It should be noted that revetments used fro coastal protection projects are often designed allowing for some minor displacement (on the order to a few particle diameters maximum) of the armor layer. Revetments are often designed using a cost optimization technique, which balances the initial capital costs with longer term maintenance costs. Thus, the revetment design methodology allows varying amounts of displacement (movement) of the armor layer. For this revetment analysis, minor displacement was included in the computations. Minor displacement is defined as few armor stones displaced (less than 5 percent) and potentially redistributed within or in the near vicinity of the armor layers.

5.1.2 Results

The results of the ACES analysis are presented in Table 5 for transect 4044 of the OU 4A and in Table 6 for transect 4061 of OU 4B.

In OU 4A, the maximum thickness of the armor layer calculated to protect the shoreline from tugboat wakes is 1.1 feet and the maximum armor stone size is 0.8 feet. The maximum thickness of the armor necessary to protect the shoreline from recreational vessels is 1.4 feet and the maximum armor stone size is 0.9 feet. The higher level of

protection is due to the ability of the recreational vessels, with their smaller draft and greater maneuverability, to access shallow portions of the OU and produce a wave, compared to the access limitations of the larger vessels.

In OU 4B, the maximum thickness of the armor layer calculated to protect the shoreline from cargo vessel wakes is 1.1 feet and the maximum armor stone size is 0.9 feet. Cargo vessels are constrained to maneuver only in the centerline of the navigational channel and with limited speed. The maximum thickness of the armor necessary to protect the shoreline from recreational vessels is 1.2 feet and the maximum armor stone size is 1.0 feet. The higher level of protection is due to the smaller draft and increased maneuverability of these vessels, which allows them to produce waves closer to the shoreline.

To determine the final filter gradation for the shoreline area, the filter gradation results from the ACES program will be modified to incorporate FHWA and Corps stability requirements, as described in Section 5.1.1. The final filter gradations for each capping area in OU 3 and OU 4 (A and B) will be refined in the year prior to construction based on a review of site-specific conditions in that area and the final remedy for each area will be documented in the annual RA Work Plans.

5.2 Submerged Shoreline Cap Design

5.2.1 Methodology

A submerged shoreline cap is required in designated areas of OU 4 (A and B). These areas are adjacent to the shoreline areas subjected to breaking waves from passing vessels, but are completely submerged. The design of the submerged cap follows the guidelines of the U.S. Environmental Protection Agency (EPA) Assessment and Remediation of Contaminated Sediments (ARCS) program for in situ sub-aqueous capping of contaminated sediments. Specifically, a stable riprap size, D_{50}, is computed as (EPA 2006):

$$D_{50} = \frac{\left(\frac{v_{b(\max)}}{C_3}\right)^2}{g * (\frac{\partial_s - \partial_W}{\partial_W})}$$

Where, C_3 is coefficient with recommended value of 1.7 for calculations of the maximum orbital velocities V_{bmax}, ∂_s is the unit weight of a stone (typical value of 165 pounds per cubic foot [lb/ft^3]), ∂_W is the unit weight of water (typical value of 62.4 lb/ft^3), and g is gravitational constant. The maximum orbital velocity was computed at the bottom of the wave using linear wave theory. The wave characteristics in the breaking zone were calculated using the ACES program.

5.2.2 Results

The results of the ACES analysis are presented in Table 7 for OU 4A (transect 4044) and in Table 8 for OU 4B (transect 4061). The highest orbital velocities exceeded 3 feet per second (fps) for recreational vessels and tugboats in reach OU 4A. The highest orbital velocities were between 2.3 and 3.0 fps for the cargo vessels in reach OU 4B and up to 4.2 fps for the recreational vessel, the *Foxy Lady*. The stable sediment size needed to resist these velocities is coarse gravel with representative D_{50} of 0.94 inches (in) [24 millimeters (mm)] for OU 4A and a D_{50} of 0.83 in (21 mm) for OU 4B.

5.3 Wave Run-up Analysis

5.3.1 Methodology

The ACES program was used to determine the distance the wave will propagate up the shoreline cap using the wave run-up module of the program. Calculations were performed for OU 4A and OU 4B using the design waves (3.2 feet and 3.3 feet, respectively) and considering a shoreline armor cap consisting of riprap with a slope of 5H:1V.

5.3.2 Results

Preliminary wave run-up calculations performed for the maximum predicted vessel wake (i.e., design wave) and a 5H:1V slope using ACES indicate that shoreline caps

should extend approximately 2 feet above the top of shoreline cap elevation to protect against scour during extreme wave events. The appropriate top of shoreline cap elevation will be determined based on the results of the hydrodynamic model generated by Sea Engineering for the RD, which incorporated a 100+ year flow event and a maximum seiche event. As the flood flow and seiche elevation will vary depending on the location within OU 4, this elevation will be site-specific.

6 SUMMARY

Based on the results of the vessel-generated waves analysis presented above, the recommended armor and filter layers to protect engineered caps from scour from vessel-generated waves is presented in Table 9. The top of shoreline cap elevation will account for the predicted 2 foot wave run-up when using a 5H:1V slope.

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TABLES

Table 1
Vessel Characteristics

Site and Water Depth	Vessel Type	Draft (ft)	Length (ft)	Beam (ft)	Typical Travel Speed (mph)	Engine Power (hp)	Maximum to Typical Time of Applied Power (%)	Capacity (Gross Tons or Deadweight)
OU 3/4A 3 to 20 feet	Recreation - Small Fishing Boat	1.5	16	-	5 to 15	15	25 to 100	-
	Recreation - Water Ski Boat	2	20	-	5 to 35	150	25 to 100	-
	Recreation - Water Ski Boat	3	24	-	5 to 40	380	25 to 100	-
OU 4A 3 to 20 feet	*Foxy Lady* (yacht)	4	65	16	8	340	25 to 75	G.T. 85 D.W. 40 (loaded)
	Foxy Lady II (yacht)	5.5	85	20	8	350	25 to 75	G.T. 61
	Gopher (tugboat)	3.5	30	9	-	200	25 to 50	D.W. 7
	Badger (tugboat)	3	30	10	-	180	-	D.W. 8.5
	Mary Jane (tugboat)	3	32	30	-	200	20 to 25	D.W. 8.5
OU 4B 22 to 26 feet	Bulk Carrier	12	650	60	5.0	4,000 to 12,000	10	-
	Alpena	26.42	503	67	3.5	4,000	15 to 50	G.T. 13,900
	J.A.W. Inglehart	27.5	502	68	3.5	4,400	10 to 50	G.T. 12,500
	Paul H. Townsend	22.17	432	50	3.5	2,150	15 to 50	G.T. 7,850
	Recreation - Yacht	-	50	-	-	600	25 to 100	-

Table 2
Vessel Wake Analysis Methods and Vessel Applicability

Method	Applicability Limits of Froude Number	Cargo Ship	Tugboat	Recreational
Sorensen and Weggel (1984, 1986)	0.2 to 0.8	Lengths of 128 to 1000 feet. Drafts of 10 to 34 feet. Speeds up to 13 knots.	Lengths of 30 to 32 feet. Drafts of 3 to 4 feet. Speeds up to 13 knots.	Speeds up to 15 mph in deeper water. Speeds of 7 knots in shallow waters.
PIANC (1987)	NA	Water depths greater than 16.5 feet.	Water depths greater than 16.5 feet.	Speeds up to 8.7 knots in water depths greater than 16.5 feet.
Kriebel & Seelig (2005)	0.1 to 0.5	Any	NA	Speeds up to 7 knots.
Bhowmik et al. (1991)	Less than 0.7	NA	NA	Various speeds

Table 3
Ship Generated Wave Height and Period – Reach OU 4A (transect 4044)

Vessel Type	Methodology Used	Distance from Sailing Line (ft)	Vessel Speed (knots)	Water Depth at Vessel (ft)	Wave Height (ft)	Wave Period (sec)	Corrected Wave Height Using Higher A and B (Sorensen Method only, where applicable)
Monterey 350 SY Cruiser	Bhowmik et al.	10	6.9	varies	2.94	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.58	2.95	
Monterey 298 SSX	Bhowmik et al.	10	6.9	varies	2.67	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.48	2.92	
Monterey 180FS	Bhowmik et al.	10	6.9	varies	1.90	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.35	2.92	
Foxy Lady	Sorensen-Weggel: A'=1, B=0	15	11.3	20.5	3.22	3.12	
	Sorensen-Weggel: A'=1, B=0	15	8.7	20.5	1.74	2.32	
	PIANC	15	7	30.5	1.00	1.88	
	PIANC	15	8.7	30.5	2.38	2.34	
	Kriebel & Seelig	15	8	20.5	2.48	2.16	
	Kriebel & Seelig	15	7	20.5	1.28	1.88	
Foxy Lady II	Sorensen-Weggel: A'=1, B=0	15	11.3	20.5	3.13	3.12	
	Sorensen-Weggel: A'=1, B=0	15	8.7	20.5	1.72	2.34	
	PIANC	15	7	30.5	1.12	1.88	
	PIANC	15	8.7	30.5	2.66	2.34	
	Kriebel & Seelig	15	8	20.5	Failed to compute		
	Kriebel & Seelig	15	7	20.5	2.55	1.88	

Vessel Type	Methodology Used	Distance from Sailing Line (ft)	Vessel Speed (knots)	Water Depth at Vessel (ft)	Wave Height (ft)	Wave Period (sec)	Corrected Wave Height Using Higher A and B (Sorensen Method only, where applicable)
Mary Jane tugboat	Sorensen-Weggel: A'=1, B=0	25	1.7	20.5	Failed to compute		
	Sorensen-Weggel: A'=1, B=0	25	8.7	20.5	1.20	2.34	2.06 A=1.73; B=0.015
	PIANC	25	1.7	20.5	Failed to compute		
	PIANC	25	8.7	20.5	2.76	2.34	
Badger tugboat	Sorensen-Weggel: A'=1, B=0	25	1.7	20.5	Failed to compute		
	Sorensen-Weggel: A'=1, B=0	25	8.7	20.5	1.21	2.34	2.07 A=1.73; B=0.015
	PIANC	22	1.7	20.5	Failed to compute		
	PIANC	22	8.7	20.5	2.32	2.34	
Gopher tugboat	Sorensen-Weggel: A'=1, B=0	22	1.7	20.5	Failed to compute		
	Sorensen-Weggel: A'=1, B=0	22	8.7	20.5	1.23	2.34	2.12 A=1.73; B=0.015
	PIANC	22	1.7	20.5	Failed to compute		
	PIANC	22	8.7	20.5	2.29	2.34	

Notes:
The model hull coefficients A′ and B′ do not directly relate to specific vessel hull characteristics. The authors recommend using their model with A′=1 and B′=0, when vessel geometry is not known, and using the model with pre-defined hull coefficients when the vessel geometry is known. The other recommended coefficients are A′=1.53 and B′=0.005 for barges (Bidde 1968), and A′=1.73 and B′=0.015 for tugboats (Hay 1967).

Table 4
Ship Generated Wave Height and Period – Reach OU 4B (transect 4061)

Vessel Type	Methodology Used	Distance from Sailing Line (ft)	Vessel Speed (knots)	Water Depth at Vessel (ft)	Wave Height (ft)	Wave Period (sec)	Corrected Wave Height Using Higher A and B (Sorensen Method only, where applicable)
MV American Integrity	Sorensen-Weggel	120	1.7	34.0	Failed to compute		
	Sorensen-Weggel	120	8.7	34.0	N/A	N/A	
	PIANC	65	1.7	34.0	-	-	
	PIANC	65	8.7	34.0	1.83	2.34	
	Kriebel & Seelig	60	1.7	34.0	Failed to compute		
	Kriebel & Seelig	60	8.7	34.0	0.22	2.34	
MV American Republic	Sorensen-Weggel	60	1.7	30.5	Failed to compute		
	Sorensen-Weggel	60	8.7	30.5	1.86	2.34	1.68 A=0.91; B=0.01
	PIANC	45	1.7	30.5	-	-	
	PIANC	45	8.7	30.5	2.05	2.34	
	Kriebel & Seelig	40	1.7	30.5	Failed to compute		
	Kriebel & Seelig	40	8.7	30.5	1.02	2.34	
MV Mark Hannah	Sorensen-Weggel	20	1.7	30.5	Failed to compute		
	Sorensen-Weggel	20	8.7	30.5	1.60	2.34	
	PIANC	30	1.7	30.5	-	-	
	PIANC	30	8.7	30.5	1.89	2.34	
Hannah 2902 (barge)	Sorensen-Weggel	28	1.7	30.5	Failed to compute		
	Sorensen-Weggel	28	8.7	30.5	2.00	2.34	3.05 A=1.53; B=0.005
	PIANC	37	1.7	30.5	-	-	
	PIANC	37	8.7	30.5	2.06	2.34	
	Kriebel & Seelig	28	1.7	30.5	Failed to compute		
	Kriebel & Seelig	28	8.7	30.5	0.45	2.34	

Vessel Type	Methodology Used	Distance from Sailing Line (ft)	Vessel Speed (knots)	Water Depth at Vessel (ft)	Wave Height (ft)	Wave Period (sec)	Corrected Wave Height Using Higher A and B (Sorensen Method only, where applicable)
St. *Herbert Jackson*	Sorensen-Weggel	70	1.7	30.5	Failed to compute		
	Sorensen-Weggel	70	8.7	30.5	1.73	2.34	
	PIANC	50	1.7	30.5	-	-	
	PIANC	50	8.7	30.5	1.96	2.34	
	Kriebel & Seelig	40	1.7	30.5	Failed to compute		
	Kriebel & Seelig	40	8.7	30.5	1.97	2.34	
Monterey 298 SSX	Bhowmik et al.	10	6.9	varies	2.67	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.48	2.92	
Monterey 350 SY Cruiser	Bhowmik et al.	10	6.9	varies	2.94	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.58	2.95	
Monterey 180 FS	Bhowmik et al.	10	6.9	varies	1.90	1.86	
	Sorensen-Weggel	10	10.4	16.0	2.35	2.92	
Foxy Lady (yacht)	Sorensen-Weggel	15	11.3	30.5	3.06	3.05	
	Sorensen-Weggel	15	8.7	30.5	1.64	2.34	
	PIANC	15	7	30.5	1.00	1.88	
	PIANC	15	9	30.5	2.73	2.42	
	Kriebel & Seelig	15	7	30.5	1.13	1.88	
	Kriebel & Seelig	15	8.7	30.5	3.30	2.34	
Foxy Lady II (yacht)	Sorensen-Weggel	15	11.3	30.5	2.95	3.05	
	Sorensen-Weggel	15	8.7	30.5	1.59	2.34	
	PIANC	15	7	30.5	1.12	1.88	
	PIANC	15	9	30.5	2.66	2.34	
	Kriebel & Seelig	15	7	30.5	1.62	1.88	
	Kriebel & Seelig	15	8.7	30.5	Failed to compute		
Mary Jane tugboat	Sorensen-Weggel	25	1.7	30.5	Failed to compute		
	Sorensen-Weggel	25	8.7	30.5	1.16	2.34	1.98 A=1.73; B=0.015
	PIANC	27	1.7	30.5	-	-	
	PIANC	27	8.7	30.5	1.99	2.34	

Vessel Type	Methodology Used	Distance from Sailing Line (ft)	Vessel Speed (knots)	Water Depth at Vessel (ft)	Wave Height (ft)	Wave Period (sec)	Corrected Wave Height Using Higher A and B (Sorensen Method only, where applicable)
Badger tugboat	Sorensen-Weggel	25	1.7	30.5	Failed to compute		
	Sorensen-Weggel	25	8.7	30.5	1.16	2.34	1.99 A=1.73; B=0.015
	PIANC	17	1.7	30.5	-	-	
	PIANC	17	8.7	30.5	1.99	2.34	
Gopher tugboat	Sorensen-Weggel	22	1.7	30.5	Failed to compute		
	Sorensen-Weggel	22	8.7	30.5	1.19	2.34	2.05 A=1.73; B=0.015
	PIANC	17	1.7	30.5	-	-	
	PIANC	17	8.7	30.5	1.96	2.34	

Note:

(1) A wave height of 0.07 ft and period of 2.34 sec were calculated, but not applicable due to the draft of the vessel in relation to the mudline at the specified vessel speed.

Table 5
Recommended Riprap Design for OU 4A (transect 4044)

Vessels		Design Wave Height and Period		Revetment Design (Surf Zone)								
				Armor Layer				Filter Layer				Thickness of Armor Layer and Filter Layer (ft)
Vessel Category	Vessel Type	Wave Height (ft)	Wave Period (sec)	D15 (ft)	D50 (ft)	D85 (ft)	D100 (ft)	D15 (ft)	D50 (ft)	D85 (ft)	D100 (ft)	
Recreational Vessels (Speed Boats)	Monterey 350 SY Cruiser	2.94	2.20	0.39	0.54	0.67	0.85	0.04	0.07	0.10	0.12	1.07/1.0
	Monterey 298 SSX	2.67	2.20	0.37	0.50	0.62	0.79	0.04	0.06	0.09	0.11	1.0/1.0
	Monterey 180FS	2.35	2.92	0.38	0.52	0.65	0.82	0.04	0.06	0.10	0.11	1.04/1.0
Recreational Vessels (Yachts)	*Foxy Lady*	3.22	3.12	0.50	0.68	0.85	1.08	0.06	0.08	0.13	0.15	1.36/1.0
	Foxy Lady II	3.13	3.12	0.49	0.67	0.84	1.06	0.05	0.08	0.12	0.15	1.34/1.0
Tugboats	*Mary Jane*	2.76	2.34	0.39	0.53	0.66	0.84	0.04	0.06	0.10	0.12	1.05/1.0
	Badger	2.32	2.34	0.34	0.46	0.58	0.73	0.04	0.06	0.09	0.10	0.92/1.0
	Gopher	2.29	2.34	0.34	0.46	0.57	0.73	0.04	0.06	0.08	0.10	0.92/1.0

Notes:
1. The wave period calculated for the Monterey 350 and 298 were adjusted upwards to satisfy the stability criteria for breaking waves in ACES.
2. A revetment slope of 5H:1V was used in the calculations.

Table 6
Recommended Riprap Design for OU 4B (transect 4061)

Vessels		Design Wave Height and Period		Revetment Design (Surf Zone)								
				Armor Layer				Filter Layer				Thickness of Armor Layer and Filter Layer (ft)
Vessel Category	Vessel Type	Wave Height (ft)	Wave Period (sec)	D15 (ft)	D50 (ft)	D85 (ft)	D100 (ft)	D15 (ft)	D50 (ft)	D85 (ft)	D100 (ft)	
Cargo Boats and Barges	*MV American Integrity*	1.83	2.34	0.29	0.39	0.48	0.61	0.03	0.05	0.07	0.08	0.77/1.0
	MV American Republic	2.05	2.34	0.31	0.42	0.53	0.67	0.03	0.05	0.08	0.09	0.84/1.0
	MV Mark Hannah	1.89	2.34	0.29	0.40	0.50	0.63	0.03	0.05	0.07	0.09	0.79/1.0
	Hannah 2902 (barge)	3.05	2.34	0.42	0.57	0.71	0.90	0.05	0.07	0.10	0.12	1.13/1.0
	St. Herbert Jackson	1.97	2.34	0.30	0.41	0.51	0.65	0.03	0.05	0.08	0.09	0.82/1.0
Recreational Vessels (Speed Boats)	Monterey 350 SY Cruiser	2.94	2.10	0.39	0.52	0.65	0.83	0.04	0.06	0.10	0.11	1.05/1.0
	Monterey 298 SSX	2.67	2.00	0.35	0.47	0.59	0.75	0.04	0.06	0.09	0.10	0.95/1.0
	Monterey 180FS	2.35	2.92	0.38	0.52	0.65	0.83	0.04	0.06	0.10	0.11	1.04/1.0
Recreational Vessels (Yachts)	*Foxy Lady*	3.30	2.34	0.44	0.60	0.75	0.96	0.05	0.07	0.11	0.13	1.20/1.0
	Foxy Lady II	3.05	2.42	0.43	0.58	0.72	0.92	0.05	0.07	0.11	0.13	1.15/1.0
Tugboats	*Mary Jane*	1.99	2.34	0.30	0.41	0.52	0.65	0.03	0.05	0.08	0.09	0.82/1.0
	Badger	1.99	2.34	0.30	0.41	0.52	0.65	0.03	0.05	0.08	0.09	0.82/1.0
	Gopher	2.05	2.34	0.31	0.42	0.53	0.67	0.03	0.05	0.08	0.09	0.84/1.0

Notes:
1. The wave period calculated for the Monterey 350 and 298 were adjusted upwards to satisfy the stability criteria for breaking waves in ACES.
2. For the Badger, the wave height is the Corrected Wave Height from Table 4 using higher A and B coefficients for the Sorensen-Weggel Method.
3. A revetment slope of 5H:1V was used in the calculations.

Table 7
Recommended Subaqueous Cap Design for OU 4A (transect 4044)

Vessel Category	Vessel Type	Wave Height (ft)	Wave Period (sec)	Breaking Wave Height (ft)	Breaking Wave Depth (ft)	Maximum Orbital Velocity (fps)	Representative Sediment Diameter D50 (in)	D50 (mm)	Sediment Type
Recreational Vessels (Speed Boats)	Monterey 350 SY Cruiser	2.94	*2.80*	2.76	3.55	2.74	0.59	14.96	fine gravel
	Monterey 298 SSX	2.67	*2.70*	2.52	3.24	2.92	0.67	16.98	fine gravel
	Monterey 180FS	2.35	2.92	2.41	3.07	2.68	0.56	14.31	fine gravel
Recreational Vessels (Yachts)	*Foxy Lady*	3.22	3.12	3.17	4.07	3.48	0.95	24.12	coarse gravel
	Foxy Lady II	3.13	3.12	3.11	3.98	3.38	0.90	22.76	coarse gravel
Tugboats	*Mary Jane*	2.76	*2.80*	2.63	3.38	3.09	0.75	19.02	coarse gravel
	Badger	2.32	*2.50*	2.23	2.86	2.70	0.57	14.52	fine gravel
	Gopher	2.29	*2.60*	2.21	2.83	2.73	0.58	14.85	fine gravel

Notes:
Italized wave period values were adjusted upwards to satisfy the stability criteria for breaking waves in ACES.
Sediment type was classified using the Unified Soil Classification System

Table 8
Recommended Subaqueous Cap Design for OU 4B (transect 4061)

Vessel Category	Vessel Type	Wave Height (ft)	Wave Period (sec)	Breaking Wave Height (ft)	Breaking Wave Depth (ft)	Maximum Orbital Velocity (fps)	Representative Sediment Diameter D50 (in)	D50 (mm)	Sediment Type
Cargo Boats and Barges	*MV American Integrity*	1.83	2.34	1.85	2.37	2.32	0.42	10.72	fine gravel
	MV American Republic	2.05	2.34	2.02	2.61	2.59	0.53	13.36	fine gravel
	MV Mark Hannah	1.89	2.34	1.90	2.44	2.39	0.45	11.38	fine gravel
	Hannah 2902 (barge)	3.05	*2.70*	2.92	3.83	3.03	0.72	18.29	fine gravel
	St. Herbert Jackson	1.97	2.34	1.95	2.53	2.49	0.49	12.35	fine gravel
Recreational Vessels (Speed Boats)	Monterey 350 SY Cruiser	2.94	*2.60*	2.78	3.68	2.85	0.64	16.18	fine gravel
	Monterey 298 SSX	2.67	*2.60*	2.58	3.38	2.86	0.64	16.29	fine gravel
	Monterey 180FS	2.35	2.92	2.50	3.13	2.96	0.69	17.45	fine gravel
Recreational Vessels (Yachts)	*Foxy Lady*	3.30	*3.00*	3.26	4.22	3.22	0.81	20.65	coarse gravel
	Foxy Lady II	3.05	*2.70*	2.92	3.84	3.03	0.72	18.29	fine gravel
Tugboats	*Mary Jane*	1.99	2.34	1.97	2.55	2.52	0.50	12.65	fine gravel
	Badger	1.99	2.34	1.97	2.55	2.52	0.50	12.65	fine gravel
	Gopher	2.05	2.34	2.02	2.61	2.59	0.53	13.36	fine gravel

Notes:
Italized wave period values were adjusted upwards to satisfy the stability criteria for breaking waves in ACES.
Sediment type was classified using the Unified Soil Classification System

Table 9
Summary of Cap Armor Recommendations for Vessel Wakes

Representative Capping Area	Critical Design Wave Height (ft)	Cap Design					
		Armor Layer			Filter Layer		
		D50 (ft)	D100 (ft)	Thickness	D50 (ft)	D100 (ft)	Thickness
		Cap Armor Within Surf Zone[a] (ft)					
OU 3/4A (Transect 4044)	3.22	0.68	1.08	1.36	0.08	0.15	1.0
OU 4B (Transect 4061)	3.30	0.60	0.96	1.20	0.07	0.13	1.0
		Capping Armor Below Surf Zone[a] D50 (in)					
OU 3/4A (Transect 4044)	3.22	0.95 (Coarse Gravel)					
OU 4B (Transect 4061)	3.30	0.81 (Coarse Gravel)					

Note:
Surf zone defined herein as water depth range subject to breaking waves, which may extend from the top of bank to approximately 1 to 2 times the wave breaking depth (i.e., 4.2 to 8.4 feet).

ATTACHMENT B-3

PROPWASH EVALUATION ON NAVIGATION CHANNEL SIDE SLOPES

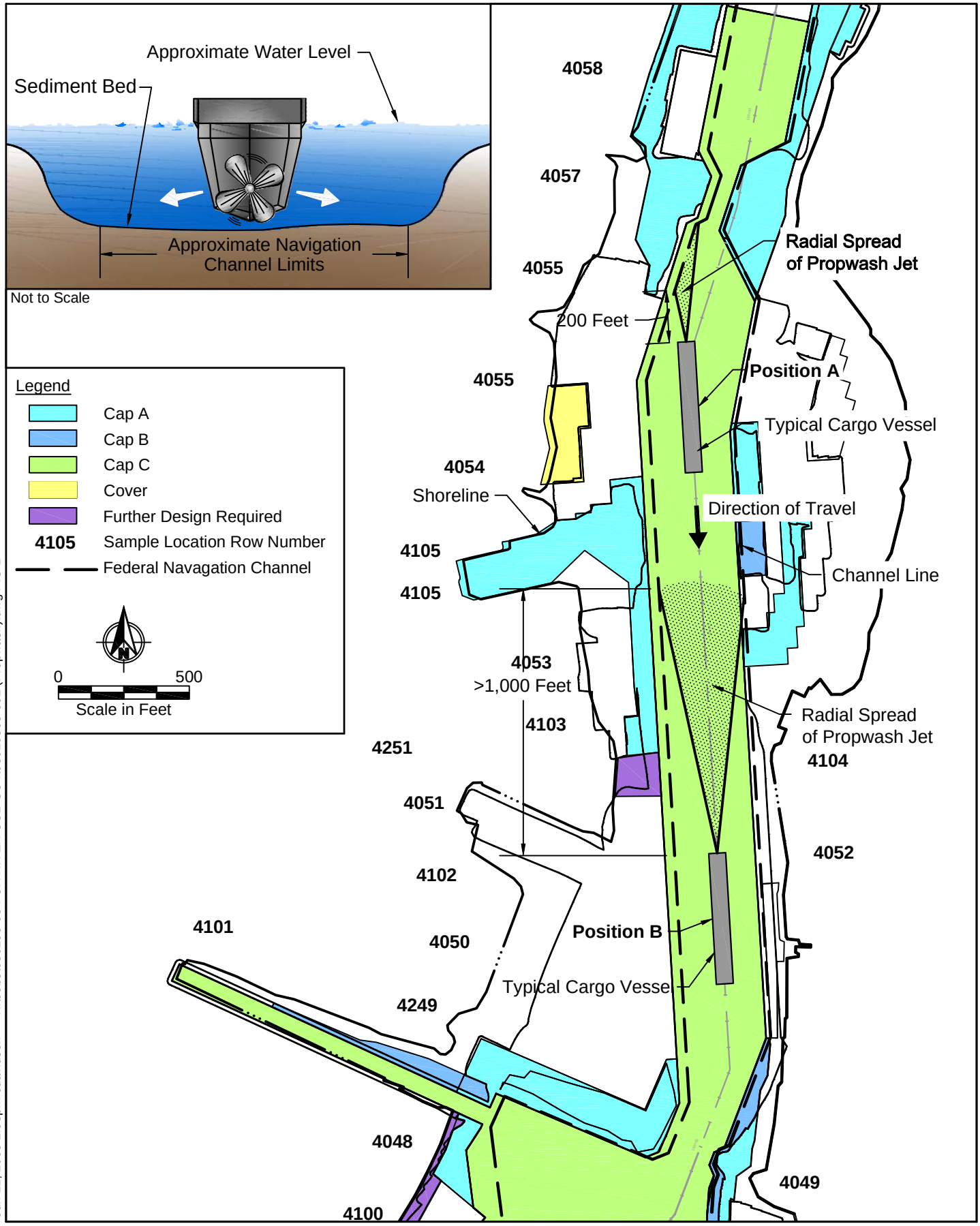
ATTACHMENT B-3

PROPWASH EVALUATION ON THE NAVIGATION CHANNEL SIDE SLOPES

This attachment presents the analysis of appropriate armoring to resist propwash along the side slopes of the navigation channel (designed at 3 horizontal to 1 vertical [3H:1V] extending outside of the limits of the authorized channel). As a vessel travels along the centerline of the navigation channel (i.e., parallel to the side slopes rather than perpendicular to it), the distance between the propeller and the side slope is typically in excess of several hundred feet, resulting in significant reductions in the erosion potential due to the radial spread and dissipation of energy within the propwash jet. Figure 1, Position B presents a conceptual depiction of a vessel's propwash jet in relation to the side slopes.

Other limited stretches of the navigation channel side slopes may be subject to propwash flows at an incident angle to the side slope (i.e., not parallel or perpendicular). This would primarily occur on the outside of a bend in the navigation channel. Within the potential capping areas delineated as part of the 60 Percent Design, only the eastern side slope of the channel between Remedial Design (RD) sampling transects 4050 and 4051 and the western side slope near RD transect 4056 could be subject to propwash flows at an incident angle. Figure 1, Position A presents a conceptual depiction of a vessel's propwash jet in relation to the side slopes. The stable sediment size estimated to resist erosion from a vessel's propwash was evaluated for a range of axial distances from the propeller plane to the side slope (i.e., 240 to 504 feet) at varying amounts of power supplied (10, 25, and 50 percent), based on discussions with commercial vessel operators from the Lake Carriers Association. An example calculation provided herein summarizes these computations. Based on the propwash evaluation for these areas, it is estimated that 3-inch-diameter cap armoring will be sufficient to protect against propwash erosion on the side slopes of the navigation channel along most of OU 4B.

Within the Fort Howard Turning Basin, it is possible that vessel maneuvering operations could result in the propeller being directed perpendicular to the side slopes. Furthermore, given the relatively limited turning radius within this area, the distance between the propeller and the side slope could be limited (200 feet or less in extreme cases). Therefore, side slopes of the Fort Howard Turning Basin that require capping will be designed for the 33-inch-thick cap with quarry spall armoring.



Jun 11, 2008 2:58pm cdavidson K:\Jobs\080295-03 FOX RIVER OU2-OU4\08029503-002 (Propwash).dwg FIG 1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Conceptual Depiction of Propwash in Navigation Channel
Fox River

CALCULATION COVER SHEET

PROJECT: Lower Fox River Remedial Design	**CALC NO.**	**SHEET** 1 of 3
SUBJECT: Propwash Evaluation for OU 4B Navigation Channel Side Slopes		

Purpose: To determine armor size necessary to prevent erosion of cap on side slopes of federal navigation channel in OU 4B due to propeller wash of maneuvering vessels.

References: Blaauw, H.G., and E.J. van de Kaa., 1978. Erosion of Bottom and Sloping Banks Caused by the Screw Race of Maneuvering Ships. Paper presented at the 7th International Harbour Congress, Antwerp, Belgium. May 22-26, 1978.

Guidance for In situ Subaqueous Capping of Contaminated Sediment, Appendix A: Armor Layer Design by S. Maynord, U.S. Army Waterways Experiment Station, Vicksburg, Mississippi. 1998

Given: Equation 28 (Blaauw and van de Kaa, 1978), Axial velocity in the propeller stream of maneuvering vessel (e.g. vessel speed of zero)

$$V_x = 2.78 * V_0 * \frac{D_0}{X} Exp(-15.43(\frac{z}{X})^2)$$

V_x	=	axial velocity at distance x	[m/s]
V_o	=	axial efflux velocity exiting propeller	[m/s]
D_o	=	initial diameter of slipstream	[m]
	=	$0.71D_p$ for non-ducted propeller	[m]
	=	D_p for ducted propeller	[m]
D_p	=	propeller diameter	[m]
x	=	axial distance from propeller plane	[m]
z	=	vertical distance from propeller axis	[m]
H_p	=	Distance from propeller shaft to channel bottom	[m]

Above eqn. valid for $\frac{D_p}{H_p} < 1.2$

RECORD OF REVISIONS

NO.	REASON FOR REVISION	BY	CHECKED	APPROVED/ ACCEPTED	DATE

Shaw ANCHOR ENVIRONMENTAL, L.L.C.

DESIGNER:	P. LaRosa	**DATE:**	10-20-07	**CALC. NO.:**		**REV.NO.:**	
				CHECKED BY:	RIW	**CHECKED DATE:**	10-20-07
PROJECT:	Lower Fox River Remedial Design						
SUBJECT:	Propwash Evaluation for OU 4B Navigation Channel Side Slopes						

Equation 25 (Blaauw and van de Kaa, 1978), Jet Velocity exiting a propeller

$$V_o = C_2 \left(\frac{P_d}{D_p^2} \right)^{1/3}$$

P_d	=	Applied engine/propeller power	[kW]
C_2	=	1.35 (Blaauw and van de Kaa, 1978)	[-]
	=	1.17 for ducted propellers (Fuehrer and Rowisch, 1987)	[-]
	=	1.48 for non-ducted propellers (Fuehrer and Rowisch, 1987)	[-]

Equation 5 (Maynord, 1998) Stone Size for Propeller Wash

$$V_b = C_3 \left(g \Delta D_{50} \right)^{1/2}$$

V_b	=	bottom velocity	[m/s]
C_3	=	0.55 for no movement allowed (repeated attack)	[-]
	=	0.70 for small transport (infrequent attack)	[-]
Δ	=	$(\gamma_s - \gamma_w)/\gamma_w$ = 1.65	[-]
γ_s	=	unit weight of stone = 2,650	[kg/m^3]
γ_w	=	unit weight of water = 1,000	[kg/m^3]
D_{50}	=	median stone size	[m]

VESSEL: *Lafarge - GL Ostrander Integrity*

Propeller Type	=	non-ducted	
D_p	=	3.66	[m]
D_o	=	2.6	[m]
Propeller Shaft Depth	=	3.35	[m]
Engine Power	=	7,200	[kW]
C_2	=	1.48	[-]
C_3	=	0.70	[-]

DESIGNER: P. LaRosa **DATE:** 10-20-07 **CALC. NO.:** **REV.NO.:**

CHECKED BY: RIW **CHECKED DATE:** 10-20-07

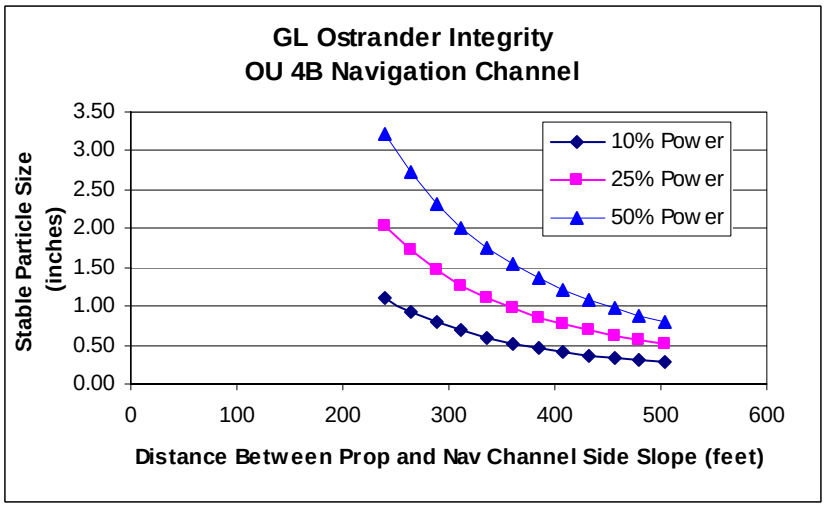
PROJECT: Lower Fox River Remedial Design

SUBJECT: Propwash Evaluation for OU 4B Navigation Channel Side Slopes

OU 4B Federal Navigation Channel

% Power Applied	P_d [kW]	Water depth [m]	H_p [m]	V_o [m/s]	D_p/H_p [-]
10%	537	7.92	4.6	5.07	0.80
25%	1,342	7.92	4.6	6.88	0.80
50%	2,685	7.92	4.6	8.66	0.80

			10%			25%			50%		
x [m]	x [ft]	z [m]	$V_{x,r}$ [m/s]	$V_{x,r}$ [ft/s]	D_{50} [inches]	$V_{x,r}$ [m/s]	$V_{x,r}$ [ft/s]	D_{50} [inches]	$V_{x,r}$ [m/s]	$V_{x,r}$ [ft/s]	D_{50} [inches]
73	240	4.6	0.47	1.54	1.10	0.64	2.10	2.03	0.81	2.64	3.23
80	264	4.6	0.43	1.42	0.93	0.59	1.93	1.72	0.74	2.43	2.72
88	288	4.6	0.40	1.31	0.80	0.54	1.78	1.46	0.68	2.24	2.33
95	312	4.6	0.37	1.22	0.69	0.50	1.65	1.26	0.63	2.08	2.01
102	336	4.6	0.35	1.14	0.60	0.47	1.54	1.10	0.59	1.94	1.75
110	360	4.6	0.32	1.06	0.52	0.44	1.45	0.97	0.56	1.82	1.53
117	384	4.6	0.31	1.00	0.46	0.41	1.36	0.85	0.52	1.71	1.36
124	408	4.6	0.29	0.95	0.41	0.39	1.28	0.76	0.49	1.62	1.21
132	432	4.6	0.27	0.89	0.37	0.37	1.21	0.68	0.47	1.53	1.08
139	456	4.6	0.26	0.85	0.33	0.35	1.15	0.61	0.44	1.45	0.98
146	480	4.6	0.25	0.81	0.30	0.33	1.10	0.56	0.42	1.38	0.88
154	504	4.6	0.23	0.77	0.27	0.32	1.05	0.51	0.40	1.32	0.80



ATTACHMENT B-4

SLOPE STABILITY ANALYSIS FOR CAPPED SIDE SLOPES

Memorandum

To: 60 Percent Design Report File

From: Wes MacDonald, Paul LaRosa, John Laplante, and John Verduin

cc:

Date: June 13, 2008

Re: Capped Slope Stability

This memorandum provides details and background on the capped slope stability analyses performed during development of the 60 Percent Design for the Fox River Operable Units (OUs) 2 to 5 project.

The accompanying memorandum detailing slope stability analysis of submerged dredge cut slopes indicates that three (3) horizontal to 1 vertical (3H:1V) slopes will be stable based on review of vane shear and triaxial strength data collected as part of the Remedial Design and previous investigations. These data indicate that a 3H:1V slope will have a factor of safety of at least 1.3 for the vast majority of the data reviewed.

The detailed stability analyses outlined below indicate that engineered caps (with thicknesses ranging from 18 to 33 inches) are predicted to be stable on submerged slopes of 3H:1V. While submerged caps will be stable on these slopes, only a few very localized sections of the capped area have an existing slope as steep as 3H:1V. The vast majority of areas proposed for capping as a primary remedy (i.e., without prior dredging) have slopes of 10H:1V or flatter.

In addition to the submerged capping areas, some limited shoreline areas may be capped (with thicknesses up to 4 feet), as described in the 60 Percent Design Report. These shoreline caps will likely extend above the water line to protect the shoreline from erosion during extreme flow events and from wave run-up. Slope stability analyses presented herein indicate a maximum stable slope angle of 5H:1V, based on the currently available geotechnical data. However, additional stability analyses with site-specific data collected prior to construction may indicate that steeper or flatter angles are appropriate. These additional site-specific analyses will be conducted prior to construction as part of the annual "infill sampling" (see 60 Percent Design

Report). Shoreline cap design refinements, including slope angle refinements as appropriate, will be presented in the RA Work Plans.

STABILITY OF CAPS ON SLOPES

To evaluate the stability of caps on slopes, areas of interest were identified in the river, and three conceptual slope caps, representative of anticipated conditions in OUs 2 to 5, were analyzed. These conceptualized slopes included the following:

- 18-inch cap on 3H:1V submerged slope (see Figure 1): This case example is representative of Cap A and B (see cap designs in 60 Percent Design – Volume 2) placed on an existing or post-dredge submerged slope
- 33-inch cap on 3H:1V submerged slope (see Figure 2): This case example is representative of Cap C (see cap designs in 60 Percent Design – Volume 2) placed on an existing or post-dredge submerged slope
- 48-inch cap on 5H:1V partially submerged slope (see Figure 3): This case example is representative of a shoreline cap (see cap designs in 60 Percent Design – Volume 2) placed on an existing or post-dredge shoreline slopes.

These conditions and conceptualized sections were analyzed with Slide 5.0 software to evaluate the stability of the capped slope. Slide 5.0 is a two-dimensional slope stability analysis software, complete with sensitivity, probabilistic and back analysis capabilities. The Slide software offers various vertical slice limit equilibrium methods (Bishop, Janbu, Spencer, Corps of Engineers #1 and #2, and more) for stability modeling. Slope stability evaluations are conducted by inputting the geometry and subsurface stratigraphy of an existing or proposed slope as well as various parameters describing the sediment and water conditions (sediment and water densities, cohesion, friction angle, soil model, groundwater/surface water elevations, etc.). The software output includes graphical solutions of the factor of safety associated with various failure surfaces as well as numerous other tabular and graphical outputs useful for data analyses.

Appropriate construction techniques will be required to ensure proper cap placement thereby limiting the potential for slope stability failures from cap construction. This will involve the placement of materials in a "bottom up" fashion, whereby materials are first placed at the toe of a slope and construction produces towards to top of slope. A toe berm can be used to provide an initial platform for the capped materials to be placed without sloughing. In this way, cap materials will be continually placed against a firm toe support and are not allowed to slump

towards the base. The top of the cap will need to be level at the cited elevation. Necessary care will need to be taken when constructing the toe berms to ensure they are at their required depth, width, height, and density to prevent movement.

In situ sediment properties for the slope stability evaluations were obtained from laboratory measurements on samples collected during the 2004 and 2005 pre-design sampling and analysis program. In addition, physical properties of the capping materials and toe berms were estimated based on the nature of the cap and berm materials proposed (sand, gravel, and quarry spalls) and the method of cap placement (broadcast spreader or mechanical clamshell). The following assumptions were used in the model:

- Caps will be constructed of sand chemical isolation layer overlain by a gravel or quarry spall armor layer.
- Cap (sand and armor material) total unit weight = 120 pcf, friction angle = 32 degrees, and cohesion = 0 psf.
- Existing sediment total unit weight= 92 pcf, friction angle = 0, and cohesion varying as a function of depth from 50 to 750 psf, based on results of the vane shear (VST) and laboratory strength testing. Note: the VST tests were conducted primarily towards the center of the river where sedimentation is greatest. Thus, we consider the VST results to represent recent, softer sediments that are minimally consolidated. At the same time, visual field evidence suggests that the underlying materials along some shorelines are native stiff clays, which presumably have greater strength than that measured for the center of the river, which were conservatively assumed for this analysis. Therefore, additional sampling and testing may be performed as construction proceeds to allow site-specific refinement.
- Cap materials will be placed in lifts (e.g. sand layer will be placed followed by armor layer). Fine grained existing sediments beneath the cap will gain strength as the thickness of the cap is built up and over time as the existing sediment consolidate under the load of the cap. For the shoreline cap example (Figure 3), some additional strength gain was assumed in the analysis to reflect the long-term condition.
- Slope caps with a thickness greater than 18 inches will be constructed with a toe berm at the bottom of the slope for constructability purposes as discussed below. The toe berm will be constructed of quarry spalls with a total unit weight = 135 pcf, friction angle = 45 degrees, and cohesion = 0 psf.
- For shoreline caps, the top elevation of the cap were assumed to be at 582.5 feet (North American Vertical Datum [NAVD] 88), extending approximately six feet above the

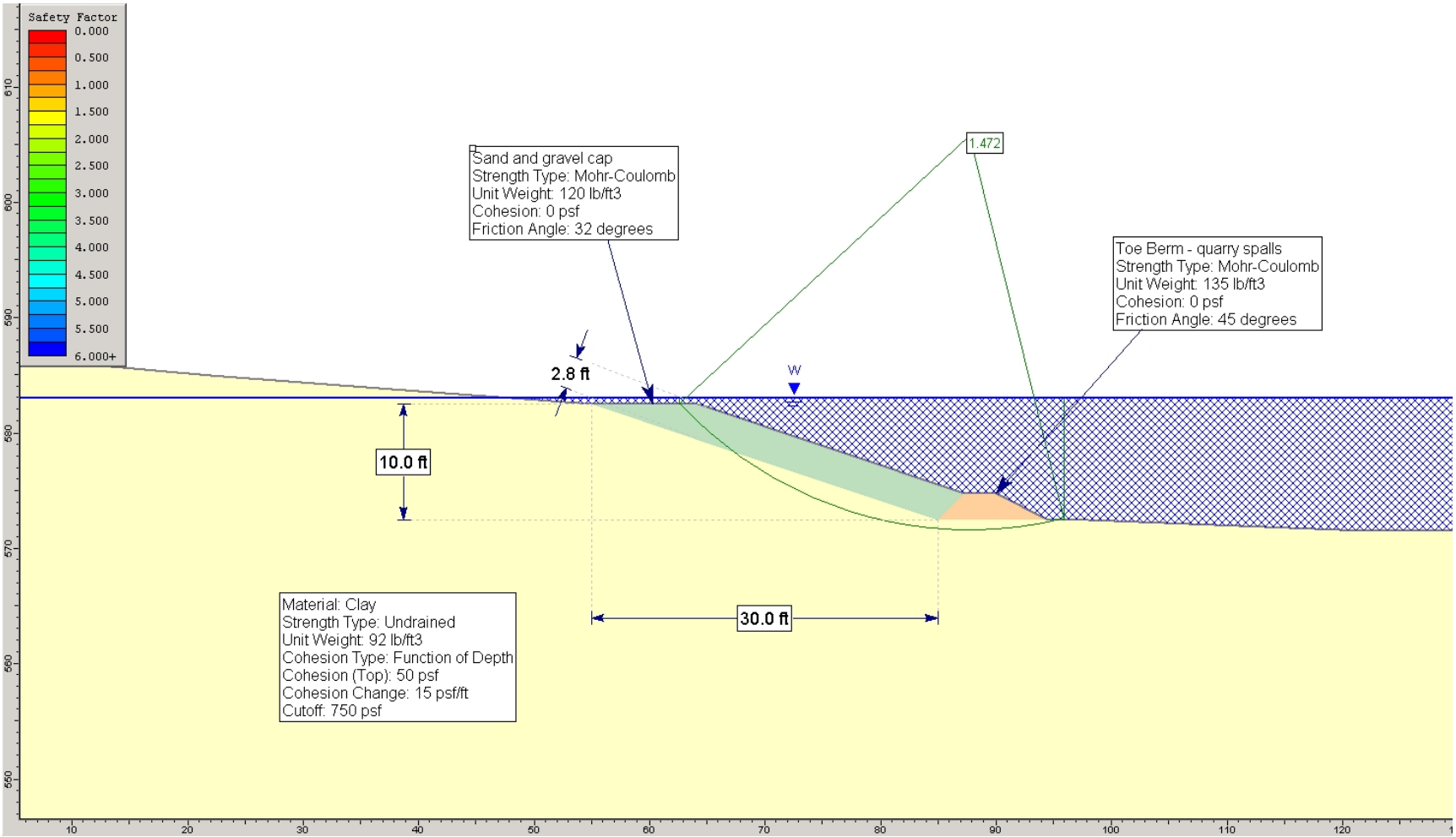
National Oceanic and Atmospheric Administration (NOAA) low water elevation of 576.6 feet (NAVD 88) for the Fox River.

Circular shear surfaces were evaluated, and the software performed a search for the critical (i.e. lowest factor of safety) slip surface. Generalized Limit Equilibrium and Spencer methods were used to compute the factor of safety.

In order to maintain long-term stability, a static factor of safety of 1.3 or better is targeted, consistent with the criteria presented by Hammer and Blackburn (1977) for the long term stability condition. Figures 1, 2, and 3 show the geometry and results of the Slide 5.0 analysis for three different cap thicknesses and their conceptualized geometry summarized above. These figures illustrate that the target factor of safety will be achieved for the conditions analyzed.

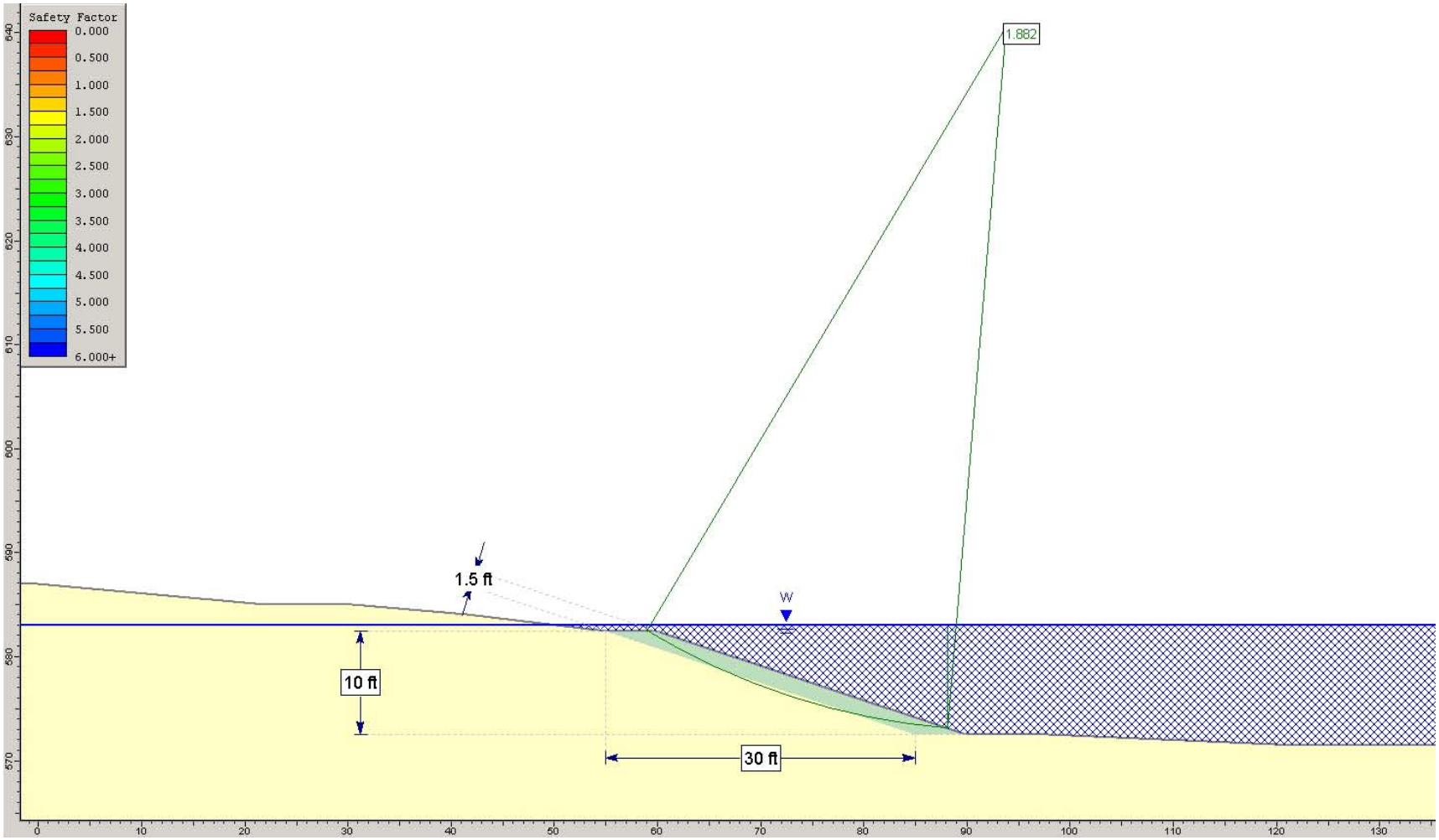
REFERENCE

Hammer, D.P. and Blackburn, E.D. 1977. "Design and Construction of Retaining Dikes for Containment of Dredged Material," Tech. Report D-77-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.



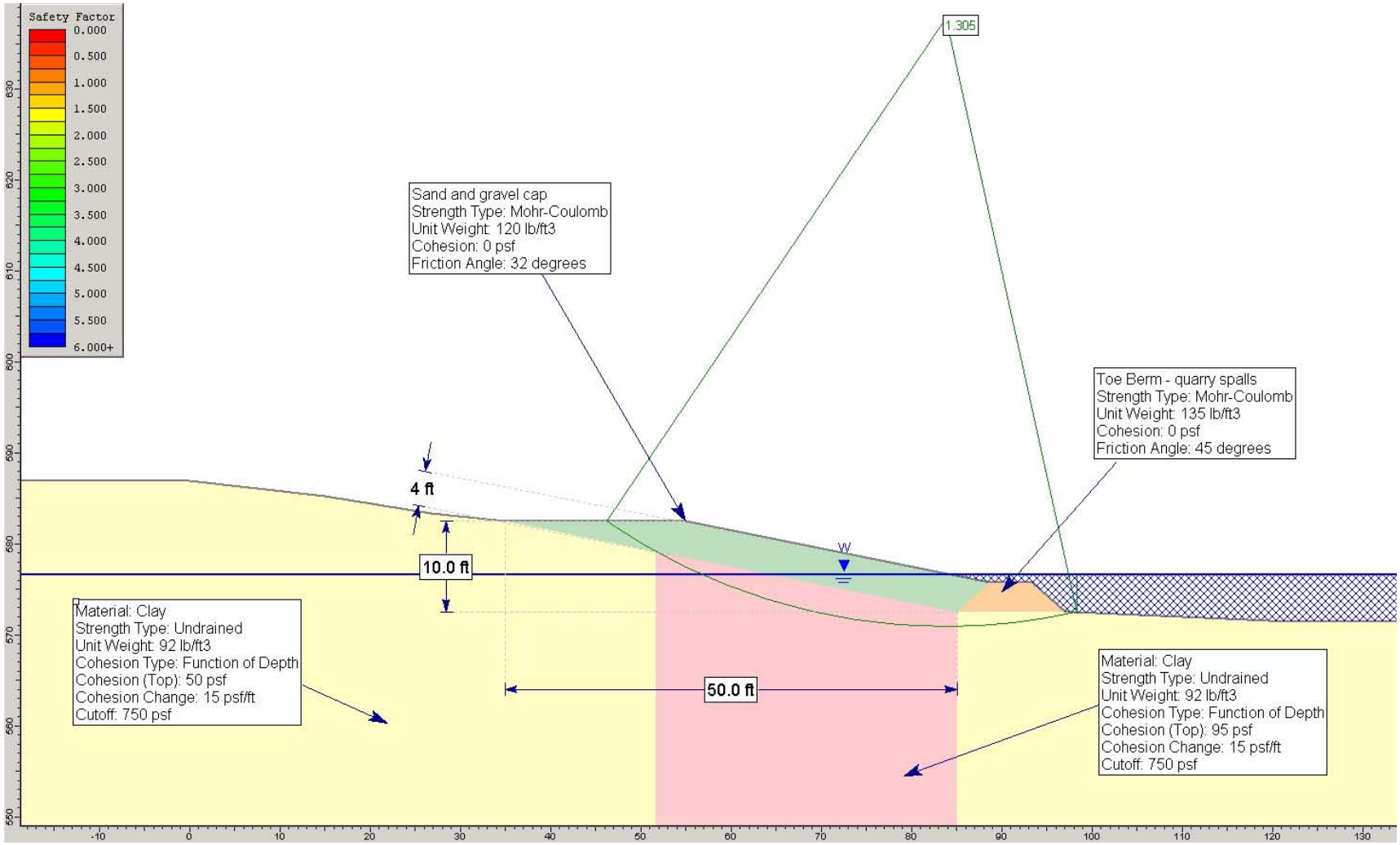
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
33” Capped Slope 3H:1V
Lower Fox River



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
18” Capped Slope 3H:1V
Lower Fox River



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
4' Capped Slope 5H:1V
Lower Fox River

ATTACHMENT B-5

CAP DESIGN REFINEMENT "GROUND RULES" MEMO

Remedial Design Technical Memorandum

To: Shoreline and Cap Design Sub-Group Coordinators: Tim Harrington (Hard Hat) and Rich Weber (NRT)

From: Matt Henderson, Paul LaRosa, Ram Mohan, and Clay Patmont (Anchor)
Gary Braun and Steve McGee (Tetra Tech)

cc: Jim Hahnenberg (U.S. Environmental Protection Agency), Greg Hill (Wisconsin Department of Natural Resources), and George Berken (Boldt)

Date: June 4, 2008

Re: 60 Percent Design – Cap Design Refinement "Ground Rules"

This remedial design (RD) technical memorandum establishes the "ground rules" for the process that will be used for the design of appropriate armor materials in capping areas subject to localized conditions (e.g. erosional characteristics, navigation requirements, etc.) that differ significantly from those that exist in majority of Operable Units (OUs) 2 to 5 of the Lower Fox River (the River) for which the general cap designs presented in the 30 Percent Design Report are appropriate. These localized areas include capping areas adjacent to storm water or other outfalls, marine terminal areas, marinas, and public boat launches. The approach for generalized local cap armor design refinements was discussed and agreed upon with the Agency/Oversight Team (A/OT) during the Workgroup 2 conference call held on April 23, 2008. The "ground rules" described herein will be incorporated into the 60 Percent Design submittal and subsequently used for the site-specific cap armor design in localized areas in the River with the final remedy for each area to be presented in the annual Remedial Action (RA) Work Plans. Examples of cap armor design refinements adjacent to a storm water outfall and marine terminal area were discussed with the A/OT and are also included in this memorandum for reference. This technical memorandum will be included as an appendix to the 60 Percent Remedial Design Report.

Storm Water and other Outfalls: The primary design consideration for the placement of capping materials around existing outfalls is the potential for erosion of cap materials due to flow velocities from the outfall pipe. In an effort to minimize the potential for erosion of the capping materials, an outfall "apron" or "splash pad" will be constructed to dissipate the

energy of the outfall discharge. The outfall apron will be design with general consideration of the Federal Highway Administrations (FHWA's) Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular Number 14 (HEC-14), Third Edition (http://www.fhwa.dot.gov/engineering/hydraulics/pubs/06086/hec14ch10.cfm#Toc103). The following ground rules were established through collaboration within Workgroup 2 for cap armor design surrounding outfalls:

1. An armor layer apron shall be placed at the base of the outfalls with an outfall pipe diameter of at least 6 inches or greater.
2. For outfalls between 6- and 12-inch diameters, the width of the outfall apron will be 6 feet (see attached detail) and shall be integrated into existing capping materials.
3. For outfalls greater than 12 inches in diameter, the width of the outfall apron will be 6 times the diameter of the outfall pipe and shall be integrated into existing capping materials.
4. The general outfall apron will consist of a 6- to 9-inch-thick layer of sand/filter material placed on the existing sediments overlain by a 12-inch-thick armor layer comprised of quarry spall stone with a median (D_{50}) stone diameter between 4 and 8 inches based on the outfall's characteristics. The thickness of the base sand layer will be based on the PCB concentration within the top 1.5 feet of sediment immediately underlying the prospective cap layer for a given location, consistent with the 30 Percent Design Report. The gradation of the sand layer will be designed with consideration of geotechnical filter criteria to avoid mixing of armor and underlying materials. If required, the filter layer may be soil (i.e., gravel) or geotextile to prevent mixing of the armor with the underlying sand.
5. Limited removal of existing sediments may be performed prior to placement of the outfall apron if necessary to avoid placing materials above the invert elevation of the outfall pipe.
6. Alternate site-specific designs for outfall aprons (dimensions, armor stone size, etc.) may be completed based on location-specific considerations including flow conditions, mudline elevations, and water depths.

The proposed capping and outfall apron will be discussed and coordinated with the owner of each outfall during the year prior to the planned RA in the vicinity of that outfall structure.

Storm water Outfall Example: Attachment A presents an example outfall design for an existing 54-inch diameter storm water outfall located in OU 4 that was discussed with the A/OT during the April 23, 2008 Workgroup 2 meeting. Sheets O-1 and O-2 present the plan and typical cross-section for this storm water outfall. The remedy proposed in this area in the 30 Percent Design consists of both dredging and capping (Type A). As described above, an outfall apron is proposed. The maximum width of the outfall apron will be 27 feet (Sheet O-2) and this apron will be integrated into the surrounding Type A cap.

Marine Terminals: The primary design considerations for the placement of capping materials within areas of vessel traffic are interference with navigation and the potential for scour of capping materials due to propeller wash. To protect against these potential impacts, the following ground rules were established through collaboration within Workgroup 2:

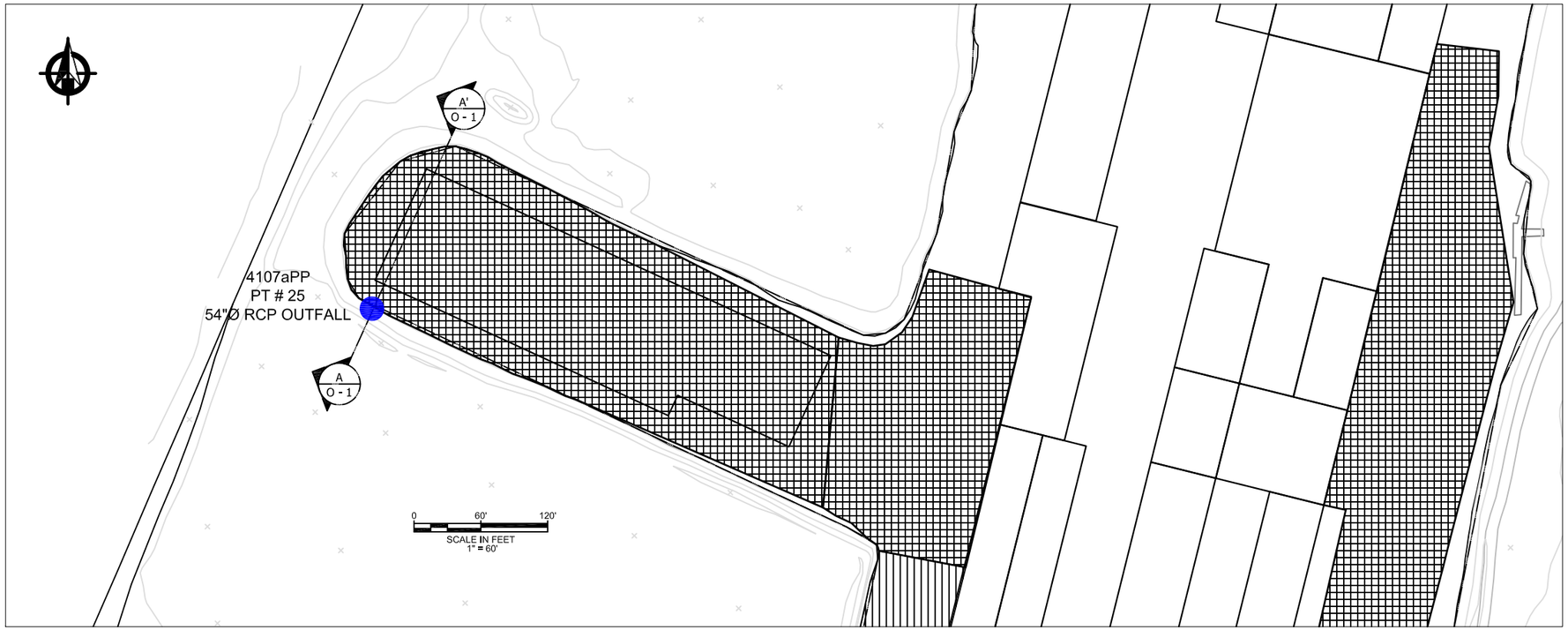
1. Discussions will be held with the owners of each marine terminal area or marina to verify the navigation depths required for berths or slips as well as vessel transit locations and authorized navigation depths in adjacent areas.
2. In commercial navigation areas, cap armor designs will be designed based on site-specific erosional characteristics (e.g. propeller wash). For instance, in the case of marine terminals in OU 4B, quarry spall armoring may be appropriate to resist the proposal forces from large commercial vessels. In addition, the design in commercial marine terminals will incorporate a minimum 2-foot offset between the top of the cap and the required navigation depth, consistent with the 30 Percent Design for caps within the federal navigation channel. Based on the bathymetry and the suitable cap thickness, dredging may be required prior to cap placement to achieve the desired final top of cap elevation. Depending on the site-specific conditions (e.g. depth of contamination, existing water depth, and navigation requirements), some areas identified for capping-only in the 30 Percent Design may be converted to dredge-and-cap or dredging-only remedies. This evaluation will be conducted on a site specific case-by-case basis.

The proposed remedy will be discussed with the owner of each marine terminal area or marina during the year prior to the planned RA in the vicinity of that facility and the design will be documented in the annual RA Work Plans.

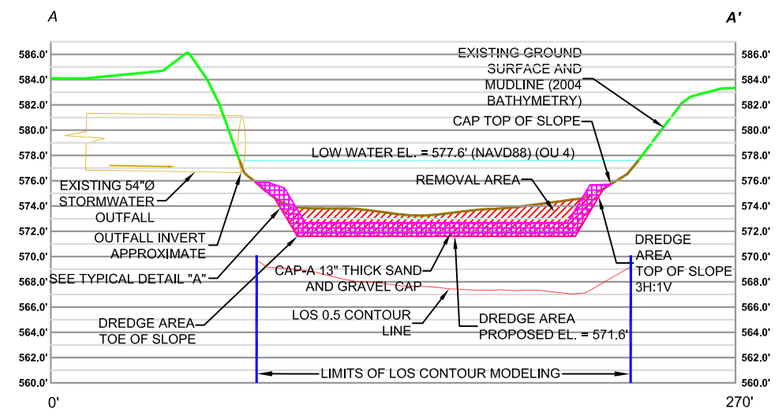
Fox River Dock Example: Attachment B presents an example marine terminal design in OU 4B that was discussed with the A/OT during the April 23, 2008 Workgroup 2 meeting. Sheet T-1 presents the plan and cross-sections for the Fox River Dock. The remedy proposed in the 30 Percent Design for this area consisted of a Type A cap (13 inches thick) and a 6-inch sand cover. This remedy is shown in the cross-section A-A' labeled "Original 30% Design" on Sheet T-1. According to the Lake Carriers Association, who oversees the majority of commercial vessel traffic to the Fox River terminal facilities, there are several vessels that berth at the Fox River Dock. These include vessels such as the *Arthur M. Anderson*, *Cason J. Callaway*, *Phillip R. Clarke*, and *John G. Munson*. These vessels typically require a maximum of 25 feet of draft to operate. Based on a review of the 2004 bathymetry survey conducted by Retec, the placement of a Type C cap on the existing mudline would reduce water depths at the Fox River Dock to less than the required navigation depth. In order to provide sufficient water depth to place a Type C cap (33-inch in thickness) with the top of cap at a depth 2 feet below the required navigation depth, removal of sediments to below the 0.5 Level of Significance (LOS) neatline would be required, thereby obviating the need for subsequent cap placement. Therefore, in this location, the prescribed remedial action would be converted from capping-only to dredging-only (see cross-section A-A' "Revised 60% Design").

ATTACHMENT A

STORM WATER OUTFALL EXAMPLE



SECTION LOCATION



A OUTFALL 4107

SCALE 1" = 30' 5X VERTICAL EX.

OUTFALL LOCATION
4-003bPP
NEATLINE DREDGING
MUDLINE (2004 BATHYMETRY)
COVER - 6" MIN. SAND COVER
CAP A - 7"-9" MIN. THICK GRAVEL AND SAND CAP
TRANSECT LOCATIONS

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM, 1988 (NAVD88), U.S. SURVEY FEET.
4. ALL STRUCTURES, LOCATIONS, AND ALIGNMENTS NEED TO BE FIELD VERIFIED AND SHOULD BE CONSIDERED APPROXIMATE.
5. OUTFALL DATA COLLECTED DURING 2006 - 2007 SHORELINE SURVEY PERFORMED BY ANCHOR ENVIRONMENTAL, LLC.

DRAFT

ANCHOR ENVIRONMENTAL, L.L.C.
1423 3RD AVENUE, SUITE 300
SEATTLE, WA 98101 (206) 287-9130

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: GABE BOLIN
DRAWN BY: GABE BOLIN
CHECKED BY: KIM POWELL
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

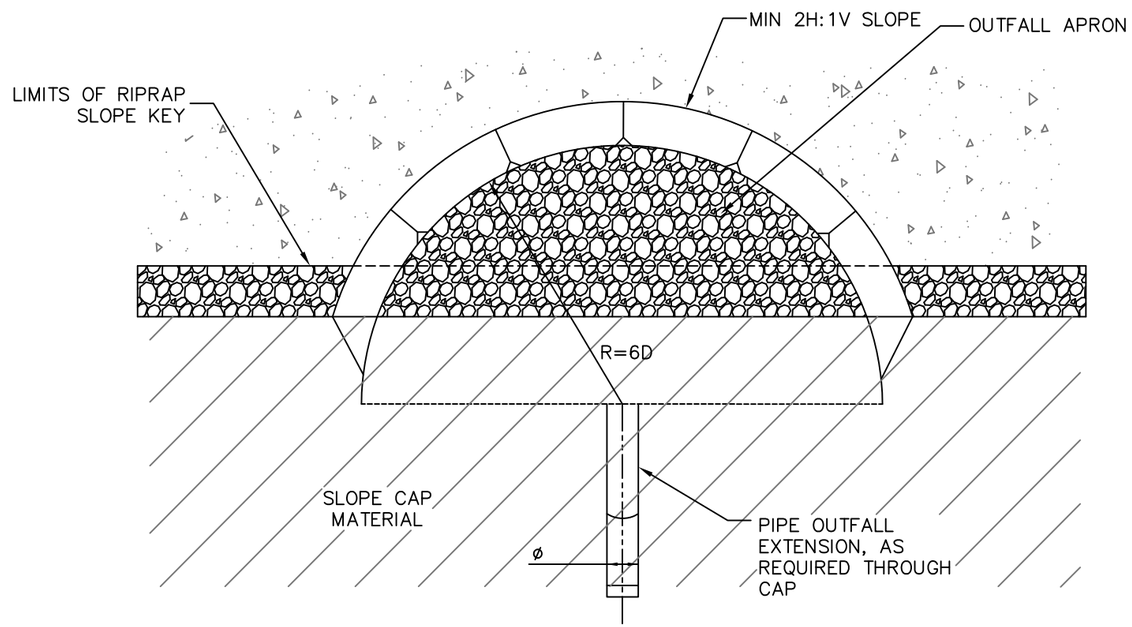
LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
STORMWATER OUTFALL PLAN AND SECTION VIEWS

O - 1

SHEET NO. 1 OF 2

C:\Documents and Settings\gbolin\My Documents\Fox River Temp Files\CAD files transferred from FUJI\08029503 EXAMPLES CAP REFINEMENTS RECOVERED.dwg OUTFALL 4107
May 30, 2008 2:00pm gbolin



DETAIL – OUTFALL APRON

NOT TO SCALE

NOTES:

1. AN ARMOR LAYER APRON SHALL BE PLACED AT THE BASE OF THE OUTFALLS WITH A DIAMETER OF AT LEAST 6 INCHES.

2. FOR OUTFALLS BETWEEN 6– AND 12–INCH IN DIAMETER, THE WIDTH OF THE OUTFALL APRON SHALL BE 6 FEET AND SHALL BE INTEGRATED INTO EXISTING CAPPING MATERIALS.

3. FOR OUTFALLS GREATER THAN 12 INCHES IN DIAMETER, THE WIDTH OF THE OUTFALL APRON SHALL BE 6 TIMES THE DIAMETER OF THE OUTFALL PIPE AND SHALL BE INTEGRATED INTO EXISTING CAPPING MATERIALS.

4. THE OUTFALL APRON SHALL CONSIST OF A 6– TO 9–INCH–THICK LAYER OF SAND/FILTER MATERIAL PLACED ON THE EXISTING SEDIMENTS OVERLAIN BY A 12–INCH THICK ARMOR LAYER COMPRISED OF QUARRY SPALL STONE WITH AN AVERAGE STONE DIAMETER BETWEEN 4 AND 8 INCHES. THE THICKNESS OF THE BASE SAND LAYER WILL BE BASED ON THE PCB CONCENTRATION WITHIN THE TOP 1.5 FEET OF SEDIMENT IMMEDIATELY UNDERLYING THE PROSPECTIVE CAP LAYER FOR A GIVEN LOCATION. THE GRADATION OF THE SAND LAYER WILL BE DESIGNED WITH CONSIDERATION OF GEOTECHNICAL FILTER CRITERIA TO AVOID MIXING OF ARMOR AND UNDERLYING MATERIALS.

5. LIMITED REMOVAL OF EXISTING SEDIMENTS MAY BE PERFORMED PRIOR TO PLACEMENT OF THE OUTFALL APRON IF NECESSARY TO AVOID PLACING MATERIALS ABOVE THE INVERT ELEVATION OF THE OUTFALL PIPE.

DRAFT

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: GABE BOLIN
DRAWN BY: GABE BOLIN
CHECKED BY: MATT HENDERSON
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
OUTFALL APRON DETAILS

O - 2

SHEET NO. 2 OF 2

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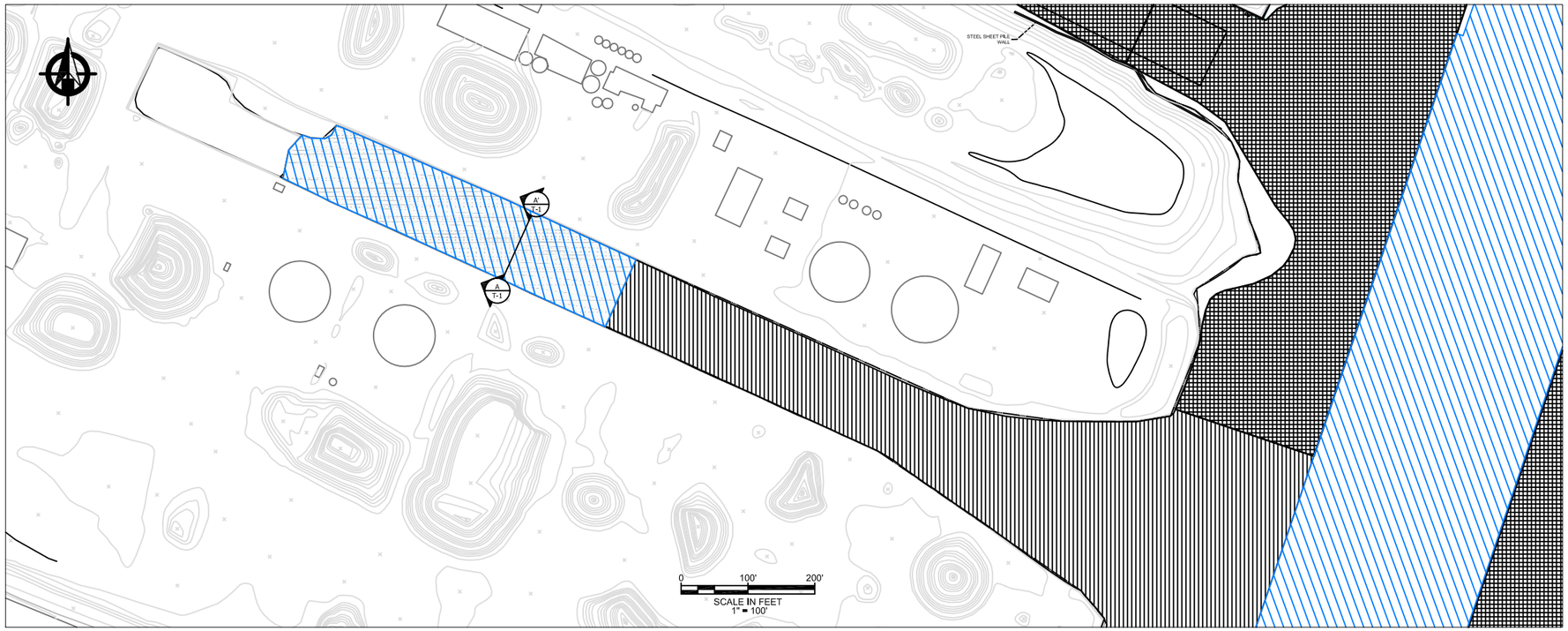
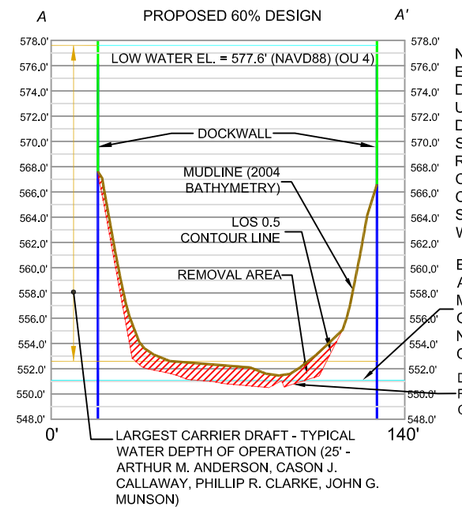
May 02, 2008 5:05pm gbolin

ATTACHMENT B

MARINE TERMINAL EXAMPLE



SECTION LOCATION



NOTE: EMBEDMENT ELEVATION OF DOCK WALLS UNKNOWN. DREDGE DESIGN SUBJECT TO REFINEMENT BASED ON VERIFICATION OF STRUCTURAL STABILITY OF DOCK WALLS.

ELEV. 551.1' - APPROXIMATE MINIMUM DEPTH OF ADJACENT NAVIGATIONAL CHANNEL

DREDGE DEPTH TO FOLLOW LOS 0.5 CONTOUR LINE

(A) FOX RIVER SLIP

SCALE 1" = 30' 5X VERTICAL EX.

NEATLINE DREDGING

MUDLINE (2004 BATHYMETRY)

COVER - 6" MIN. SAND COVER

CAP A - 7"-9" MIN. THICK GRAVEL AND SAND CAP

TRANSECT LOCATIONS

NOTES:
1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM, 1988 (NAVD88), U.S. SURVEY FEET.
4. ALL STRUCTURES, LOCATIONS, AND ALIGNMENTS NEED TO BE FIELD VERIFIED AND SHOULD BE CONSIDERED APPROXIMATE.

DRAFT

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DRAFT DOCUMENT:
DO NOT QUOTE OR CITE
THIS DOCUMENT HAS NOT BEEN REVIEWED OR APPROVED BY USEPA AND ITS FEDERAL AND STATE PARTNERS AND IS SUBJECT TO CHANGE IN WHOLE OR IN PART.

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: GABE BOLIN
DRAWN BY: GABE BOLIN
CHECKED BY: MATT HENDERSON
APPROVED BY:
FILE: AS SHOWN
DATE: APRIL 2008

LOWER FOX RIVER OPERABLE UNIT 2 - 5

EXAMPLE CAP REFINEMENT DRAWINGS
TERMINAL PLAN AND SECTION VIEWS

T - 1

SHEET NO. 1 OF 1

C:\Documents and Settings\gbolin\My Documents\Fox River Temp Files\CAD files transferred from FUJI\08029503 EXAMPLES CAP REFINEMENTS RECOVERED.dwg FOX RIVER SLIP
May 30, 2008 2:03pm gbolin

ATTACHMENT B-6

CAP DESIGN TYPE SUMMARY TABLE

ATTACHMENT B-6

ENGINEERED CAP DESIGN SUMMARY

The attached table documents the preliminary cap type (i.e., A, B, or C as described in Section 6.3 of this report) selected for each engineering cap location shown on the Engineering Plan Drawings (Appendix C).

The appropriate cap type (A, B, or C) was evaluated at each dredge & cap and cap-only general core location. At each cap-only location, the concentration at the sediment surface was compared to each cap's criteria and the appropriate cap was selected. For each dredge & cap location, a residual concentration was first estimated by averaging the concentrations encountered in the last production dredge pass, approximately the bottom 2-foot interval of sediment above the required dredge elevation. This residual concentration was then averaged with the concentration of the sediment just below the cut to provide a "mixed" concentration. Using a conservative approach, the maximum of the residual and the "mixed" concentration was used for selecting the appropriate cap. Additionally, at core locations where the bottom sample interval was above the remedial action level (RAL), the PCB data was evaluated and in cases where significant uncertainty exists, the cap type was upgraded to the next highest/more conservative cap design (i.e., Cap A was upgraded to Cap B). The remedial approach in these areas will be reviewed by the technical workgroup and may potentially be refined based on additional data collection as part of the annual infill sampling (see CQAP). Refinements to the remedial actions will be documented in the annual RA Work Plans.

The process for the dredge & cap areas is not precise and it is anticipated that confirmation sampling during construction will be performed to confirm the appropriate cap type required. The scope and frequency of this sampling will be determined in the final CQAPP. Cap-only locations would not require such confirmation

Column 'K' in the spreadsheet notes areas that were upgraded using best professional judgment regarding potential high concentration residuals.

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
2004-01	D&C		585.08	589.80	4.72	34.00	48.00	41.00	41.00	no	no	B	
2005-01	D&C		588.58	589.90	1.32	1.80	0.84	1.32	1.80	no	no	A	
2006-01	D&C		588.58	590.24	1.66	1.20	0.61	0.91	1.20	no	no	A	
3006-08	Cap	0.10						0.10	0.10	no	no	A	
3007-05	Cap	0.62						0.62	0.62	no	no	A	
3028-09	Cap	8.60						8.60	8.60	no	no	A	
3029-04	Cap	1.20						1.20	1.20	no	no	A	
3034-05	Cap	1.20						1.20	1.20	no	no	A	
3035-06	Cap	5.50						5.50	5.50	no	no	A	
3035-07	Cap	3.40						3.40	3.40	no	no	A	
3036-05	Cap	5.50						5.50	5.50	no	no	A	
3038-03	Cap	3.67						3.67	3.67	no	no	A	
3039-02	Cap	8.10						8.10	8.10	no	no	A	
3041-21	Cap	5.30						5.30	5.30	no	no	A	
3042-21	Cap	13.00						13.00	13.00	no	no	B	
3043-21	Cap	9.00						9.00	9.00	no	no	A	
3044-21	Cap	3.70						3.70	3.70	no	no	A	
3044-02	Cap	6.80						6.80	6.80	no	no	A	
3045-21	Cap	4.00						4.00	4.00	no	no	A	
3045-02	Cap	7.00						7.00	7.00	no	no	A	
3045-04	D&C	3.20	577.58	580.62	3.04			3.20	3.20	no	no	None	Required dredge elevation exceeds DOC - verify
3046-22	Cap	3.30						3.30	3.30	no	no	A	
3048-01	Cap	9.20						9.20	9.20	no	no	A	
3048-21	Cap	3.30						3.30	3.30	no	no	A	
3049-21	Cap	10.00						10.00	10.00	no	no	B	
3050-02	Cap	7.50						7.50	7.50	no	no	A	
3051-02	Cap	5.90						5.90	5.90	no	no	A	
3052-02	Cap	3.30						3.30	3.30	no	no	A	
3053-03	Cap	4.90						4.90	4.90	no	no	A	
3054-01	Cap	1.90						1.90	1.90	no	no	A	
3054-21	Cap	8.40						8.40	8.40	no	no	A	
3055-22	Cap	20.00						20.00	20.00	no	no	B	
3056-02	Cap	13.00						13.00	13.00	no	no	B	
3056-22	Cap	3.70						3.70	3.70	no	no	A	
3058-01	Cap	14.00						14.00	14.00	no	no	B	
3058-02	Cap	2.70						2.70	2.70	no	no	A	
3059-21	Cap	32.00						32.00	32.00	no	no	B	
3060-01	Cap	2.80						2.80	2.80	no	no	A	
3061-02	Cap	14.00						14.00	14.00	no	no	B	
3064-02	Cap	10.00						10.00	10.00	no	no	B	
4004R-12	D&C		561.47	570.07	8.6	14.1	5.66	9.88	14.10	no	no	B	
4004-51	D&C		561.47	566.47	5.0	47.00	25.45	36.23	47.00	no	no	B	
4201-06	D&C		562.57	575.64	13.07	26.00	14.98	20.49	26.00	no	no	B	Bottom interval above RAL - upgrade to CAP C
4001-07	D&C		569.07	575.49	6.42	13.00	8.73	10.86	13.00	no	no	B	Bottom interval above RAL - upgrade to CAP C
4204-04	Cap	1.9						1.9	1.90	no	no	A	
4008-11	Cap	2.9						2.9	2.90	no	no	A	
4009-06	D&C		554.07	560.41	6.34	29.00	31.38	30.19	30.19	no	yes	C	

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
4010-01	D&C		570.57	573.62	3.05	3.70	4.07	3.88	3.88	no	no	A	
4010-02	Cap	1.9						1.9	1.90	no	no	A	
4010-05	D&C		556.07	559.93	3.86	32.00	40.25	36.13	36.13	no	yes	C	
4011-04	D&C		557.57	559.74	2.17	37.00	50.00	43.50	43.50	no	yes	C	
4012-03	D&C		557.57	562.00	4.43	64.00	55.38	59.69	64.00	yes	yes	C	
4013-02	D&C		557.57	561.55	3.98	37.00	49.25	43.13	43.13	no	yes	C	
4014-03	D&C		557.57	562.44	4.87	10.85	24.00	17.43	17.43	yes	yes	C	
4015-23	Cap	1.83						1.8	1.83	no	no	A	Cap at channel edge - upgrade to CAP B
4016-02	D&C		571.57	572.70	1.13	0.03	1.61	0.82	0.82	no	no	A	
4016-03	D&C		559.07	563.08	4.01	5.00	37.33	21.17	21.17	no	yes	C	
4016-04	Cap	7						7.0	7.00	no	no	A	
4016-05	Cap	0.03						0.0	0.03	no	no	A	
4017-02	Cap	0.03						0.0	0.03	no	no	A	
4017-03	Cap	1.6						1.6	1.60	no	no	A	Cap at channel edge - upgrade to CAP B
4017-04	Cap	5.8						5.8	5.80	no	yes	C	
4018-03	Cap	1.7						1.7	1.70	no	no	A	
4018-04	Cap	46						46.0	46.00	no	no	B	
4018-05	Cap	0.75						0.8	0.75	no	yes	C	
4019-01	Cap	0.16						0.2	0.16	no	yes	C	
4019-25	Cap	15						15.0	15.00	no	no	B	
4020-12	D&C		558.07	559.77	1.70	32.00	19.40	25.70	32.00	no	yes	C	
4021-02	Cap	0.47						0.5	0.47	no	yes	C	
4022-06	Cap	14						14.0	14.00	yes	yes	C	
4023-06	Cap	23.00						23.0	23.00	no	yes	C	
4024-04	D&C		571.07	574.74	3.67	0.45	27.40	13.93	13.93	no	no	B	
4024-06	Cap	5.60						5.6	5.60	no	yes	C	
4025-03	Cap	5.90						5.9	5.90	no	yes	C	
4025-22	Cap	0.13						0.1	0.13	no	no	A	
4225-01	Cap	3.90						3.9	3.90	no	yes	C	
4026-03	Cap	1.9						1.9	1.90	yes	no	C	
4026-04	Cap	11.00						11.0	11.00	yes	no	C	
4226-01	Cap	2.50						2.5	2.50	yes	yes	C	
4027-01	Cap	2.30						2.3	2.30	no	no	A	Cap at channel edge - upgrade to CAP B
4027-02	Cap	11.00						11.0	11.00	yes	no	C	
4028-04	Cap	0.24						0.2	0.24	no	no	A	
4028-22	Cap	2.30						2.3	2.30	no	no	A	
4029-24	D&C		566.57	571.55	4.98	5.60	4.11	4.86	5.60	no	yes	C	
4030-04	D&C		566.57	568.25	1.68	4.28	3.23	3.75	4.28	no	yes	C	
4030-22	D&C		567.57	572.45	4.88	8.20	23.28	15.74	15.74	no	no	B	
4031-01	D&C		566.57	570.84	4.27	5.60	4.18	4.89	5.60	yes	yes	C	
4231-01	D&C		567.07	572.07	5.00	2.05	1.30	1.68	2.05	yes	no	C	
4032-06	D&C		566.57	570.84	4.27	5.64	4.51	5.08	5.64	yes	yes	C	
4032-07	Cap	3.20						3.2	3.20	no	no	A	
4032-08	Cap	2.40						2.4	2.40	no	no	A	
4232-01	D&C		565.07	572.57	7.50	8.10	5.55	6.83	8.10	yes	yes	C	
4033-02	D&C		566.57	570.58	4.01	6.08	3.52	4.80	6.08	yes	yes	C	
4033-03	Cap	1.70						1.7	1.70	no	no	A	

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
4033-04	Cap	5.60						5.6	5.60	no	no	A	
4233-01	D&C		567.07	570.59	3.52	4.70	3.30	4.00	4.70	yes	yes	C	
4034-04	D&C		566.57	570.33	3.76	7.10	4.86	5.98	7.10	yes	yes	C	
4034-05	Cap	2.60						2.6	2.60	no	no	A	
4234-01	D&C		566.57	569.65	3.08	4.10	2.55	3.33	4.10	yes	yes	C	
4035-03	D&C		566.57	570.70	4.13	8.20	33.88	21.04	21.04	no	no	B	
4035-04	D&C		566.57	569.41	2.84	5.70	3.87	4.78	5.70	yes	yes	C	
4035-05	Cap	15.00						15.0	15.00	no	no	B	
4036-05	D&C		568.07	571.55	3.48	0.12	17.50	8.81	8.81	no	no	A	
4036-06	D&C		568.07	570.39	2.32	45.00	8.10	26.55	45.00	no	no	B	
4036-07	D&C		568.07	571.18	3.11	9.50	8.41	8.96	9.50	no	no	A	
4036-10	D&C		570.07	571.92	1.85	0.46	7.11	3.79	3.79	no	no	A	
4036-21	Cap	8.50						8.5	8.50	no	no	A	
4037-04	Cap	2.50						2.5	2.50	no	no	A	
4037-22	D&C		566.57	568.93	2.36	2.90	2.65	2.78	2.90	no	no	A	Cap at channel edge - upgrade to CAP B
4038-04	Cap	2.20						2.2	2.20	no	no	A	
4038-05	Cap	2.10						2.1	2.10	no	no	A	
4039-22	D&C		566.57	567.81	1.24	2.70	2.15	2.43	2.70	no	yes	C	
4040-01	Cap	2.70						2.7	2.70	no	no	A	
4040-03	D&C		567.57	568.69	1.12	2.95	2.75	2.85	2.95	no	no	A	Bottom interval above RAL - upgrade to CAP B
4040-04	D&C		567.57	568.43	0.86	1.41	0.41	0.91	1.41	no	no	A	
4041-23	Cap	2.88						2.9	2.88	yes	yes	C	
4042-02	Cap	8.00						8.0	8.00	no	no	A	
4042-03	Cap	2.90						2.9	2.90	yes	yes	C	
4043-23	D&C		559.57	560.42	0.85	2.00	2.10	2.05	2.05	no	yes	C	
4044-03	D&C		557.57	560.55	2.98	7.40	15.75	11.58	11.58	no	yes	C	
4044-22	Cap	2.00						2.0	2.00	no	no	A	
4045-05	D&C		558.57	562.31	3.74	1.90	17.24	9.57	9.57	no	no	A	
4245-01	D&C		567.07	571.04	3.97	5.00	18.90	11.95	11.95	no	no	B	Adjacent to SMU 56/56 Project
4245-02	D&C		565.07	567.80	2.73	3.30	15.58	9.44	9.44	no	no	A	Adjacent to SMU 56/56 Project - Upgrade to CAP B
4245-03	D&C		565.07	566.33	1.26	19.65	2.30	10.98	19.65	no	no	B	Adjacent to SMU 56/56 Project
4245-04	D&C		559.07	563.83	4.76	8.73	17.50	13.12	13.12	no	no	B	Adjacent to SMU 56/56 Project
4245-05	D&C		554.57	561.95	7.38	37.00	30.17	33.58	37.00	no	no	B	Adjacent to SMU 56/56 Project
4045-06	Cap	1.70						1.7	1.70	no	no	A	
4046-01	D&C		565.07	571.14	6.07	95.00	115.63	105.31	105.31	yes	no	C	Adjacent to SMU 56/56 Project
4046-02	D&C		564.07	568.39	4.32	29.00	14.83	21.92	29.00	yes	no	C	Adjacent to SMU 56/56 Project
4046-03	D&C		564.07	566.36	2.29	29.50	6.21	17.86	29.50	yes	no	C	Adjacent to SMU 56/56 Project
4046-04	D&C		560.07	564.12	4.05	28.00	24.30	26.15	28.00	yes	no	C	Adjacent to SMU 56/56 Project
4046-05	D&C		553.57	562.56	8.99	18.00	28.50	23.25	23.25	no	yes	C	Adjacent to SMU 56/56 Project
4046-06	Cap	0.96						1.0	0.96	no	no	A	
4246-21	D&C		563.07	566.47	3.40	1.90	7.28	4.59	4.59	no	no	A	Within SMU 56/57 Project Area - Upgrade to CAP B
4246-01	D&C		563.07	565.03	1.96	24.00	8.33	16.17	24.00	no	no	B	Adjacent to SMU 56/56 Project
4047-21	D&C	2.40	567.07	567.03				2.40	2.40	no	no	A	Within SMU 56/57 Project Area
4047-01	D&C		559.57	565.35	5.78	80.00	29.93	54.97	80.00	yes	no	C	Adjacent to SMU 56/56 Project
4047-02	D&C		552.57	557.19	4.62	1.90	3.08	2.49	2.49	no	yes	C	
4047-03	Cap	2.40						2.4	2.40	no	no	A	
4247-01	D&C		552.57	561.16	8.59	3.00	4.98	3.99	3.99	no	yes	C	

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
4100-01	D&C		552.57	556.92	4.35	20.00	6.57	13.28	20.00	no	yes	C	
4100-02	D&C		552.57	554.17	1.60	0.08	2.34	1.21	1.21	no	yes	C	
4100-03	Cap	0.03						0.0	0.03	no	no	A	
4048-01	D&C		572.07	577.35	5.28	0.87	2.41	1.64	1.64	yes	no	C	Adjacent to SMU 56/56 Project
4048-02	D&C		565.57	572.73	7.16	20.00	183.25	101.63	101.63	no	no	C	Adjacent to SMU 56/56 Project
4048-03	D&C		552.57	557.81	5.24	6.98	5.69	6.33	6.98	no	yes	C	
4048-04	D&C		552.57	557.19	4.62	2.60	2.69	2.64	2.64	no	yes	C	
4048-05	D&C		552.57	556.11	3.54	4.10	3.38	3.74	4.10	no	yes	C	
4048-06	D&C		552.57	555.34	2.77	3.40	3.30	3.35	3.40	no	yes	C	
4048-07	D&C	1.73	552.57	550.49				1.73	1.73	no	yes	C	Dredging not required at immediate core location
4048-08	Cap	1.80						1.8	1.80	no	no	A	
4101-01	D&C		552.57	556.43	3.86	1.60	1.91	1.76	1.76	no	no	A	GP coal slip - upgrade to CAP C
4101-02	D&C		552.57	557.45	4.88	14.00	4.26	9.13	14.00	no	no	B	GP coal slip - upgrade to CAP C
4101-03	D&C		552.57	556.28	3.71	11.25	2.66	6.96	11.25	no	no	B	GP coal slip - upgrade to CAP C
4101-04	D&C		552.57	554.85	2.28	7.45	3.69	1.73	7.45	no	no	A	GP coal slip - upgrade to CAP C
4101-05	D&C		552.57	555.33	2.76	2.35	2.70	2.53	2.53	no	yes	C	
4101-06	D&C		552.57	555.97	3.40	3.00	11.68	7.34	7.34	no	yes	C	
4101-07	D&C		552.57	557.48	4.91	5.45	2.80	4.13	5.45	no	yes	C	
4101-08	D&C		552.57	556.19	3.62	2.20	2.60	2.40	2.40	no	yes	C	
4049-02	D&C		571.57	575.01	3.44	2.10	28.36	15.23	15.23	no	no	B	Additional information required - Under rail swing bridge
4049-03	Cap	2.80						2.8	2.80	no	no	A	Additional information required - Under rail swing bridge
4049-04	Cap	2.90						2.9	2.90	no	no	A	Additional information required - Under rail swing bridge
4049-05	Cap	5.60						5.6	5.60	no	no	A	Additional information required - Under rail swing bridge
4049-06	Cap	4.60						4.6	4.60	no	no	A	Additional information required - Under rail swing bridge
4049-08	Cap	2.30						2.3	2.30	no	no	A	
4050-06	D&C		548.57	552.98	4.41	20.00	14.90	17.45	20.00	no	yes	C	
4051-06	D&C		548.57	553.27	4.70	19.50	13.10	16.30	19.50	no	yes	C	
4251-02	D&C		548.57	556.87	8.30	26.00	36.67	31.33	31.33	no	yes	C	
4052-03	D&C		548.57	552.72	4.15	11.00	2.63	6.82	11.00	yes	yes	C	
4103-01	Cap	2.50						2.5	2.50	no	no	A	
4053-03	Cap	3.40						3.4	3.40	no	no	A	
4053-04	D&C		548.57	552.00	3.43	33.00	20.05	26.53	33.00	no	yes	C	
4104-01	D&C		548.57	552.71	4.14	0.48	2.07	1.27	1.27	no	yes	C	
4105-01	Cap	2.00						2.0	2.00	no	no	A	
4054-01	Cap	2.80						2.8	2.80	no	no	A	
4054-02	Cap	2.40						2.4	2.40	no	no	A	
4054-03	D&C		548.57	554.80	6.23	20.00	3.83	11.92	20.00	no	yes	C	
4054-04	D&C		548.57	553.79	5.22	12.00	13.54	12.77	12.77	no	yes	C	
4054-06	Cap	3.20						3.2	3.20	no	no	A	
4055-03	D&C		548.57	556.27	7.70	3.70	9.67	6.68	6.68	no	yes	C	
4055-04	D&C		548.57	551.38	2.81	10.80	7.13	8.96	10.80	no	yes	C	
4055-05	Cap	2.73						2.7	2.73	no	no	A	
4056-03	D&C		548.57	555.93	7.36	6.96	9.23	8.10	8.10	no	yes	C	
4056-04	D&C		548.57	555.00	6.43	4.20	2.60	3.40	4.20	no	yes	C	
4057-02	Cap	2.50						2.5	2.50	no	no	A	
4057-03	D&C		548.57	551.24	2.67	0.13	2.58	1.36	1.36	no	yes	C	

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
4057-04	Cap	2.60						2.6	2.60	yes	no	C	50 ppm sample is buried - placement of a minimum 13-inch cap with armor stone comprised of 3-inch D_{50} material (Cap "A1") is appropriate for this area
4058-01	Cap	2.30						2.3	2.30	no	no	A	
4058-02	Cap	2.70						2.7	2.70	no	no	A	
4058-03	D&C	1.80	548.57	542.77				1.80	1.80	no	yes	C	Dredging not required at immediate core location
4058-04	Cap	2.47						2.47	2.47	no	no	A	
4059-01	Cap	2.10						2.1	2.10	no	no	A	
4059-02	D&C		548.57	551.43	2.86	0.03	0.09	0.06	0.06	no	yes	C	
4059-03	D&C		548.57	551.10	2.53	0.03	2.35	1.19	1.19	no	yes	C	
4059R-04	Cap	2.10						2.1	2.10	no	no	A	
4060-04	Cap	2.10						2.1	2.10	no	no	A	
4060-31	Cap	1.50						1.5	1.50	no	no	A	
4061-01	Cap	0.72						0.7	0.72	no	no	A	
4061-02	Cap	0.56						0.6	0.56	no	no	A	
4063-03	Cap	0.65						0.7	0.65	no	no	A	
4107-01	D&C		571.57	571.96	0.39	1.15	1.15	1.15	1.15	no	no	A	
4107-02	D&C	1.63	571.57	571.17				1.63	1.63	no	no	A	Dredging not required at immediate core location
4107-31	Cap	2.10						2.1	2.10	no	no	A	
4064-33	Cap	1.05						1.1	1.05	no	no	A	
4066-31	Cap	1.10						1.1	1.10	no	no	A	
4066-33	Cap	0.77						0.8	0.77	no	no	A	
4069-01	Cap	1.60						1.6	1.60	no	no	A	
4069-02	Cap	8.00						8.0	8.00	no	no	A	
4070-01	Cap	1.43						1.4	1.43	no	no	A	
4070-02	Cap	2.10						2.1	2.10	no	no	A	
4073-03	D&C		559.57	562.98	3.41	14.00	9.48	11.74	14.00	no	no	B	
4074-01	Cap	1.40						1.4	1.40	no	no	A	
4074-05	Cap	1.20						1.2	1.20	no	no	A	
4074-41	D&C		572.07	572.07	0.00	0.31	0.31	0.31	0.31	no	no	A	
4075-07	D&C		565.07	570.07	5.00	26.5	23.02	24.76	26.50	no	no	B	
4076-01	Cap	0.57						0.6	0.57	no	no	A	
4076-04	Cap	1.70						1.7	1.70	no	no	A	Bottom interval above RAL - upgrade to CAP B
4080-03	Cap	0.46						0.5	0.46	no	no	A	
4081-01	Cap	1.70						1.7	1.70	no	no	A	
4109-01	Cap	1.65						1.7	1.65	no	no	A	
4085-01	D&C		568.57	572.57	4.00	19.00	27.21	23.11	23.11	no	no	B	
4086-02	Cap	0.91						0.9	0.91	no	no	A	
4087-01	Cap	1.70						1.7	1.70	no	no	A	
4087-02	Cap	1.13						1.1	1.13	no	no	A	
4087-09	Cap	2.10						2.1	2.10	no	no	A	
4088-01	Cap	1.40						1.4	1.40	no	no	A	
4088-04	Cap	1.60						1.6	1.60	no	no	A	Bottom interval above RAL - upgrade to CAP B
4089-01	D&C		571.57	578.41	6.84	1.50	2.23	1.86	1.86	no	no	A	
4089-02	D&C		571.57	578.41	6.84	2.20	1.85	2.03	2.20	no	no	A	
4089-03	Cap	1.30						1.3	1.30	no	no	A	
4089-04	Cap	1.70						1.7	1.70	no	no	A	

Attachment B-6
Cap Type Verification

(A) Core Location	(B) 60 Percent Design Remedial Action	(C) Existing Surface Concentration [ppm]	(D) Required Dredge Elevation [feet, NAVD88]	(E) 2003 Mudline Elevation [feet, NAVD88]	(F) Depth of Cut [feet]	(G) Concentration below cut [ppm]	(H) Estimated residuals concentration [ppm]	(I) Average of (G) and (H) [ppm]	(J) Max of Columns (G) and (I) [ppm]	(K) 50 ppm interval remaining?	(L) Cap in Channel?	(M) Type of Cap Required[a]	(K) Comments
4090-04	Cap	1.10						1.1	1.10	no	no	A	
4090-05	D&C	0.57	571.57	570.41				0.57	0.57	no	no	A	Dredging not required at immediate core location
4091-05	Cap	0.77						0.8	0.77	no	no	A	
4091-06	D&C		571.57	575.16	3.59	0.94	0.27	0.61	0.94	no	no	A	
4092-06	Cap	0.50						0.5	0.50	no	no	A	
4092-09	Cap	1.40						1.4	1.40	no	no	A	
4092-10	Cap	1.30						1.3	1.30	no	no	A	
5001-05	D&C		572.07	573.70	1.63	7.80	1.44	4.62	7.80	no	no	A	
5001-09	Cap	1.3						1.3	1.30	no	no	A	Bottom interval above RAL - upgrade to CAP B
5001-10	D&C		563.07	567.62	4.55	2.60	9.08	5.84	5.84	no	no	A	
5001-11	Cap	0.95						1.0	0.95	no	no	A	
5002-06	D&C		571.57	573.43	1.86	1.10	10.62	5.86	5.86	no	no	A	
5002-07	Cap	1.4						1.4	1.40	no	no	A	Bottom interval above RAL - upgrade to CAP B
5002-09	Cap	0.74						0.7	0.74	no	no	A	Bottom interval above RAL - upgrade to CAP B
5002-10	Cap	1.50						1.5	1.50	no	no	A	
5003-04	Cap	0.14						0.1	0.14	no	no	A	
5003-07	Cap	1.50						1.5	1.50	no	no	A	
5100-01	Cap	1.50						1.5	1.50	no	no	A	Bottom interval above RAL - upgrade to CAP B
5100-02	Cap	0.73						0.7	0.73	no	no	A	

Notes:
a – Cap A = Minimum 13 inches thick; Cap B = Minimum 16 inches thick; Cap C = Minimum 33 inches thick; See 60 Percent Design Report for details

APPENDIX C

ENGINEERED PLAN DRAWINGS

(SEE ATTACHED FOLDER)

APPENDIX D

SPECIFICATIONS/CONSTRUCTION WORK PLANS FOR KEY DESIGN ELEMENTS

Including

Attachment D-0 Project Plan and Sheets P-101 through P-107

Attachment D-1 Site Prep SOW

Attachment D-2 Shell Site Prep

Attachment D-3 Little Rapids Site Prep

Attachment D-4 Building Foundation WP

Attachment D-5 Building Erection WP

Attachment D-6 Dredging Equipment Documents

Attachment D-7 DWP Equipment Documents

Attachment D-8 Water Treatment Plant Equipment

ATTACHMENT D-0

PROJECT PLAN AND SHEETS P-101 THROUGH P-107

APPENDIX C-0

PROJECT PLAN

LOWER FOX RIVER REMEDIAL DESIGN
60 PERCENT DESIGN REPORT

Prepared for:

Appleton Papers Inc.
Georgia-Pacific Consumer Products, LP
NCR Corporation

For Submittal to:

Wisconsin Department of Natural Resources
U.S. Environmental Protection Agency

Prepared by:

Anchor Environmental, L.L.C.
Tetra Tech EC, Inc.

June 2008

GENERAL REQUIREMENTS

01 11 00 - Summary of Work 6
01 33 00 - Submittal Procedures 9
01 57 20 - Environmental Protection 13
01 71 00 - Examination and Preparation 17
01 71 13 - Mobilization and Demobilization 20
01 78 00 - Closeout Submittals 24

TECHNICAL SPECIFICATIONS

02 21 00 - Site Surveying and Grade Control 27
02 41 13 - Demolition 32
02 81 00 - Transportation and Disposal 38
31 00 00 - Earthwork and Road Construction 46
31 11 00 - Clearing and Grubbing 55
31 41 16 - Steel Sheet Piling 57
35 20 23 - Dredging and Dewatering 63
35 43 00 - Capping and Sand Cover Placement 71

ACM	asbestos-containing material
BRM	beneficial reuse material
CCU	cap certification unit
CD	Consent Decree
CFR	Code of Federal Regulations
cm	centimeter
CMU	cap management unit
CQAPP	Construction Quality and Assurance Project Plan
cy	cubic yards
DCU	dredge certification unit
DMU	dredge management unit
DOT	Department of Transportation
DWP	Dewatering Plant
GPS	Global Positioning System
gpm	gallons per minute
HASP	Health and Safety Plan
HDPE	high-density polyethylene
mg/L	milligrams per liter
$\mu g/m^3$	micrograms per cubic meter
NTU	nephelometric turbidity units
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCB	polychlorinated biphenyl
PCP	Project Control Point
PPE	personal protective equipment
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	remedial action
RAL	remedial action level
RAO	remedial action objective
RD	Remedial Design
ROD	Record of Decision
RTK	Real Time Kinematic
SAP	Sampling and Analysis Plan

SLAMM	Source Loading and Management Model Modeling
SOW	Statement of Work
SWAC	surface weighted average concentration
SWPPP	Stormwater Pollution Prevention Plan
Tetra Tech	Tetra Tech EC, Inc.
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
µg	microgram (or micron)
UMR-IWW	Upper Mississippi River-Illinois Waterway
USDOT	United States Department of Transportation
USEPA	U.S. Environmental Protection Agency
VMW	vehicle maintenance waste
WDNR	Wisconsin Department of Natural Resources
WTP	wastewater treatment plant

BACKGROUND INFORMATION

With the award of the remediation for the Lower Fox River Operable Units (OUs) 2 through 5 to the Tetra Tech Team, under a design-build scenario, the need or format for some of the specifications described in the 30% Design Report has changed in some cases. Following is the entire specification list from the 30% Design Report:

- Summary of Work
- Measurement and Payment
- Project Management and Coordination
- Construction Progress Documentation
- Project Schedule
- Submittal Procedures
- Health, Safety, and Emergency Response Procedures for Contaminated Sites
- Quality Control
- Temporary Construction Facilities and Controls
- Temporary Erosion, Sediment and Pollution Control
- Environmental Protection
- Examination and Preparation
- Mobilization and Demobilization
- Cleaning and Waste Management
- Closeout Procedures
- Closeout Submittals
- Maintenance of Existing Conditions
- Surveying and Grade Control
- Existing Conditions Assessment
- Site Demolition
- Water Treatment
- Transportation and Disposal of Hazardous Materials
- Earthwork
- Clearing and Grubbing
- Metal Sheet Piling
- Signaling and Control Equipment for Waterways
- Dredging and Dewatering
- Capping and Sand Cover Placement

Under design-build performed by the Tetra Tech Team, the Measurement and Payment specification is no longer needed. In addition, the following specification sections are described as noted in this Design Report (in whole or as part of other plans) based on the Tetra Tech Team's design-build role:

- Project Schedule – See Section 7 of Volume 1, or Section 9 of Volume 2
- Health, Safety and Emergency Response Procedures for Contaminated Sites – See the Appendix containing the Health and Safety Plan (HASP) and Contingency Plan.

- Quality Control – See the Construction Quality Assurance Project Plan (CQAPP) with Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) attachments
- Temporary Construction Facilities and Controls – The requirements for this specification are described in the Building Erection Work Plan and the Site Preparation Work Plans included in the Design Report appendices.
- Temporary Erosion, Sediment and Pollution Control – The requirements for this specification are addressed as part of the Tetra Tech Team's submittal of the Storm Water Pollution Prevention Plan (SWPPP) documentation to the City of Green Bay and the Wisconsin Department of Natural Resources (WDNR).
- Water Treatment – The requirements for this specification is described in Section 5 of the Design Report and the Wastewater Treatment Plant (WTP) design drawings included in the Technical Specifications at the end of this Project Plan.
- Signaling and Control Equipment for Waterways – The requirements for this specification are addressed as part of the Tetra Tech Team's coordination of the waterway marker requirements with the U.S. Coast Guard.
- Cleaning and Waste Management – This information is included in Section 35 20 23 and Section 01 57 20.
- The requirements for Project Management and Controls, Existing Conditions Assessment, Maintenance of Existing Conditions and Construction Progress Documentation have been addressed within the text of the Design Report and are thus not included as separate specifications within this Project Plan.

The following general requirements specifications are included in this Project Plan, which presents an overview of the project under design-build:

01 11 00 Summary of Work
01 33 00 Submittal Procedures
01 57 20 Environmental Protection
01 71 00 Examination and Preparation
01 71 13 Mobilization and Demobilization
01 78 00 Closeout Submittals

The following technical specifications have been included in this Project Plan for performance of the project:

02 21 00 Surveying and Grade Control
02 41 13 Site Demolition
02 81 00 Transportation and Disposal of Hazardous Materials
31 00 00 Earthwork and Road Construction
31 11 00 Clearing and Grubbing
31 41 16 Metal Sheet Piling
35 20 23 Dredging and Dewatering
35 43 00 Capping and Sand Cover Placement

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Project Description and Location

The Lower Fox River and Green Bay Site includes approximately 39 miles of the Lower Fox River, as well as the bay of Green Bay. The Fox River portion of the site extends from the outlet of Lake Winnebago and continues downstream to the mouth of the Fox River at the City of Green Bay. The Bay portion of the site extends from the mouth of the Fox River at the City of Green Bay to the point where the Green Bay enters Lake Michigan. The site has been divided into five geographically-defined Operable Units (OU) – 1, 2, 3, 4, and 5 – for the remediation of polychlorinated biphenyls (PCBs) that have been released into the river.

Remedial design sampling indicated elevated concentrations of PCBs in sediments along the west bank of the river, just downstream of the De Pere Dam. Decisions by the U.S. Environmental Protection Agency (USEPA) and WDNR (collectively known as the "Response Agencies"), concluded that the accelerated removal of PCBs in this area would have significant benefits to the environment and public health. Therefore, it was determined that the remedial actions for OUs 2 through 5 should be conducted in two phases with Phase 1 implemented to address sediments just downstream of the De Pere Dam and all remaining elements of the remedial action in OUs 2 through 5 implemented in Phase 2. Phase 1 of the remedial action is currently being conducted under a Consent Decree (CD) between the Response Agencies, and NCR Corporation and Sunoco–U. S. Mills, Inc. All remaining elements of the remedial action in OUs 2 through 5 will be implemented in Phase 2.

The overall remediation program to be implemented for the removal of PCBs in OUs 2 through 5 is set forth in a Record of Decision (ROD) and the 2007 ROD Amendment (USEPA and WDNR 2002, 2003, and 2007). The 2007 Administrative Order for Remedial Action (RA) directed respondents to implement the remedial action for OUs 2 through 5. The following parties are collectively referred to as the "Respondents to the 2007 Administrative Order for RA" or "RA Order Respondents": Appleton Papers Inc., CBC Coating, Inc. (formerly known as Riverside Paper Corporation), Georgia-Pacific Consumer Products, LP (formerly known as Fort James Operating Company, Inc.), Menasha Corporation, NCR Corporation, P.H. Glatfelter Company, U.S. Paper Mills Corp., and WTMI Company (formerly known as Wisconsin Tissue Mills, Inc.). To adhere to the project schedule, Phase 2 of the OU 2-5 remedial action will be subdivided into stages, Phase 2A and 2B. Certain of the 2007 RA Order Respondents (collectively, the "Phase 2A Respondents") are required to conduct the Phase 2A work; these are Appleton Papers Inc., CBC Coating, Inc., Georgia-Pacific Consumer Products, LP, NCR Corporation, and U.S. Paper Mills Corp. As set forth in the 2007 Administrative Order for RA and associated Statement of Work (SOW) for completion of Phase 2A work elements, certain RA tasks will be expedited and completed in 2008 in order to commence full-scale sediment remediation in OUs 2 through 5 at the start of the 2009 construction season

and/or as necessary to allow for continuation of full-scale actions in subsequent years. Phase 2B work will start at the beginning of the 2009 construction season and continue with full scale sediment remediation within OUs 2 through 5 during the subsequent years.

B. Summary of Work – Phase 2A

Phase 2A for the remediation of OUs 2 through 5 consists of work to be performed before the start of the 2009 construction season in preparation for the commencement and continuation of full-scale sediment remediation within OUs 2 through 5 which is to start at the beginning of the 2009 construction season. Phase 2A work will include:

1. Taking the necessary steps to procure equipment in order to ensure that such equipment will be available as needed at the start of the 2009 construction season
2. Taking the necessary steps to procure equipment that will be required for continuation of full-scale sediment remediation throughout the 2009 construction season and throughout the subsequent years
3. Securing on-shore staging areas and performing staging site preparation work and associated infrastructure construction that will be needed for full-scale sediment remediation at the start of the 2009 construction season and through out subsequent years
4. Developing agreements with landfill disposal facilities for disposal of sediments to be dredged during the 2009 construction season and the subsequent years
5. Completion of site surveys, including in-water and upland archaeological surveys, upland geodetic control network and construction layout survey

C. Summary of Work – Phase 2B

Phase 2B work will start at the beginning of the 2009 construction season and continue with full scale sediment remediation, processing and disposal within OUs 2 through 5 and continue through the end of the 2017 construction season.

Remedial work activities will include:

1. Mobilization of dredging equipment
2. Removal of Toxic Substances Control Act (TSCA) sediments
3. Removal of non-TSCA sediments
4. Sediment de-sanding using hydrocyclones
5. Sediment dewatering using membrane presses
6. Sediment transportation and disposal of both TSCA and non-TSCA sediments to approved landfill facilities
7. Treatment of process water with a 3-unit operation, sand filtration, bag filters, and carbon canisters with polishing accomplished using cartridge filters. A diffuser will be located in the river channel for discharge.

8. Confirmation sampling conducted after dredging is complete to verify the 1.0 ppm remedial action level (RAL) has been achieved.
9. Post-dredge residual management
10. Sediment capping using sand covers and engineered caps
11. Institutional controls that may include access restrictions, land use or water use restrictions, dredging moratoriums, fish consumption advisories, and domestic water use restrictions
12. Demobilization and site restoration

Requirements for materials and construction, as well as performance, for the various project elements are provided in these specifications and the associated Work Plans developed for specific operations.

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

This section addresses the documents that must be submitted throughout the duration of the contract. The following documents shall be submitted to the Respondents and Response Agencies as summarized in this section. A draft of each document shall be prepared for review by Respondents and Response Agencies. Suggested changes made by the Respondents and Response Agencies will be considered and required changes will be incorporated to prepare a final version of each document. Submittals shall bear the contract name and number, date of submission, reference to what the submittal applies, and the preparer's or responsible person's signature.

1.2 PRE-MOBILIZATION SUBMITTALS

Prior to mobilization, a full set of detailed, site-specific, pre-mobilization submittals will be submitted for review and any required changes will be incorporated prior to commencing any in-water construction activities. When applicable, work will not commence until approval has been received. These submittals will include but not be limited to the following:

A. Preliminary Schedule

B. Draft Schedule of Values

C. Construction Quality Assurance Plan

D. Construction Health and Safety Plan

E. Community Health and Safety Plan

F. Contingency Plan

G. Annual RD/RA Work Plan (including Dredging and Capping Design Plans, as applicable)

H. Stormwater Pollution Prevention Plan

I. Adaptive Management Plan

J. Operations, Maintenance and Monitoring Plan

1.3 CONSTRUCTION SUBMITTALS

The following table presents the schedule for documentation that will be submitted during construction activities. Besides the documents listed in the table, others may be submitted.

Documentation Schedule During Construction

Daily Construction Report to include daily dredging, dewatering, transportation and disposal information, daily cap and cover installation performed , and materials received on site	Submitted prior to 10 a.m. on the following work day
Daily QA / QC Report	Submitted prior to 10 a.m. on the following work day
Daily Health and Safety Report	Submitted prior to 10 a.m. on the following work day
Weekly Progress Reports and Two-Week Look-Ahead	Submitted at each weekly progress meeting, distributed on Friday during design
Monthly Progress Reports	On or before the fifth day of each month
Confirmation Sediment Sampling	Included in the Daily Construction Report
Acceptance Surveys	Included in the Daily Construction Report, rolls up into Dredge Certification Unit (DCU) and Cap Certification Unit (CCU) Reports
Borrow Source Characterization Report	Prior to any and all imported material arriving on site
Cap and Cover Acceptance Survey	Included in the Daily Construction Report.
Summary of Acceptance Surveys, and Confirmation Sample results	At the end of each construction season for the dredge management unit (DMU) completed that season
Record Documents	Within 60 days following completion of the work, or upon request
Pre-final and Final Inspection	At completion of construction of material processing building and wastewater treatment plant

All submittals and reports shall be submitted in electronic format with the exception of the Project Schedule, which may be prepared in other suitable format but submitted in Portable Document Format (PDF).

1.4 SUBMITTAL DESCRIPTION

A. Daily Construction Report

A Daily Construction Report shall be submitted in electronic format, for each day of construction by 10 a.m. on the following work day. If multiple shifts are used, a Daily Construction Report shall be submitted for each shift.

The Daily Construction Report shall consist of a summary of all activities worked on each day, including photo documentation as necessary. Work activities shall be categorized by trade and employer.

The dredging subcontractor shall provide a report to Tetra Tech detailing all dredging, capping, and sand cover placement activities performed each day so that this information can be included with the Daily Construction Report. It will include shipping receipts and material volumes for shipments of imported materials, daily volumes of material placed, area of cap placed, hours of cap placement operations, and survey measurements of material placed.

B. Daily QA / QC Report

At a minimum, information in the Daily QA/QC Report will include the date, period covered by the report, equipment used, description of activity as identified by stationing and offset, quantity of materials placed and/or excavated that day and to date, downtime and delays to the operation, health and safety status, and other relevant information concerning conduct of the operation. The report shall include the results of all inspections, surveys, and monitoring activities and shall be signed by the QA/QC Manager.

C. Daily Health and Safety Report

The Daily Health and Safety Report will contain all relevant monitoring and incidents that occur on site.

D. Weekly Progress Report and Two-Week Look-Ahead

The Weekly Progress Report will include a narrative describing the work accomplished the preceding week, identify the completion of major milestones and activities, and describe any problems encountered during the week and their subsequent resolution. The Two-Week Look-Ahead is an annotated version of the Monthly Update Schedule, which reflects work tasks to be completed in the next 2-week period and that were completed in the preceding 1-week period.

E. Monthly Progress Report

The Monthly Progress Report shall include the activities that have been performed during the previous month and includes a summary of all results of sampling and testing performed in the previous month. It will include all actions, including but not limited to, data collection and implementation of work plans that are scheduled for the next month and will provide other information relating to the progress of construction. The Monthly Progress report will also include information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule, and a description of efforts made to mitigate those delays or anticipated delays.

F. Acceptance Surveys

Acceptance surveys will be performed as follows:

1. Upon completion of all dredging in a DMU, as established though verification sampling

2. Upon completion of cap or sand cover placement in a cap management unit (CMU)

G. Record Documents

An accurate record of the Work completed, including record drawings. At a minimum, record documentation submitted at the following stages of the Work:

1. After completion of dredging of each DCU: This record documentation will include the acceptance survey performed for each DMU and will confirm that specified dredge depths and extents have been achieved.
2. After completion of each layer of cap material within each CCU: These record drawings will include the acceptance survey performed for each CMU and will be used to confirm that specified cap layer thicknesses and extents have been achieved, and to verify the volume of capping materials placed.
3. Progress surveys shall be completed as needed to track work progress and shall be submitted upon request.

H. Pre-Final and Final Inspection

Pre-Final Inspections will be performed at the completion of construction of the sediment dewatering plant and wastewater treatment plant. Final Inspection will be performed by the Tetra Tech Team to verify that all deficiencies have been corrected. Final inspections and correction of deficiencies must be accomplished within the time stated for completion of the work.

- END OF SECTION –

SECTION 01 57 20 - ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. This section includes requirements for managing materials and remediation waste generated during dewatering activities at the former Shell site. Management includes activities such as storage (i.e., containerization and/or stockpiling), labeling, processing, transporting and disposing of remediation wastes.

1.2 DEFINITIONS

A. Approved recycling facility: An off-site facility that receives demolition or remediation-generated material from the Lower Fox River project for approved re-use or recycling, and that is approved to accept the material.

B. Container: A competent unit used to store and transport remediation waste that includes, but is not limited to, bags, wrappings, drums, overpack drums, rolloffs, tankers, trucks, frac/Baker-type tanks or other type of Contractor-approved competent containment unit.

C. Disposal facility: The final off-site destination for remediation and other wastes.

D. DOT: The U.S. Department of Transportation, which regulates the commercial transport of hazardous materials on public highways.

E. EPA: U.S. Environmental Protection Agency.

F. Incidental remediation waste: Wastestreams generated during implementation of remedial activities. Incidental wastes will be classified for disposal using existing documentation, material safety data sheets, or analytical results (if sampling must be performed to identify a waste).

G. Nonroutine remediation waste: Wastestreams that may be generated during project implementation that were not specifically identified when the ROD was developed and were not identified during project planning. Nonroutine wastes may include unknown liquids, sludges or solids, containers of chemicals, and/or other wastes encountered during the Work.

H. Recycling: On-site or off-site recycling of demolition/remediation waste, including, but not limited to, structural steel, used oil, and other materials.

I. Routine waste: ROD-identified waste and incidental waste.

J. Secondary wastes: Wastes generated during decontamination/cleaning processes.

K. Storage: Includes both containerization and stockpiling of remediation waste.

L. Processing: Includes, but is not limited to, dewatering of sediment utilizing membrane presses and/or solidification of sediment where excess moisture is present or where the waste is not capable of passing the disposal facility acceptance criteria.

M. Vehicle maintenance wastes (VMW): Includes wastes generated by subcontractors during vehicle maintenance activities, including but not limited to, oils, filters, tires, batteries and antifreeze.

1.3 GENERAL OBJECTIVES

A. Ensure remediation waste is properly managed from the point of origination at the project to the appropriate on-site disposal facility.

B. Prevent cross-contamination of environmental media.

C. Minimize generation of secondary wastes.

1.4 INSPECTIONS/NOTIFICATIONS

A. Perform and document inspections of storage and stockpile areas.

B. Notify the Construction Manager immediately upon discovery of nonroutine remediation waste. Segregate this waste from other remediation waste in an area designated by the Construction Manager.

C. Notify Construction Manager immediately of spills, releases, or leaks.

1.5 TRAINING

Subcontractor employees working on the former Shell site shall complete required health and safety training prior to initiation of field work.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Provide incidentals and accessories (including containers and appropriate secondary containment and storage tanks) as required for the proper management of remediation waste.

B. Provide containers for the temporary on-site storage and transportation of remediation wastes and off-site recycling of VMWs.

C. Provide spill response kits in requisite numbers and locations.

D. Provide materials and equipment necessary to implement dust, odor, and stormwater erosion control on remediation waste stockpiles.

2.2 MATERIALS

A. Provide materials necessary for management of remediation waste such as, but not limited to, the following:

1. Impervious liner material (20 mil [minimum]) to be used for the lining of container storage areas
2. DOT labels and placards for off-site transportation of VMWs
3. Bags for the storage of personal protective equipment (PPE) and trash
4. Signs, rope/tape, and posts as appropriate for demarcation of storage areas

5. Labels for specialty wastes (e.g., PCBs and asbestos) and vehicle maintenance wastes
6. Absorbent (if used)
7. Spill response kits in requisite numbers and locations

B. Provide the following:

1. Transport and disposal services for wastes prohibited from on-site treatment and/or from disposal at TSCA and non-TSCA facilities planned for use by the project. Examples include mercury, lead-acid batteries, chemical solvents, oily wastes, and wastewaters not treatable by the site's wastewater treatment system.
2. "Remediation Waste" labels
3. Bins for recycling office waste (paper, aluminum cans, glass, and newspaper)

PART 3 EXECUTION

3.1 GENERAL STORAGE REQUIREMENTS

A. Implement best management practices to minimize contaminant dispersion including, but not limited to, the following:

1. Clearly demarcate the storage area limits using legible signs, markings, barricades, fences, or other appropriate means
2. Post signs with information such as project name, company name, phone number, contents, and disposal destination
3. Locate storage areas away from high-traffic areas and drainage flow paths such as ditches, streams, and stormwater culverts
4. Maintain good drainage within the storage area to prevent standing water

B. Close storage areas by removing remediation waste and isolation material (e.g., liner).

3.2 CONTAINERS

A. Implement best management practices for containers including, but not limited to, the following:

1. Consolidate storage of containers, as practicable
2. Ensure that containers are in good condition and compatible and impervious to the waste
3. Keep containers closed or covered except when adding or removing wastes
4. Store containerized liquid waste (excluding decontamination water) in a secondary containment area that is lined and bermed
5. Close container storage areas by removing remediation waste and isolation material (e.g., liner)

B. Label containers/items (including bags of PPE) with project name, company name/contact name and phone number, contents, and disposal destination. Describe waste contents on label.

C. Maintain a Container/Drum Storage Log when accumulating drums.

D. Poly, steel, or fiber containers may also be used for temporary storage of wastes.

3.3 STOCKPILING AND STAGING

A. Filter cake from sediment processing shall be stockpiled only in the designated area within the processing building.

B. Other remediation wastes may be staged separately from the filter cake, but only for immediate load-out.

C. Remediation wastes placed on-site shall be fully covered at all times. The cover used shall be secured so as not to be removed by weather or nearby work on the site.

3.4 SPILLS AND RELEASES

A. Immediately report spills/releases/leaks to the Construction Manager.

B. Immediately contain and clean up spills/releases/leaks.

C. Containerize spill material including spill-contaminated soil/gravel, sorbents and PPE. Recovered oil-spill materials shall be disposed of in accordance with the waste management guidance in this Section, based on the characterization of the original material spilled.

D. Repair damage to area resulting from cleanup. Return area to approximately original grade and revegetate or resurface, as required.

3.5 WASTE TRACKING

A. Notify the Construction Manager in advance of loading operations and types of waste to ensure that the waste tracking system is updated.

B. Complete a Waste Profile Form, if required by the disposal facility, prior to transporting waste off site for disposal.

3.6 WASTES DESIGNATED FOR OFF-SITE DISPOSAL

A. Transport filter cake generated from dewatering of sediments dredged from TSCA and non-TSCA areas for off-site disposal in accordance with Section 02 81 00. Debris from these areas shall be managed in accordance with Section 02 81 00.

B. Containerize non-routine remediation wastes for off-site disposal in accordance with Subpart 3.2.

C. Store wastes awaiting off-site disposal in accordance with requirements identified in Subpart 3.1.

-END OF SECTION-

SECTION 01 71 00 - EXAMINATION AND PREPARATION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

The work includes examination and preparation for site work, including the following:

A. Clearing and grubbing of the upland work area as necessary

B. Construction of temporary access roads necessary to complete the work

C. Placing impermeable surfaces to prevent loss of sediment or effluent to the ground

D. Establishing construction layout controls

E. Establishing upland erosion and sediment controls

F. Removing or temporarily relocating existing facilities

G. Providing security fencing and performing any other upland work necessary to support the in-water work as shown in the Site Preparation Work Plan

1.2 RELATED WORK DESCRIBED ELSEWHERE

This section specifies requirements and procedures for examining existing conditions and preparation of upland processing and staging areas. Additional information can be found in the Site Preparation Work Plan.

1.3 SUBMITTALS

A. A Site Development Plan and SWPPP have been prepared and submitted that present the procedures which shall maintain environmental protection during preparation of the upland site, including plans for controlling erosion and water turbidity as a result of upland staging area activities. A HASP and Community HASP have been prepared and are included in the Design Report appendices that describe air monitoring plans and measures to be taken to control fugitive dust in compliance with applicable local, state, and federal laws and regulations.

B. An Operations, Maintenance, and Monitoring Plan shall be submitted. At a minimum, this plan will contain the following information:

1. Description of the planned operations including sequencing of work, hours of operation, and coordination of activities of subcontractors

2. Description of regularly scheduled maintenance of equipment and facilities, including planned shutdown periods

1.4 REFERENCES

Site Preparation Work Plan, Appendix C-2 of the 60 Percent Design Report, Vol. 1.

1.5 DEFINITIONS

A. Processing facility: The facility to be constructed on the upland site that will be used to offload, stockpile, rehandle, dewater, and transfer onto trucks, contaminated sediments or debris that have been dredged from the project area.

B. TSCA sediments: Dredged material with a PCB concentration of 50 ppm or greater, removed from above the required dredge elevation, which will require removal and off-site disposal at an approved TSCA landfill facility.

C. Non-TSCA sediments: Dredged material with a PCB concentration less than 50 ppm that is removed from above the required dredge elevation and which will require removal and off-site disposal at an approved upland landfill facility.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Existing Conditions

The Shell Property is a former petroleum storage facility location encompassing approximately 22 acres. In 1999 and 2000 the site was used as a staging area for dredged material processing. For this prior operation, the west side of the site near State Street was paved with asphalt and used as a storage and dewatering area. Upon completion of this work, the site was allowed to return to its natural state and currently has numerous trees, brush, and vegetation extending to the Fox River bank.

B. Utility Location

Complete utility locate will be performed prior to any intrusive activities, including but not limited to, excavation, boring, auguring, sample collection, and hand digging. See the Site Preparation Work Plan (Appendix C-2 of 60 Percent Design Report) for additional information.

C. Acceptance of Conditions

The Shell property is available for the purpose of staging boats and other equipment or material that must be delivered to the project area by water. Use of this property shall include de-watering and de-sanding of dredged material, water treatment, and staging of materials.

3.2 PREPARATION OF SITE

A. The site shall be cleared and grubbed of all trees and woody vegetation, as needed, within the areas necessary to complete the work by cutting, breaking, uprooting, and other means. Clearing and grubbing shall be performed in accordance with Section 31 11 00 of the Technical Specifications.

B. Existing Utility Information

Prior to using the Shell Property, coordination with the local utility companies will be required to make necessary provision for temporary utilities such as electricity, lighting, heating, ventilation, telephone service, water, and sanitary. Currently an energized power line extends east and west on the southern portion of the site. There is also a series of light poles around the western perimeter of the site.

C. Surveying

Before the work begins, an accurate method of survey control shall be established. A geodetic control network will be established at the site for this project. Control points locations will facilitate Global Positioning System (GPS) base station control. All survey and control will be performed by a Licensed Land Surveyor registered in the State of Wisconsin.

D. Field Measurements

See Appendix C-2 of the 60 Percent Design, Site Preparation Work Plan for additional information.

E. Space Requirements

The staging and processing area shall be constructed within the working limits of the site. The size, configuration, and material of construction for the staging and processing area shall conform to the project design drawings.

F. Review of Contract Documents and Field Conditions

See Appendix C-2 of the 60 Percent Design, Site Preparation Work Plan for additional information.

3.3 CONSTRUCTION LAYOUT

A. Care shall be exercised when conducting operations so as not to damage, undermine, or otherwise disturb other facilities. Loss of sediment, stabilizing additives, or other material that could damage or coat existing structures, shorelines, and/or facilities shall be prevented. This includes preventing loss of material through windborne means.

B. Building Lines and Levels

See Appendix C-2 of the 60 Percent Design, Site Preparation Work Plan for additional information.

C. Record Log

Characterization of any and all imported material shall be submitted prior to any on-site placement. The characterization shall include an analysis of the material source sample, site inspection, and site characterization.

3.4 SAMPLE TESTING, REPORTING AND CERTIFICATION TESTS

A. Field Engineering and Surveying

Geotechnical data will be obtained in the building and equipment area foundation footprint. Based on these data, building and equipment foundations will be designed. Elevation and related information will be per the building construction specifications and design, along with the building erection plans.

- END OF SECTION -

SECTION 01 71 13 - MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Mobilization includes the procurement, preparation and transport to the site of all personnel, equipment, and materials necessary to execute the full-scale remediation in accordance with the approved Project Plan, Work Plans, and design drawings; and other contractual requirements. Mobilization activities will be coordinated with the Respondents. Mobilization activities will occur on an as-needed basis, and will be dependent on the work activities scheduled.

1.2 PROCUREMENT

Procurement of long lead items will be performed to ensure that the full-scale remediation will begin in 2009. These items include, but are not limited to, the following:

A. Membrane presses

B. Dredging equipment and peripherals

C. Process equipment

D. Water treatment system

E. The purchase of steel for the completion of the process plant building

F. The steel required for the sheet pile wall for Shell site buildout

G. Temporary support facilities to support the 2008 operations facility at the Shell property

1.3 PERSONNEL

A. Professional Staff

Professional staff (Project Managers, Line Managers and Technicians, Project Engineers, etc.) required to support the construction and remedial activities will be on site prior to the commencement of activities, if required, so as to avoid work delays. Professional staff will be qualified to perform their specific duties.

Site-specific training required by such personnel will be completed and documented as required prior to their participation in work activities. Other required training that is not site specific (i.e., HAZWOPER 40-hour) will be documented and kept in project files.

Professional staff will be mobilized to the site annually and as required, determined by need and based on project activities.

B. Craft Personnel

Craft personnel (i.e., operators and laborers) required to support the construction and remedial activities will be on site prior to the beginning of activities and as required to avoid work delays. Craft personnel will be hired through local unions unless on-

site staff are or will be members of such unions. Personnel will be qualified to perform their specific duties.

Site-specific training required by such personnel will be completed and documented as required prior to their participating in work activities. Other required training not site specific (i.e., HAZWOPER 40-hour) will be documented and kept in project files.

Craft personnel will be mobilized to the site annually and as project activities dictate.

1.4 EQUIPMENT

Equipment required for construction activities will be mobilized to the site so as to not delay the activities in which they are required. This will include, but not be limited to the following:

A. Dredge equipment

1. Dredges
2. Booster pumps
3. High-density polyethylene (HDPE) pipe required for the dredge line
4. Excavators
5. Open-top containers
6. GPS equipment

B. Process equipment

1. Desanding equipment and accessories
2. Dewatering equipment and accessories
3. Membrane presses and accessories
4. Water treatment equipment and accessories

C. Capping equipment

1. Barges
2. Slurry plants
3. Broadcast spreaders
4. Excavators
5. Cranes
6. Tugboats

D. Upland support equipment

1. Wheeled loaders
2. Cranes
3. Excavators

1.5 MATERIALS

Materials needed for the completion of the remedial action will be mobilized to the site on an as-needed basis. Such items will include:

A. Backfill as needed for the Shell site grading

B. Concrete for the foundation of the process facility

C. Sand for cover and engineered cap installation

D. Aggregate for engineered cap installation

2.0 DEMOBILIZATION

Demobilization activities will occur annually as required and upon project completion. Demobilization activities will include demobilization of personnel, equipment, and transportation from the site. Demobilization activities will be coordinated with the respondents to ensure completion of all required activities prior to the removal from the site.

2.1 PERSONNEL

A. Professional Staff

Professional staff will demobilize from the site on an annual basis upon completion of work for each construction season. The end of the season will be dictated by either completion of scheduled work activities or the on-set of conditions (i.e., ice on the river, snow on the roads and upland facilities) that limits the ability to complete the scheduled activities for the season.

As work activities are completed and certain professional staff are no longer required, those personnel will be released from duty. In such event, the appropriate notifications will be made.

Upon project completion, professional staff will demobilize from the site upon acceptance by the respondents and agencies of the remedial action.

B. Craft Personnel

Craft personnel will demobilize from the site on an annual basis upon completion of work for each construction season. The end of the season will be dictated by either completion of scheduled work activities or the on-set of conditions (i.e., ice on the river, snow on the roads and upland facilities) that limit the ability to complete the scheduled activities for the season.

As work activities are completed and certain craft personnel are no longer needed, those personnel will be released from duty. In this event, the appropriate notifications will be made. In such cases, proper procedures with the unions will be followed.

Upon project completion, professional staff will demobilize from the site upon completion and acceptance by the respondents and agencies of the remedial action.

2.2 EQUIPMENT

Demobilization of equipment will occur annually and as required. Demobilization will include the removal of equipment (i.e., tugboats, barges, and booster pumps) from the Fox River as required. In addition, demobilization and transportation of any equipment that may be rented or returned to the home bases of operations will be performed as required to perform maintenance and repair activities.

Equipment will also be demobilized and transported off site when no longer required based on scheduled work or upon completion of activities.

Upon completion and acceptance of the remedial action by the respondents and agencies, all project equipment, both rented and owned, used for the project will be permanently removed from the site and transported back to home bases of operation or to new projects.

2.3 MATERIALS

Any materials remaining at the completion of the project will be removed from the site during the demobilization process.

-END OF SECTION-

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

Requirements for closeout submittals for each DCU and CCU documenting the completion of remedial activities for the Lower Fox River Remedial Action OUs 2 through 5.

1.2 SUMMARY OF WORK

A. Provide documentation that remedial activities have been completed within each DCU and CCU and that the work performed meets the requirements of the approved Work Plans, Project Design Drawings, Project Plan, and other applicable documents describing the work.

B. Submit documentation for each DCU and CCU on an annual basis which will collectively make up the complete Final Remedial Action Closure Report.

1.3 RELATED WORK

A. Other related Work activities include, but are not limited to, the following:

1. Section 01 33 00: Submittal Procedures
2. Section 03 20 23: Dredging and Dewatering, including procedures for the Dredge Certification Report and approval
3. Section 03 43 00: Capping and Sand Cover Placement, including procedures for the Cap/Cover Certification Report and approval

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ANNUAL CLOSE-OUT REPORTS

A. Provide an annual report describing the remedial activities that occurred during the construction season for each DCU and CCU completed.

B. Relevant documentation will be compiled, including:

1. Work Schedule
2. Plans (and/or Revisions to Plans)
3. Record Drawings
4. QA/QC Reports
5. Monthly Progress Reports
6. Pre-dredge surveys
7. Dredge Certification Reports

8. Cap/Cover Certification Reports

3.2 FINAL CLOSURE REPORT

A. Each annual report that is submitted will constitute a volume of the final closure report.

B. Upon final completion of the project, submittal of the final annual report will complete the submittal requirements for the project.

-END OF SECTION-

TECHNICAL SPECIFICATIONS

SECTION 02 21 00 - SITE SURVEYING AND GRADE CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for topographic and hydrographic surveying.

B. Controlling the work as needed to construct the project according to the Design Drawings and Specifications.

C. Survey datum information.

1.2 RELATED WORK

A. Appendix B-1: Dredging Drawings

B. Appendix B-2: DWP Drawings

C. Appendix B-3: WTP Drawings

D. Appendix C-1: Site Preparation Statement of Work

E. Appendix C-2: Site Preparation Work Plan – Shell Property

F. Appendix C-3: Site Preparation – Little Rapids Dam Area

G. Appendix C-4: Foundation Work Plan for Building

H. Section 31 00 00 Earthwork

I. Section 31 11 00 Clearing and Grubbing

J. Section 31 41 16 Metal Sheet Piling

K. Section 35 20 23 Dredging and Dewatering

L. Section 35 43 00 Capping and Sand Cover Placement

1.3 SURVEYOR QUALIFICATIONS

A. All record surveys will be performed and stamped by a Licensed Land Surveyor registered in the State of Wisconsin.

B. Survey work shall be performed using surveying techniques that meet or exceed the requirements set forth herein.

1.4 GENERAL REQUIREMENTS AND INFORMATION

A. Perform surveying and grade checking as required to control the Work.

B. Use baseline survey performed by STS Consultants for the former Shell site, if appropriate.

C. For topographic surveys, furnish digital terrain model drawings and topographic maps, with 1-foot contour intervals, of the Work with prescribed grade control points. The survey grid width shall be 100-foot intervals at a minimum.

D. A survey control network shall be installed by the Subcontractor. This network shall consist of no fewer than three points and shall be referred to herein as Project Control Points (PCPs). These PCPs shall be maintained as permanent points on the site by the Subcontractor. In addition, these PCPs shall be tied to into any located existing survey benchmarks located on the site. It shall be the responsibility of the Subcontractor to provide additional PCPs as needed.

E. The Subcontractor shall maintain and protect the PCPs throughout the length of the project and make the PCPs available for use by others. This established network shall be used for the construction of all features shown on the project drawings.

F. QA Surveys shall be performed by the Licensed Land Surveyor on all submitted Subcontractor survey data to ensure that the required accuracies are met.

G. Vertical datum for the upland sites (former Shell site and Little River Dam site) shall be North American Vertical Datum 1988 (NAVD 88). Horizontal datum for the site shall be Brown County (Wisconsin) Coordinates. PCPs shall be tied into and presented using these two datums. The vertical control benchmark and corresponding elevation are shown on the project drawings.

H. Horizontal datum for the Fox River shall be Wisconsin State Plane – Central Zone NAD83, U.S. Survey feet. Vertical datum for the Fox River shall be North American Vertical Datum 1988 (NAVD88), U.S. Survey feet.

I. All survey points shall include northing, easting, and elevation coordinates. Base each land survey on the same ground control established for the subject site.

J. Each survey event shall be tied to a minimum of two PCPs horizontally and one PCP vertically. Document with submittals along with any temporary benchmarks established by the Licensed Land Surveyor. When Real Time Kinematic (RTK) GPS technique is used, the vertical PCP shall be occupied at the beginning of the survey event, near midway if event is longer than 7 hours and at the end of the event.

K. All surveying shall meet the accuracies set forth in this specification. The accuracy governing each survey shall be clearly shown on the submitted documents.

L. Subcontractor shall collect survey data digitally (unless Tetra Tech approves otherwise) and at prescribed locations to support digital terrain modeling database. Provide all coordinates, acronyms, and descriptions necessary to clarify items shown on survey.

1.5 SUBMITTALS

Furnish each of the following in accordance with Specification Section 01300 – Submittal Procedures:

A. Survey Plan, as part of the work specified in the Work Plan pertaining to a particular activity (such as development of the former Shell site), for acceptance prior to initiating Work, to include the following:

1. Equipment list, calibration and control system, and manner to achieve required accuracies
2. Computer software to be used for volume calculations and drawing preparation
3. Methods for surveying and grade checking earthwork
4. Sequence of surveying operations
5. Proposed data management consistent with the requirements set forth in this specification and proposed schedule of data transfer to the Subcontractor
6. A list of all acronyms and definitions used in record survey documentation tables and field staking
7. Copy of the responsible Land Surveyor's License

B. For topographic surveys, survey grid, prior to initiating work, that includes the following:

1. An accurate topographic description of the work site
2. Include project boundaries, work area boundaries, a uniform grid, control points provided on the project drawings, and grade breaks on distinguishable surface features
3. Boundary point spacing shall not exceed 100 feet
4. Grid spacing shall not exceed 100 feet

C. One set of stamped Drawings for PCPs and benchmarks required for survey control in each Work Area, prior to beginning earthwork in the respective Work Area. Include a signed copy of computations by the responsible Licensed Land Surveyor.

D. Survey data in electronic format.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Provide the equipment needed to perform land-based topographic surveying.

B. Provide the equipment and vessels needed to perform hydrographic surveys in designated areas of the Fox River.

C. Provide cylindrical, flat-bottomed "Topo Shoes" for collection of data with GPS or Total Stations.

D. Provide pin flags with fiberglass or other nonmetallic material shafts for land-based marking.

E. Provide anchored buoy markers for marking off areas in the Fox River.

PART 3 EXECUTION

3.1 SURVEY CONTROL AND ACCURACY

A. Use the Subcontractor-provided PCPs as the basis for all surveys. Added project control points may be installed as needed by the Surveyor, coordinates of which shall be provided to the Subcontractor for verification prior to use.

B. Order of accuracy of ground control shall conform to the standards of the Federal Geodetic Control Committee of the U.S. Department of Commerce for triangulation, traverse, and leveling surveys as noted below:

1. Horizontal and vertical surveys to establish local project control shall conform to Second Order, Class II Standards.

2. For general construction layout, verification, and obtaining topography, accuracy shall be +/- 0.06 ft.

3.2 PERFORMANCE OF SURVEYS

A. Perform surveys as required to control the work and to comply with documentation requirements.

B. The Surveyor's presence on site shall not impact the project schedule in any manner.

C. Perform pre-excavation and pre-placement surveys in accordance with the survey grid to record site conditions prior to the initiation of work and for use in survey reports of the excavation and placement areas.

D. Perform post-excavation and post-placement surveys to verify the achievement of design elevations within the required tolerances and to prepare survey reports of the excavation and placement areas. Survey grid points within 0.25 feet (laterally) of the previously established points. Work that does not meet the specification will require correction by the Subcontractor, at no cost to Tetra Tech.

E. When stakes are placed, identify installer of survey points by providing name of the survey company on stakes, pin flags, or other physical survey point markers.

F. Stake locations and spacing shall be at the discretion of the Subcontractor.

3.3 REQUIRED SURVEYS

A. Pre-construction and post-construction topographic surveys

1. Perform as required by site development plans and in accordance with requirements of Parts 3.1 and 3.2 above.

2. Submit detailed survey information in accordance with Part 1.5 of this Section.

B. Pre-dredge and post-dredge bathymetric surveys

C. Pre-capping/sand cover and post-cover/sand cover surveys

D. Progress surveys will be performed to control the work and to accompany payment requests. These interim surveys will not be used for any other purpose.

E. Final acceptance surveys shall be performed to confirm that the work conforms to the lines and grades shown on the design drawings. Baseline control and soundings for the final acceptance survey will be consistent with the pre-construction and progress surveys. A certification of compliance will be provided by the Subcontractor and will be signed and sealed by the Licensed Land Surveyor. The certification of compliance will certify that the work as constructed conforms to the lines and grades shown on the design drawings.

-END OF SECTION-

SECTION 02 41 13 - DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

Requirements for demolition or removal of structures, below-grade foundations and footers, electric poles, asphalt and concrete blocks, as needed, to prepare the former Shell site and the Little Rapids Dam site for construction of process-related buildings and/or staging areas.

1.2 SUMMARY OF WORK

A. Demolish, size, transport, and dispose of structures located within the work area of each site, including below-grade foundations and footers, and transport to an appropriate off-site disposal facility, unless the material can be recycled. Structures may include, but are not limited to, the following:

1. Building structures and slabs (Little Rapids Dam site)
2. Below-grade piping and conduits
3. Roads and parking/paved areas
4. Tank saddles, equipment pedestals
5. Stockpiled equipment and debris
6. Culverts and headwalls
7. Fencing
8. Utility poles
9. Miscellaneous debris

B. Other related Work activities include, but are not limited to, the following:

1. Capping or plugging of below-grade utilities at the edge of excavations, unless otherwise noted
2. Miscellaneous debris encountered on the sites shall be picked up and hauled to associated disposal facility.
3. Removal and disposal of liquids and sediment in sumps, vaults, tanks, pits, and basements, if present
4. Removal and disposal of isolated stored drums and containers, if present
5. Removal of hazardous materials (if present)

C. Refer to Drawings for existing structures, debris piles, and foundations to be demolished and removed.

D. Prior to performing the work, complete the following:

1. *Hazardous Materials Survey* that identifies the locations of, but is not limited to, the following items that may be present in each structure:

   i. Floor drains and conduits to the environment

   ii. Confirmed and/or suspected PCB-contaminated equipment

   iii. Mercury switches

   iv. Friable and nonfriable asbestos

   v. Animal droppings

1.3 SCHEDULING / SEQUENCING / HOLD POINTS

A. Do not commence hazardous materials abatement or demolition activities until all stormwater and erosion control structures have been constructed in accordance with the project drawings.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Provide incidentals and accessories as required for the proper execution of the work.

B. Provide containers for the storage, transportation, and disposal of materials.

C. Provide spill control equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Survey the site, and the structures to be demolished, for structural integrity and overall work area safety. Prepare and submit an Occupational Safety and Health Administration (OSHA) Engineering Survey in accordance with OSHA 29 CFR Subpart T, Demolition, latest revision. Engineering survey shall be prepared by a competent person knowledgeable in demolition techniques and experienced in demolition.

B. Perform a Hazardous Materials Survey of structures to identify potentially hazardous and toxic materials.

1. Identify locations of other hazardous or suspected hazardous materials.

3.2 PREPARATION

A. Perform and/or verify and document facility de-energization prior to commencing work in or around structures.

B. Construct sediment and erosion control measures, prior to work, in accordance with SWPPP.

3.3 DRAINS AND UTILITIES

A. Seal floor drains and other conduits to the environment on all structure floors with nonshrink grout (Masterflow 928, or Contractor-approved equal) placed in a stiff consistency.

B. Small, horizontal conduits may be sealed with waterproof nonshrink spray foam as approved by the Contractor.

3.4 WATER REMOVAL

Remove standing water from sumps, pits, vaults, tanks, and basements, including standing water from floor slabs, prior to hazardous material abatement and/or demolition.

3.5 HAZARDOUS AND TOXIC MATERIALS ABATEMENT AND DISPOSAL

A. Remove hazardous and toxic material in accordance with federal, state, and local regulations. Hazardous and toxic materials that may be present include, but are not limited to, the following:

1. Friable asbestos-containing material (ACM)
2. Nonfriable ACM (including Transite and asbestos)
3. PCB-containing/-contaminated materials and components, including, but not limited to, those items identified below:
   - i. Oil stains sampled and confirmed to contain ≥ 50 ppm of PCB
   - ii. Equipment “confirmed” or “representative” to be contaminated with ≥ 50 ppm of PCB
   - iii. PCB fluorescent light ballasts
   - iv. Other equipment with tags or markings indicating PCB contamination or potential PCB contamination
   - v. Other locations and equipment identified during the structure walk-through
4. Mercury switches and instruments
5. Animal feces – Animal feces require abatement (i.e., bleach spray or equivalent) when personnel will be performing work in the area. Dry removal will not be permitted. If manual work will not be performed in the area, the droppings may be left in place during structure demolition, provided that sufficient wetting is applied during the demolition process.
6. Lighting – fluorescent, mercury vapor, and sodium vapor
7. Containers and drums stored in structures
8. Sludges in tanks

B. Remove chlorofluorocarbons (CFCs), if encountered or suspected, in accordance with federal, state, and local regulations. Removal shall be performed by licensed personnel or licensed lower-tier subcontractor.

C. Stage, transport, and dispose of hazardous and toxic material in accordance with Section 02 81 00.

D. Notify the Construction Manager immediately if chemical, hazardous, or toxic materials not previously identified are suspected or encountered.

E. Allow one working day for the confirmation of hazardous and toxic material abatement by the Contractor.

3.6 DEMOLITION

Demolition includes complete removal of foundations and other below-grade features.

A. Completely remove any structures, foundations, footers, basements, and vaults for the structures identified on the sites that are slated for removal.

B. Completely remove any tank saddles, concrete pads, and other equipment pedestals, including foundations.

C. Remove approach roads, parking areas, and areas in the immediate surroundings of the structures unless these areas have been identified for re-use as part of the Site Development Plan.

D. Minimize cross-contamination of recyclable materials during structure demolition. Decontaminate materials that come in contact with potentially-contaminated material.

E. Segregate, size, and transport materials/debris.

F. Protect and leave in place fire hydrants (if present).

G. Install fencing/barricades around any open structure basements and pits after structure demolition. Maintain fencing in good order until disturbed area has been backfilled and area is no longer a hazard. NO EXCEPTIONS.

   1. Protect openings 4 feet deep or greater with 4-foot-high square wire fencing with T-posts.

   2. Steel road plate, ¾-inch thick, may be placed over openings in lieu of fencing for protection, where it can be properly installed.

3.7 BELOW-GRADE UTILITIES

HOLD POINT: Prior to backfilling excavations, plug utilities at the perimeter of the excavation.

3.8 ENVIRONMENTAL COMPLIANCE

A. Manage materials and remediation waste generated as a result of work activities in accordance with Section 02 81 00.

B. Notify the Construction Manager immediately in the event of any spill. Contain and clean up all spills immediately and manage spill cleanup in accordance with the Spill Prevention, Control and Countermeasures Plan.

C. Do not discharge any liquids into sanitary water system, storm drain systems, drainage ditches, or onto the ground, except as approved by local authorities.

D. Do not allow trash, debris, and other materials to enter sanitary water system, storm drain systems, or drainage ditches. Clean up worksite at the end of each work shift. Manage trash, garbage, sanitary waste, debris, and other materials in accordance with Section 01 74 00.

E. Control fugitive dust emissions during demolition and material sizing/handling.

F. Notify the Construction Manager immediately if nonroutine waste(s) are suspected or encountered.

3.9 RECYCLING

Recycle useable materials from demolition activities if possible and if absence of contamination can be confirmed.

3.10 DECONTAMINATION/CLEANING

A. Perform decontamination activities in accordance with Section 01 74 00, Cleaning and Waste Management.

B. Manage decontamination water in accordance with Section 02 72 00, Water Treatment.

3.11 WORKING AND STAGING AREAS

Manage material and material storage areas in accordance with Specification Section 01 50 00, Temporary Construction Facilities and Controls.

3.12 FINAL INSPECTION AND ACCEPTANCE

A. Perform a final inspection to ensure that the completed project satisfies contractual requirements. Prepare a written punch list of those items or conditions not approved. Subcontractor acknowledges that completion of all punch list items shall be performed within the established Subcontract Period of Performance. In the event that Subcontractor fails to complete punch list items within the stipulated Period of Performance, as stated in the Subcontract, the Subcontractor shall be liable for all damages to Contractor, including Contractor's other Subcontractors, due to such delay.

B. Upon completion and acceptance of the work, the Subcontractor shall promptly remove all equipment, excess materials, and supplies from the work area. Contractor and Subcontractor shall jointly inspect the Construction Activity Boundary to ensure removal of Subcontractor equipment, materials, and supplies. Further, the parties shall inspect the areas surrounding the Construction Activity Boundary to identify any damage to the ecosystem, pursuant to the Article entitled "Protection of Property" set forth in the General Terms and Conditions of the Subcontract. Finally, all Contractor-provided equipment shall be returned to the Contractor as a condition for release of final payment.

C. The final site configuration following demolition activities is shown on project drawings. If the Subcontractor is uncertain about the disposition of a site item, Subcontractor shall contact the Contractor for guidance/direction.

-END OF SECTION-

SECTION 02 81 00 - TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY OF WORK

Dredging operations in the Lower Fox River will generate various materials (both TSCA- and non-TSCA-regulated PCB waste) that will require eventual off-site disposal. Dredging is scheduled to begin in April or May 2009. This specification focuses on the off-site transportation and disposal of the waste streams generated as a result of sediment dredging and associated activities. These waste streams will include:

A. TSCA-regulated and Non-TSCA River Debris,

B. TSCA-regulated and Non-TSCA Sand and Sediments, and

C. Other Waste Materials (i.e., construction debris and trash).

The following sections provide a general description of the materials as well as the procedures Tetra Tech will follow to prepare the material for transport.

1.2 DEBRIS REMOVAL, DECONTAMINATION AND DISPOSAL

Debris in the river within the dredging management units and capping management units that may interfere with the dredging and or capping process will be removed using a barge and excavator. Contaminated debris removed from the Fox River will be segregated by waste type (i.e., TSCA or non-TSCA), reduced in size to meet the disposal facility standard, and placed in open-top containers.

A. Non-porous debris (TSCA or non-TSCA) may be decontaminated in accordance with TSCA regulations for decontamination of bulk remediation waste.

   1. TSCA debris that is decontaminated to a surface concentration of less than 100 µg/100 cm^2 of surface area may be disposed of at a non-TSCA landfill.

   2. TSCA and/or non-TSCA debris that is decontamination to a surface concentration of less than 10 µg/100 cm^2 of surface area may be recycled without restriction. However, re-use of decontaminated TSCA debris will not occur without WDNR approval.

B. Porous TSCA debris, such as logs and vegetation will be sized to fit in containers acceptable to the TSCA disposal facility and disposed of off site along with the TSCA filter cake materials.

C. Porous non-TSCA debris will be sized to be no larger than 1 cubic yard and placed in an open-top container designated for disposal at a non-TSCA disposal facility.

D. Debris removal and off-loading locations will be specific to material characteristics. All contaminated debris, which includes debris encased in sediment that cannot be

removed, and debris with cellular structures, i.e., trees and logs, will be moved to the Shell site for final off-loading.

E. Decontamination of non-porous debris shall be performed in accordance with the double-wash-rinse procedure specified in 40 CFR 761.123. Wastewater generated from the decontamination process shall be treated in the WTP prior to discharge. Surface wipe testing to verify decontamination levels shall be performed in accordance with 40 CFR 761.130.

1.3 SEDIMENTS

A. During the course of dredging, most of the material will be removed using hydraulic dredging. All sediment removed from the Fox River OUs 2 through 5 will be moved to the Shell site for sediment separation, dewatering, and final load-out for disposal. Dewatered sediments will include filter cake material and screened materials (i.e., separated coarse and fine sands). The dredging and subsequent process treatment is expected to generate the amounts of material shown in the following table.

Estimated Daily Sediment Dewatering Production

Material Produced	Production Based on Average Sediment Composition	Truck Loads Per Day (20 tons per load)
Average Sand and Gravel	60 tons/hr or 1,440 tons/day	72 loads per day
Average Filter Cake	70 tons/hr or 1,680 tons/day	84 loads per day
Peak Sand and Gravel	115 tons/hr or 2,760 tons/day	138 loads per day
Peak Filter Cake	130 tons/hr or 3,120 tons/day	156 loads per day
Total Average Output	3,300 tons/day	165 loads per day
Total Peak Output	6,000 tons/day	300 loads per day

1.4 OTHER WASTE MATERIALS

A. Site preparation at the Little Rapids Staging Area will generate broken concrete, brick, trees, and brush debris. This material will be recycled or disposed of as non-TSCA waste at a local landfill. No other wastes are expected.

B. During the clearing and grubbing activities at the former Shell site all materials will be separated and sized reduced to meet disposal facility requirements. These materials will be transported and disposed of at an approved facility. All remaining

construction debris and trash will be collected in roll-off containers and handled through a local waste collection service.

1.5 RELATED WORK DESCRIBED ELSEWHERE

A. Appendix B (G-01 Proposed Building and Stockpile Layout) of the Work Plan, Volumes 1 and 2.

1.6 REGULATIONS, CODES, AND STANDARDS

A. Subcontractor services furnished shall be in accordance with all applicable state, federal, and local codes and standards. Services furnished will be in accordance with but not limited to, the codes and standards listed below.

1. Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions [40 CFR 268].
2. Non-Hazardous (Sanitary) Landfill Requirements [40 CFR 257/258] and Wisconsin state equivalents.
3. Transportation Requirements for Hazardous Waste [40 CFR 263].
4. Hazardous Waste Treatment, Storage and Disposal Facility Standards [40 CFR 264/265].
5. OSHA Recordkeeping, Reporting and Related Regulations [29 CFR 1904].
6. OSHA Hazardous Waste Operations and Emergency Response [29 CFR 1910.120].
7. RCRA Hazardous Waste Identification Requirements [40 CFR 261].
8. Contingency Plan and Emergency Procedures.
9. USDOT Transportation Requirements for Hazardous Materials [49 CFR 100 through 180].
10. All applicable requirements for transportation and disposal of hazardous and non-hazardous waste of the state of Wisconsin.
11. All applicable laws/regulations related to recycling.
12. All applicable permit requirements of the hazardous waste treatment, storage, and disposal (TSD) facility and non-hazardous facility.

1.7 SUBMITTALS

A. The Subcontractor shall schedule and prepare all submittals and deliverables in accordance with this specification, including but not limited to the following items. The Subcontractor shall submit to Tetra Tech:

1. Site-specific DOT Hazardous Materials Security Plan and Emergency Response Plan for waste transportation activities; (Note: The security plan

shall address security issues associated with transportation of hazardous materials over roads.)

2. Draft waste profiles, Land Disposal Restriction Notification forms, waste manifests, and Bills of Lading for review and approval by Tetra Tech
3. A copy of the manifest signed by the disposal facility
4. A copy of the shipping papers used for non-hazardous waste (e.g., bills of lading) signed by the waste disposal/recycling facility
5. Facility's documentation of quantity of waste received **within 30 calendar days of receipt of waste. This can include weight tickets, if appropriate.**
6. Waste disposal certifications, if available, **within 25 calendar days after the date of disposal**

1.8 QUALIFICATIONS

A. The Subcontractor, or a second-tier subcontractor, must be a licensed hazardous waste transporter in good standing for hazardous waste and solid waste shipments in the state of Wisconsin and must possess all necessary federal and state permits and insurance for shipping and disposal of waste to a licensed TSD facility, whether in Wisconsin or another state.

B. Training and Certifications

1. The vehicle drivers shall have the required USDOT training under 49 CFR 172 Subpart H applicable to transporting contaminated material and/or hazardous materials.
2. A copy of each driver's current DOT training and DOT license, along with the DOT Physician's Statement, shall be provided to Tetra Tech.

PART 2 PRODUCTS

The Subcontractor shall provide copies of all manifests, Bills of Lading, weight tickets, and any other documentation required for disposal of these materials.

PART 3 EXECUTION

1.1 TRANSPORTATION AND DISPOSAL OF NON-TSCA DREDGED MATERIAL FOR DISPOSAL

A. The dredged materials will be treated, and excess moisture removed and disposed of, either at a non-TSCA landfill or for beneficial reuse. The following assumptions are used: Process operations are 5 days a week, 24 hours a day for approximately 8 months a year (April 1 through Nov 15). Trucks are assumed to carry 20 tons per load in accordance with Wisconsin DOT regulations.

B. A total of at least 1,500,000 tons of non-TSCA filter cake will require disposal. The material will be loaded onto the trucks with a wheeled loader or other conveyance mechanism. PPE waste is allowed to be disposed of with the filter cake, provided it does not constitute more than 10 percent of the load volume.

1.2 TRANSPORTATION AND DISPOSAL OF TSCA DREDGED MATERIAL FOR DISPOSAL

A. TSCA wastes (equal to or greater than 50 ppm PCBs) are expected to be generated and will require disposal. While on the Shell site, these materials will be stored in accordance with TSCA PCB waste storage regulations within the process building. After leaving the presses, the filter cake will be conveyed to stockpiles within the process building to await loading onto disposal trucks.

B. Currently it is estimated that 170,000 tons of filter cake will be TSCA regulated and require disposal in a TSCA-permitted landfill. The distance from the work site to the landfill will likely require temporary on-site storage of TSCA PCB wastes on the Shell site; however, this is not anticipated to exceed 30 days, and trucking will continue after dredging and processing have been completed until all wastes have been removed for the construction season.

C. It is currently estimated, based on sediment sampling, that 8,500 trucks (at 20 tons per truck) of TSCA filter cake PCB wastes will require disposal over the life of the project (7 years).

1.3 DISPOSAL SERVICES

A. The Subcontractor shall be responsible for the proper disposal of the waste streams according to all applicable federal, state, and local regulations and requirements.

B. Non-TSCA PCB wastes, including filter cake and river debris generated (i.e., with less than 50 ppm of PCBs) will require disposal. Much of the sand is expected to be suitable for beneficial reuse. Sand that is not suitable, along with gravel and other minor debris, will be disposed of in a landfill permitted for bulk low-level PCB wastes.

C. TSCA wastes with PCBs at 50 ppm or greater will be generated and will be disposed of at a landfill permitted for disposal of TSCA waste.

D. Tetra Tech will designate the disposal facilities to be used for both TSCA and non-TSCA materials. Substitutions or additions shall not be permitted without prior written approval from Tetra Tech, and if approved, shall be at no extra cost to Tetra Tech.

E. No changes, including additions or deletions, can be made to the disposal/recycling facility(ies) on the shipping papers without direct authorization from Tetra Tech.

1.4 TRANSPORTATION SERVICES

A. The Subcontractor will provide open-top containers for debris removed from the Fox River site and rolloffs for construction debris at the former Shell site. In addition, the Subcontractor will provide appropriately permitted/certified, lined trucks (for TSCA-regulated sediments) and non-lined trucks (for non-TSCA sediments) to be loaded at the former Shell site Staging Area. The Subcontractor shall provide appropriate DOT- and state-permitted transport vehicles with appropriately licensed and permitted drivers. The Subcontractor shall utilize drivers who are DOT-trained for transportation of contaminated material and/or hazardous materials.

B. **The Subcontractor shall utilize the transporter(s) that have been approved in advance by Tetra Tech.** These transporters shall be one of the approved transporters identified by Tetra Tech in the Subcontract. **Transporter(s) used for TSCA regulated PCB waste must have submitted the "TSCA PCB Waste Notification" form to the USEPA and must submit a copy of the form to Tetra Tech.** Substitutions or additions shall not be permitted without prior written approval from Tetra Tech, and if approved, shall be at no extra cost to Tetra Tech.

C. Tetra Tech retains the right to inspect the vehicle for safety requirements and DOT Emergency Response information, which shall remain the responsibility of the Subcontractor. The Subcontractor shall retain ultimate responsibility for ensuring that the vehicle can be released from the site onto the public roadways.

D. If for any reason the waste is rejected from the designated disposal/recycling facility, the transporter shall immediately notify Tetra Tech upon rejection of the waste. Tetra Tech will immediately notify Tetra Tech's client of the situation to obtain direction on the handling of the waste. The transporter shall not leave the waste or turn over custody of the waste to anyone without prior direction and approval from the generator and Tetra Tech.

E. For all materials, the Subcontractor shall obtain and submit to Tetra Tech loaded weights by using the truck scales at the waste receiving facility. The Subcontractor shall comply with all state and USDOT vehicle weight limits.

F. The Subcontractor is responsible for meeting all applicable federal, state, and local regulations and requirements governing the transport of contaminated material and hazardous materials including 49 CFR 100-179. This includes, but is not limited to, labeling, manifesting, placarding, licensing, weight and route restrictions, and proper covering of any bulk loads. All transportation shall be by licensed, insured, and permitted carriers. The Subcontractor shall comply with all Federal Motor Carriers Safety Regulations and shall have current permits and licenses, as required by federal, state, and local authorities. The transporter shall have a current MC Safety Rating of "Satisfactory" or have Tetra Tech's and the U.S. Army Corps of Engineers approval of their safety record.

G. The Subcontractor shall maintain an Emergency Response telephone number (manned 24 hours), or shall subscribe to a reputable outside service (e.g., Chemtrec or Infotrac) that provides emergency response information and meets all DOT requirements for the Emergency Contact. The Subcontractor shall allow use of this phone number or service to complete Section 3 of the EPA Uniform Waste Manifest and to serve as the DOT Emergency Contact, on behalf of the generator. Tetra Tech will verify that this telephone number is appropriate prior to shipment of wastes off-site.

H. The Subcontractor shall utilize drivers who are DOT-trained for transportation of hazardous or TSCA-regulated materials.

I. Transport vehicles may be inspected by Tetra Tech for compliance, including:

1. Safety requirements (back-up alarm, fire extinguisher, first-aid kit, etc.)
2. Placarding
3. Emergency Response information (Emergency Response Plan, DOT Guidebook)
4. Current state and federal DOT inspection documentation

J. The transporter(s) of PCB waste shall have a written DOT Hazardous Materials Security Plan, in accordance with 49 CFR 172.800.

1.5 GENERAL TRAFFIC CONTROLS

A. All trucking will be in accordance with Wisconsin and DOT regulations. Drivers and trucks hauling hazardous materials will be in compliance with the additional requirements related to hauling those materials. Trucks hauling materials in or away from the site will abide by restrictions for truck traffic and will travel on approved truck routes. The trucking subcontractors will be evaluated for safety and past DOT compliance. Equipment will be required to be new or like new. Tetra Tech will oversee subcontractor activities and equipment as well as perform truck inspections.

B. Certified Scales
Truck scales will be available at the Shell site for weighing trucks for operational safety and for manifesting purposes.

1.6 DOCUMENTATION

A. Waste Manifests
All TSCA PCB waste shipments (and all TSCA and non-TSCA-regulated shipments containing $\geq$ 1 pound reportable quantity of PCBs) will be manifested in accordance with DOT requirements. All non-TSCA PCB waste shipments will be weighed and provided a bill of lading for tracking and accounting purposes. Prior to shipping of

any TSCA PCB wastes, Tetra Tech will notify the appropriate state and USEPA officials.

B. The documentation requirements for disposal shall include the following:

1. Provide all necessary labor, supervision, insurance, equipment, and material to properly package, label, mark, and placard the materials for transport.

2. Provide drafts and finals of all waste documentation, including waste profiles, manifests/shipping papers, and RCRA Land Disposal Restrictions Notification forms (if required), including any required documentation under the Universal Treatment Standards regulations, to Tetra Tech's Technical Representative (identified in the Subcontract) for review and approval by Tetra Tech.

3. Provide Tetra Tech's Site Superintendent with a legible copy of the material weight tickets, bills of lading, or hazardous waste manifests signed by the disposal facility's representative.

4. Provide Tetra Tech's Site Superintendent with a legible copy of Certificates of Disposal for the TSCA PCB wastes (and other wastes, if available).

– END OF SECTION –

SECTION 31 00 00 - EARTHWORK AND ROAD CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for construction of the soil components on site. This includes all excavation, cutting and filling of soils, movement of soil, construction of roadways, and general earthwork/grading required for drainage controls.

B. Publications listed below form a part of this specification section to the extent referenced. Publications are referenced in the text by basic designation only. The latest published version of the referenced publication shall apply. In the event of contradiction, the more stringent requirement shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136 Sieve Analysis of Fine and Coarse Aggregates

ASTM D 422 Particle-Size Analysis of Soils

ASTM D1557 Laboratory Compaction Characteristics of Soils Using Modified Effort

ASTM D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

1.2 DEFINITIONS

A. Degree of Compaction: Where specified as such, shall be expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D 1557 (Modified Proctor). All moisture-density (Proctor) curves shall be developed using 5 points

B. Frozen material: Soil with a temperature less than 32°F (+/- the accuracy of the thermometer), or containing visible ice crystals or clods of frozen soil larger than 4 inches in any dimension

C. The following defines materials that shall be used under this specification:

<u>Aggregate:</u> A composite mixture of hard, durable mineral materials that have been mechanically processed

<u>Virgin materials:</u> Mineral materials in a native or raw form, not previously used

Gravel: Naturally occurring rounded particles of rock that will be retained on a No. 10 (2.0-mm) sieve

Sand: Granular material having at least 90 percent passing the No. 4 (4.75-mm) sieve and predominantly retained on the No. 200 (75-µm) sieve.

Crushed stone: Crushed angular particles of rock

Fractured face: An angular, rough, or broken particle surface with sharp edges

Reprocessed material: Waste material for which a commercially demonstrated process uses the material as a raw material

Reclaimed asphaltic material: Crushed or processed asphaltic pavement or surfacing recovered from a Construction Manager-designated source

Salvaged asphaltic material: Crushed or processed asphaltic pavement or surfacing recovered from a department-designated source

Select crushed material: Crushed and screened aggregate with particles predominately larger than 1 1/2 inches

Beneficial reuse material: Sand derived from the hydrocyclone separation process used to separate sand from TSCA and non-TSCA sediment

1.3 RELATED WORK

A. Appendix C-1: Statement of Work for Construction of Staging Area and Access Roads

B. Appendix C-2: Site Preparation Work Plan – Former Shell Site CY 2008-09

C. Appendix C-3: Site Preparation Work Plan – Little Rapids Dam Area

D. Appendix C-4: Concrete Foundation Work Plan

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, Submittal Procedures:

A. Record surveys and drawings

B. Field Density Test Reports

C. Certified test reports and analysis certifying that materials from off-site sources (if used) proposed for use at the project site conform to the specified requirements and are free from chemical contamination

PART 2 PRODUCTS

2.1 BORROW MATERIAL

A. Obtain soil materials required for fills from designated on-site stockpiles. Obtain rock and gravel materials from off-site sources, which meet the requirements herein.

B. Obtain documentation or chemical analyses from borrow source certifying that the material is not contaminated.

2.2 GRANULAR BACKFILL

A. Furnish natural sand or a mixture of sand with gravel, crushed gravel, crushed stone, or other broken or fragmented material.

B. Do not use materials with a liquid limit greater than 25 and a plasticity index greater than 6 as defined by ASTM D4318.

2.3 STRUCTURAL BACKFILL

A. Furnish and use sand, a mixture of sand and gravel, crushed gravel, crushed stone, crushed concrete, or other fragmented mineral material.

2.4 UTILITY TRENCH BACKFILL

A. Material for the pipe bedding and initial backfill in utility trenches shall consist of well-graded sand, gravel, crushed gravel, crushed stone, or crushed slag composed of hard, tough, and durable particles to the dimensions shown on the drawings.

B. Backfill shall contain material less than ¾ inch in any dimension, or the maximum size recommended by the pipe manufacturer, whichever is smaller. This material shall extend to approximately 6 inches above the crown of the pipe. From 6 inches above the crown of the pipe, the trench shall be filled with general fill material.

C. Material shall classify according to ASTM D 2487 as coarse-grained (cohesionless) soil, classifying as GW, GW-GM, GW-GC, GP, GP-GM, GP-GC, SW, SW-SM, SW-SC, SP, SP-SM, or SP-SC.

2.5 GENERAL FILL

A. General fill is material that has been generated on site and can be used for the general backfill. This material will be free of debris and will meet any compaction requirements where used.

2.6 BENEFICIAL REUSE MATERIAL (BRM) FILL

A. BRM fill shall be sand separated from the sediment during processing, containing < 12 percent passing the No. 200 sieve, and having a PCB concentration of 1.0 ppm or less, unless otherwise approved by WDNR.

2.7 ROAD BASE

A. Description

This section describes constructing a granular base on the prepared roadbed.

B Base course materials shall conform to Section 2.2 for granular backfill. Road areas around the processing building and parking lots shall be hard surfaced with asphalt or concrete.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform grading and placement for all materials, regardless of material encountered, within the grading limits of the project to the lines and grades indicated on the design drawings.

B. Transport suitable material; place directly as fill materials, or stockpile (as required) in areas within the limits of the work, as shown on the drawings or as designated by the Construction Manager.

C. Construction haul roads or temporary access roads may be needed to permit truck access to sections of the site. The extent and location of temporary access roads are subject to approval by the Construction Manager.

3.2 PLACEMENT OF ROAD BASE

A. Preparing Subgrade

1. Clear road footprint of vegetation, roots, and debris. Excavate and backfill areas of soft, yielding, or spongy subgrade or otherwise treat unstable areas. Remove upper 6 inches of topsoil in road footprint and stockpile.

2. Scarify the subgrade and recompact subgrade to 90 percent of the maximum dry density based on a Modified Proctor (ASTM D 1557) to form a firm base.

3. If firmness of subgrade is inadequate as determined by load and/or volume of truck traffic anticipated, install an appropriate geotextile layer for road reinforcement, or increase thickness of aggregate used on roads. Consult Project Engineer for identification of appropriate geotextile.

B. Placing and Compacting Road Base Material

1. Deposit, spread, and level the road base material in layers generally no thicker than 8 inches before compaction.

2. Compact the base until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment. Compact each layer of the road base until the compaction equipment achieves no further significant consolidation (90 percent of Modified Proctor maximum dry density). The

required compaction for each layer will be achieved before placing any material for a succeeding layer.

3. Controlling Dust
   Apply water or other approved dust control materials to control dust during construction and maintenance of the roads.

3.3 EXCAVATION FOR UTILITIES

A. Unless otherwise indicated, perform excavation by open cut methods, except where sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Construction Manager, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

B. Stockpile material acceptable for backfilling during excavation in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 12 inches, or as governed by OSHA requirements.

C. Place excavated material not required or not acceptable for backfill in the general fill stockpile provided the excavated materials meet the requirements for general fill in these specifications, or dispose of at a location designated by the Construction Manager.

D. Perform grading as necessary to prevent surface water from flowing into the excavation, and remove any water that accumulates therein to maintain stability of the bottom and sides of excavations.

E. Shore or otherwise cut back to achieve a stable slope all trench walls more than 3 feet high, or provide equivalent means of protection for employees who may be exposed to moving ground or cave-in.

F. Give special attention to slopes that may be adversely affected by weather or moisture content.

G. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and shall not exceed 36 inches plus pipe O.D. for pipes larger than 24 inches inside diameter.

H. Over-excavate trench bottoms to allow installation of bedding material as shown on the drawings.

I. Where material is encountered that is unacceptable or too wet to properly support pipe or appurtenant structures, remove such material and replace with suitable material.

3.4 EXCAVATION OF APPURTENANCES

A. Excavation for catch basins, inlets, manholes, or similar structures shall be sufficient to leave at least 24 inches clear between the outer structure surfaces and the face of the excavation or support members.

B. Clean rock of loose debris and cut to a firm surface level, stepped, or serrated, as shown, or as directed by the Construction Manager. Remove loose disintegrated rock and thin strata.

C. Do not disturb the excavation bottom when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is placed.

3.5 EXCAVATION OF DRAINAGE DITCHES

A. Cut drainage ditches accurately to the cross sections and grades indicated on the drawings.

B. Backfill excessive excavation to grade with suitable material and compact as directed by the Construction Manager.

C. Remove roots, stumps, rock, or foreign matter in the sides and bottom of drainage ditches to a minimum depth of 6 inches below final ditch subgrade elevation.

D. Backfill material due to excessive excavation or removal of roots, stumps, rock, or foreign material shall consist of general fill material.

E. Maintain all drainage ditches excavated under this section until final acceptance of the work. Place material excavated from drainage ditches and suitable for other uses as fill or in stockpiles as appropriate and as approved by the Construction Manager.

F. Place excess excavated material in the general fill stockpile, provided that the materials meet the requirements for general fill in these specifications, or dispose of at a location designated by the Construction Manager.

3.6 STORMWATER CONTROLS

A. Maintain excavations in a dry condition, as practicable, during subgrade preparation and continually thereafter until installation has been completed.

B. Divert or otherwise prevent surface water from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

C. Manage stormwater that accumulates within the excavation during construction in accordance with the SWPPP.

D. Leave all pipe and conduits clean and free of sediment.

3.7 USE OF EXCAVATED MATERIAL

A. Acceptable material removed from required excavation under this section and any excess material from building excavation may be used in the formation of embankments, subgrades, shoulders, slopes, bedding, backfill for culverts and other structures, and for such other purposes as directed by the Construction Manager.

B. Material that is determined to be not suitable for general fill by the Construction Manager will be stockpiled separately from suitable general fill material in a manner directed by the Construction Manager, which does not obstruct flow characteristics of any stream or impair the efficiency of any structure. This material may be used as

directed by the Construction Manager. This material may be disposed of only at the discretion and direction of the Construction Manager.

C. Do not deposit or dispose of any excavated materials at any time in a manner that may endanger a partly finished structure by direct pressure or by overloading banks adjacent to the operation, or that may in any other way be detrimental to the completed work.

3.8 BACKFILL AND COMPACTION FOR GENERAL FILL, UTILITIES, AND STRUCTURES

A. General Requirements

1. Strip or otherwise remove all vegetation to include roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish, and other unacceptable material within the area upon which fill is to be placed before the fill is started. In no case shall unsuitable material remain in or under the fill area.
2. Excavate and remove stumps, logs, and roots more than 1/2 inch in diameter to a depth not less than 18 inches below the original ground surface.
3. Scarify sloped ground surfaces steeper than 4H:1V on which fill is to be placed so that fill material will bond with the existing surface.
4. Add water or dry prepared surfaces on which compacted fill is to be placed as required to obtain the specified moisture content and density.
5. Do not place material in overly wet or frozen areas.
6. Provide compaction by the means specified and to the required moisture and density for various parts of the work.
7. Degree of compaction shall be 90 percent of Modified Proctor maximum dry density.

B. Adjacent to and Beneath Structures and Appurtenances

1. Backfill adjacent to and beneath structures and appurtenances shall consist of general fill.
2. Do not place backfill on surfaces that are muddy or frozen. Remove unacceptable material in surfaces to receive fill or in excavated areas and replace with acceptable materials. Scarify the surface prior to fill placement.
3. Plow, step, bench, or otherwise break up fill material on sloped surfaces steeper than 4H:1V so that fill material will bond with existing material.
4. When subgrades are less than the specified fill density, process the subgrade soils to a minimum depth of 6 inches and compact to the specified fill density.

5. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact as specified for the adjacent fill.

6. Place fill in layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated machine compactors are used.

7. Place backfill carefully around pipes, manholes, or tanks to avoid damage to coatings, wrappings, or tanks.

8. During backfilling operations and in the formation of embankments, do not use equipment that will overload the structure in passing over and compacting fills.

9. Compact general fill materials to 90 percent Modified Proctor maximum dry density at a moisture content to facilitate compaction without bulking.

C. Utility Trenches

1. Initial and final backfill, and backfill for utility appurtenances, shall consist of general fill.

2. Place pipe bedding materials as indicated on the drawings. Partially backfill utility trenches prior to performing pressure tests, where required. Prior to pressure testing, compact the fill materials under the pipe to provide adequate support. Take care to ensure thorough compaction of fill under pipe haunches. Refer to the details on the drawings.

3. Do not completely backfill the trench until all specified tests are performed. Backfill trenches after all required tests are performed and approved to final grades indicated.

4. Backfill evenly on both sides of the pipe for the full length of the pipe. Place remaining backfill material in loose lifts not to exceed 12 inches and compact to a minimum of 90 percent of Modified Proctor maximum dry density. Material shall not exceed 6 inches in any dimension and shall meet the requirements for general fill.

5. Compact cohesive soils at a moisture content from -2 percentage points below to + 2 percentage points above Modified Proctor optimum moisture.

6. Compact cohesionless soils at a moisture content as required to facilitate compaction without bulking.

3.9 FIELD TESTING AND CONTROL

A. The Quality Control Manager, or his designee, will perform all QA and QC sampling and testing in accordance with the CQAPP.

B. Should test results indicate lack of compliance, rock or soil materials shall be added to the noncomplying material, and the material reworked until material complies with the project specifications.

C. Retesting will be performed to verify compliance.

3.10 PROTECTION AND REPAIRS

A. Where ruts occur, the surface shall be brought to grade and reshaped prior to placing additional fill.

B. Repair and regrade any areas where settlement or erosion results and reestablish the required elevations and slopes.

C. Protect existing service lines and utility structures as follows:

1. All utility lines to be retained, including existing utility lines, utility lines whose locations are made known prior to excavation, and new utility lines constructed, shall be protected from damage. (Note: Utility locates shall be conducted by the Subcontractor(s) prior to construction and as part of the permitting process.)

2. Subcontractor(s) will not proceed until an Intrusive Work Permit is obtained and a copy furnished to the Construction Manager.

3. Any damaged utility lines that fall within the above categories shall be repaired.

-END OF SECTION-

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clear and grub all areas necessary to complete the work required. Limits for clearing and grubbing shall be marked in the field and approved by the Construction Manager before the work commences.

1.2 RELATED WORK

A. Related work and/or equipment that is specified in other sections of the Project Plan includes, but is not limited to, the following:

Appendix C-1: Site Preparation Statement of Work

Appendix C-2: Site Preparation Work Plan – Shell Property

Appendix C-3: Site Preparation – Little Rapids Dam Area

Section 31 00 00 Earthwork and Road Construction

Section 31 41 16 Metal Sheet Piling

1.3 SOIL EROSION AND SEDIMENT CONTROL

A. No land disturbance, which is defined as the excavation and disturbance of erodible soils, shall be performed until all erosion and sediment control measures have been implemented in accordance with the SWPPP developed for the site.

1.4 OTHER REQUIREMENTS

A. Conform to applicable local, state, and federal codes for transportation, recycling, and disposal of debris.

B. Coordinate any tree-clearing work that involves overhead wires with utility company(s) as appropriate.

PART 2 PRODUCTS

2.1 MATERIALS

Not used.

2.2 EQUIPMENT

A. Provide all equipment needed to clear and grub areas of trees, stumps, root, vegetation, debris, and other deleterious material.

PART 3 EXECUTION

3.1 PROTECTION OF UTILITY LINES

A. Notify the Construction Manager immediately if damage to a known or an unknown utility line occurs. The Subcontractor shall be responsible for completing the repairs to any utility lines that are damaged. The Subcontractor shall provide ample notification, to the utility companies, for utilities that require removal or relocation, so that interruption of service shall be at a minimum.

3.2 CLEARING AND GRUBBING

A. Clearing and grubbing shall consist of the removal and satisfactory disposal of vegetation designated for removal, including trees, stumps, logs, shrubs, snags, and brush occurring within the site boundaries as defined by the design drawings. The surface of the ground within these areas shall be cleared and grubbed as required for the installation of facilities, utilities, and improvements. Clearing operations shall be conducted in a manner that prevents damage to existing structures and installations and those under construction, and that provides for the safety of employees and others. The Subcontractor shall clear and grub on an as-needed basis as its work progresses, or as otherwise directed by the Construction Manager.

B. The Subcontractor shall remove any rubbish, rubble piles, debris, and all other objectionable obstructions resting on or protruding through the surface of the ground that would otherwise adversely impact the construction activities.

C. The Subcontractor shall not clear and grub any area beyond the Subcontractor's working area, unless otherwise directed by the Construction Manager. No stumps, tree limbs, or brush shall be buried in any fills or embankments. Damage of any nature shall not be inflicted upon adjoining properties by unwarranted entry on such land.

D. The Subcontractor shall chip for mulch all cleared and grubbed materials that are less than 3 inches in diameter.

3.3 DISPOSAL OF CLEARING AND GRUBBING MATERIAL

A. If deemed necessary by the Construction Manager, cleared and grubbed material may be disposed of off site. All excavated soil will be used to re-grade the site.

- END OF SECTION -

SECTION 31 41 16 - STEEL SHEET PILING

PART 1 GENERAL

1.1 SECTION INCLUDES

Requirements for sheet pile to be installed as part of site staging area development at the former Shell site.

Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by designation only. The latest published version of the referenced publication shall apply. In the case of contradiction the most stringent requirement shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A328 Grade 50 - Standard Specification for Steel Sheet Piling

ASTM A572 Grade 50 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC) SSPC-10 Near White Blast Metal Cleaning

1.2 SUMMARY OF WORK

A. Provide all labor, equipment, and material and perform all operations in connection with installation of the open cell steel sheet pile bulkhead and associated backfill to the lines and grades shown on the drawings provided by PND Engineers, Inc.

1.3 RELATED WORK

A. Other related Work activities include, but are not limited to, the following:

1. Clearing, grubbing, and removal of debris
2. Removal of hazardous and nonhazardous materials (if present), including mechanical removal of contaminated sediment that may be present within the area to be developed into the Open Cell® Bulkhead and staging area.

B. Refer to drawings for existing site conditions and site grading plan.

1.4 SCHEDULING / SEQUENCING / HOLD POINTS

A. Do not commence sheet pile installation or backfilling activities until removal of contaminated sediment has been completed and confirmed with verification sampling.

1.5 QUALITY ASSURANCE

A. Field Monitoring

1. The Contractor (Tetra Tech) shall be granted access to observe and/or test all steel sheet piles prior to installation. Observations and/or testing shall include:

   i. Checking sheet piles for general straightness: Piles with kinks in local areas along the interlock or that have excessive bowing or camber shall be rejected and replaced at no additional cost to Contractor.

   ii. Gauging all pile interlocks: Thumbs of interlocks shall be of the proper size to fit into the corresponding interlock openings. Piles whose interlocks are not within acceptable tolerance shall be rejected and replaced at no additional cost to the Contractor.

   iii. Checking piles for lamination flaws or gas pockets: Piles showing evidence of lamination flaws shall be rejected and replaced at no additional cost to contractor.

   iv. Testing of coated steel sheet piles with holiday detectors, field adhesion test, or a combination of both.

1.6 SUBMITTALS

A. Provide the following listed submittal requirements in accordance with Section 01300 of these specifications.

1. Driving plan and schedule for installation of the steel sheet pile bulkhead.
2. Method of installation of steel sheet piling including size and type of pile hammer, and temporary support systems.
3. Templates and false work to be used for support and layout of sheet piles during driving.
4. Certify that materials are new and meet or exceed specification requirements by submitting a notarized copy of chemical and physical test results.
5. Coating manufacturer's product literature and recommended preparation and application instructions.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All materials necessary for the installation of the steel sheet pile shall be delivered in a timely manner to ensure the continuity of pile driving.

B. Sheet piles shall be handled, transported, and stacked so as to prevent damage.

C. Materials shall be stored on site or on barges as designated by the Contractor.

1.8 LINES AND GRADES

A. The Subcontractor shall establish sheet pile locations and all elevations required. Vertical and horizontal benchmarks located on the site will be provided by the Contractor. The Subcontractor shall be responsible for maintenance and protection of all pile location markers.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel sheet pile shall meet the following requirements:

1. PS 27.5 flat sheets with SWC 120 degree extruded wye piles and SWC extruded anchor piles (unless otherwise notified) in dimensions shown on the Open Cell® Bulkhead Design drawings provided by PND Engineers, Inc.
2. All steel sheet piling shall be sections meeting either ASTM A328 Grade 50 or ASTM A572 Grade 50.

B. Steel Sheet Pile Coating

1. Steel sheet pile coating shall be Carboline Bitumastic 300 M, manufactured by Carboline of St. Louis, MO, or an approved equal.
2. All coating shall be applied by brush or spray using commercially available spray equipment. The coatings shall exhibit reasonable leveling without excessive sagging when applied at the required film thickness.
3. Thinning: Whenever possible the material shall be applied without thinning. Where thinning must be done, it shall be as recommended by the coating manufacturer.
4. The finished coating shall be generally smooth and free of sharp protuberances which could be removed by abrasion. A minor amount of sags, dimpling, or curtaining that does not exceed 2 to 3 percent of the surface will not be considered cause for rejection unless they present sharp edges that might be removed by abrasion. Sharp protuberances shall be cut off using a sharp wood chisel laid flat against the surface. The area from which material has been removed shall be recoated to smooth the surface.
5. Steel sheeting shall be coated on both sides.
6. Coating shall be applied according to manufacturer's recommendations to a dry film thickness of 16 mil. Coating shall be applied in one coat.
7. Prior to coating steel shall be prepared by grit blasting to a near white equivalent as defined by SSPC certification SSPC-10.
8. Any damaged coating shall be touched up in the field using Carboline Bitumastic 300 M or approved equal. Damaged area of coating and sheet shall be prepared and touch up coating applied according to coating manufacturer's recommendations.

B. Sand backfill for the Open Cell® Bulkhead will be provided by the Contractor, and will meet the following requirements:

1. Contain a PCB concentration no greater than 1.0 mg/kg using analysis based on SW-846 Method 8080 or using the Fox River Method, unless otherwise approved by WDNR
2. Contain less than 12 percent of material passing the number 200 sieve

C. Provide incidental materials, such as bracing, bolts, and sealants, necessary for installation of the sheet pile and cellular fill.

2.2 EQUIPMENT

A. Provide two marine plants, each with spud barge, material barge, crew boats, crane, pile driving hammers (diesel and vibratory), manlift, crew shelter, timber mats, navigation lights, and any other tools needed for proper execution of the work.

B. Provide land-based crane(s), excavator(s), loader(s), and any other equipment needed for transfer of materials and equipment to the marine plants.

C. Provide containers for the storage, transportation, and disposal of debris and materials.

D. Provide equipment needed to transport materials to the site from rail off-loading area and to off load at the site, if needed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine area where sheet pile will be installed to identify obstructions. Review hydrographic surveys and utility maps to assist in identification of potential utilities and other obstructions that may be present.

3.2 PREPARATION

A. Install sediment and erosion control measures, prior to work, in accordance with SWPPP.

B. Survey and clearly mark sheet pile alignment for the Open Cell® Bulkhead construction.

C. Survey and clearly mark any utility or pipeline obstructions that can not be removed. Remove all debris within the Open Cell® Bulkhead footprint that may interfere with sediment dredging operations and place in designated debris storage areas on the former Shell site.

D. Dredge sediment within the Open Cell® Bulkhead footprint to elevation 562, prior to backfill placement. Perform sediment sampling, if required, to verify sediment removal is complete to approved RAL of 1.0 ppm.

E. Perform post-dredge survey within the Open Cell® Bulkhead footprint area to document sediment removal.

3.3 INSTALLATION OF SHEET PILE

A. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

B. Steel sheet piling shall be installed at the locations as shown on the drawings provided by PND Engineers, Inc.

C. Sheet piles shall be driven plumb and true to line. Tail wall sheets may be shifted to avoid visible obstructions. Face sheet maximum deviation from the intended wall line shall be 6 in. per 100 ft. but shall not exceed 6 in. over the entire length.

D. Sheet piles shall be driven to elevations specified on the drawings provided by PND Engineers, Inc.

E. No pile splices shall be permitted.

F. Obstructions encountered during the driving process

1. General

   Subcontractor shall be responsible for the removal of all obstructions encountered during the installation of the steel sheet pile. If obstructions are found in known TSCA-contaminated area, these obstructions and any associated sediment shall be removed and handled according to established project procedures defined under Specification Sections 35 20 23 and/or Section 02 81 00.

2. Tail Wall Sheet Installation

   The tail wall sheet may be shifted in order to avoid surface or sub-surface obstructions. The tail wall shall be shifted in a gradual manner so as not to overstress the interlocks of the affected sheets. Subcontractor shall check with sheet manufacturer for allowable rotation of sheet at each interlock and shall not exceed this value.

3. Face Sheet Installation

   Face sheets shall be installed in location shown on drawing to all extents practicable. Sheet line shall not be shifted in an amount greater than stated in Section 3.3 C of this specification.

3.4 PLACEMENT OF SAND BACKFILL

A. Sand backfill shall be placed in lifts within completed cells and within the general bulkhead footprint area, commencing in the deepest portion of the dredged area at approximate elevation 562.

B. Sand will be dropped through the water column from a marine plant or material barge, or dropped from a conveyor operating from land. Sand will be placed in lifts to maintain relatively equal elevation as the area is filled. However, the bulkhead may be subdivided into areas that are backfilled in stages, in which case one area may be completely backfilled prior to other area(s).

C. When the sand backfill reaches approximately elevation 574 feet, placement of sand backfill may be performed from land by spreading sand out over the area using low ground pressure equipment. When the sand base firmness allows, additional compaction may be performed on the sand lifts using standard compaction and/or construction equipment.

D. Placement of sand backfill will continue in lifts until the sand reaches the final elevation of 592 feet.

E. At no time shall the elevation differential of the sand on either side of a single tail wall be greater than 5 feet.

3.5 INSTALLATION RECORDS

A. Provide as-built survey of installed sheet pile and Open Cell® Bulkhead area when complete. Sheet pile alignment shall be surveyed prior to and following sand backfill placement. Final elevations of the entire Open Cell® Bulkhead area shall be provided on the as-built survey.

-END OF SECTION-

SECTION 35 20 23 - DREDGING AND DEWATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

Requirements for dredging and dewatering of PCB-impacted sediments

1.2 SUMMARY OF WORK

A. Install equipment and supply materials needed to dredge, transport, and process sediment from OUs 2 through 5 of the Fox River. Processing of sediment includes sand separation, dewatering, and treatment of water from the process.

B. Perform dredging of approximately 520,000 cubic yards (may be as much as 580,000 cubic yards) of sediments in designated areas of OUs 2 and 3 and downstream of the DePere Dam in OU 4 of the Fox River in 2009, and approximately 3.35 million cubic yards of impacted sediments in OU 4 and OU 5 from 2010 to 2017 (approximately). Dredge areas of TSCA sediments (approximately 70,000 cubic yards) and non-TSCA sediments (approximately 470,000 cubic yards) separately and keep material segregated.

C. Transport dredged material to the material staging area located at the former Shell site,

D. Dewater sediment to meet landfill disposal facility requirements for acceptance of waste (e.g., filter cake).

E. Installation of appropriate channel crossing buoys, warning buoys, and pipeline delineator buoys to mark river work areas and pipeline routes, and to provide warnings to vessels and boaters.

1.3 RELATED WORK

A. Other related Work activities include, but are not limited to, the following:

1. Clearing, grubbing, and removal of debris
2. Removal of hazardous and nonhazardous materials (if present), including mechanical removal of contaminated sediment that may be present within the area to be developed into the Open Cell® Bulkhead and staging area
3. Work described in the Site Preparation Work Plan – Shell Property
4. Work described in the Site Preparation Work Plan – Little Rapids Dam Area

B. Refer to drawings for existing site conditions and site grading plan.

C. Refer to Appendices C-6, Dredging Equipment Documents; C-7, DWP Equipment Documents; and C-8, WTP Equipment Documents

D. Section 02 21 00, Surveying and Grade Control — includes bathymetric surveying, side-scan sonar surveying, sub-bottom profiling, and marine magnetometer surveys to provide elevation data and locate obstructions and/or debris.

E. Section 01 57 20, Environmental Protection

1.4 DEFINITIONS

A. Required dredging: Removal of sediment to the dredge template elevation indicated on the dredging drawings.

B. Overdredge dredging: An assumed additional thickness of sediment removed to ensure that dredging to the neatline is accomplished

C. Dredging tolerances: Equipment-specific degree of accuracy that is achievable during dredging

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide polymer for sediment dewatering.

B. Provide solidification reagent, such as fly ash or kiln dust, if needed, for solidification of sediment that may be dredged prior to installation of the dewatering facility at the former Shell site.

C. Provide 8-inch and 12-inch SDR 17 HDPE piping as required to install sediment transfer pipelines shown on the project design drawings.

D. Provide materials required for construction of sediment dewatering and wastewater treatment plant, which are described in detail in Appendix C-1, Site Preparation Statement of Work; C-2, Shell Site Preparation Work Plan – Shell Property; C-4, Foundation Work Plan for Building; and C-5, Building Erection Work Plan. Materials, equipment, and methods for performing the work described in these documents will not be described further here. This work must be completed prior to production dredging.

E. Provide silt curtains and/or turbidity barriers, as needed, to control migration of solids during dredging activities.

2.2 EQUIPMENT

A. Provide debris removal plants consisting of barges with cranes and/or a backhoe with suitable rake, orange-peel, or grapple-type attachments to remove debris. Provide separate containers on the barge for placement of debris from TSCA and non-TSCA areas.

B. Provide hydraulic and mechanical dredging equipment, as needed, to complete removal of impacted sediments within OUs 2 through 5 of the Fox River. This effort is expected to require the use of two 8-inch-diameter hydraulic dredges and one

12-inch-diameter hydraulic dredge, at a minimum. A mechanical dredge plant shall be provided for removal of heavier sediment and debris in shoreline and other select areas.

C. Provide booster pump stations, as needed, in OUs 2, 3, and 4 along the HDPE pipeline route to facilitate transfer of dredged material over a long distance.

D. Provide dewatering equipment sized to process/dewater the sediment at the rates shown in the mass balance presented in Exhibit A.

E. Provide flow meters, gages, and testing equipment needed to monitor operation of the dewatering plant and associated equipment (such as the wastewater treatment plant).

F. Provide equipment needed to construct storage areas required for storage of filter cake and sand.

PART 3 EXECUTION

3.1 SURVEY/DELINEATION OF OBSTRUCTIONS

A. Review hydrographic surveys and utility maps to assist in identification of potential utilities and other obstructions that may be present. Clearly mark all utility and pipeline structures present within the areas to be dredged and/or where pipelines will be installed for transfer of sediment.

3.2 SURVEY AND DELINEATION OF HDPE PIPELINE ROUTE(S)

A. Survey and clearly mark pipeline route for HDPE dredge slurry pipeline(s) from sediment removal areas to the former Shell site.

3.3 DREDGE MANAGEMENT UNITS

A. Survey and clearly mark limits of designated DMUs prior to performing dredging activities in an area.

3.4 PREPARATION

A. Install sediment and erosion control measures, prior to work, in accordance with SWPPP.

B. Install one background turbidity monitoring station 500 feet upstream, where the predominant flow passes through the river, and one turbidity monitor a distance of 500 feet downstream of dredging operations in the flow path extending from the DMU being dredged.

C. Conduct pre-dredge survey prior to initiating dredging in a DMU.

3.5 DREDGING AND TRANSPORT OF SEDIMENT

A. Perform all dredging in an upstream-to-downstream direction.

B. Remove impacted sediments in shallow water using 8-inch dredges; with possible final pass clean-up using the Vic-Vac™.

C. Use mechanical excavator or derrick for shallow water environments with insufficient draft for hydraulic removal.

D. Use 12-inch hydraulic dredge for initial bulk removal of sediment from thicker deposits in OU 4, with clean-up passes by the 8-inch hydraulic dredge for greater precision. Remove TSCA-level sediments in OU 4 and keep segregated from non-TSCA sediment.

E. Use 12-inch hydraulic dredge for the mouth of the Fox River and for Green Bay dredging.

F. Perform multiple passes using the hydraulic dredges where thicker sediment deposits exist.

G. Remove sediment to the dredge template elevations provided in the sediment removal design drawings. Following removal of sediments to the neatline elevations, the DMU will be sampled to verify compliance with the performance standards specified in Part 3.6 of this Section.

H. Near utilities and infrastructure, use the following guidelines to protect these structures:

1. For residential docks – Dredging and capping will be performed within 25 feet of a pile.

2. For bridge crossings – No dredging will be conducted within 25 feet of a bridge pier, dolphin, or fender, which may be increased if site-specific conditions warrant a larger off-set.

3. For submerged utilities/pipelines – Dredging will not be conducted within 50 feet of a known or reported river utility crossing. However, dredging may be conducted to an offset distance of 25 feet if the horizontal and vertical position of the utility is known within an accuracy of ± 6 inches vertically and ± 5 feet horizontally along the entire length of the utility as verified by physical surveys; and if RD sampling results indicate elevated PCB concentrations and environmental risk warrant.

I. Monitor the dredge pipeline to ensure operation is in compliance with design, and to document that no damage has been incurred and no leakage is occurring.

3.6 DREDGING PERFORMANCE STANDARDS

A. Sediment exceeding the RAL of 1.0 ppm PCBs goal in OUs 2 through 5, excluding exceptional areas, is required to be addressed either through removal, capping, or sand cover.

B. If the RAL is not achieved in an OU, the remedy may be considered complete if the surface weighted average concentrations (SWAC) goal is met and the residuals are managed as follows:

1. In 2009, generated residuals exceeding 10.0 ppm PCB will be re-dredged to meet the RAL or identified for capping in 2010 or beyond.
2. In 2009, generated residual exceeding 1.0 ppm PCB but < 10.0 ppm PCB will be identified for covering with at least 6 inches of sand in 2010 and beyond, provided this placement is necessary to meet the SWAC goal for the OU. The SWAC goal for OU 3 is 0.28 ppm PCB, and the SWAC goal for OU 4 is 0.25 ppm PCB.
3. Engineered caps will be installed in designated areas of the site – see design drawings for details.
4. Sand covers comprised of at least 6 inches of sand will be installed in certain undredged areas and in areas not meeting the RAL. This work is described in Section 35 43 00.

3.7 TURBIDITY MONITORING DURING DREDGING

A. Perform monitoring for turbidity during dredging operations in accordance with Section 10.1 of the CQAPP.

3.8 POST-DREDGE SAMPLING

A. Perform post-dredge sampling in accordance with the sediment removal verification plan in the CQAPP.

3.9 SURVEYS

A. Perform survey checks in areas requiring multiple dredge passes to monitor removal.

B. Perform post-dredge multi-beam survey to document that final removal elevations have been achieved. This survey will be used as the record document to verify achievement of design grades.

3.10 SEGREGATION OF SAND FROM SEDIMENT

A. Segregate coarse and fine fraction of sand from dredged sediment using hydrocyclones installed at the sediment processing plant on the former Shell site.

B. Perform sampling and analysis of sand to measure effectiveness of separation, and relationship between organic matter and PCB concentration.

C. If sand separation does not yield sand meeting the requirements for beneficial re-use, consistent with WDNR's *Guidance for the Reuse of Sand Separated from the Fox River PCB Sediment*, dated April 18, 2008, additional measures such as scrubbing or treatment to removal residual contamination may be considered. Sand containing < 1.0 ppm PCB is potentially available for reuse, but if the concentration exceeds 0.25 ppm PCBs the sand must be covered with a low-permeability material. Sand with a PCB concentration > 1.0 ppm may be considered for reuse on a case-by-case basis, pending WDNR approval. Re-use of sand separated from TSCA sediment may be performed only if approved by WDNR.

D. The sand must be free of other contaminants of potential concern, which must be verified by analyses.

E. Testing frequencies for sand to determine reuse suitability are as follows:

Additional Analyses to Determine Reuse Suitability

Beneficial Reuse Criteria/Guidance	Test Method	Test Frequency	Acceptable Range
Chemical Parameters		1 sample/1,000 cubic yards (cy) for the first 10,000 cy then 1 sample/10,000 cy for 10,000 to 50,000 cy then 1 sample/50,000 cy thereafter.	To be determined for all parameters (*)
Total 2,3,7,8 TCDD			
Total 2,3,7,8 TCDF			
DDT			
Arsenic	EPA 6000/7000		
Barium			
Cadmium	EPA 6000/7000		
Chromium	EPA 6000/7000		
Copper	EPA 6000/7000		
Cyanide			
Iron			
Lead	EPA 6000/7000		
Manganese			
Mercury	EPA 6000/7000		
Nickel	EPA 6000/7000		
Selenium			
Zinc	EPA 6000/7000		
Physical Parameters			
Grain-Size	SOP-Appendix D/Sieve and Hydrometer		
Percent Solids			
Total Organic Carbon	Walkley-Black/EPA 415-1		
Moisture Content	SOP-Appendix D		
Settleability	SOP-Appendix D and E		

DDT = Dichloro-Diphenyl-Trichloroethane
EPA = U.S. Environmental Protection Agency
SOP = standard operating procedure
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibzofuran

[1/] Determined by uses approved by WDNR.

3.11 DEWATERING

A. Perform pre-thickening of sediment slurry following sand separation process and prior to routing to the membrane presses.

B. Feed pre-thickened sediment into membrane presses at flow rates consistent with the mass balance design and with planned sediment removal rates. The process shall be sized to handle a maximum rate of approximately 3,000 tons per day of sediment (based on expected filter cake production) in a slurry with approximately 5 to 6 percent solids without interruption.

C. Adequate capacity and redundancy shall be provided for all processes to allow system components to go off-line for routine maintenance and cleaning while maintaining operation of the system at the design flow rates.

D. Polymer addition shall be monitored and adjusted, as needed, and membrane presses shall be operated to provide dewatering of the sediment to meet the requirements specified for filter cake disposal. These properties are as follows:

   1. Undrained shear strength of 800 psf, or
   2. Frictional strength of 25 degrees, or
   3. A combined frictional and cohesive strength that provides filter cake of sufficient strength to achieve a comparable factor of safety (as the strength in (1) or (2)) for slope stability, as determined by a geotechnical engineer.

E. In addition to the above properties, a firm filter cake with nominally 50 percent solids or greater is desired. Although failure to meet this requirement may not impact landfill disposal, adjustments to the dewatering system should be made if the percent solids in the filter cake begins to decline below 50 percent and process adjustments may improve this property.

F. In addition to the above tests, grain size analyses will be performed on filter cake samples during the initial startup period to monitor the effectiveness of the sand separation process.

3.12 REMEDIAL ACTION COMPLETION CERTIFICATION PROCEDURE

A. Upon completion of a DCU (3 - 1 Acre DMUs) a Dredge Certification Report, stamped by a Wisconsin-certified Professional Engineer, will be submitted to the agencies for approval. The package will identify the DCU to be certified, identify the DMUs that are included in the DCU and will include record drawing information and confirmation sample information for each DMU that is included in the DCU.

B. The Agencies will review the documentation to verify that the dredging in the DCU has been completed and has met the RA requirements set forth in the contract documents.

C. Agencies will approve the Dredge Certification Report, confirming that the DCU is complete.

D. All Dredge Certification Reports will be compiled and submitted as part of the final closure report annual volume.

-END OF SECTION-

SECTION 35 43 00 - CAPPING AND SAND COVER PLACEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

Requirements for materials and installation of engineered caps and sand covers in OUs 2 through 5 of the Fox River.

1.2 SUMMARY OF WORK

A. Provide equipment and materials needed to construct engineered caps and sand covers for OUs 2 through 5 of the Fox River, as delineated on the design drawings and/or determined following post-dredge surveys.

B. Provide silt curtains or turbidity barriers for turbidity control.

1.3 RELATED WORK

A. Other related Work activities include, but are not limited to, the following:

1. Section 02 21 00, Surveying and Grade Control, includes bathymetric surveying, side-scan sonar surveying, sub-bottom profiling, and marine magnetometer surveys to provide elevation data and locate obstructions and/or debris.

2. Section 01 57 20, Environmental Protection

1.4 DEFINITIONS

A. Engineered cap: A soil cover installed over sediments that includes a sand layer and an armor layer. Caps with large armor also include a filter layer of finer aggregate material. Thickness of the sand and armor layers varies by location.

B. Sand cover: A minimum 6-inch thickness of sand placed over residual contamination. Areas to receive sand cover will be based on residual PCB concentrations in the sediment as determined by post-dredge sampling and analysis described in the CQAPP.

C. Engineered cap design and designations: Cap designs have been designated according to thickness and materials used, which was based on PCB concentration remaining in undredged sediment and other considerations. The designated cap designs are as follows:

Designated Cap Designs

Cap Description	PCB Concentration range (in 0 to 6-inch Interval)	Comments
Cap A - Minimum 13-inch Sand Cap with Gravel Armor	< 10 ppm	Used in low concentration areas where mixing zone of clean sand provides necessary chemical isolation.
Cap B - Minimum 16-inch Sand Cap with Gravel Armor	10-50 ppm	Used in areas where 3 inches of uncompromised chemical isolation layer is necessary for protection.
Cap C - 33-inch Sand/Quarry Spall Cap	10-100 ppm	Used only in OU 4 navigation channel and/or where PCB concentrations exceed 50 ppm at any depth.
Shoreline Caps – Minimum 44-inch Sand/Gravel/Quarry Spall Cap	varies	Used in areas near shorelines where water depth will exceed 3 feet after cap installation.

1.5 SITE CONDITIONS

A. Sediments in OUs 2 to 4 are characterized as soft, silty, clayey sand, with trace gravel. Limited areas of stiff clayey soils exist immediately under the soft sediments.

B. Pre-capping bathymetry in a DMU will be provided by the post-dredge survey.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sand - provide sand for cap and sand cover construction. Sand shall meet the following specifications:

1. < 12% passing the No. 200 sieve
2. Classification by the Unified Soil Classification System as SP, SW, or SW-SM

B. Gravel - provide gravel for armor and filter layers meeting the following specifications:

1. for armoring - up to D50 of 1.5 inches
2. for filter layer in OU 4 - D50 of 3 inches

C. Quarry spall – provide for armoring in OU 4 (Federal Navigation Channel) - D50 = 6 to 9 inches

D. Provide silt curtains or turbidity barriers, as needed, to maintain turbidity to less than actionable levels.

2.2 EQUIPMENT

A. Provide material transfer barges, a marine capping plant, a mechanical capping plant and associated equipment needed to load, transport, and spread and/or place cover materials at designated locations in OUs 2 through 5.

B. Provide equipment and devices for monitoring/surveying of material placement thicknesses.

PART 3 EXECUTION

3.1 PRE-CAP AND POST-CAP SURVEYS

A. Perform pre-cap delineation of each CMU to define and clearly mark the area to be capped prior to commencing capping or sand placement activities.

B. Perform pre-cap (or in dredged areas, post-dredge) and post-cap bathymetric surveys in the CMU to document cap and/or sand cover thicknesses.

C. Review hydrographic surveys and utility maps to assist in identification of potential utilities and other obstructions that may be present. Clearly mark all utility and pipeline structures present within the areas to be capped or covered.

3.2 MATERIAL STAGING

A. Capping and sand cover materials will be staged and loaded from the Little Rapids Dam staging area for capping/sand cover areas located south of the De Pere Dam and from the former Shell site staging area for capping/sand cover areas located north of the De Pere Dam. This material will be staged from clean areas and kept segregated from potentially contaminated material being processed at the former Shell site.

B. Load materials into material barges for transport to the CMU. Monitor material inventories and placement schedules to ensure sufficient volume of material is available for scheduled capping/covering activities.

3.3 SEQUENCE OF CAPPING AND SAND COVER PLACEMENT

A. Sand covering will be conducted from 2010 through 2017 in areas designated for covering of residuals.

B. Capping of residuals and/or sediment left in place will be conducted from 2010 through 2017 in areas designated for placement of Cap A, B, or C.

C. Capping and sand cover placement shall be conducted in an upstream-to-downstream direction, as soon as possible following dredging (if applicable) and verification of residual levels.

3.4 PREPARATION

A. Implement sediment and erosion control measures, prior to work, in accordance with the SWPPP.

B. Install one background turbidity monitoring station 500 feet upstream, where the predominant flow passes through the river, and one turbidity monitor a distance of 500 feet downstream of dredging operations in the flow path extending from the DMU being dredged.

C. Conduct pre-dredge survey prior to initiating dredging in a DMU.

3.5 PLACEMENT OF SAND COVER AND CAPPING MATERIALS

A. A barge will be used to transfer granular sand cover and capping materials to the slurry barge associated with the marine capping plant or mechanical capping plant.

B. Sand cover shall be placed in designated areas using a broadcast spreading technique to place relatively uniform thin lifts of sand gradually over the area.

C. Transfer cap/cover material to a conveyor that feeds a metered hopper, followed by a slurry hopper. Inject water into the slurry hopper to create a slurry. Transfer slurry from the hopper via pipeline to the broadcast spreading barge.

D. After the slurried cap material enters the broadcast spreading barge, the material passes across a vibrating dewatering screen.

E. The granular cap material will roll off the dewatering screen and into a hopper that conveys material to the broadcast spreader. Excess water returns to the river.

F. Particles spread out into the water and fall through the water column under the spreader pool, an area of open water enclosed by floating barriers measuring approximately 35 feet by 12 feet.

G. Maintain material placement rates of 40 to 60 cubic yards per hour, per broadcast spreading plant.

H. Near utilities and infrastructure, use the following guidelines to protect these structures:

1. For residential docks – Capping will be not be performed within 25 feet of a pile, unless otherwise directed by the Construction Manager.

2. For bridge crossings – No capping will be conducted within 25 feet of a bridge pier, dolphin, or fender, which may be increased if site-specific conditions warrant a larger off-set.

3. For submerged utilities/pipelines – Capping will not be conducted within 50 feet of a known or reported river utility crossing. However, capping may be conducted to an offset distance of 25 feet if the horizontal and vertical position of the utility is known within an accuracy of + 6 inches vertically and + 5 feet

horizontally along the entire length of the utility as verified by physical surveys; and if RD sampling results indicate elevated PCB concentrations and environmental risk warrant.

I. Monitor the volume of material placed based on volumes measured by the metered conveyor(s) and hoppers to compare with pre- and post-cap/cover survey volumes.

3.6 DREDGING PERFORMANCE STANDARDS FOR CAP/COVER DETERMINATION

A. Sediment exceeding the RAL of 1.0 ppm PCBs goal in OUs 2 through 5, excluding exceptional areas, is required to be addressed either through removal, capping, or sand cover.

B. If the RAL is not achieved in an OU, the remedy may be considered complete if the SWAC goal is met and the residuals are managed as follows:

1. In 2009, generated residuals exceeding 10.0 ppm PCB will be re-dredged to meet the RAL or identified for capping in 2010 or beyond.
2. In 2009, generated residuals exceeding 1.0 ppm PCB but < 10.0 ppm PCB will be identified for covering with at least 6 inches of sand in 2010 and beyond, provided this placement is necessary to meet the SWAC goal for the OU. The SWAC goal for OU 3 is 0.28 ppm PCB, and the SWAC goal for OU 4 is 0.25 ppm PCB.
3. Engineered caps will be installed in designated areas of the site – see design drawings for details.
4. Sand covers comprised of at least 6 inches of sand will be installed in certain undredged areas and in areas not meeting the RAL. This work is described in Section 35 43 00.

3.7 TURBIDITY MONITORING DURING SAND COVERING AND CAPPING

A. Commence monitoring of upstream nephelometer prior to commencing sand and/or cap placement in the downstream CMU. Hourly readings shall be logged at each location during capping/sand covering activities.

B. Obtain discrete turbidity measurements at the monitoring stations 3 times per week during capping/sand covering activities for comparison to nelephometer reading and calibrate accordingly.

C. Correlate logged turbidity data to total suspended solids (TSS) using data from Phase I project. If data correlate poorly, perform additional sampling for TSS and develop correlations for turbidity specific to this site.

D. Compare measured turbidity levels downstream to the upstream turbidity and notify the Construction Manager immediately if the background level is more than 40 nephelometric turbidity units (NTUs) above the background level for four

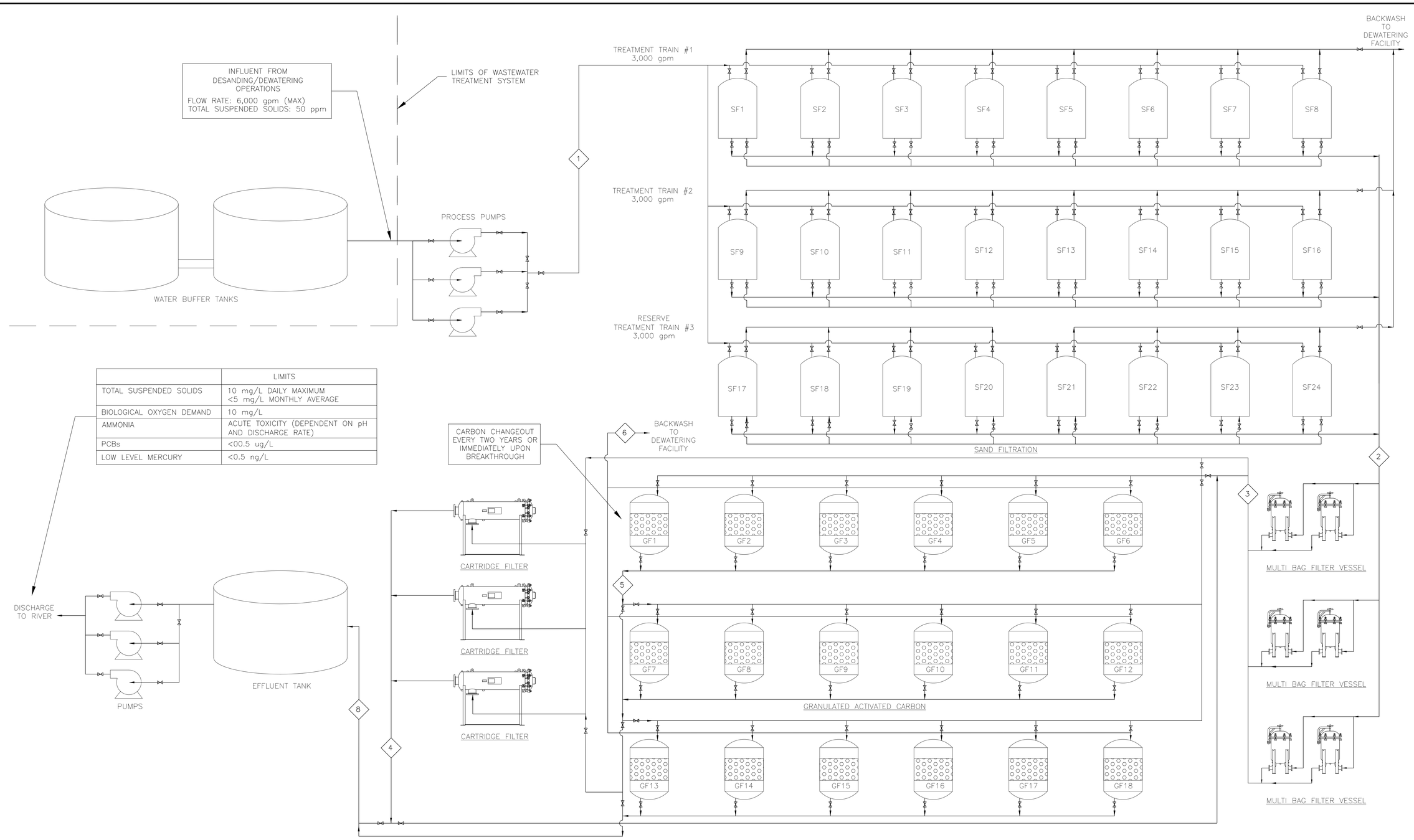
consecutive readings (i.e., over 4 hours). The Construction Manager will notify the material barge operator, who will evaluate best management practices and/or modify material placement methods to reduce turbidity.

E. If the background level is more than 80 NTUs above the background level for four consecutive readings (i.e., over 4 hours), the Construction Manager will notify the barge operator, who will immediately suspend capping/sand cover placement operations to reduce turbidity.

F. In the event capping/sand cover placement operations are suspended due to turbidity, capping/sand cover placement will not resume until four consecutive readings below 80 NTUs have been achieved.

-END OF SECTION-

Wastewater Treatment Plant Design Drawings



	LIMITS
TOTAL SUSPENDED SOLIDS	10 mg/L DAILY MAXIMUM <5 mg/L MONTHLY AVERAGE
BIOLOGICAL OXYGEN DEMAND	10 mg/L
AMMONIA	ACUTE TOXICITY (DEPENDENT ON pH AND DISCHARGE RATE)
PCBs	<00.5 ug/L
LOW LEVEL MERCURY	<0.5 ng/L

WTP Mass Balance

Parameter	1	2	3	4	5	6	7	8
Max Water Flow Rate (gpm)	6000	6000	6000	6000	6000	281	NA	5719
Total Suspended Solids (mg/L)	50	10	2	0	0	0	0	0
PCBs (ug/L)	NA	NA	NA	5	0	0	0	0
pH (S.U.)	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
BOD (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Hg (ng/L)	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
NA Data Not Available
0 indicates "non-detectable levels"

Discharge Criteria
10 mg/L (daily maximum) 5mg/L (monthly average)
0.5 ug/L
6-9 S.U.
8.41 mg/L times dilution ratio
867 lbs/day
0.5 ng/L

90% DESIGN

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P. E. SEAL

REV	DESCRIPTION	DRN	DES	CHK	APR	DATE
A	90% DESIGN SUBMISSION	FM	JF	JS	RF	05/12/08

DESIGNED BY: J. FRANCIS
DRAWN BY: F. MENICHELLI
CHECKED BY: J. SCARAMUZZO
APPROVED BY: R. FEENEY
DATE: MAY 12, 2008

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LOWER FOX RIVER PRP GROUP
GREEN BAY, WISCONSIN

LOWER FOX RIVER SITE OPERABLE UNITS 2-5
GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN

PROCESS FLOW DIAGRAM
(SHEET 1 OF 1)

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: 3667-P-101-REV A.DWG
SHEET – OF –
SIZE: D
P-101

VALVE AND PIPING SYMBOLS

- GLOBE VALVE
- GATE VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- PLUG VALVE
- 3-WAY VALVE
- ANGLE VALVE
- RELIEF OR SAFETY VALVE
- DIAPHRAGM VALVE
- BALL VALVE
- SELF-CONTAINED PRESSURE REGULATING VALVE W/RELIEF
- KNIFE GATE VALVE
- BP — BACKFLOW PREVENTER
- NO — NORMALLY OPEN
- NC — NORMALLY CLOSED
- SP — SAMPLE PORT
- FLEXIBLE HOSE
- FLEXIBLE CONNECTOR
- BASKET TYPE STRAINER
- Y-TYPE STRAINER
- DUPLEX STRAINER
- SLEEVE COUPLING
- FLOOR DRAIN
- EQUIPMENT DRAIN
- CLEANOUT (CO)
- REMOVABLE PLUG
- REMOVABLE CAP
- BF — BLIND FLANGE
- EXHAUST TO ATMOSPERE (INSIDE)
- EXHAUST TO ATMOSPERE (OUTSIDE)
- REDUCER
- FLANGE
- UNION
- QUICK DISCONNECT COUPLING
- GAUGE SEAL
- DAMPER
- PITLESS ADAPTOR

VALVE OPERATOR SYMBOLS

- S — SOLENOID
- M — MOTOR, ELECTRIC
- DIAPHRAGM
- DIAPHRAGM WITH POSITIONER
- HANDWHEEL OR LEVER
- CHAINWHEEL

PRIMARY ELEMENT SYMBOLS – FLOW

- ORIFICE PLATE
- PITOT TUBE
- AVERAGING PITOT TUBE
- VENTURI OR FLOW TUBE
- TOTALIZING FLOWMETER
- FLUME
- WEIR
- TURBINE OR PROPELLER TYPE METER
- MAGNETIC FLOW METER
- ROTAMETER

EQUIPMENT SYMBOLS

- PUMP
- GHOSTED WHERE SHARED WITH OTHER PID ON WHICH ITEM IS SHOWN NORMAL WEIGHT (TYP)
- PNEUMATIC DIAPHRAGM PUMP
- METERING PUMP
- STATIC MIXER
- MIXER
- BLOWER
- RECIPROCATING AIR COMPRESSOR AND TANK
- FLOW DAMPENER
- ROTARY SCREW AIR COMPRESSOR
- SHELL AND TUBE HEAT EXCHANGER
- VSD — VARIABLE SPEED DRIVE
- PARTICULATE FILTER
- COALESCING FILTER
- AIR FILTER/SILENCER
- HAND OPERATED DIAPHRAGM PUMP

GENERAL INSTRUMENT SYMBOLS

ONE VARIABLE	TWO VARIABLES	
		LOCALLY MOUNTED
		PANEL MOUNTED
		REAR-OF-PANEL MOUNTED
I		INTERLOCK (FOR LOGIC DESCRIPTION SEE SPEC. 13600)
P		PURGE
PLC		PROGRAMMABLE LOGIC CONTROLLER
LCP		LOCAL CONTROL PANEL
LSL		PERSONAL COMPUTER SOFT SWITCH
		PERSONAL COMPUTER HUMAN MACHINE INTERFACE
		PERSONAL COMPUTER
A		ALARM

LINE SYMBOLS

- PROCESS PIPES OR CHANNELS
- HT — HEAT TRACE
- CONNECTION TO PROCESS, MECHANICAL LINK OR INSTRUMENT SUPPLY
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL NO WIRING OR TUBING
- O — DATA HIGHWAY SIGNAL

INSTRUMENT IDENTIFICATION TABLE

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME				
C	CONDUCTIVITY			CONTROL	
D	DENSITY (SP. GR.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOWRATE	RATIO			
G	GAUGING (DIMENSIONAL)		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE			CONTROL SWITCH	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				MIDDLE
N					
O			ORIFICE		
P	PRESSURE OR VACUUM		POINT (TEST)		
Q	QUANTITY OR EVENT	INTEGRATE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION		
V	VISCOSITY			VALVE OR DAMPER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED		UNCLASSIFIED		
Y				RELAY OR COMPUTE	
Z	POSITION			DRIVE ACTUATE	

PROCESS LINE ABBREVIATIONS

AIR	AIR, ATMOSPERIC PRESSURE
BD	BIODIESEL
BW	BACKWASH
CA	COMPRESSED AIR
CF	CHEMICAL FEED
CGW	CONTAMINATED GROUNDWATER
CHR	CHILLED WATER RETURN
CHS	CHILLED WATER SUPPLY
CR	CONDENSATE RETURN
CWR	COOLING WATER RETURN
CWS	COOLING WATER SUPPLY
D	DRAIN
EFF	EFFLUENT
EXH	EXHAUST
FS	FEEDSTOCK
G	GLYCERIN
GW	GROUNDWATER
IA	INSTRUMENT AIR
(I)	INSULATION
MA	METHANOL
NPW	NON-POTABLE WATER
P	PRODUCT
PROP	PROPANE
PW	POTABLE WATER
S	SANITARY
SL	SLUDGE
SP	SAMPLE PORT
SS	STORM SEWER
ST	STEAM SUPPLY
TF	TOTAL FLUIDS
V	VENT
VAP	VAPOR
WW	WASTEWATER

PIPING MATERIAL ABBREVIATIONS

ABS	ACRYLONITRILE BUTADIENE STYRENE
AL	ALUMINUM
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
COP	COPPER
CMP	CORRUGATED METAL PIPE
CIP	CAST IRON PIPE
DIP	DUCTILE IRON PIPE
FLEX	FLEXIBLE PIPE/DUCT/TUBING
GALV	GALVANIZED STEEL
HDPE	HIGH DENSITY POLYETHYLENE
NEO	NEOPRENE HOSE
PE	POLYETHYLENE
PP	POLYPROPYLENE
PVC	POLYVINYL CHLORIDE
PVDF	POLYVINYLIDENE FLUORIDE
RCP	REINFORCED CONCRETE PIPE
RUB	RUBBER HOSE
SS	STAINLESS STEEL PIPE/TUBING
TEF	TEFLON TUBING
VCP	VITRIFIED CLAY PIPE

PROCESS PIPING IDENTIFICATION

PROCESS PIPE

XXX-YY-Z

- PIPE CONTENTS
- PIPING MATERIAL
- PIPE DIAMETER (INCHES)

INSTRUMENT IDENTIFICATION

INSTR LOOP — FIT-100A

- SUFFIX (NOT NORMALLY USED)
- TAG NUMBER
- SUCCEEDING LETTERS
- FIRST LETTER

FUNCTION ABBREVIATIONS

DO	DISSOLVED OXYGEN	OC	OPEN-CLOSE
FC	FAIL CLOSED	OO	ON-OFF (MAINTAINED)
FL	FAIL LOCKED	ORP	OXIDATION REDUCTION POTENTIAL
FO	FAIL OPEN	OSC	OPEN-STOP-CLOSE (MOMENTARY)
HOA	HAND-OFF-AUTOMATIC	SI	MOTOR SPEED INDICATION
I/I	CURRENT-TO-CURRENT	SS	START-STOP (MOMENTARY)
I/P	CURRENT-TO-PNEUMATIC	↑	HIGH SELECT
LCP	LOCAL CONTROL PANEL	↓	LOW SELECT
LEL	LOWER EXPLOSIVE LIMIT	√	SQUARE ROOT
LR	LOCAL-REMOTE	Σ	ADD OR TOTALIZE
MI	MOTOR RUN INDICATION		

GENERAL NOTES:

1. ALL EQUIPMENT DOWNSTREAM OF PRESSURE RELIEF/SAFETY VALVES DESIGNED FOR PUMP SHUTOFF PRESSURE.
2. ALL CARBON STEEL PIPING IS SCHEDULE 40.
3. ALL CONTROL VALVES FAIL CLOSED, UNLESS OTHERWISE SPECIFIED.

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P. E. SEAL

REV	DESCRIPTION	DRN	DES	CHK	APR	DATE
A	90% DESIGN SUBMISSION	FCM	JF	JS	RF	05/12/08

DESIGNED BY: COMPILED
DRAWN BY: F. MENICHELLI
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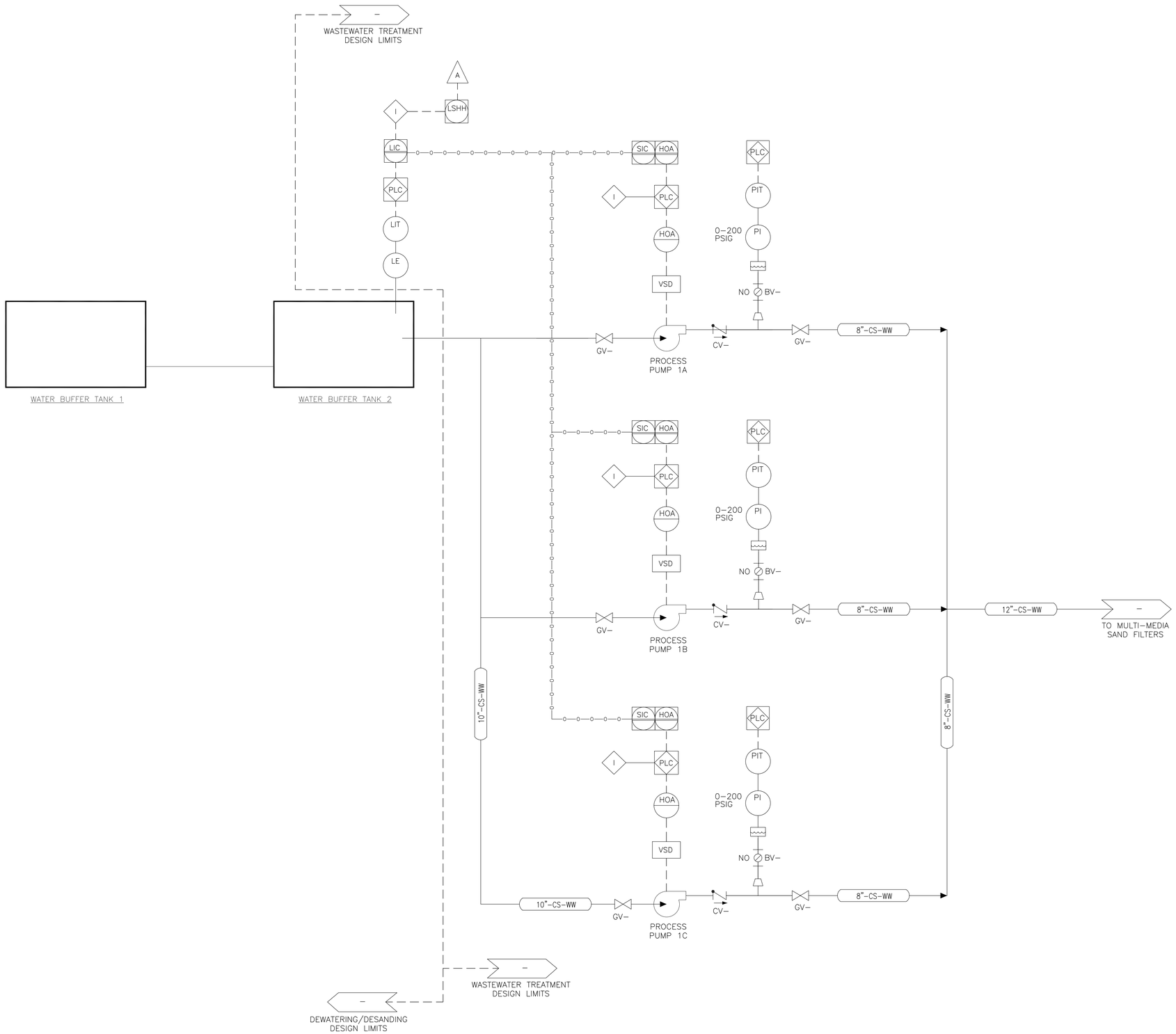
LOWER FOX RIVER PRP GROUP
GREEN BAY, WISCONSIN

LOWER FOX RIVER SITE OPERABLE UNITS 2-5
GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
LEGEND AND ABBREVIATIONS

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: 3667-P-102-REV A.DWG
SHEET – OF –
SIZE: D
P-102



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P. E. SEAL

REV	DESCRIPTION	DRN	DES	CHK	APR	DATE
A	90% DESIGN SUBMISSION	FGM	JF	JS	RF	05/12/08

DESIGNED BY: J. FRANCIS
DRAWN BY: F. MENGHELLI
CHECKED BY: J. SCARAMUZZO
APPROVED BY: R. FEENEY
DATE: MAY 12, 2008

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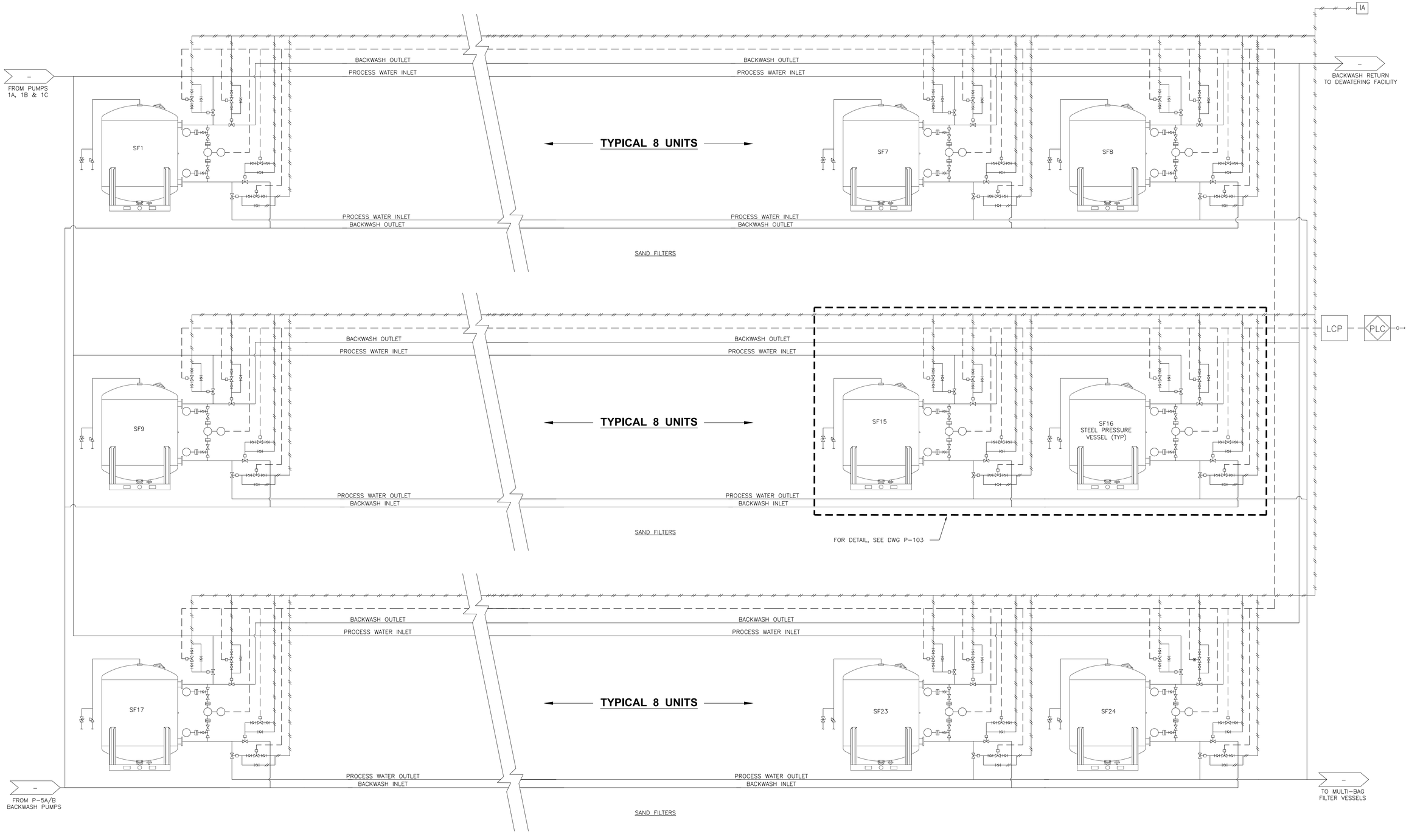
LOWER FOX RIVER PRP GROUP
GREEN BAY, WISCONSIN

LOWER FOX RIVER SITE OPERABLE UNITS 2-5
GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
(SHEET 1 OF 5)

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: 3667-P-103-REV A.DWG
SHEET - OF -
SIZE: D
P-103



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P. E. SEAL

REV	DESCRIPTION	DRN	DES	CHK	APR	DATE
A	90% DESIGN SUBMISSION	FGM	JF	JS	RF	05/12/08

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WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
(SHEET 2 OF 5)

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: 3667-P-104-REV A.DWG
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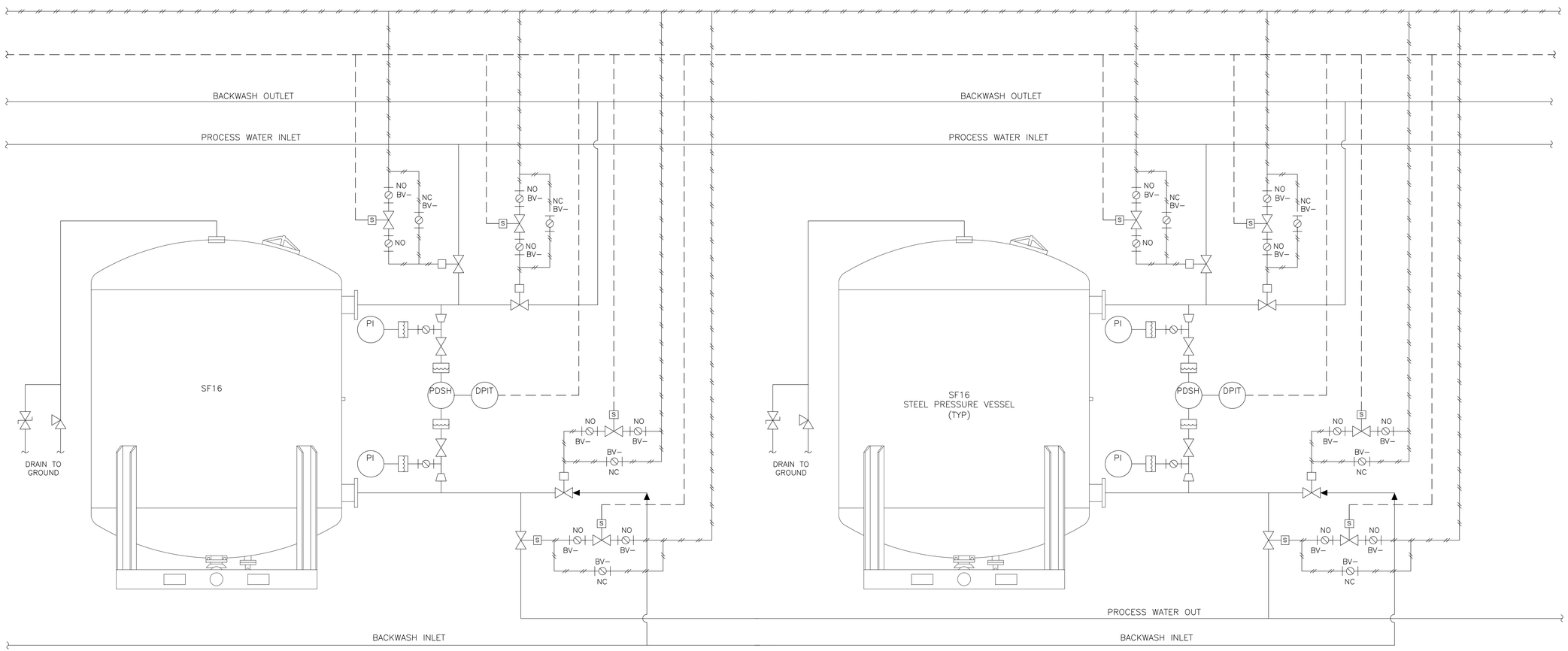
P-104



SAND FILTERS

FOR LAYOUT CONFIGURATION
SEE DWG P–102

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WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
(SHEET 3 OF 5)

CONTRACT NO.:
SPEC. NO.
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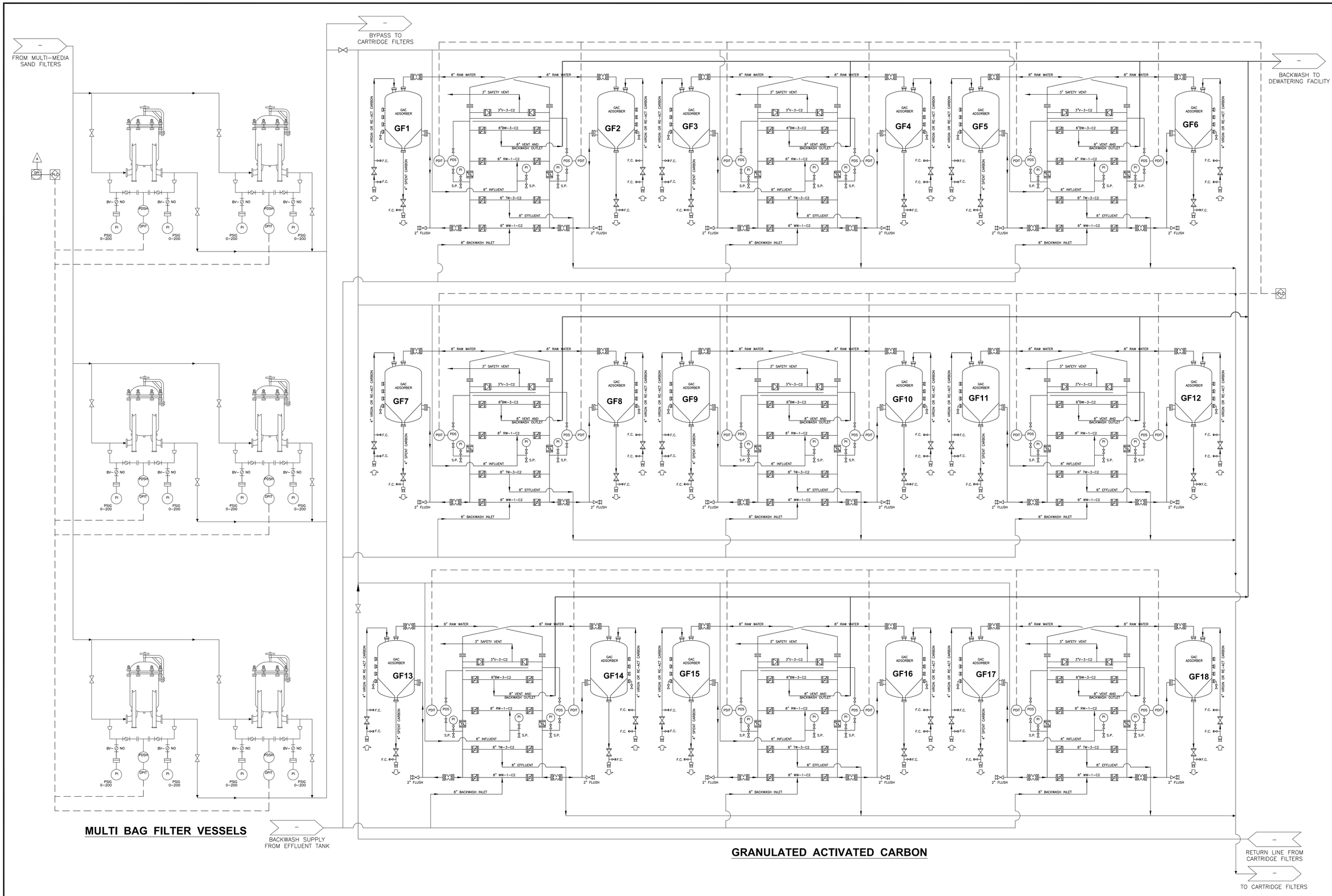
P–105



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GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
(SHEET 4 OF 5)

CONTRACT NO.:
SPEC. NO.
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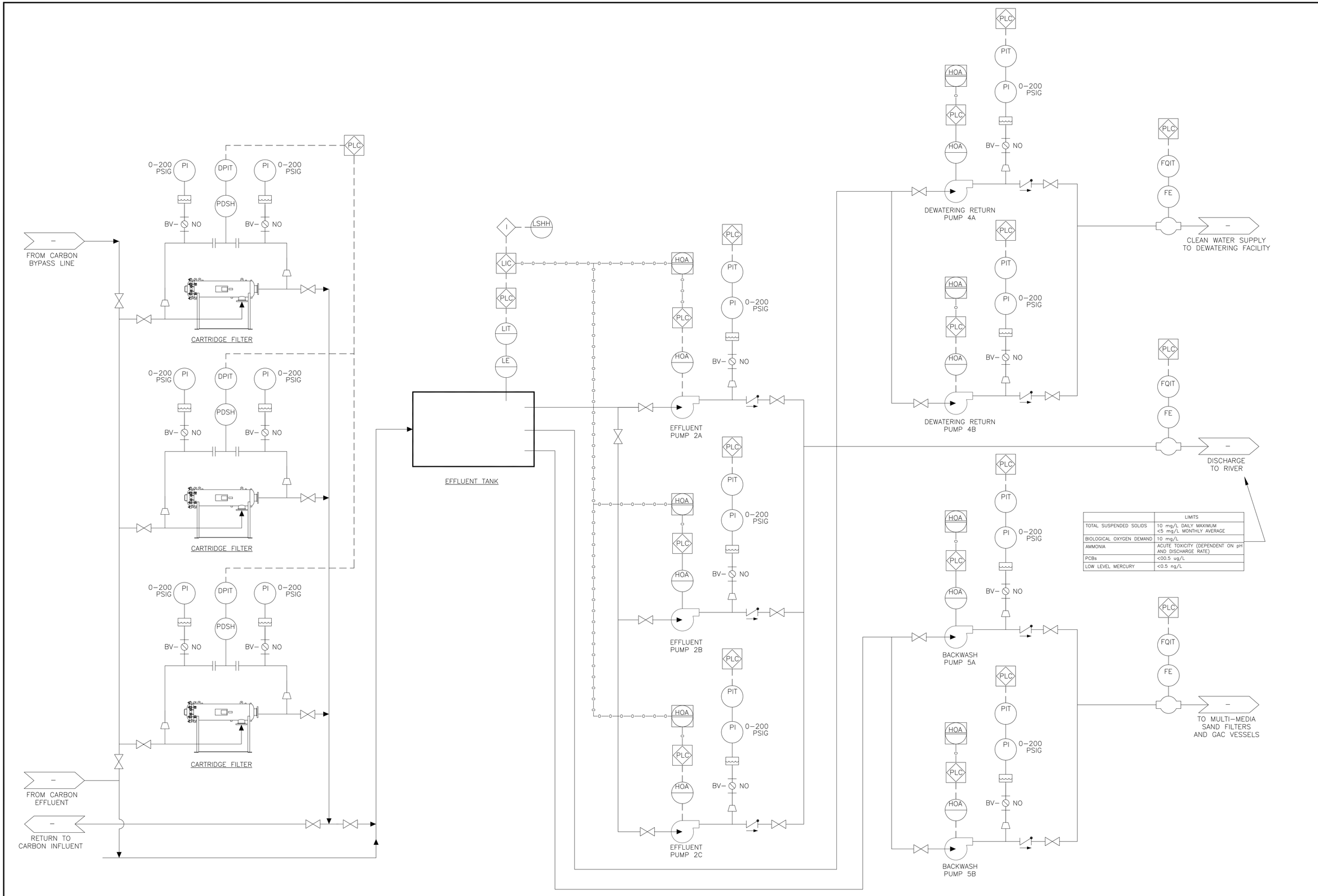
SIZE: D
P-106



	LIMITS
TOTAL SUSPENDED SOLIDS	10 mg/L DAILY MAXIMUM <5 mg/L MONTHLY AVERAGE
BIOLOGICAL OXYGEN DEMAND	10 mg/L
AMMONIA	ACUTE TOXICITY (DEPENDENT ON pH AND DISCHARGE RATE)
PCBs	<00.5 ug/L
LOW LEVEL MERCURY	<0.5 ng/L

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WATER TREATMENT PLANT DESIGN

PROCESS AND INSTRUMENTATION DIAGRAM
(SHEET 5 OF 5)

CONTRACT NO.:
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SIZE: D
P–107

ATTACHMENT D-1

SITE PREP SOW

APPENDIX C-1

Lower Fox River Remedial Design
60 Percent Design Report

Statement of Work
for
Construction of Staging Area and
Access Roads

Table of Contents

1.0 GENERAL DESCRIPTION 1

1.1 PROJECT DESCRIPTION 1
1.2 SCOPE OF WORK 1
1.3 WORK PROVIDED BY SUBCONTRACTOR 3
1.4 WORK PROVIDED BY TETRA TECH 4
1.5 SCHEDULE 5
1.6 POINTS OF CONTACT 5

2.0 TECHNICAL SPECIFICATIONS 5

2.1 CODES AND STANDARDS 5
2.2 SITE ACCESS WORK AREA 5
2.3 CONSTRUCTION 5

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
HASP	Health and Safety Plan
OU	Operable Unit
PCB	polychlorinated biphenyl
PPE	personal protective equipment
SHSO	Site Health and Safety Officer
SWPPP	Stormwater Pollution Prevention Plan
Tetra Tech EC, Inc.	Tetra Tech
TPHs	total petroleum hydrocarbons

1.0 GENERAL DESCRIPTION

1.1 PROJECT DESCRIPTION

Tetra Tech EC, Inc. (Tetra Tech) is the General Contractor for remediation of polychlorinated biphenyls (PCBs) in Operable Units (OUs) 2, 3, 4, and 5 of the Lower Fox River and Green Bay site. The site extends 39 miles from the outlet of Lake Winnebago to the mouth of the river where it discharges into the bay of Green Bay.

The project involves construction of an upland staging area for desanding, dewatering, and water treatment operations. The former Shell Oil Property adjacent to the Georgia-Pacific West Mill in OU 4 was identified as the staging area. The proposed staging area will cover about 27 acres of upland space following buildout of the shore line.

The site includes several locations where residual total petroleum hydrocarbons (TPHs) are present at low concentrations, associated with the former Shell Oil Tank Farm. The Tetra Tech Team understands, however, that TPH concentrations in this material are such that it does not pose a hazard to workers performing intrusive on-site activities. Work will be initiated in Level D personal protective equipment (PPE). Upgrades in levels of protection may need to be initiated as directed by the Tetra Tech Site Health and Safety Officer (SHSO).

1.2 SCOPE OF WORK

This statement of work defines the technical and construction requirements for site preparation activities for the upland staging area. The seven tasks required to perform this work are as follows:

Task 1: **Mobilization/Demobilization.** This task includes the work associated with moving equipment and supplies to the site vicinity prior to beginning work and moving off site after the job has been completed. This task is to be performed in accordance with the requirements of technical specification Section 01 71 13. This task also includes ensuring that all construction equipment delivered to the site is clean and free of foreign matter, cleaning around construction sites after field activities are completed, decontaminating all the equipment prior to demobilization, and conformance of subcontractor personnel with specified health and safety requirements.

Task 2: **Site Clearing and Grubbing.** This task includes removal of vegetation, debris, and other undesirable materials such as rock and obstructions from the staging area, building footprint(s), and the areas where the entrance/exit roads are to be constructed. Material that cannot be beneficially reused may be stockpiled on site prior to disposal. Disposal will be at an approved off-site location. This work is to be performed in accordance with the requirements of technical specification Section 31 11 00.

Task 3: **Subgrade Preparation.** This task includes following:

A. Remove 6 inches (typical) of topsoil for the entire width of the entrance/exit roads and stockpile material at the designated area.

B. Scarify the subgrade supporting the access road surfacing to a depth of 6 inches and recompact to 90 percent of Modified Proctor maximum dry density in

accordance with American Society for Testing and Materials (ASTM) D1557, Standard Proctor.

C. Following stripping, proof roll exposed subgrade of proposed staging areas with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas and that speeds are between 2 ½ and 3 ½ mph. When proof rolling, half of the passes made with the dump truck will be in a direction perpendicular to the other passes. In areas where pumping or excessive subgrade movement occurs, scarify, aerate, and recompact existing material as directed by the Tetra Tech Field Engineer.

D. Where subgrade soils are loose, remove to solid bearing and replace material in compacted lifts.

E. Minimize traffic over prepared surface.

F. Perform this work in accordance with the requirements of technical specification Section 31 00 00.

Task 4: Grading. This task includes grading the subgrade to meet lines, grades, and cross sections indicated on drawings. Remove unsuitable subgrade materials and fill with structural fill.

Task 5: Stockpiling.

A. Stockpile material on site at the location(s) indicated on the site layout plan.

B. The maximum height of soil stockpile(s) will not exceed 9.5 feet.

C. Different material will be stockpiled at a minimum distance of 30 feet from each other to prevent intermixing and to allow access of equipment.

D. Direct surface water away from all stockpile locations to prevent erosion or deterioration of materials.

E. All stockpiles will have sediment controls such as silt fence or other engineered controls installed around the base, in accordance with the requirements of the Stormwater Pollution Prevention Plan (SWPPP), to prevent erosion.

Task 6: Fill Placement.

A. Fill areas to meet designed lines and grades with structural fill. Use specified materials where indicated on drawings.

B. Place and compact fill materials in continuous layers not exceeding 8 inches loose depth.

C. Maintain optimum moisture content of fill materials, within Proctor tolerances to attain required compaction density.

D. Do not fill over unsuitable subgrade conditions.

E. Do not place fill materials that are frozen or contain ice or snow.

F. Suspend placing fill when the climatic conditions will not allow specified placement and fill compaction requirements.

Task 7: Compacting.

A. Compact backfill material using mechanical compactors, towed or self-propelled compactors, or hand-operated compactors.

B. Place loose backfill material in maximum 8-inch lifts prior to compaction.

C. Compact material to meet specification requirements.

D. Fill under buildings and to a point 10 feet horizontal beyond the building perimeter will be to 90 percent per ASTM D1557, Modified Proctor.

E. Perform this work in accordance with the requirements of technical specification Section 31 00 00.

1.3 WORK PROVIDED BY SUBCONTRACTOR

A list of the work that will be provided by the Subcontractor follows:

A. Construction Activities: The Subcontractor will provide supervision, labor, materials, and equipment necessary to perform work.

B. Site Housekeeping: The Subcontractor will remove from any portion of the site any material, debris, or rubbish that may interfere with the work or constitute a nuisance. All rubbish or debris derived from drilling activities will be removed daily from each drilling location at the completion of drilling operations. The Subcontractor will return the site to as nearly the original condition as is reasonably possible.

C. Compliance Standard: The Subcontractor's activities must meet all applicable state and local regulations governing construction activities and specification requirements.

D. Health and Safety: All of the Subcontractor's activities will be subject to the requirements of the Contractor’s Site Health and Safety Plan (HASP). The Subcontractor personnel must meet the requirements of this HASP and follow the guidance, rules, and regulations of the HASP to protect personnel and/or the environment.

E. Emergency/Contingency Procedures: Should it become necessary, the Subcontractor will follow and implement the Emergency/Contingency Procedures outlined in the HASP.

F. Field Activities: All activities will be conducted in an efficient and professional manner, with the minimum practical damage to the site environment.

G. Cleaning: The Subcontractor is responsible for the disposal of surplus or unsuitable material to a site designated by Tetra Tech. Special material handling may be required and should be performed as detailed in the HASP provided by Tetra Tech.

H. Security: The Subcontractor will be responsible for securing the Subcontractor's equipment and materials at the site.

I. Required Documents: The Subcontractor will furnish the following documents for Tetra Tech's review and records prior to the commencement of the project:

1. A Certificate of Compliance stating the following: "All work provided under the Contract complies with all requirements of the specification."
2. All required federal, state, and/or local permits
3. Documents identifying any deviations
4. Schedule of Value
5. Copies of health and safety training certificates, medical certificates, and any other documentation of Subcontractor's personnel required by the HASP
6. All Terms and Conditions set forth in the subcontract

J. Protective Equipment and Clothing: It is assumed that the work will be conducted in Level D PPE. The Subcontractor will supply all of the necessary equipment and clothing for Level D. Additional pricing for possible upgrades from Level D to Modified Level D and Level C PPE should be included in the price form.

K. Designated Areas: Tetra Tech will designate parking, equipment storage, and personnel areas.

1.4 WORK PROVIDED BY TETRA TECH

The work to be provided by Tetra Tech includes the following:

A. Site Access: Access to all locations will be arranged by Tetra Tech prior to commencement of work. Tetra Tech will also contact all utility owners at the site and clear the construction area through them. No Subcontractor personnel or equipment are to enter any location without first obtaining clearance from Tetra Tech.

B. Work Direction: Tetra Tech will mark the construction limits. Locations of underground utilities (pipes, conduits, etc.) will be marked by utility locators before the Subcontractor begins work at these locations. The Subcontractor is responsible for verifying these locations and the performance of the locating activities before beginning work.

C. Quality Control: Tetra Tech will inspect the work in progress and at completion to ensure compliance with the specification. Any documentation verifying that compliance to the specification has been met, such as testing or surveyor, will be submitted to Tetra Tech for confirmation.

D. Health and Safety Monitoring: Tetra Tech provides management and oversight responsibilities over all health and safety activities. Tetra Tech's responsibilities include authorizing persons to enter or work at the site, establishing levels of

protection for operating personnel, conducting environmental monitoring for health and safety purposes, and supervising the adequacy of field procedures. The Subcontractor is responsible for ensuring all health and safety requirements are met.

E. Site Engineer: Tetra Tech will provide a Site Engineer to observe and to document daily activities. The Subcontractor will generate a Daily Activity Report to be given to the Site Engineer no later than the day following the occurrence of the activity.

1.5 SCHEDULE

The dates proposed for the services are anticipated to begin in June 2008.

1.6 POINTS OF CONTACT

- The Tetra Tech Project Manager for this Project is Ray Mangrum, who can be reached at (770) 825-7100, Cell: (713) 876-8528, or via email at ray.mangrum@tteci.com.
- The Tetra Tech Construction Manager for this Project is Michael Estess, who can be reached at (803) 646-0938, or via email at Michael.estess@tteci.com.
- The Tetra Tech Lead Civil Engineer for this Project is Josh Singer, who can be reached at (617) 457-8270, or via email at josh.singer@tteci.com.
- The Tetra Tech Procurement lead for this subcontract is Vanessa Paolini who can be reached at (262) 781-3992, or via email at Vanessa.paolini@tteci.com.

2.0 TECHNICAL SPECIFICATIONS

2.1 CODES AND STANDARDS

In addition to the codes and standards for the performance of the field effort specified in this document, the Subcontractor will comply with applicable state and local ordinances, laws, and regulations. Any modifications to the standards specified herein must be approved by Tetra Tech.

2.2 SITE ACCESS WORK AREA

Access to the project site will be provided through Tetra Tech. The Subcontractor will be responsible for the storage and security of its own equipment. The Subcontractor will be responsible for containerizing any debris and wastes requiring isolation and for transporting wastes off site for disposal.

2.3 CONSTRUCTION

The Subcontractor will supply construction crew and equipment; Tetra Tech will supply a Field Engineer and SHSO. The Tetra Tech Construction Manager will supervise construction operations.

ATTACHMENT D-2

SHELL SITE PREP

APPENDIX C-2

Lower Fox River Remedial Design
60 Percent Design Report

Site Preparation Work Plan

Former Shell Site CY 2008-09

Table of Contents

1.0 INTRODUCTION **1**

2.0 SITE LOCATION **1**

3.0 PERMITS, RELEASES, AND APPROVALS **1**

4.0 GENERAL ACTIVITIES **1**

4.1 SITE SUPPORT FACILITIES 1
4.2 DEBRIS REMOVAL 2
4.2.1 Land Areas *2*
4.2.2 Debris Removal – Shore and Fox River Areas *2*
4.3 REMOVAL OF EXISTING UTILITIES 2
4.4 EXISTING ASPHALT AND CONCRETE PAVING 3
4.5 FILLING AND GRADING 3
4.6 WATER RUNOFF CONTROLS 3
4.7 DRIVE SHEET PILING 4
4.8 UTILITIES 4
4.9 PROJECT OUTFALL AND DISCHARGE LINE 4
4.10 RADIO TRANSMITTERS 4
4.11 SECURITY 5
4.12 BUILDING FOOTPRINTS AREAS 5
4.12.1 Stockpile and Yard Areas *5*
4.13 FIRE PROTECTION DURING SITE PREPARATION 6
4.14 SITE ROADS 6
4.15 EQUIPMENT FUELING 6
4.16 DOCK LIFT PAD FOUNDATION FOR CRANE 7
4.17 PUG MILL 7
4.18 DECONTAMINATION 7

List of Figures

Figure G-01. Master Site Layout with Phase 1 Grading

1.0 INTRODUCTION

The purpose of this Work Plan is to provide a summarized narrative on the approach to the Site Preparation Work at the State Street Shell Site during the 2008 and early 2009 calendar years. Detailed requirements are contained in the project specifications, drawings, and schedules that will be finalized in the 100 percent designs.

Site preparation includes all the activities to clear the site of prior use materials and vegetation; filling, cutting, grading, and compacting soils and other fill materials; maintaining stormwater and runoff controls; installation of underground utilities; preparation of foundation areas; installation of site security fencing and lighting; and construction of road and storage areas.

2.0 SITE LOCATION

This plan addresses the site preparation at the former Shell Oil facility, located at 1505 State Street, Green Bay, Wisconsin 54301. This is a former petroleum storage facility location consisting of approximately 22 acres. The site was operated from 1940 to 1980, with surface equipment removed in 1988 and 1989. In 1999 and 2000, the site was used as the staging area for a dredge process area for the SWMU 56/57 project. For this operation, the area near State Street was paved with asphalt and used as a storage and dewatering area, and two wastewater storage basins were constructed in-line to the east of the pad. Upon completion of this work, the site was left vacant and currently has numerous trees, brush, and vegetation going to the Fox River bank.

In preparation for the construction of the waste processing facilities and sand storage area, the site will be cleared, leveled, and prepared for use. The clearing, preparation, and construction at the Shell site will take place in 2008 and early 2009 to support the active removal of contaminants from the affected river areas. A drawing of the property showing the planned facilities over the existing features can be found as Figure G-01.

3.0 PERMITS, RELEASES, AND APPROVALS

Prior to the start of site preparation, all required permits will be in place and project personnel made aware of the provisions and conditions. Permits required include:

- Building permits
- Stormwater Pollution Prevention Permit
- Curb Cut Permits

Any other permits required will be acquired as they are identified. Inspections by local and other officials will be coordinated to ensure that they are not overlooked or do not delay work.

4.0 GENERAL ACTIVITIES

4.1 SITE SUPPORT FACILITIES

A mobile office trailer will be placed on site during mobilization to allow project personnel to be at the site. As work progresses, additional permanent trailers will be added to support the work crew on site. The trailer(s) will be electrically powered. Portable restroom facilities will be placed on site and increased in number as the workforce grows. The temporary trailers are

expected to remain on the site until the process facility offices are completed in early 2009, at which time the temporary trailer(s) may be demobilized and removed from the site.

Worker parking will be delineated on existing paved areas away from heavy equipment working during the site preparation and will be moved as necessary until the permanent parking is completed.

4.2 DEBRIS REMOVAL

4.2.1 Land Areas

The unpaved area of the site is currently littered with miscellaneous pipe, concrete, scrap soil piles, vegetation, and piling materials. Numerous trees, brush, and other materials have grown up. Along the river, the remains of an old dock (piling with caps, abandoned piling, and other debris) are in or near the river.

A boundary line access will be opened on the property line and silt fencing installed to prevent waterborne runoff from the site. Drainage areas will be benched; retained with silt fences, hay bales, and/or erosion control mats; and prepared to retain water and prevent silt runoff into the river. The trees and vegetation will be cut or pushed over and chipped. The chipped materials will be stockpiled for later use on ground cover and runoff control. Pipe and other miscellaneous debris will be gathered and stockpiled for scrap sale or disposal. Concrete foundations, rock, gravel, boulders, and the like will be removed and sized using conventional equipment and stockpiled for later use as backfill on site or properly disposed of at the appropriate facility. Clearing of the site will focus on the building area (property near State Street) first in order to allow the building construction to commence.

Efforts will be made to maintain ground cover in order to reduce the potential for dust or waterborne runoff. Areas may be mulched, receive temporary seeding, etc., as needed.

This work is to be performed in accordance with the requirements of technical specification Section 31 11 00.

4.2.2 Debris Removal – Shore and Fox River Areas

On the riverfront area, debris, old piling and caps, and other debris will be removed from the shore and out in the Fox River in preparation for a sheet pile dock wall that will be installed. The removed materials will be collected and disposed of in a manner similar to that used for the land areas.

4.3 REMOVAL OF EXISTING UTILITIES

Currently an energized power line extends east to west on the southern portion of the site from State Street. There are also a series of light poles around the perimeter on the State street side of the site.

The powerline will be deenergized and removed. The poles will be retained for possible reuse. The light poles will also be de-activated and removed; again, these will be retained for possible reuse.

A stormwater line extends onto the site from the asphalt paved area near State Street and is believed to end at the river with an intermediate line draining a low area at the river. This line was believed to have been closed off in the past but may have been reopened. This line will be

disconnected and blocked (if not already so) before the portion at the river's edge. The remainder of the pipe will be either filled or removed.

An underground petroleum line runs along the edge of the site along State Street. This line is currently inactive. This line will be located and protected during the installation of other utilities. The depth will be confirmed but it is currently believed to be at a depth sufficient that truck traffic and other loadings will not affect it.

4.4 EXISTING ASPHALT AND CONCRETE PAVING

Asphalt and concrete paving exists on several areas of the site. The area of the existing asphalt pad that lies in the footprint of the process facility will be removed and stockpiled for later possible road construction. The stockpiles will be bermed or channeled to a retention area to prevent rainwater runoff sheens from moving off site. The concrete will be broken and sized for use as fill in other areas of the site. Concrete piers, miscellaneous slabs, and other structures will also be removed, sized, and stockpiled for later use.

4.5 FILLING AND GRADING

Detailed quantities of on-site fill required have not been finalized. It is currently believed that current on-site materials will not provide adequate volumes for filling and leveling the site, and additional clean fill material will have to be imported to meet final grades. The building area will be filled, leveled, and compacted first to expedite the building construction. Other areas of the site will be graded, filled, and compacted later to provide areas for storage areas, roadways, and laydown areas. Compaction and materials specifications are contained in the specifications.

The area between the new sheet pile dock wall and the existing river shoreline will be filled to provide equipment staging areas. The area will be filled with sand generated from the processing of dredge materials deemed sufficient for beneficial reuse, or excess inert materials from the remainder of the property. If additional materials are required for any area, clean fill will be imported from local suppliers.

Throughout the grading and filling, drainage runoff controls will be maintained to prevent stormwater from entering the Fox River. As larger areas are completed they will be mulched or seeded or finished with final surfaces.

This work is to be performed in accordance with the requirements of technical specification Section 31 00 00.

4.6 WATER RUNOFF CONTROLS

Stormwater runoff will be controlled in accordance with the Stormwater Pollution Prevention Plan and best management practices to prevent movement off site of sediment due to stormwater from disturbed soil areas. When unprotected soils are exposed during site preparation, stormwater runoff will be controlled by drainage into temporary retention areas for absorption and/or discharge at the 2-year 24-hour predevelopment rate and with silt fences and temporary seeding or mulching. Current plans for stormwater retention are being finalized. Stormwater from process areas and storage areas containing potentially contaminated materials will be collected and processed through the water treatment system for discharge to the Fox River. From areas that are clean, such as the gutters of the process plant building and other areas containing clean materials, stormwater will be collected and discharged to the City of Green Bay stormwater system. The retention systems will be sized and tentatively placed below other non-

building areas and would be installed during the site preparation. Additionally silt fence will be installed as needed and maintained to control run-off and drainage during the life of the project.

4.7 DRIVE SHEET PILING

Sheet piling will be installed according to the project specifications and locations shown on the design drawings. Approximately 1,500 feet of sheet piling will be driven after removal of the shore and near-in debris. Fill for the area between the sheet pile and existing shoreline will include some excess site materials and sand generated from the processing of dredge material deemed acceptable by the regulatory agencies for beneficial reuse. Sheet pile design details and supporting information have been prepared and submitted separately for regulatory approval.

This work is to be performed in accordance with the requirements of technical specification Section 31 41 16.

4.8 UTILITIES

Utilities will be located, tapped, or connected and brought to the connect points by the responsible local utilities. Utilities will be kept underground whenever possible to avoid overhead hazards and to prevent damage to the utilities. During the site preparation these utility lines will be installed (or prepared for installation) with water, gas, electric, and sanitary sewer brought into the site and terminated at the building connect points. Utilities planned are:

- Locate electrical substation/transformers to tap in points
- Locate and run potable water to tap in
- Locate and run sanitary sewer to tap in
- Locate phone to tap in
- Natural gas to tap in
- Potable water and fire protection water supplies
- Yard area lighting (conduits)
- Sanitary sewer

Utility tie-in points will be identified on the detailed drawings for the site preparation and building areas.

4.9 PROJECT OUTFALL AND DISCHARGE LINE

The process will treat water to permit requirements and discharge this water to the Fox River via a discharge line and outfall. This discharge line will be installed after other site preparations are completed. The outfall and discharge line will be installed in accordance with the specifications and drawings. Approval for this discharge will be obtained from the Wisconsin Department of Natural Resources.

4.10 RADIO TRANSMITTERS

Due to the large area that personnel will be working during the project, provisions for radio communications will be needed including FM and Marine frequencies. It is anticipated that needed antennas can be mounted on the main building. If a separate antenna structure is needed, it will be installed according to design drawings and specifications, along with permit conditions.

4.11 SECURITY

Currently security fencing and gates exist on the project site facing State Street and along the property line to the north. These will be left in place during the early part of construction to provide interim site security. Later in the construction phase, the existing fencing will be removed in certain areas to allow for new gates to be installed. Existing fencing is a 6-foot chain-link fence enclosing three sides of the site and will remain in place (with the Fox River side left open). Four gates from State Street onto the site will be established, including two for heavy truck and other traffic entry and exit, with the two existing gates in the center of the fence line to be exclusively for worker vehicle parking. The gates will be closeable during off-work hours and controlled during work hours. The heavy vehicle exit will have an auto-opening gate to prevent traffic from entering, and the heavy vehicle entrance will be controlled from a portable structure security building. Conduits for powering the gates and security shed will be installed during the site preparation. Curb cuts, turn radius, and traffic controls will be included in the specifications and permits from the City of Green Bay.

Security lighting will be installed on the site. During the initial site work, several area lights will be installed near State Street around the construction trailer area. Later in the construction, permanent security and yard area lighting will be installed. Lighting will be focused for on-site lighting. Parking and yard lighting will be sufficient for general work, and reduced lighting will be used during non-working hours for security.

4.12 BUILDING FOOTPRINTS AREAS

Geotechnical data have been obtained by drilling in the building area, and foundation designs are in process. Site preparation of the building area will be dependent on the selected foundation (spread footings, piling, etc.). The general area will be cleared of any surface and subsurface obstructions, graded and compacted in advance of the foundation work to provide a stable working area. Elevations and related information will be per the building construction specifications and design and the Building Foundation and Building Erection Plans.

4.12.1 Stockpile and Yard Areas

Any storage areas that are planned to have, or could potentially have, Toxic Substances Control Act materials stored on them will have geosynthetic liners installed under them with upturned edges. The liners are impermeable and will prevent any spillage or releases from migrating downward. Liners will be covered with a sand layer and a marker material placed, then covered with additional gravel materials. The marker material will serve as a visual warning to operators and others that a liner is below to prevent damage. The stockpile areas will be surfaced with compact crushed base coarse material to provide a firm and uniform surface.

The stockpile storage areas will be constructed to reduce or prevent runoff and windblown dust. Stockpiles are expected to be constructed with low slopes with approximate 50-foot separations to allow for drainage and to prevent mixing. Alternatively, to increase capacity barriers or walls to form bunkers (sheet piling, ecology blocks, or precast concrete panels) may be installed. For materials that may be fine enough to become windblown, the piles will be treated with crusting agents applied with a water truck to lock down the particles.

Much of the material may be moved using conveyor belts, which will reduce traffic in the stockpile area and will also reduce the generation of dust.

The stockpile areas will have mild slopes for drainage and control of water.

4.13 FIRE PROTECTION DURING SITE PREPARATION

Fire protection during the early site activities will include controls to prevent fires from starting and means to control or extinguish them if they should occur.

The greatest fire hazard on the project will be the existing dead vegetation that covers much of the site. Removal of this material will occur in the spring and early summer timeframe before the materials have had time to dry out. No open burning will be allowed on the site, and activities that could initiate a fire, such as welding or other hot work, will be limited to areas that are 50 feet or more from combustible materials.

Refueling of heavy equipment will take place away from vegetation areas. All heavy equipment, trucks, and light vehicles will be equipped with a fire extinguisher that can be used to control small fires.

If a fire should ignite on the project site, the local fire department will be called to respond. Emergency phone numbers along with 911 numbers are posted on the site. The site will also have a water truck available for wetting down areas for dust control as well as fire prevention. The water truck can also be used to assist the local fire department in extinguishing a fire.

4.14 SITE ROADS

During the initial stages of construction, on-site roads will be located for convenience and graded as needed. As the site preparation continues and underground work is completed, the permanent site roads will be constructed. Road subgrades will be constructed and tested in conformance with the design specifications and drawings. When required, road beds will be reinforced with geosynthetic fabrics and materials.

Dust control will be maintained during the early stages of construction using water trucks. Water additives will be used if needed to further lock dust particles and prevent them from becoming airborne.

Roads around the processing building and parking lots will be hard surfaced (asphalt or concrete). Roads in the yard and stockpile areas will be base course gravel surfaces. Recycled asphalt pavement may be placed on some of the yard roads to further reduce dust generation and mud tracking. The location and elevations of the roads will be defined in the final design documents and constructed as early as possible to support construction of the other facilities. Roads traveled by trucks and heavy equipment will be a minimum of two lanes wide, and will be one-way whenever possible for safety purposes.

The proposed layout of the roads is depicted on Figure G-01. Specifications are included in the Project Plan that is contained in the Design Report. This work is to be performed in accordance with the requirements of technical specification Section 31 00 00.

The Transportation Plan will address traffic controls both on site and off site for the safety of the project workers and the general public. During site preparation, Tetra Tech will be working with the city to enhance traffic control, including possible turn lanes into and out of the site.

4.15 EQUIPMENT FUELING

Heavy equipment on site during the site preparation and clearing will be refueled from light vehicle mounted transfer tanks, with fuel being procured from off site. Equipment services for

lubrication will require that used oil be removed from the site for recycling and that filters and other materials be disposed of in accordance with local regulations.

Dependent on fuel needs during operations, a fueling area may be established towards the end of the site preparation. On-site fueling includes use of double-walled tanks, lined fueling pads, and appropriately rated grounding and pump systems in accordance with the Spill Prevention, Control and Countermeasures Plan.

4.16 DOCK LIFT PAD FOUNDATION FOR CRANE

Capability to lift barges and other equipment related to the dredging process into and out of the waterway will be required. A crane will be brought to the site and set up when these activities are required. The crane will require a stable and level site adjacent to the water from which to operate. The design of the crane pad will be finalized during the 100 percent design. Dependent on the design and location, the pad may require piling or large spread foundations.

4.17 PUG MILL

A pug mill may be used to blend sands and additives. There are no special provisions for preparation since foundations are relatively minor and the units are typically engine powered. Electrical power to operate the additives silo (carbon), supporting conveyor belts, and other equipment will be routed underground to the area.

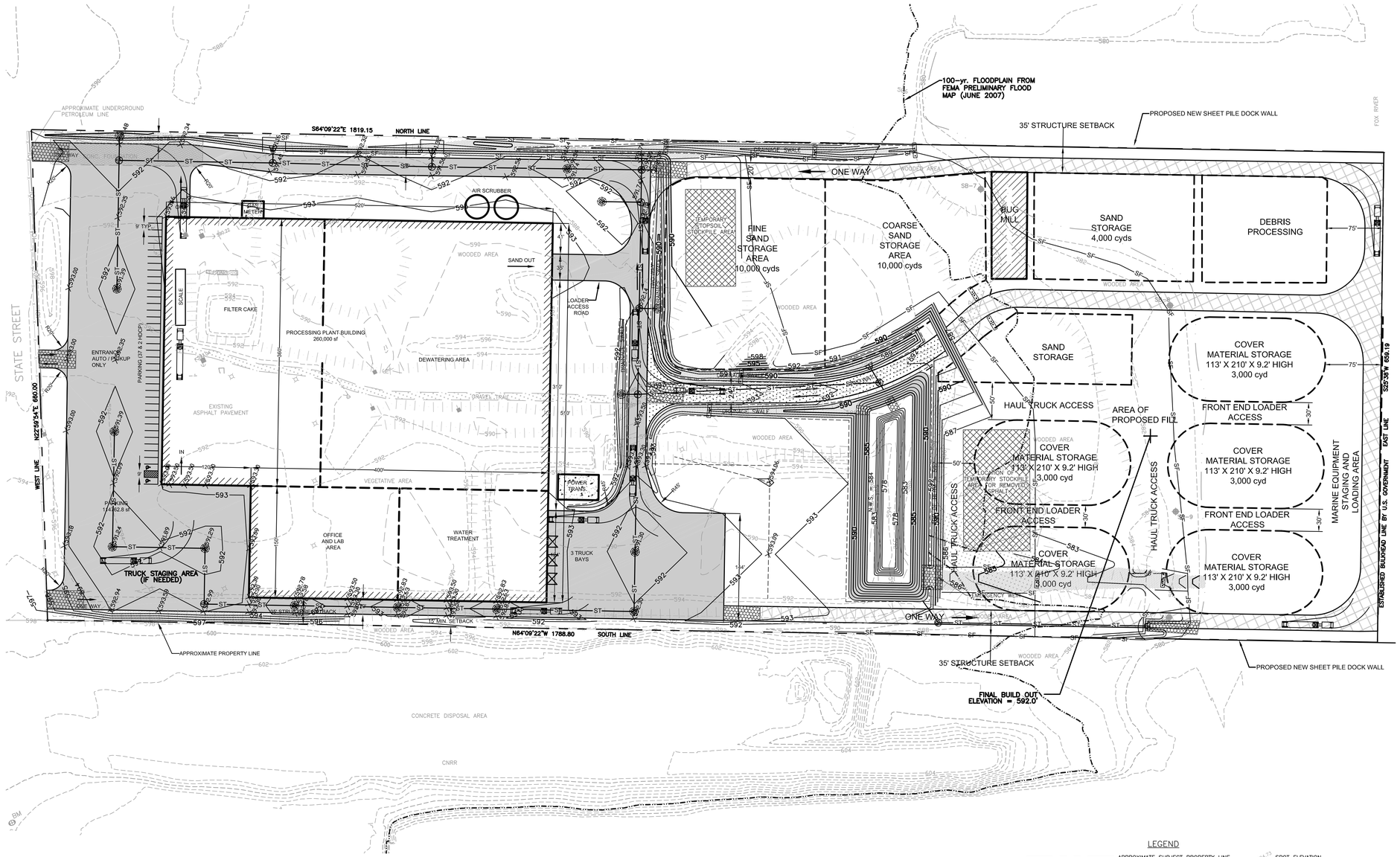
4.18 DECONTAMINATION

Equipment that has been in contact with polychlorinated biphenyls (PCBs) or with other contaminants or organisms will require decontamination and cleaning prior to release from the project. Heavy equipment and other mobile equipment will be decontaminated over an established decontamination area. For non-mobile equipment, such as barges, temporary decontamination liners will be put in place to collect all decontamination liquids and solids for treatment. Decontamination equipment will include high-pressure and steam cleaners as well as hand tools. Temporary enclosures will be available to place around equipment to protect from wind, low temperatures, or other inclement weather.

For water craft or equipment that has been in the water where viral hemorrhagic septicemia is a concern (either incoming or outgoing), after draining of all water (bilges, tanks, etc.) the decontamination will include a cleaning with a detergent followed by a disinfectant solution followed by drying.

Trucks hauling materials to disposal will go through an external wash prior to release from the site.

Figures



BENCHMARK
BM-1 INTERSECTION OF LIBERTY STREET AND STATE STREET NGS DISK ON THE TOP OF A COPPER COATED STEEL ROD AT GROUND LEVEL ELEVATION = 598.21

EXISTING SITE INFORMATION DATA
EXISTING SITE AREA = 1,188,498 SQ.FT. (27.284 ACRES)
EXISTING PAVEMENTS AREA = 153,473 SQ. FT. (3.523 ACRES)
EXISTING GRAVEL AREA = 32,397 SQ. FT. (.744 ACRES)
EXISTING WOODED AREA = 320,985 SQ. FT. (7.369 ACRES)
EXISTING GREENSPACE = 489,203 SQ. FT. (11.231 ACRES)

PROPOSED TOTAL SITE INFORMATION DATA
TOTAL SITE AREA = 1,188,498 SQ.FT. (27.284 ACRES)
PROPOSED PAVEMENTS AREA = 166,121 SQ. FT. (3.814 ACRES)
PROPOSED ROOF AREA = 247,200 SQ. FT. (5.675 ACRES)
PROPOSED GREENSPACE = 502,543 SQ. FT.(11.537 ACRES)
PROPOSED POND AREA = 14,095 SQ. FT. (0.324 ACRES)
TOTAL AREA OF DISTURBANCE = 762,300 SQ. FT. (17.5 ACRES)

N

50 0 50 100
1" = 50'

"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 PROPERTIES UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

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

WIS STATUTE 182.0175(3)(4)
REQUIRES NOT 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE

LEGEND

- APPROXIMATE SUBJECT PROPERTY LINE
- SECTION LINE
- LOT LINE
- EASEMENT LINE
- EDGE OF WATER
- 2' CONTOUR
- 10' CONTOUR
- FENCE LINE
- TREE LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- UNDERGROUND PHONE LINE
- WATER LINE
- UNDERGROUND GAS LINE
- UNDERGROUND ELECTRIC LINE
- OVERHEAD ELECTRIC LINE
- CONCRETE PAVEMENT
- GRAVEL
- PROPOSED ASPHALT
- PROPOSED GRAVEL (PHASE 1)
- PROPOSED GRAVEL (PHASE 2)
- PROPOSED BUILDING
- SPOT ELEVATION
- SANITARY MANHOLE
- STORM MANHOLE
- ROUND CATCH BASIN
- CURB INLET
- UNKNOWN MANHOLE
- FIRE HYDRANT
- WATER VALVE UNDERGROUND
- LIGHT POLE
- POWER POLE
- POWER & LIGHT POLE
- GUY WIRE
- ELECTRIC MANHOLE
- TRAFFIC SIGNAL
- ELECTRIC BOX / PEDESTAL
- TRAFFIC SIGNAL BOX
- TELEPHONE PEDESTAL
- GAS METER
- SIGN
- BOLLARD
- WHEEL STOP
- FOUND IRON PIPE
- SET IRON PIPE
- TREE & APPROXIMATE SIZE
- BUSH / SHRUB

CAD FILE: JRSpipeline1-Figure G-01.dwg

G:\106-3667.2008.02 Design-(Fox River)\STS UPDATES-MAY 29\STS Prop Site Layout-Figure G-01.dwg, 6/10/2008 10:40:48 AM, STS-PIPELINES-Adobe PDF.pc3

ANCHOR ENVIRONMENTAL, L.L.C.

TETRA TECH

Figure G-01

Master Site Layout with Phase 1 Grading

Lower Fox River-OUs 2 to 5

ATTACHMENT D-3

LITTLE RAPIDS SITE PREP

APPENDIX C-3

Lower Fox River Remedial Design
60 Percent Design Report

Site Preparation Work Plan

Little Rapids Dam Area

2008 and 2009

Table of Contents

1.0 INTRODUCTION **1**

2.0 SITE LOCATION **1**

3.0 PERMITS, RELEASES, AND APPROVALS **4**

4.0 GENERAL ACTIVITIES **4**

4.1 SITE ACCESS 4
4.2 CLEARING, GRUBBING, AND DEBRIS REMOVAL 4
4.3 GRADING AND LEVELING 5
4.4 TEMPORARY FACILITIES 5
4.5 UTILITIES 5
4.6 TRAFFIC CONTROL – ONSITE ONLY 5
4.7 STOCKPILE AREAS 5
4.8 FUELING 5
4.9 SECURITY 5

List of Figures

FIGURE 1. SITE LOCATION BEFORE CONSTRUCTION 2
FIGURE 2. SITE LOCATION AFTER CONSTRUCTION 3

1.0 INTRODUCTION

Year 2008 of the project will involve development of the project site and mobilization of dredge plant materials later in the year. In year 2009, access site work will include mobilization of dredging equipment, setting up the barge loading dock, and dredging in the Operable Unit (OU) 2 and OU 3 areas. Years 2010 through 2012 will require capping activities at upriver locations that are substantial distances from the Former Shell Property Staging Area, particularly for work in the upper OU 2 and OU 3 areas. In order to minimize the need to navigate the locks at the De Pere Dam and reduce capping material transportation time, a facility will be established upriver to receive, store, and transfer capping and cover materials as well as armored cap materials to the distribution barges. The facility would receive capping materials delivered by truck and deposited into various stockpiles. Barges would be docked and loaded by conveyor or other means with capping materials. No treatment or handling of contaminated wastes would occur at this site.

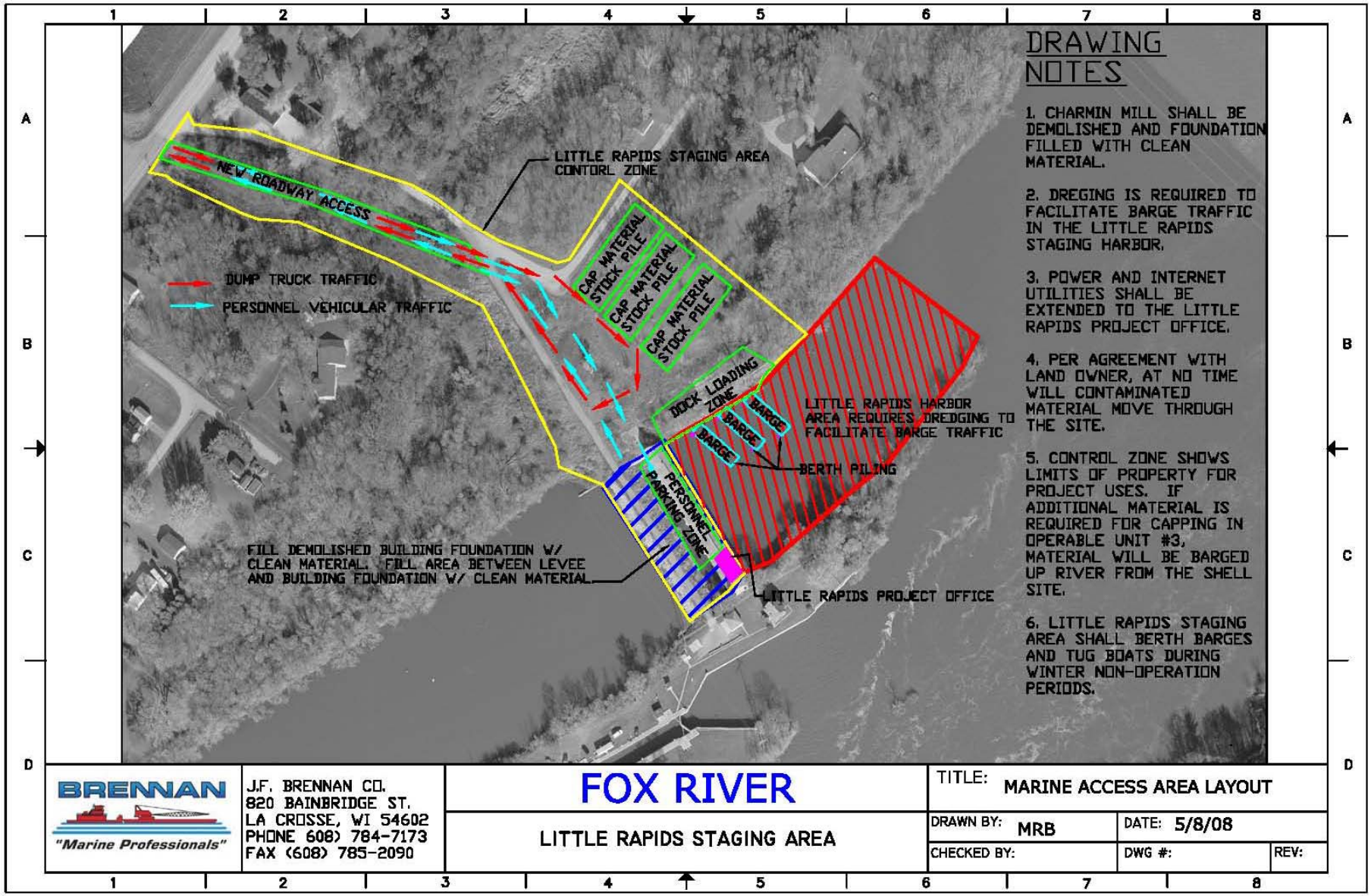
A site near the Little Rapids Dam area known as the Van Den Heuvel Property has been identified as an optimal location. At this time, several surveys related to the leasing agreements are underway (e.g., archaeological, historical, and land surveys). This document is written under the assumption that rights to use the Van Den Heuvel Property will be acquired.

2.0 SITE LOCATION

The Van Den Heuvel Property is also known as the Little Rapids Dam Area site. The property is located on the north side of the Little Rapids Dam and Lock area and accessed from Lost Dauphin Road. The total property includes a causeway across a dam, an older mill building below the dam, and a residence. Current plans are to lease part of the property to establish aggregate materials storage areas and barge loading. Figure 1 shows an aerial photo of the site before construction work, and Figure 2 is a photo with an overlay showing the project facilities.

Figure 1. Site Location before Construction

Figure 2. Site Location after Construction



3.0 PERMITS, RELEASES, AND APPROVALS

Activities are currently underway to prepare for permit applications, survey, and reviews for:

- Historical site reviews
- Site development plan
- 401 water quality certification for dredging and filling, if applicable
- 404 submittal site activities (U.S. Army Corps of Engineers)
- Chapter 30 submittal site activities (Wisconsin Department of Natural Resources)
- Building demolition review
- Excavation permits
- Local county and township permitting as required
- Stormwater discharge Notice of Intent plan
- Access road construction and drainage plan
- Lead sampling of soils and building structure
- Additional wetland delineation review of access site

If additional permits are identified, they will be acquired before the controlled work is initiated.

4.0 GENERAL ACTIVITIES

4.1 SITE ACCESS

The current access road is steep, narrow, and rough and will require improvement. An alternate route from the site would involve construction of a new access road that would provide a safer Lost Dauphin Road entrance and exit; however, the new access road would require filling across a lowland depression (possible wetlands).

Roads into the site will be approximately 25 feet wide (two-lane), crowned for drainage, and surfaced with gravel roadbase materials. Side ditches will be seeded to prevent silt runoff or erosion. The Transportation and Disposal Plan will address signage, turn lanes, etc., on Lost Dauphin Road.

Access to the dam area, causeway, and residence areas will be maintained. If the proposed new access road is developed, the existing road to the residence may be rerouted and separated from the site to avoid commingling of traffic.

This work is to be performed in accordance with the requirements of technical specification Section 31 00 00.

4.2 CLEARING, GRUBBING, AND DEBRIS REMOVAL

The site is currently covered with numerous trees and brush that will be cleared using construction equipment. Trees and other materials will either be chipped for later use or hauled offsite for disposal.

Concrete foundations, brick, and other former building debris will be removed and used for fill in lower areas, covered in place, or removed for offsite disposal.

This work is to be performed in accordance with the requirements of technical specification Section 31 11 00.

4.3 GRADING AND LEVELING

The proposed site has substantial elevation changes that will require cutting and filling to prepare the site for use as a storage area. Surveys are in progress, and the soil balance will be maintained to avoid the importing of additional fill materials.

The surface of the storage areas will be covered with a compacted base course material to prevent contamination of the stored materials with the native soils.

Silt fences will be installed prior to the start of clearing and earthwork and will be maintained throughout the use of the site. The site drainage will be controlled during the earthwork to prevent silt and stormwater runoff from entering the Fox River.

Barges will be loaded using conveyors or directly by loader. Current plans on the river shoreline will include cutting of trees and other brush to allow movement of the material barges and leaving the remainder of the shoreline undisturbed.

4.4 TEMPORARY FACILITIES

The site will be unoccupied for significant periods and will have only limited personnel onsite during active use to receive materials and assist in barge loading operations. A small site trailer is anticipated, with portable restroom facilities for site personnel.

Parking areas will be near the trailer and outside the active work area.

4.5 UTILITIES

Electric power is present on the site and will be used for the temporary trailer, security lighting, etc. No other utilities are anticipated.

4.6 TRAFFIC CONTROL – ONSITE ONLY

Offsite traffic control will be included in the project Transportation and Disposal Plan.

Onsite traffic will be limited to the capping materials, delivery trucks, and a limited number of workers. Onsite traffic controls will be speed limits (to help control dust generation and to provide safe turnaround), dumping, and exit paths using one-way loops whenever possible. In addition, stop signs will be placed for all directions at all intersections.

4.7 STOCKPILE AREAS

The stockpiles will be stacked using either stacker conveyors or loaders. Separation will be maintained between the stockpiles to minimize commingling of the materials. To optimize space, concrete barriers may be used in some areas. Silt fences will be installed in the drainage lines to filter any sheet drainage from the stockpile areas.

4.8 FUELING

Only limited equipment will be onsite, and it is anticipated that this equipment will be fueled either by a fueling service or by use of light, vehicle-mounted fuel transfer tanks with fuel purchased locally.

4.9 SECURITY

The site will not contain hazardous or high-value equipment or materials and is therefore a low security risk. Site security will include a pole or trailer area light and a gate or other closure at the Lost Dauphin Road entrance to the storage area.

ATTACHMENT D-4

BUILDING FOUNDATION WP

APPENDIX C-4

Lower Fox River Remedial Design
60 Percent Design Report

Concrete Foundation Work Plan

Table of Contents

Section **Page**

1.0 INTRODUCTION....1

1.1 PROJECT BACKGROUND....1
1.2 CONCRETE FOUNDATION DESCRIPTION....1

2.0 DESIGN REQUIREMENTS....1

3.0 FIELD ACTIVITIES....2

3.1 PREPARATION OF SURFACES....2
3.2 FORMWORK....3
3.3 REINFORCEMENT....3
3.4 JOINTS....3
3.5 CONCRETE PLACEMENT....4
3.6 CURING AND PROTECTION....5
3.7 SURFACE DEFECT REPAIRS....5
3.8 CONCRETE FINISHES....5
3.9 CONCRETE STRENGTH SAMPLES....5

4.0 REQUIRED SUBMITTALS....5

5.0 HEALTH AND SAFETY REQUIREMENTS....6

List of Figures

G-101 Dewatering and Water Treatment Facilities, General Building Layout

Acronyms and Abbreviations

ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
ft	foot
in.	inch
OU	Operable Unit(s)
PCB	polychlorinated biphenyl
psi	pounds per square inch
Tetra Tech	Tetra Tech EC, Inc.
WP	Work Plan

1.0 INTRODUCTION

This document presents the plan for the design and construction of the Dewatering Plant Building foundation. This Work Plan (WP) addresses the pertinent elements of the design and construction of the concrete building foundation and other concrete pads to support the dewatering facility operations. Both the design and construction of the concrete foundation will be performed by others.

1.1 PROJECT BACKGROUND

Tetra Tech EC, Inc. (Tetra Tech) is the General Contractor for remediation of polychlorinated biphenyls (PCBs) in Operable Units (OUs) 2, 3, 4, and 5 of the Lower Fox River and Green Bay Site. The Lower Fox River Site extends 39 miles from the outlet of Lake Winnebago to the mouth of the river, where it discharges into Green Bay.

The project involves construction of an upland staging area for de-sanding, dewatering, and water treatment operations. The former Shell Oil Property adjacent to Georgia-Pacific West Mill in OU 4 was identified as the staging area. The proposed staging area covers about 16 acres of upland space. The dewatering plant is located on the west side of the site and will be used to dewater dredged material from the Fox River.

1.2 CONCRETE FOUNDATION DESCRIPTION

The concrete foundation for the dewatering plant is divided into four distinct areas, as shown on Figure G-101:

Dewatering Area—approximately 280 feet (ft) x 360 ft, divided into three 120-ft-wide bays and supporting a 67-ft-tall prefabricated metal building. Concrete pads and curbs will be provided for various tanks and other equipment, as necessary.

Filter Cake Storage Area—approximately 240 ft x 360 ft, divided into four separate bays and supporting a 31-ft-tall prefabricated metal building. Concrete pads and curbing will be provided to subdivide areas for storage of sludge filter cakes.

Water Treatment Facility—approximately 150 ft x 200 ft, divided into three areas and supporting a 31-foot-tall prefabricated metal building. Concrete pads and curbs will be provided for various tanks and other equipment, as necessary.

- Laboratory—approximately 150 ft x 200 ft, divided into three areas and supporting a 31-foot-tall prefabricated metal building. An exterior concrete pad, approximately 6 ft x 20 ft, will support gas lines.

The work shall entail the structural design and construction of all building foundations, footings, tank and equipment pads, curbing, and any other concrete items associated with the Dewatering Facility.

2.0 DESIGN REQUIREMENTS

The design of the concrete foundation will be in accordance with the latest edition of American Concrete Institute (ACI) 301, *Specification for Structural Concrete for Buildings*; ACI 318,

Building Code Requirements for Reinforced Concrete; and the following American Society for Testing and Materials (ASTM) standards.

ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Specification for Sheet Materials for Curing Concrete
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Standard Specification for Epoxy-Resin Base Bonding System for Concrete
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM D994	Preformed Expansion Joint Filler for Concrete (Bituminous Type)

The concrete shall have a 28-day compressive strength of 4,500 pounds per square inch (psi).

3.0 FIELD ACTIVITIES

The WP activities for the construction of the concrete foundation include the following:

- Excavation and compaction, as necessary, for proper placement of the concrete foundation forms and slab, in accordance with Specification Section 31 00 00
- Mixing, placing, and curing of cast-in-place concrete to include, but not be limited to, slabs on grade, curbs, grade beams, footings, sumps, and equipment pads
- Installation of embedded items and inserts furnished under other specifications
- Form materials and related items, including installation and removal of formwork
- Application of treatments and finishes
- Curing of concrete
- Installation of joint seals and waterstops, as necessary
- Any miscellaneous items necessary for concrete placement

All concrete shall be placed in accordance with ACI 304, *Guide for Measuring, Mixing, Transporting and Placing Concrete*. Concrete will be batched, mixed, and transported in accordance with ASTM C94.

3.1 PREPARATION OF SURFACES

Subgrade or surfaces of previously hardened concrete not treated with a bonding adhesive against which fresh concrete will be placed will be moistened with clean water prior to concrete

placement. Such surfaces shall also be clean and free of frost, ice, mud, and standing water. In locations where new concrete is doweled to existing work, dowel holes will be drilled in the existing concrete and steel dowels will be installed with epoxy resin, in accordance with the manufacturer's recommendations.

Subgrade surfaces shall be adequately compacted and free of any organic matter prior to concrete placement. Any gravel subbase placed beneath a slab will be compacted to near maximum density in thin layers not to exceed 4 inches (in.) prior to compaction.

No concrete will be placed until all adjacent operations that might be detrimental to the proper setting and curing of concrete have been completed.

3.2 FORMWORK

All formwork shall be constructed in accordance with ACI 347, *Recommended Practice for Concrete Formwork*. Forms will be fabricated and erected to accurately conform to the required lines, grades, and shapes indicated on the construction drawings. Forms will be sufficiently tied and braced to maintain proper position and dimensions during concrete placement. Forms and supports will be arranged so that they may be readily removed without hammering or prying against concrete. The Contractor's approval of the completed formwork will be obtained prior to placement of concrete.

Forms and shores for load-carrying concrete structures will not be removed until 7-day test cylinders have been broken and results provide a basis for predicting when concrete will attain sufficient strength to support expected loads. In general, the strength must be at least 70 percent of the required 28-day compressive strength.

Forms will be constructed of lumber, steel, plywood, or wood fiberboard, or a combination of these materials. All forms will be clean and properly coated prior to use, and free of surface defects that would affect the concrete finish. Formwork for exposed concrete will be designed to produce the required concrete finish.

All tolerances, preparation of forms surfaces, removal of forms, reshoring, and removal strength shall be in accordance with ACI 301.

3.3 REINFORCEMENT

All reinforcement bars will meet the requirements of ACI 315, *Details and Detailing of Concrete Reinforcement*. Welded wire reinforcement will meet the requirements of ASTM A185. All reinforcement will be bent cold, unless prior Contractor approval is obtained.

Concrete reinforcement will be accurately placed and supported prior to concrete placement. All reinforcement will be secured against displacement during concrete placement.

3.4 JOINTS

All construction joints will be placed as shown on the design drawings. Joints not shown on the drawings, but necessary for construction, will be located so as to least impair the strength of the structure and will be approved by the Contractor prior to being incorporated in the field. All joints will be perpendicular to the main reinforcing, and reinforcement will be continuous across all construction joints.

Contraction joints will be installed at locations indicated on the design drawings, or at alternate locations with Contractor approval. Contraction joints will be saw cut as a continuous slot to a depth of one-fourth the slab thickness, and made within 12 hours of concrete placement. All such joints will be sealed with elastomeric joint sealant that complies with ASTM C920.

Expansion joints will be installed at the locations and in the manner shown on the design drawings. All expansion joints will be filled with expansion joint filler that complies with ASTM D994.

All embedded items will be placed accurately and supported against displacement prior to placement of concrete. All embedded items will be relatively clean and free of oil, loose scale / rust, or paint.

Waterstops will be located in concrete joints as indicated on the design drawings, and installed in accordance with the manufacturer's recommendations.

3.5 CONCRETE PLACEMENT

All concrete will be placed in accordance with ACI 304 and ACI 318. The Contractor will be notified at least 24 hours prior to commencement of concrete placement. All formwork will have been completed and inspected by the Contractor. Underground pipe, conduits, and ducts in the pour area will be completely installed prior to placing concrete. The placement area will be free of debris.

Concrete will be placed continuously between predetermined expansion, control, and construction joints. New construction joints will be only at locations permitted by the Contractor. Concrete will be placed with chutes as close as possible to the final position.

Concrete will be consolidated with high-frequency, internal vibrators to work concrete around all reinforcement, embedments, and into corners to eliminate all air or stone pockets. The type and number of vibrators will be pre-approved by the Contractor. Only experienced personnel will operate the vibrators. Vibrators will be inserted and withdrawn in the vertical position at approximate 18-inch separation points. Vibrators will not be used to transport concrete within forms or in chutes.

Concrete placed in cold weather will be in accordance with ACI 306, *Cold Weather Concreting*, and that placed in hot weather will be in accordance with ACI 305, *Hot Weather Concreting*.

Records of concrete placement will be maintained at the site and include date of placement, location, quantity, air temperature, and test samples taken. Delivery tickets for each batch of ready-mixed concrete will be provided to the Contractor. Each delivery ticket will include, as a minimum, the following:

- Water/cement ratio and amount of water
- Type, brand, and amount of cement
- Type, brand, and amount of admixtures
- Maximum size of aggregate
- Weights of fine and coarse aggregate
- Indication that all ingredients are as previously certified or approved (approved mix number, etc.)

- Date and time

3.6 CURING AND PROTECTION

Immediately following placement, concrete will be protected from premature drying with water, waterproof sheeting, or approved curing compounds. Waterproof sheet material will comply with ASTM C171 and curing compounds with ASTM C309. Curing compounds, if approved by the Contractor, will not be applied to areas that will receive fresh cement, paint, or other coatings.

Freshly placed concrete will be protected from excessively hot or cold temperatures in accordance with ACI 305 or 306 (blankets, tents, fans, etc.).

Freshly placed concrete will be protected from mechanical injury and flowing water by the forms, sandbags, warning tape, or other means, as necessary.

3.7 SURFACE DEFECT REPAIRS

All surface repairs, after removal of forms, will be in accordance with ACI 301. Excessive honeycomb or embedded debris will be cut out and repaired. All tie holes and spreaders will be cut back 1-1/2 in., and the resulting hole will be cleaned, moistened, and patched.

3.8 CONCRETE FINISHES

All concrete surfaces not placed in contact with formwork will receive the following treatment before receiving the final surface finish: strike off top surface to the proper contour, grade, and elevation, and wood float to correct any unevenness. The final surface finish for unformed areas will be a "broom or belt finish" complying with ACI 301, Paragraph 5.3.4. Formed surfaces will comply with ACI 301, Paragraph 5.3.3, for "smooth-form finish."

3.9 CONCRETE STRENGTH SAMPLES

A minimum of three concrete test cylinders will be prepared for each class of concrete placed per day. Additional sets of three cylinders will be made for each 50 cubic yards of concrete placed per day. These test cylinders will be prepared and cured, under standard moisture and temperature conditions, in accordance with ASTM C31.

One moisture-cured test cylinder will be tested at 7 days after the concrete is placed. The remaining two test cylinders will be tested at 28 days after the concrete is placed. An additional, or fourth, test cylinder may be prepared, as directed by the Contractor, to cure in the field for 28 days under the same conditions as the main concrete. This test cylinder will be held in reserve to test if another specimen develops a dubious test value.

All test cylinders will be tested for compressive strength at an independent laboratory in accordance with ASTM C39. The testing laboratory will provide two copies of all test reports to the Contractor, and one copy to the concrete Supplier.

4.0 REQUIRED SUBMITTALS

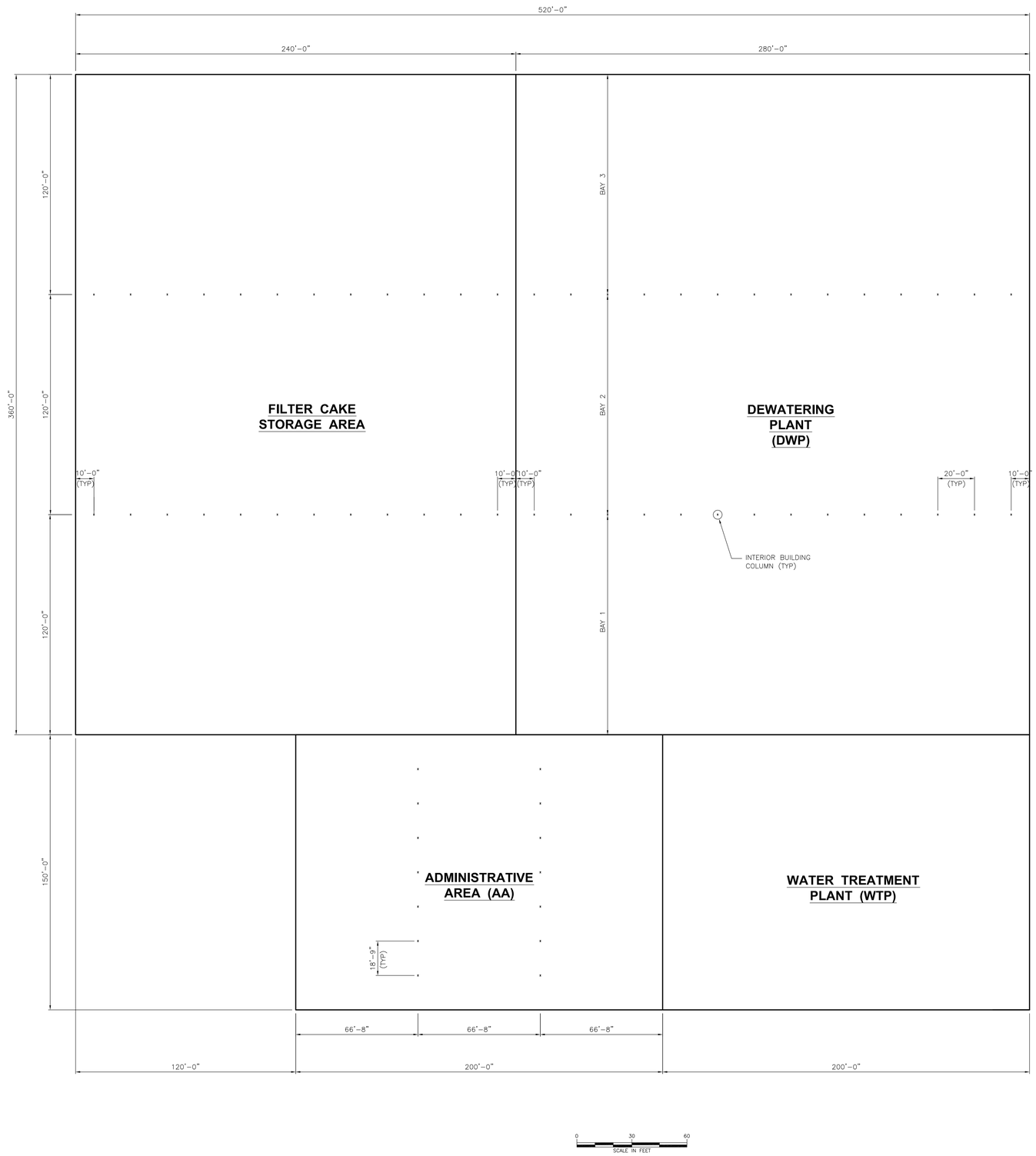
The flowing documents will be submitted for Contractor review and approval:

- Shop drawings of reinforcing steel, construction joint details and alternate locations, and embedded items, as required
- Manufacturer's product data on admixtures, joint sealants, waterstops, and miscellaneous items
- A concrete mix design for each concrete mix used in the work
- Certifications from the Manufacturer(s) that materials supplied meet or exceed the specification requirements

5.0 HEALTH AND SAFETY REQUIREMENTS

All construction work will be conducted in accordance with the approved task-specific Health and Safety Plan.

Figures



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P. E. SEAL

REV	DESCRIPTION	DRN	DES	CHK	APR	DATE
B	90% DESIGN SUBMISSION	FM	JS	JF	RF	05/15/08
A		KM/FM	JS	JF	RF	05/12/08

DESIGNED BY: J. SINGER
DRAWN BY: F. MENICHELLI
CHECKED BY: J. FRANCIS
APPROVED BY: R. FEENEY
DATE: MAY 15, 2008

TETRA TECH EC, INC.
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LOWER FOX RIVER PRP GROUP
GREEN BAY, WISCONSIN

LOWER FOX RIVER SITE OPERABLE UNITS 2-5
GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN
DEWATERING AND WATER TREATMENT FACILITIES
GENERAL BUILDING LAYOUT

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: J667-G-101-REV B.DWG
SHEET – OF –
SIZE: D
G-101

G:\106-3667.2008.02 Design-(Fox River)\90% Design -Building Specifications Submission - (WTP Fox River) - Rev B\3667-G-101-REV B.dwg, 6/10/2008 11:12:40 AM, fox PDF.pc3

ATTACHMENT D-5

BUILDING ERECTION WP

APPENDIX C-5

Lower Fox River Remedial Design
60 Percent Design Report

Metal Building Erection Work Plan

Table of Contents

Section **Page**

1.0 INTRODUCTION....1

1.1 PROJECT BACKGROUND....1
1.2 METAL BUILDING DESCRIPTION....1

2.0 REFERENCES....1

3.0 FIELD ACTIVITIES....2

3.1 GENERAL....2
3.2 FRAMING AND STRUCTURAL MEMBERS....3
3.3 SIDING AND ROOF COVERING....3
3.4 GUTTERS AND DOWNSPOUTS....3
3.5 INSULATION, WALL LINER/VAPOR RETARDER....3
3.6 DOORS AND WINDOWS....3
3.7 LOUVERS AND VENTILATORS....4
3.8 OVERHEAD COILING DOORS....4
3.9 FIELD PAINTING....4
3.10 CLEANUP....4

4.0 REQUIRED SUBMITTALS....4

5.0 HEALTH AND SAFETY REQUIREMENTS....4

List of Figures

Figure G-101. Dewatering and Water Treatment Facilities, General Building Layout

Preliminary Pre-Engineered Building Design Drawings

Acronyms and Abbreviations

AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
ft	foot
MBMA	Metal Building Manufacturers Association
OU	Operable Unit(s)
PCB	Polychlorinated Biphenyl
QA	Quality Assurance
QC	Quality Control
SSPC	Society for Protective Coating
Tetra Tech	Tetra Tech EC, Inc.
WP	Work Plan

1.0 INTRODUCTION

This document presents the plan for the erection of the Dewatering Plant Metal Building. This Work Plan (WP) addresses the pertinent elements for the construction of the prefabricated metal building system to support the dewatering facility operations. Both the design and construction of the metal building system will be performed by others.

1.1 PROJECT BACKGROUND

Tetra Tech EC, Inc. (Tetra Tech) is the General Contractor for remediation of polychlorinated biphenyls (PCBs) in Operable Units (OUs) 2, 3, 4 and 5 of the Lower Fox River and Green Bay Site. The Lower Fox River Site extends 39 miles from the outlet of Lake Winnebago to the mouth of the river where it discharges into Green Bay.

The project involves construction of an upland staging area for desanding, dewatering, and water treatment operations. The former Shell Oil Property adjacent to Georgia-Pacific West Mill in OU 4 was identified as the staging area. The proposed staging area covers about 16 acres of upland space. The dewatering plant is located on the west side of the site and will be used to dewater dredged material from the Fox River.

1.2 METAL BUILDING DESCRIPTION

The metal building system for the dewatering plant is divided into four distinct areas, as shown on Figure G-101:

- Dewatering Plant – approximately 280 feet (ft) x 360 ft, divided into three 120-foot-wide bays with an eave height of 67 ft
- Filter Cake Storage Area – approximately 240 ft x 360 ft, divided into four separate bays and with an eave height of 31 ft
- Water Treatment Plant – approximately 150 ft x 200 ft, with an eave height of 31 ft
- Administrative Area – approximately 150 ft x 200 ft, divided into three areas and with an eave height of 14 ft

The work shall entail the erection of a pre-fabricated metal building and all ancillary items associated with the Dewatering Facility.

2.0 REFERENCES

The erection of the metal building system will be in accordance with the latest edition of MBMA, *Metal Building Systems Manual*, Specification 02500, the Building Site Layout Drawings (provided by Contractor), General Steel Building Plans, and the latest edition of the following Standards and Codes.

AISC S303	Code of Standard Practice for Steel Buildings and Bridges
AISC 348	Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts
ANSI/AISC 360	Specification for Structural Steel Buildings
AISC 325	Manual of Steel Construction 13th Edition

AISC 326	Detailing for Steel Construction
AISC 341	Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	Cold-Formed Steel Design Manual

WISCONSIN COMMERCIAL BUILDING CODE

WISCONSIN FIRE PREVENTION CODE

BROWN COUNTY (WISCONSIN) CODE OF ORDINANCES

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA-06	Metal Building Systems Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	Structural Welding Code – Steel (20th Edition)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-02	Hand Tool Cleaning Preparation

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc (Hot-Dip) on Iron and Steel Hardware
ASTM C1107/WK13513	Standard Specification for Packaged, Dry Hydraulic-Cement Grout (Non-Shrink)
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120-105 ksi Minimum Tensile Strength
ASTM A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

3.0 FIELD ACTIVITIES

The WP activities for the erection of the metal building system include the following elements.

3.1 GENERAL

Erection will be in accordance with the approved Manufacturer's erection instructions and drawings and with applicable provision of AISC S303, 348, 360, 325, 326, and 341 as well as AISI SG-673 and MBMA-06. Assembly will follow all requirements of the Wisconsin Commercial Building Code, the Wisconsin Fire Prevention Code, and the Brown County (Wisconsin) Code of Ordinances. All welding of steel will be in accordance with AWS D1.1. High-strength bolting will conform to AISC 326 using ASTM A325 or ASTM A490 bolts.

All required building permits will be prominently displayed at the building site. A utility locate (Dig Safe) organization will be contacted to mark all existing underground utilities prior to the start of field work.

Materials will be delivered to the site in a dry, undamaged condition, stored out of contact with the ground, and protected from the weather. Any delivered items that are damaged and cannot be restored to "like-new" conditions will be replaced. Stained or discolored items will be replaced, as directed by the Contractor.

3.2 FRAMING AND STRUCTURAL MEMBERS

All field welding required for erection of the metal building will comply with AWS D1.1. A nonshrink grout will be used under base plates and sill members to provide a uniform bearing on the foundation. Temporary bracing will be provided to assure stability of the structure during construction. Field cutting or altering structural members will be done only with prior approval from the Contractor.

Base plate anchor bolts will be hot-dipped galvanized according to ASTM A123 or A153, as applicable.

Structural members will be accurately placed to ensure proper fitting of side and roof covering.

3.3 SIDING AND ROOF COVERING

Wall coverings will be installed with the longitudinal configuration in the vertical direction and roof coverings with the longitudinal configuration in the direction of the roof slope. Closure strips will be installed to provide weathertight construction. All accessories will be installed to the framing members, except as noted on the drawings.

Concealed fastening clips will be used to fasten exterior panels to the framing members. Spacing of such clips will be in accordance with the manufacturer's recommendations. Fasteners or anchor clips will not exceed 12 inches on center spacing unless otherwise approved. Fasteners will not puncture covering sheets except as approved for certain items (i.e., flashing, closures, or trim). All joints will be sealed per the manufacturer's recommendations.

3.4 GUTTERS AND DOWNSPOUTS

Rigid attachments will be used for attaching all gutters and downspouts to the building. Cleat spacing for gutters will be at 16 inches. Brackets and spacers for gutters will be spaced at 36 inches on center. Downspout supports will be per manufacturer's recommendations.

3.5 INSULATION, WALL LINER/VAPOR RETARDER

Insulation and wall liner/vapor retarder for the building exterior will be installed in accordance with the manufacturer's instructions.

3.6 DOORS AND WINDOWS

All doors and windows will be installed plumb and true, anchored to the supporting construction, and adjusted for proper operation. All joints at doors and windows will be sealed, per the manufacturer's recommendations, to provide weathertight construction.

3.7 LOUVERS AND VENTILATORS

All louvers and ventilators will be installed, per the manufacturer's instructions, to assure weathertight construction.

3.8 OVERHEAD COILING DOORS

All overhead coiling doors will be securely attached to the building structure, in accordance with the manufacturer's instructions. Once installed, such doors will be adjusted to allow door to operate freely and correctly.

3.9 FIELD PAINTING

Any detected abrasions or corroded spots on shop-painted surfaces will be prepared in accordance with SSPC-02, prior to touch-up painting to match the shop coat. Factory color finishes will be touched up, as necessary, with the manufacturer's recommended touch-up paint.

3.10 CLEANUP

The building site will be left in a neat and clean condition. Building debris will be cleaned up periodically during erection and at final completion.

4.0 REQUIRED SUBMITTALS

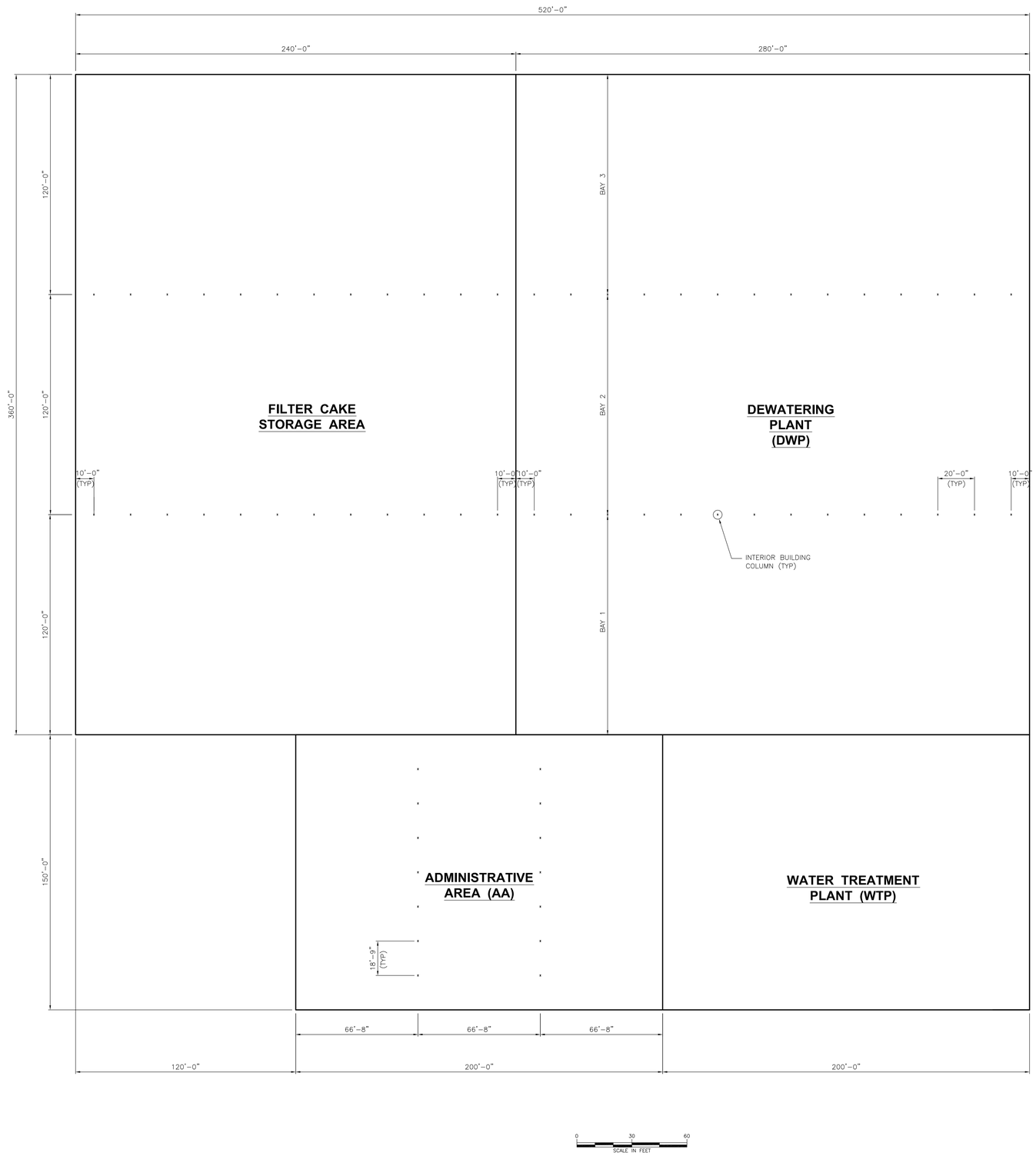
Five copies of the following documents will be submitted for Contractor review and approval:

- Erection Plan - to include instructions and drawings that describe the preparation requirements, assembly sequence, temporary bracing, and shoring necessary for the metal building system erection
- Subcontractor qualifications for similar types of buildings for at least 5 years of experience
- A Site-Specific Quality Assurance Plan
- All building permits, as necessary

5.0 HEALTH AND SAFETY REQUIREMENTS

All construction work will be conducted in accordance with the approved task-specific Health and Safety Plan.

Figures



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P. E. SEAL

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B	90% DESIGN SUBMISSION	FM	JS	JF	RF	05/15/08
A		KM/FM	JS	JF	RF	05/12/08

DESIGNED BY: J. SINGER
DRAWN BY: F. MENICHELLI
CHECKED BY: J. FRANCIS
APPROVED BY: R. FEENEY
DATE: MAY 15, 2008

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LOWER FOX RIVER PRP GROUP
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LOWER FOX RIVER SITE OPERABLE UNITS 2-5
GREEN BAY, WISCONSIN

WATER TREATMENT PLANT DESIGN
DEWATERING AND WATER TREATMENT FACILITIES
GENERAL BUILDING LAYOUT

CONTRACT NO.:
SPEC. NO.
SCALE : AS SHOWN
CAD FILE: J667-G-101-REV B.DWG
SHEET – OF –
SIZE: D
G-101

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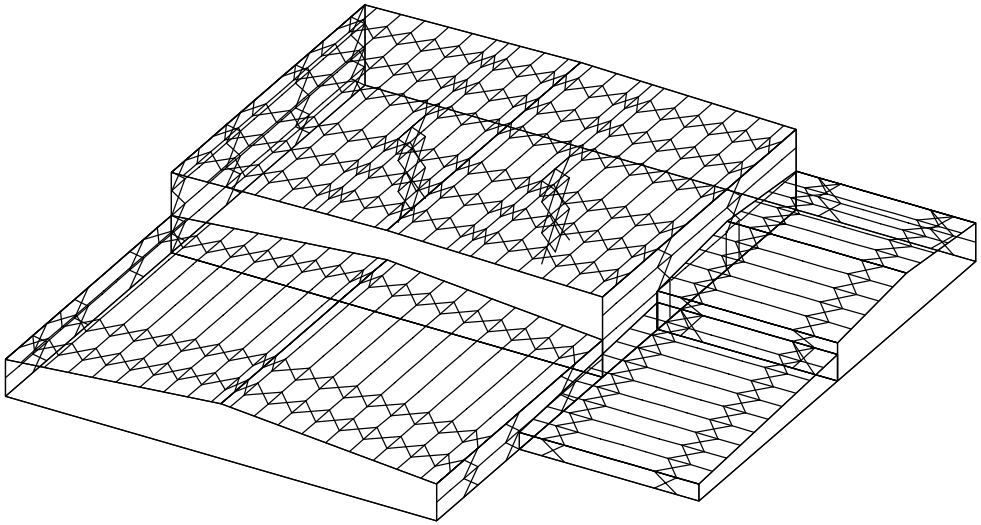
DRAWING INDEX	
DRAWING TITLE	PAGES
Cover Sheet	
Notes	
Anchor Rod Plan	
Primary Structural	
Secondary Structural	
Covering	
Special Drawings	
Standard Erection Details	

DRAWING RELEASE HISTORY		
TYPE	DATE	DESCRIPTION



GENERAL NOTES

MATERIALS

	ASTM DESIGNATION	
3 PLATE WELDED SECTIONS	A529, A572, A1011, A1018	GRADE 55
COLD FORMED LIGHT GAGE SHAPES	A653, A1011	GRADE 55
BRACE RODS	A572	GRADE 65
HOT ROLLED MILL SHAPES	A36, A529, A572, A588, A709, A992	GRADE 36 KSI UNLESS NOTED
HOT ROLLED ANGLES	A529, A572, A588, A709, A992	GRADE 50
HOLLOW STRUCTURAL SECTION (HSS)	A500	GRADE B
CLADDING	A653, A792	GRADE 50 OR GRADE 80

A325 & A490 BOLT TIGHTENING REQUIREMENTS

IT IS THE RESPONSIBILITY OF THE ERECTOR TO INSURE PROPER BOLT TIGHTNESS IN ACCORDANCE WITH APPROPRIATE REGULATIONS. THE FOLLOWING CRITERIA IS IN COMPLIANCE WITH THE LATEST SPECIFICATIONS, HOWEVER THE ERECTOR IS RESPONSIBLE TO VERIFY LOCAL AUTHORITY REQUIREMENTS.
ALL CONNECTIONS MADE WITH A325 BOLTS MAY BE TIGHTENED TO THE "SNUG TIGHT" CONDITION AS PERMITTED BY THE SPECIFICATION FOR STRUCTURAL JOINTS USING A325 OR A490 BOLTS (2004 ED), UNLESS INDICATED AS "PRE-TENSIONED" ELSEWHERE IN THESE DRAWINGS, OR AS INDICATED BELOW.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, AND STRUT CONNECTIONS IF LOCATED IN IBC SEISMIC PERFORMANCE / DESIGN CATEGORY D, E OR F, UBC ZONE 3 OR 4. SEE CODES AND LOADS NOTES BELOW FOR SEISMIC DESIGN CATEGORY. PRE-TENSION ALL PRIMARY FRAMING CONNECTIONS IN CANADA.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, STRUTS AND CRANE RUNWAY CONNECTIONS IF BUILDING SUPPORTS A CRANE WITH A CAPACITY GREATER THAN 5 TONS.

CONNECTIONS THAT SUPPORT RUNNING MACHINERY AND OTHER SOURCES OF IMPACT OR STRESS REVERSAL MUST BE PRE-TENSIONED.

ALL SLIP CRITICAL CONNECTIONS AS INDICATED IN THESE DRAWINGS WITH -SC DESIGNATION MUST BE PRE-TENSIONED. SC TYPE CONNECTIONS MUST BE FREE OF PAINT, OIL OR OTHER MATERIALS THAT REDUCE THE FRICTION AT CONTACT SURFACES.

CONNECTIONS DESIGNATED AS A325-X OR A490-X SHALL BE IINSTALLED WITH BOLT HEAD ON SIDE OF THE THINNEST PLATE BEING CONNECTED.

SECONDARY MEMBERS AND FLANGE BRACE CONNECTIONS ARE ALWAYS "SNUG TIGHTENED", EVEN IF ABOVE CONDITIONS EXIST, UNLESS SPECIFICALLY NOTED OTHERWISE ON DETAILS.
WASHERS ARE NOT REQUIRED FOR "SNUG-TIGHT" CONNECTIONS. PRE-TENSIONED A325 OR A490 CONNECTIONS TIGHTENED USING THE TURN-OF-THE-NUT METHOD DO NOT REQUIRE WASHERS. A490 BOLTS MUST ALWAYS BE PRE-TENSIONED.

CODES AND LOADS

WHEN MULTIPLE BUILDINGS ARE INVOLVED, SPECIFIC LOAD FACTORS FOR DIFFERING OCCUPANCIES, BUILDING DIMENSIONS, HEIGHTS, FRAMING SYSTEMS, ROOF SLOPES, ETC., MAY RESULT IN DIFFERENT LOAD APPLICATION FACTORS THAN INDICATED BELOW. SEE CALCULATIONS FOR FURTHER DETAILS.

Building Code: 2008 Wisconsin Building Code
Based on Building Code: 2006 International Building Code
Building A: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building B: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building C: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building D: Building Use:Hazardous / Special Occupancy, Collateral Gravity: 11.00 psf (Not Including bldg wt)
LIVE LOADS AND RAINFALL
Live Load 20.00 psf (Not Reducible)
Rainfall: 5.00 inches per hour

SNOW LOAD
Ground Snow: 40.00 psf, Flat Roof Snow: 25.20 psf
Snow Exposure Category (Factor): 1 Fully Exposed (0.90)
Snow Importance: 1.000 Thermal Category (Factor): Heated (1.00)

WIND LOAD
Wind Speed: 90.00 mph, Wind Exposure: C
Basic Wind Pressure: 20.50 psf
Wind Importance Factor: 1.000, Ft= Topographic Factor: 1.0000
Wind Enclosure: Enclosed, 0.180
Note: All windows, doors, skylights and other covered openings must be designed for the specified above wind loads

EARTHQUAKE DESIGN DATA
Lateral Force Resisting Systems using Equivalent Force Procedure
Mapped Spectral Response - Ss:6.60 %g, S1:3.10 %g
Seismic Hazard / Use Group: Group 1
Seismic Performance / Design Category: A (See Bolt Tightening Note Above)
Seismic Snow Load: 0.00 psf
Seismic Importance: 1.000
Soil Profile Type: Stiff soil (D, 4)
Design Spectral Response - Sds: 0.0000, Sd1: 0.0000

Ordinary Steel Moment Frames
Frame Redundancy Factor:1.0000
Framing R-Factor: 3.0000, Frame Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W
Ordinary Steel Concentric Braced Frames
Brace Redundancy Factor:1.0000
Bracing R-Factor: 3.0000, Brace Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W

THE GENERAL CONTRACTOR AND/OR ERECTOR IS SOLELY RESPONSIBLE FOR ACCURATE, GOOD QUALITY WORKMANSHIP IN ERECTING THIS BUILDING IN CONFORMANCE WITH THIS DRAWING, DETAILS REFERENCED IN THIS DRAWING, ALL APPLICABLE ERECTION GUIDES, AND INDUSTRY STANDARDS PERTAINING TO PROPER ERECTION, INCLUDING THE CORRECT USE OF TEMPORARY BRACING.

COVER SHEET

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDERS PO#	
JOB #	
DATE	6/20/2007
DRAWN / CHECK	
PAGE	1

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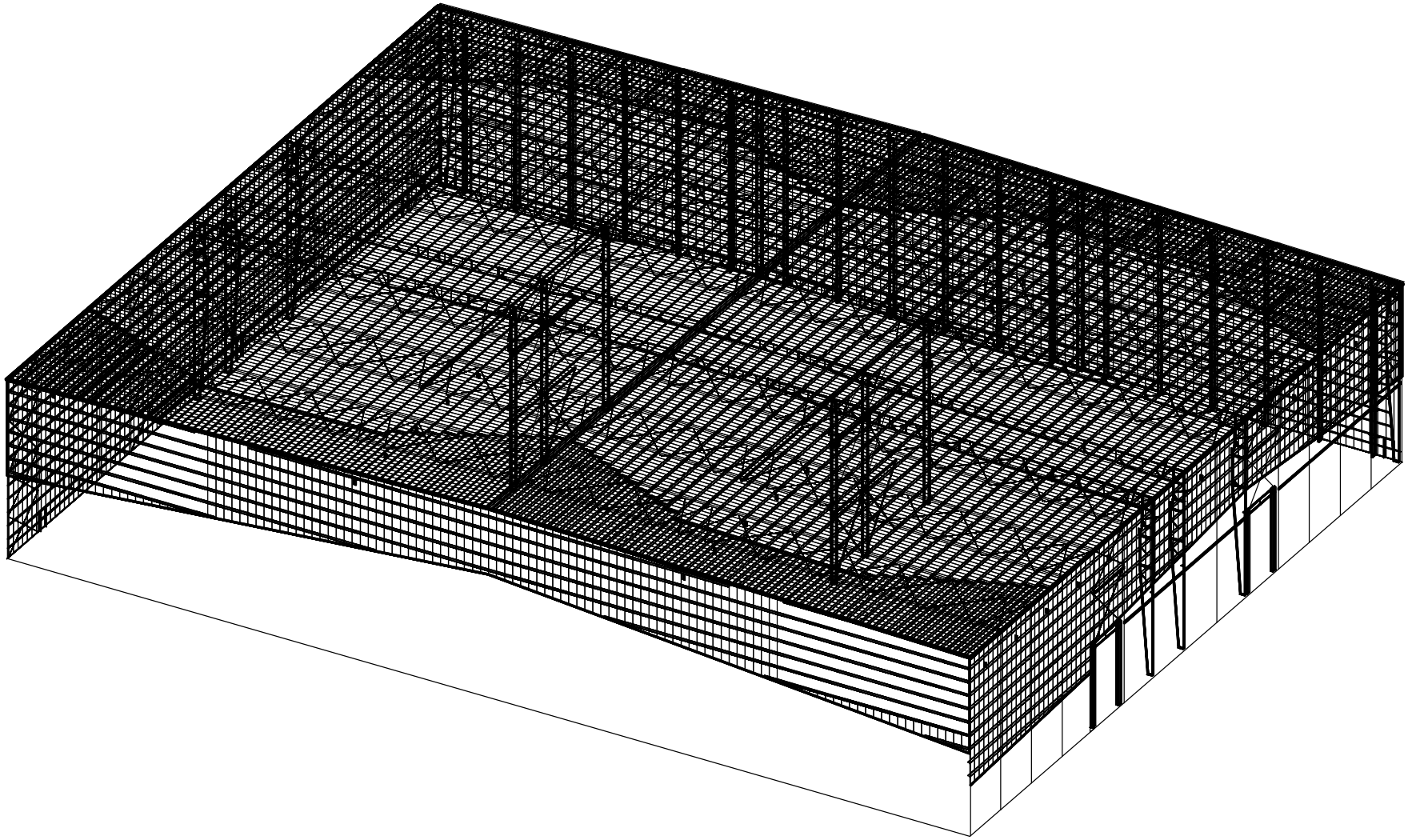

Building A

REV	DATE	BY	DESCRIPTION

NTS

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BUILDER General Steel

CUSTOMER

LOCATION Green Bay, Wisconsin

PROJECT

BUILDER'S PO#

FILENAME:

JOB #

DATE 6/20/2007

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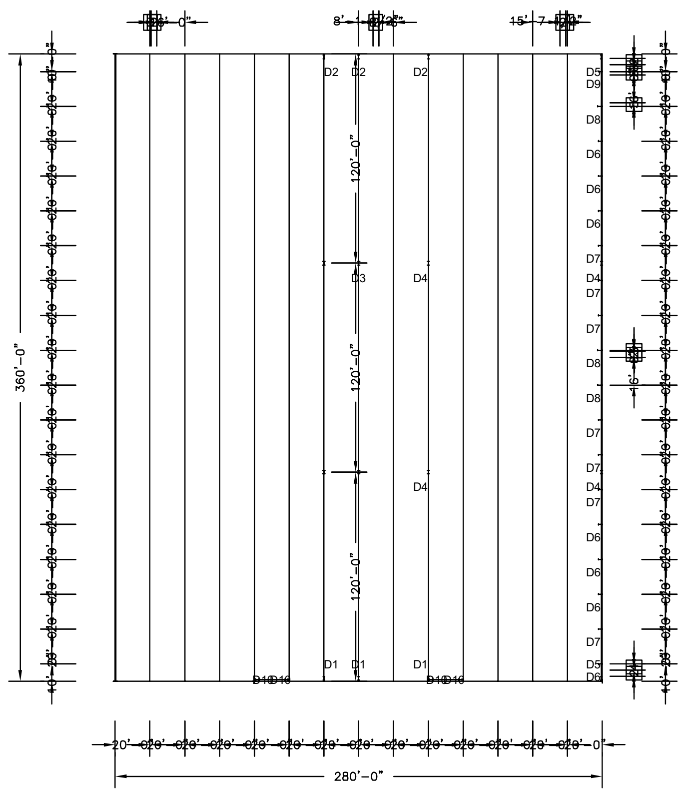
PAGE



Building A

6 4'-0"
5 2'-0"
4 3'-7 1/2"
3 7 1/2"
2 3'-4 1/2"
1 1'-0"
☐Dimension Key

Finished Floor Elevation = 100'-0" (Unless Noted Otherwise)

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 12:57:16

Building A

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
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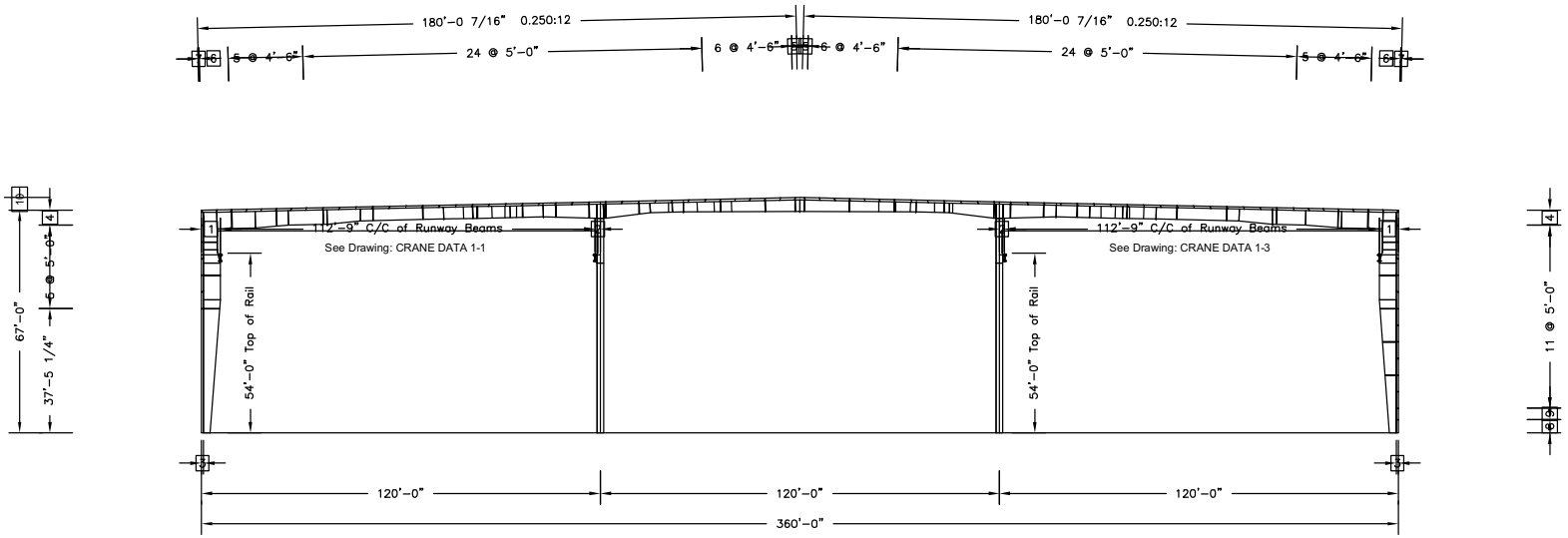
PAGE



FRAME CROSS SECTION AT FRAME LINE(S) 10

10 70'-9" Ridge Ht.
9 3'-5 1/4"
8 4'-0"
7 3 1/2"
6 2 @ 4'-4 3/8"
5 1'-6 3/16"
4 4'-6 3/4"
3 8 1/2"
2 1'-6 1/2" BL to CL of Runway Beam
1 5'-8 1/2" BL to CL of Runway Beam

☐Dimension Key

Shape Name = Building A Wall 4, Frame 8

1. USE 1/2 X 1 1/2 A325 SNUG TIGHTENED BOLTS FOR PURLIN TO FRAME, GIRT TO FRAME, AND GIRT TO CLIP CONNECTIONS UNLESS NOTED OTHERWISE.
2. SLOT REINFORCEMENT PLATES NEED NOT BE LOCATED ON THE SAME SIDE OF THE WEB AS THE HILLSIDE WASHER.

REV	DATE	BY	DESCRIPTION

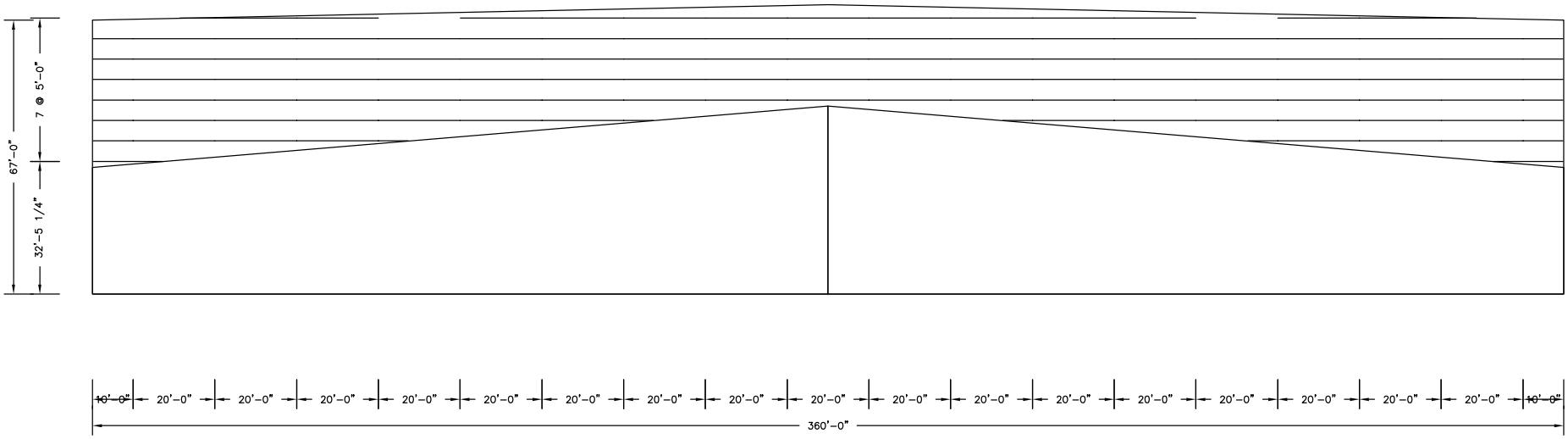
NTS

5/2/2008 12:57:50

Building A Typical Frame

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
DRAWN/CHECK	
PAGE	



Building A LEW Secondary

Shape Name = Building A, Wall = 1

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 14:05:26

Building A LEW Secondary

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
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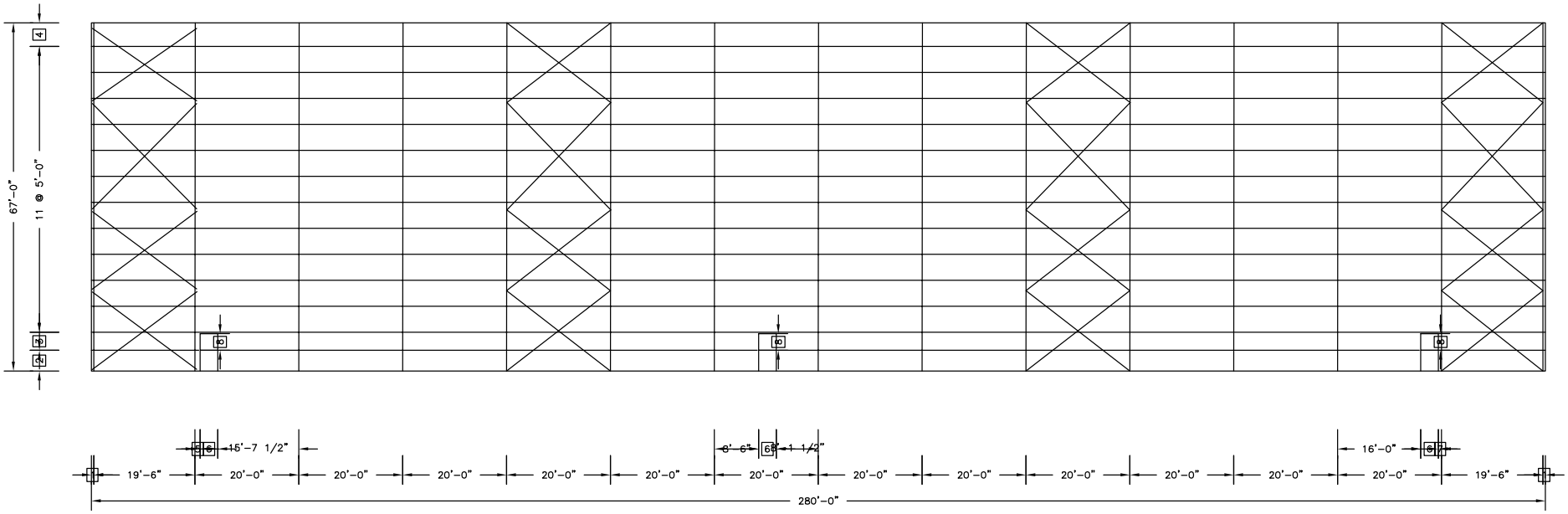
PAGE



Building A BSW Secondary

8 3'-2 1/4"
7 7 1/2"
6 3'-4 1/2"
5 1'-0"
4 4'-6 3/4"
3 3'-5 1/4"
2 4'-0"
1 6"

☐Dimension Key

Shape Name = Building A, Wall = 2

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

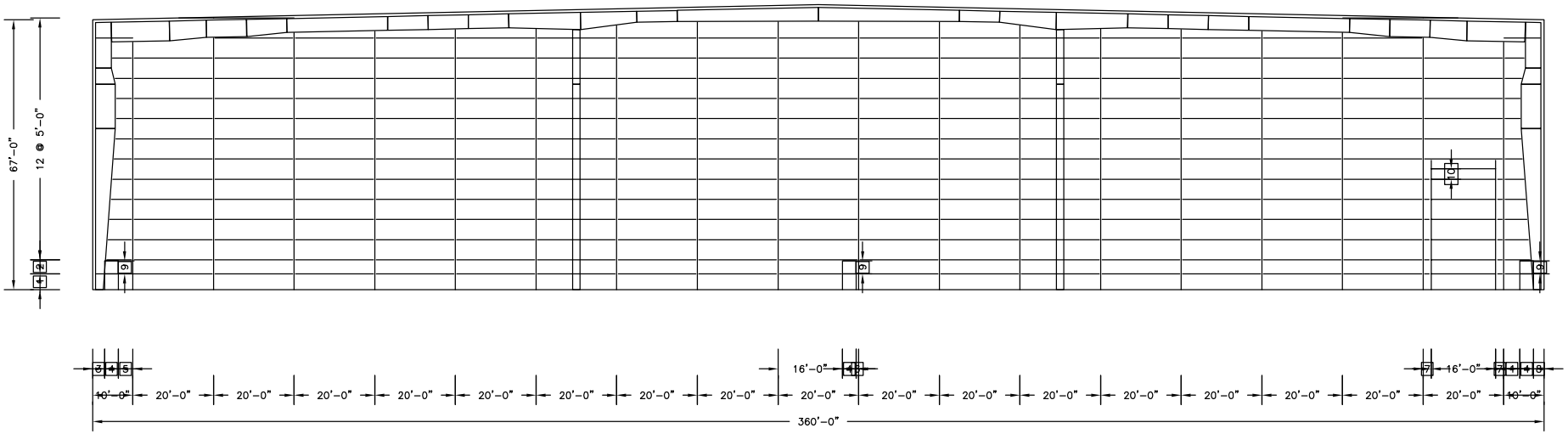
NTS

5/2/2008 14:06:22

Building A BEW Secondary

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE



Building A REW Secondary

10 2'-6 3/4"
9 3'-2 1/4"
8 2'-7 1/2"
7 2'-0"
6 7 1/2"
5 3'-7 1/2"
4 3'-4 1/2"
3 3'-0"
2 3'-5 1/4"
1 4'-0"

☐Dimension Key

Shape Name = Building A, Wall = 3

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

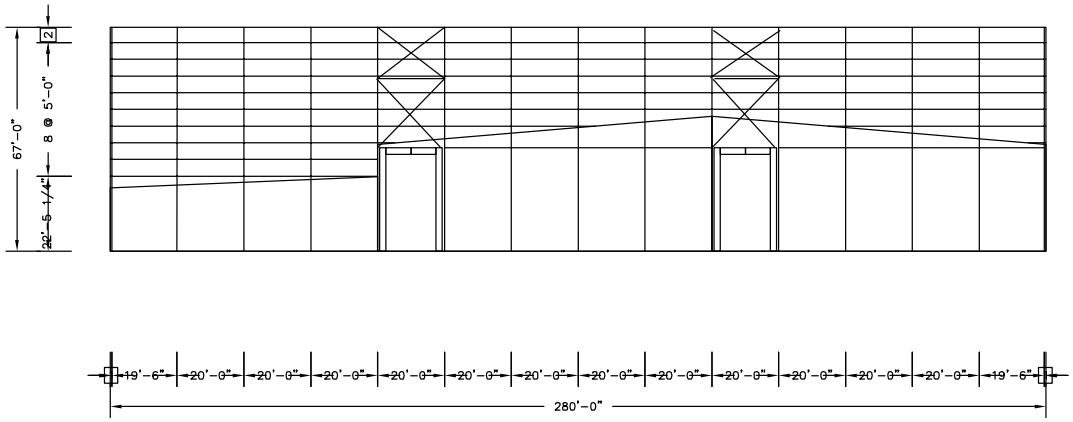
NTS

5/2/2008 14:06:49

Building A REW Secondary

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE



Building A FSW Secondary

2 4'-6 3/4"

1 6"

Dimension Key

Shape Name = Building A, Wall = 4

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 14:07:21

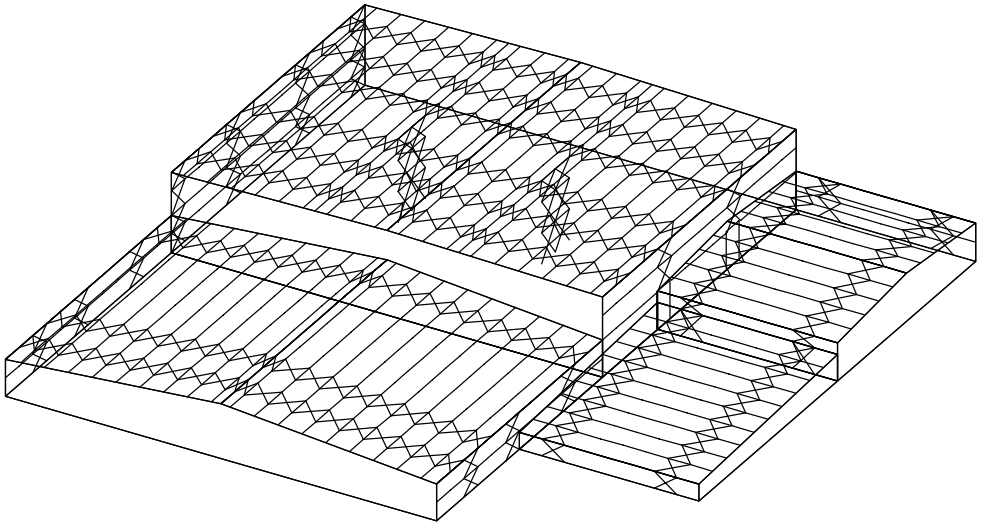
Building A FSW Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
DRAWN/CHECK	
PAGE	

DRAWING INDEX	
DRAWING TITLE	PAGES
Cover Sheet	
Notes	
Anchor Rod Plan	
Primary Structural	
Secondary Structural	
Covering	
Special Drawings	
Standard Erection Details	

DRAWING RELEASE HISTORY		
TYPE	DATE	DESCRIPTION



GENERAL NOTES

MATERIALS

	ASTM DESIGNATION	
3 PLATE WELDED SECTIONS	A529, A572, A1011, A1018	GRADE 55
COLD FORMED LIGHT GAGE SHAPES	A653, A1011	GRADE 55
BRACE RODS	A572	GRADE 65
HOT ROLLED MILL SHAPES	A36, A529, A572, A588, A709, A992	GRADE 36 KSI UNLESS NOTED
HOT ROLLED ANGLES	A529, A572, A588, A709, A992	GRADE 50
HOLLOW STRUCTURAL SECTION (HSS)	A500	GRADE B
CLADDING	A653, A792	GRADE 50 OR GRADE 80

A325 & A490 BOLT TIGHTENING REQUIREMENTS

IT IS THE RESPONSIBILITY OF THE ERECTOR TO INSURE PROPER BOLT TIGHTNESS IN ACCORDANCE WITH APPROPRIATE REGULATIONS. THE FOLLOWING CRITERIA IS IN COMPLIANCE WITH THE LATEST SPECIFICATIONS, HOWEVER THE ERECTOR IS RESPONSIBLE TO VERIFY LOCAL AUTHORITY REQUIREMENTS.
ALL CONNECTIONS MADE WITH A325 BOLTS MAY BE TIGHTENED TO THE "SNUG TIGHT" CONDITION AS PERMITTED BY THE SPECIFICATION FOR STRUCTURAL JOINTS USING A325 OR A490 BOLTS (2004 ED), UNLESS INDICATED AS "PRE-TENSIONED" ELSEWHERE IN THESE DRAWINGS, OR AS INDICATED BELOW.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, AND STRUT CONNECTIONS IF LOCATED IN IBC SEISMIC PERFORMANCE / DESIGN CATEGORY D, E OR F, UBC ZONE 3 OR 4. SEE CODES AND LOADS NOTES BELOW FOR SEISMIC DESIGN CATEGORY. PRE-TENSION ALL PRIMARY FRAMING CONNECTIONS IN CANADA.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, STRUTS AND CRANE RUNWAY CONNECTIONS IF BUILDING SUPPORTS A CRANE WITH A CAPACITY GREATER THAN 5 TONS.

CONNECTIONS THAT SUPPORT RUNNING MACHINERY AND OTHER SOURCES OF IMPACT OR STRESS REVERSAL MUST BE PRE-TENSIONED.

ALL SLIP CRITICAL CONNECTIONS AS INDICATED IN THESE DRAWINGS WITH -SC DESIGNATION MUST BE PRE-TENSIONED. SC TYPE CONNECTIONS MUST BE FREE OF PAINT, OIL OR OTHER MATERIALS THAT REDUCE THE FRICTION AT CONTACT SURFACES.

CONNECTIONS DESIGNATED AS A325-X OR A490-X SHALL BE IINSTALLED WITH BOLT HEAD ON SIDE OF THE THINNEST PLATE BEING CONNECTED.

SECONDARY MEMBERS AND FLANGE BRACE CONNECTIONS ARE ALWAYS "SNUG TIGHTENED", EVEN IF ABOVE CONDITIONS EXIST, UNLESS SPECIFICALLY NOTED OTHERWISE ON DETAILS.
WASHERS ARE NOT REQUIRED FOR "SNUG-TIGHT" CONNECTIONS. PRE-TENSIONED A325 OR A490 CONNECTIONS TIGHTENED USING THE TURN-OF-THE-NUT METHOD DO NOT REQUIRE WASHERS. A490 BOLTS MUST ALWAYS BE PRE-TENSIONED.

CODES AND LOADS

WHEN MULTIPLE BUILDINGS ARE INVOLVED, SPECIFIC LOAD FACTORS FOR DIFFERING OCCUPANCIES, BUILDING DIMENSIONS, HEIGHTS, FRAMING SYSTEMS, ROOF SLOPES, ETC., MAY RESULT IN DIFFERENT LOAD APPLICATION FACTORS THAN INDICATED BELOW. SEE CALCULATIONS FOR FURTHER DETAILS.

Building Code: 2008 Wisconsin Building Code
Based on Building Code: 2006 International Building Code
Building A: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building B: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building C: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building D: Building Use:Hazardous / Special Occupancy, Collateral Gravity: 11.00 psf (Not Including bldg wt)
LIVE LOADS AND RAINFALL
Live Load 20.00 psf (Not Reducible)
Rainfall: 5.00 inches per hour

SNOW LOAD
Ground Snow: 40.00 psf, Flat Roof Snow: 25.20 psf
Snow Exposure Category (Factor): 1 Fully Exposed (0.90)
Snow Importance: 1.000 Thermal Category (Factor): Heated (1.00)

WIND LOAD
Wind Speed: 90.00 mph, Wind Exposure: C
Basic Wind Pressure: 20.50 psf
Wind Importance Factor: 1.000, Ft= Topographic Factor: 1.0000
Wind Enclosure: Enclosed, 0.180
Note: All windows, doors, skylights and other covered openings must be designed for the specified above wind loads

EARTHQUAKE DESIGN DATA
Lateral Force Resisting Systems using Equivalent Force Procedure
Mapped Spectral Response - Ss:6.60 %g, S1:3.10 %g
Seismic Hazard / Use Group: Group 1
Seismic Performance / Design Category: A (See Bolt Tightening Note Above)
Seismic Snow Load: 0.00 psf
Seismic Importance: 1.000
Soil Profile Type: Stiff soil (D, 4)
Design Spectral Response - Sds: 0.0000, Sd1: 0.0000

Ordinary Steel Moment Frames
Frame Redundancy Factor:1.0000
Framing R-Factor: 3.0000, Frame Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W
Ordinary Steel Concentric Braced Frames
Brace Redundancy Factor:1.0000
Bracing R-Factor: 3.0000, Brace Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W

THE GENERAL CONTRACTOR AND/OR ERECTOR IS SOLELY RESPONSIBLE FOR ACCURATE, GOOD QUALITY WORKMANSHIP IN ERECTING THIS BUILDING IN CONFORMANCE WITH THIS DRAWING, DETAILS REFERENCED IN THIS DRAWING, ALL APPLICABLE ERECTION GUIDES, AND INDUSTRY STANDARDS PERTAINING TO PROPER ERECTION, INCLUDING THE CORRECT USE OF TEMPORARY BRACING.

COVER SHEET

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDERS PO#	
JOB #	
DATE	6/20/2007
DRAWN / CHECK	
PAGE	1

5/2/2008 11:02:28

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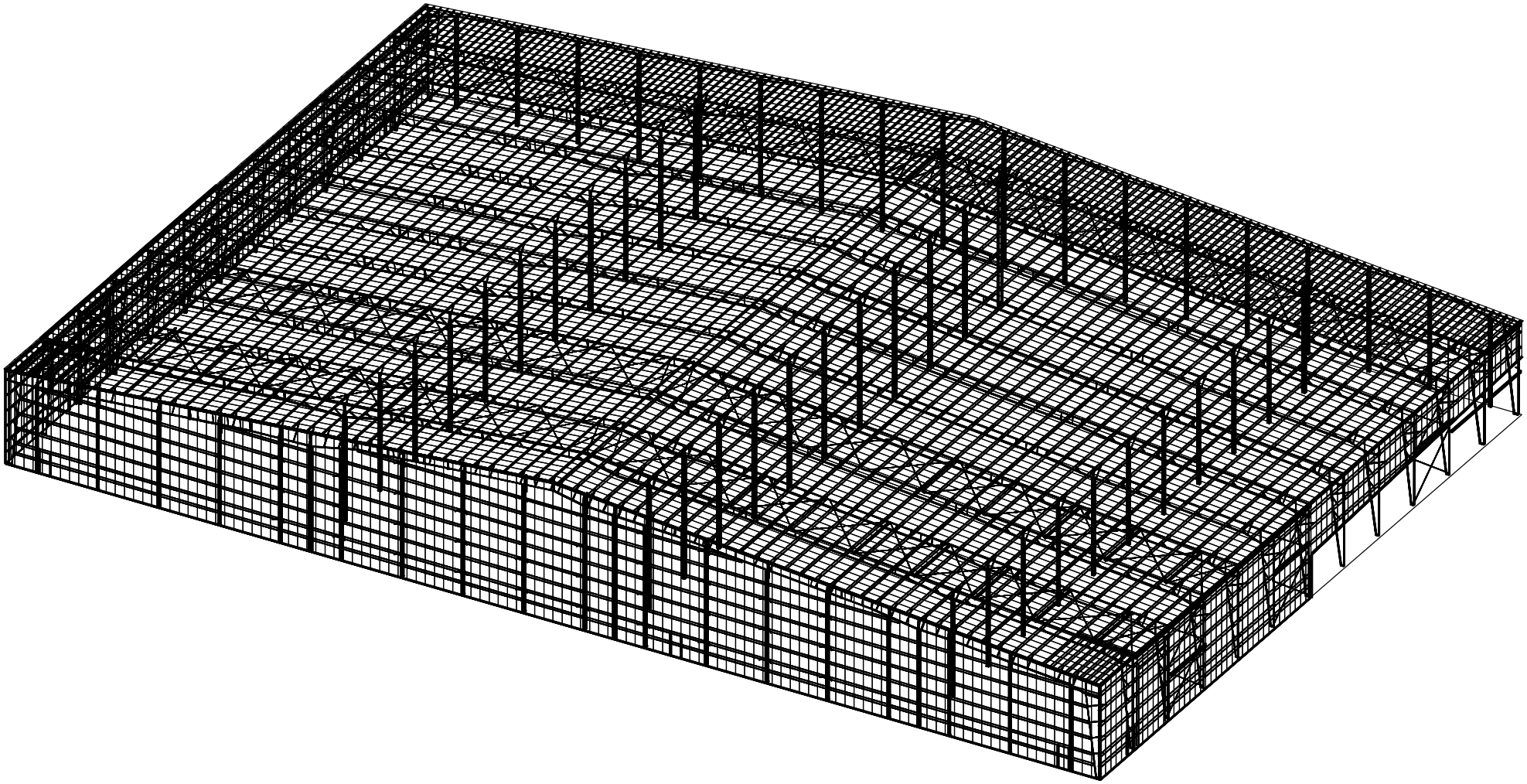


Building B Perspective

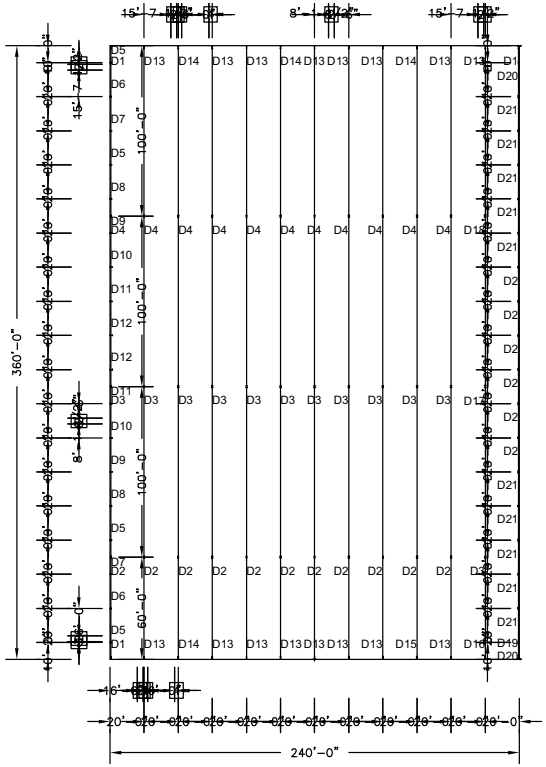
REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 13:18:18

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE



Building B Plan

4 2'-0"
3 7 1/2"
2 3'-4 1/2"
1 1'-0"
Dimension Key

Finished Floor Elevation = 100'-0" (Unless Noted Otherwise)

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 13:18:35

Building B Plan

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE

Frame Clearances

Horiz. Clearance between members 1(CX015) and 26(CX016): 349'-9"

Vert. Clearance at member 1(CX015): 26'-4 3/4"

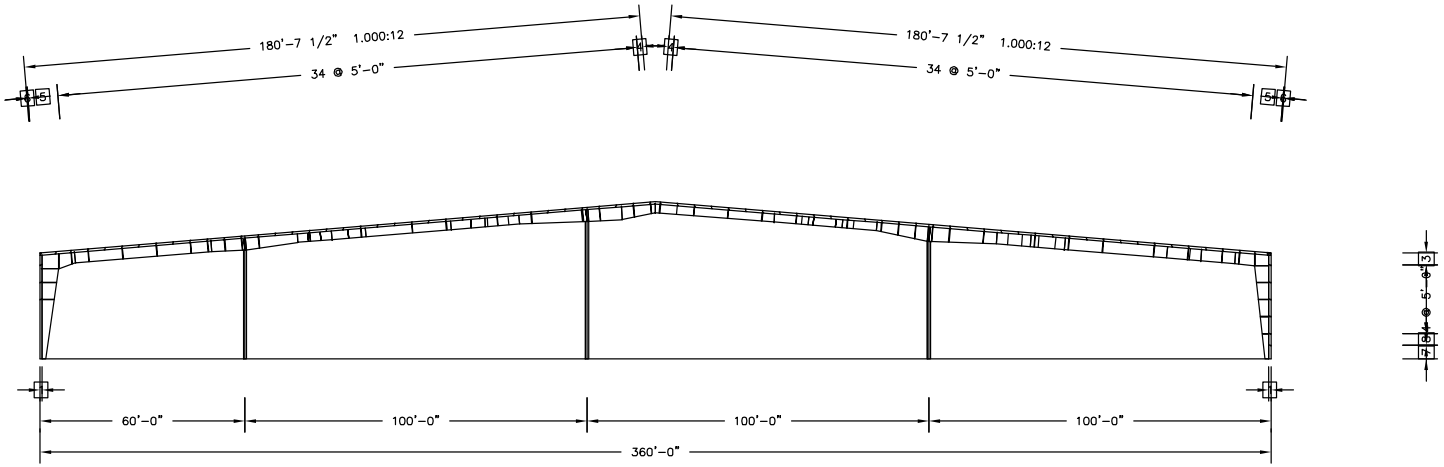
Vert. Clearance at member 26(CX016): 27'-3 1/8"

Vert. Clearance at member 27(ICX001): 31'-9 5/16"

Vert. Clearance at member 28(ICX002): 40'-2 3/8"

Vert. Clearance at member 29(ICX003): 34'-3 3/8"

Finished Floor Elevation = 100'-0" (Unless Noted Otherwise)



FRAME CROSS SECTION AT FRAME LINE(S) 9

9 46'-0" Ridge Ht.

8 3'-5 1/4"

7 4'-0"

6 3 1/2"

5 2 @ 4'-4 5/8"

4 1'-6 11/16"

3 3'-6 3/4"

2 2 @ 5'-0"

1 8 1/2"

☐Dimension Key

Shape Name = Building B Wall 4, Frame 9

1. USE 1/2 X 1 1/2 A325 SNUG TIGHTENED BOLTS FOR PURLIN TO FRAME, GIRT TO FRAME, AND GIRT TO CLIP CONNECTIONS UNLESS NOTED OTHERWISE.
2. SLOT REINFORCEMENT PLATES NEED NOT BE LOCATED ON THE SAME SIDE OF THE WEB AS THE HILLSIDE WASHER.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 13:18:55

Building B Typical Frame Section

BUILDER General Steel

CUSTOMER

LOCATION Green Bay, Wisconsin

PROJECT .

BUILDER'S PO#

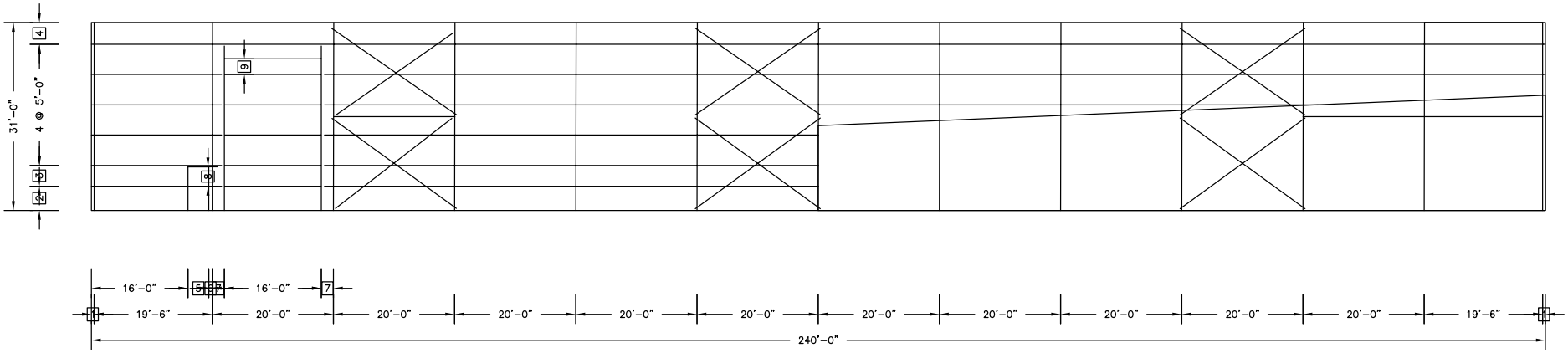
FILENAME:

JOB #

DATE 6/20/2007

DRAWN/CHECK

PAGE



Building B FSW Secondary

9 2'-6 3/4"
8 3'-2 1/4"
7 2'-0"
6 7 1/2"
5 3'-4 1/2"
4 3'-6 3/4"
3 3'-5 1/4"
2 4'-0"
1 6"

☐Dimension Key

Shape Name = Building B, Wall = 4

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

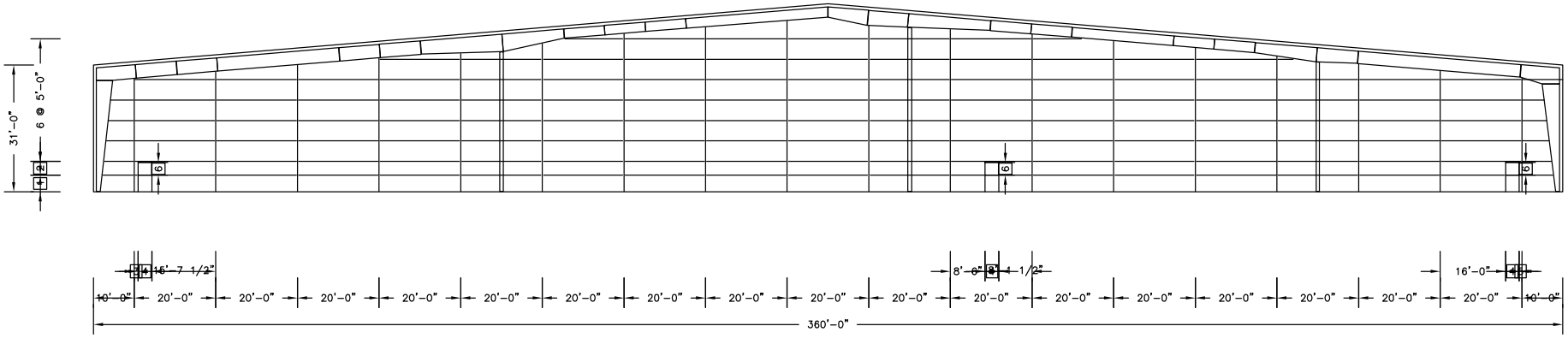
NTS

5/2/2008 14:34:25

Building B FSW Secondary

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE



Building B LEW Secondary

6 3'-2 1/4"
5 7 1/2"
4 3'-4 1/2"
3 1'-0"
2 3'-5 1/4"
1 4'-0"

☐Dimension Key

Shape Name = Building B, Wall = 1

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

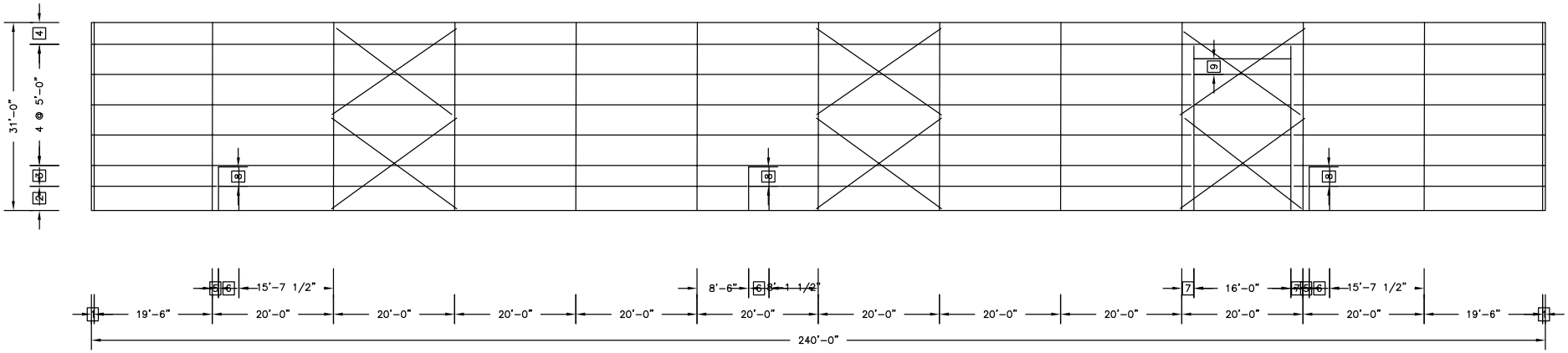
NTS

5/2/2008 14:33:43

Building B LEW Secondary

BUILDER General Steel
CUSTOMER
LOCATION Green Bay, Wisconsin
PROJECT .
BUILDER'S PO#
FILENAME:

JOB #
DATE 6/20/2007
DRAWN/CHECK
PAGE



Building B BSW Secondary

Shape Name = Building B, Wall = 2

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 14:34:03

Building B BSW Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

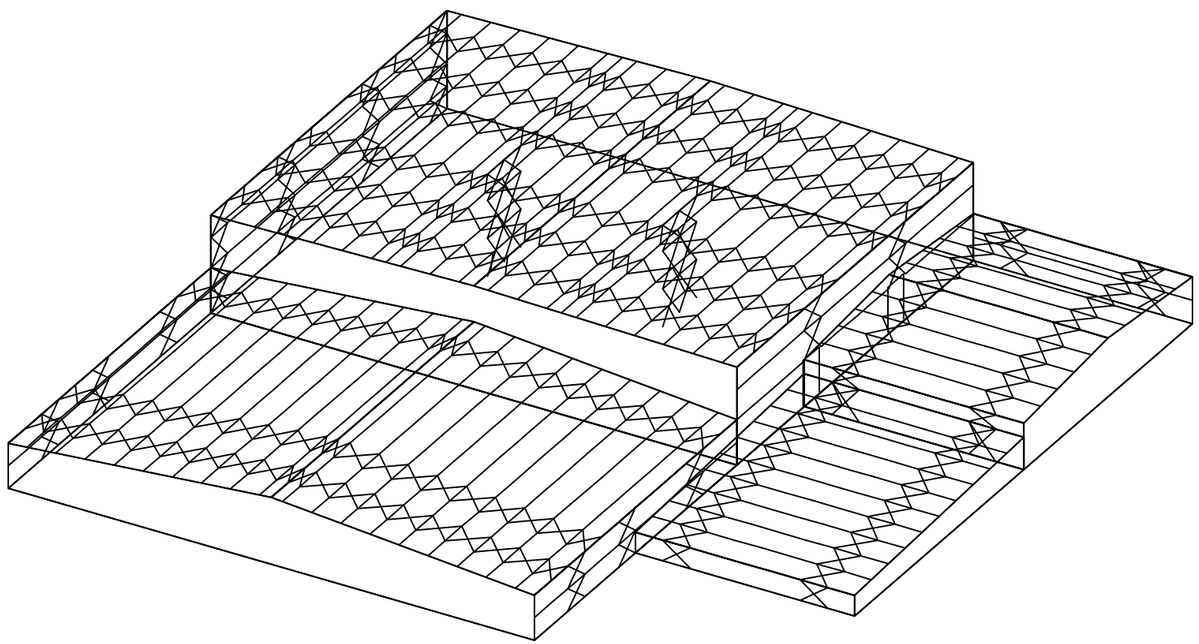
JOB #	
DATE	6/20/2007
DRAWN/CHECK	
PAGE	

DRAWING INDEX

DRAWING TITLE	PAGES
Cover Sheet	
Notes	
Anchor Rod Plan	
Primary Structural	
Secondary Structural	
Covering	
Special Drawings	
Standard Erection Details	

DRAWING RELEASE HISTORY

TYPE	DATE	DESCRIPTION



GENERAL NOTES

MATERIALS

	ASTM DESIGNATION	
3 PLATE WELDED SECTIONS	A529, A572, A1011, A1018	GRADE 55
COLD FORMED LIGHT GAGE SHAPES	A653, A1011	GRADE 55
BRACE RODS	A572	GRADE 65
HOT ROLLED MILL SHAPES	A36, A529, A572, A588, A709, A992	GRADE 36 KSI UNLESS NOTED
HOT ROLLED ANGLES	A529, A572, A588, A709, A992	GRADE 50
HOLLOW STRUCTURAL SECTION (HSS)	A500	GRADE B
CLADDING	A653, A792	GRADE 50 OR GRADE 80

A325 & A490 BOLT TIGHTENING REQUIREMENTS

IT IS THE RESPONSIBILITY OF THE ERECTOR TO INSURE PROPER BOLT TIGHTNESS IN ACCORDANCE WITH APPROPRIATE REGULATIONS. THE FOLLOWING CRITERIA IS IN COMPLIANCE WITH THE LATEST SPECIFICATIONS, HOWEVER THE ERECTOR IS RESPONSIBLE TO VERIFY LOCAL AUTHORITY REQUIREMENTS.
ALL CONNECTIONS MADE WITH A325 BOLTS MAY BE TIGHTENED TO THE "SNUG TIGHT" CONDITION AS PERMITTED BY THE SPECIFICATION FOR STRUCTURAL JOINTS USING A325 OR A490 BOLTS (2004 ED), UNLESS INDICATED AS "PRE-TENSIONED" ELSEWHERE IN THESE DRAWINGS, OR AS INDICATED BELOW.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, AND STRUT CONNECTIONS IF LOCATED IN IBC SEISMIC PERFORMANCE / DESIGN CATEGORY D, E OR F, UBC ZONE 3 OR 4. SEE CODES AND LOADS NOTES BELOW FOR SEISMIC DESIGN CATEGORY. PRE-TENSION ALL PRIMARY FRAMING CONNECTIONS IN CANADA.

PRE-TENSION BOLTS ON PRIMARY FRAMING, BOLTED BRACING, STRUTS AND CRANE RUNWAY CONNECTIONS IF BUILDING SUPPORTS A CRANE WITH A CAPACITY GREATER THAN 5 TONS.

CONNECTIONS THAT SUPPORT RUNNING MACHINERY AND OTHER SOURCES OF IMPACT OR STRESS REVERSAL MUST BE PRE-TENSIONED.

ALL SLIP CRITICAL CONNECTIONS AS INDICATED IN THESE DRAWINGS WITH -SC DESIGNATION MUST BE PRE-TENSIONED. SC TYPE CONNECTIONS MUST BE FREE OF PAINT, OIL OR OTHER MATERIALS THAT REDUCE THE FRICTION AT CONTACT SURFACES.

CONNECTIONS DESIGNATED AS A325-X OR A490-X SHALL BE IINSTALLED WITH BOLT HEAD ON SIDE OF THE THINNEST PLATE BEING CONNECTED.

SECONDARY MEMBERS AND FLANGE BRACE CONNECTIONS ARE ALWAYS "SNUG TIGHTENED", EVEN IF ABOVE CONDITIONS EXIST, UNLESS SPECIFICALLY NOTED OTHERWISE ON DETAILS.
WASHERS ARE NOT REQUIRED FOR "SNUG-TIGHT" CONNECTIONS. PRE-TENSIONED A325 OR A490 CONNECTIONS TIGHTENED USING THE TURN-OF-THE-NUT METHOD DO NOT REQUIRE WASHERS. A490 BOLTS MUST ALWAYS BE PRE-TENSIONED.

CODES AND LOADS

WHEN MULTIPLE BUILDINGS ARE INVOLVED, SPECIFIC LOAD FACTORS FOR DIFFERING OCCUPANCIES, BUILDING DIMENSIONS, HEIGHTS, FRAMING SYSTEMS, ROOF SLOPES, ETC., MAY RESULT IN DIFFERENT LOAD APPLICATION FACTORS THAN INDICATED BELOW. SEE CALCULATIONS FOR FURTHER DETAILS.

Building Code: 2008 Wisconsin Building Code
Based on Building Code: 2006 International Building Code
Building A: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building B: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building C: Building Use:Standard Occupancy Structure, Collateral Gravity: 3.00 psf (Not Including bldg wt)
Building D: Building Use:Hazardous / Special Occupancy, Collateral Gravity: 11.00 psf (Not Including bldg wt)
LIVE LOADS AND RAINFALL
Live Load 20.00 psf (Not Reducible)
Rainfall: 5.00 inches per hour

SNOW LOAD
Ground Snow: 40.00 psf, Flat Roof Snow: 25.20 psf
Snow Exposure Category (Factor): 1 Fully Exposed (0.90)
Snow Importance: 1.000 Thermal Category (Factor): Heated (1.00)

WIND LOAD
Wind Speed: 90.00 mph, Wind Exposure: C
Basic Wind Pressure: 20.50 psf
Wind Importance Factor: 1.000, Ft= Topographic Factor: 1.0000
Wind Enclosure: Enclosed, 0.180
Note: All windows, doors, skylights and other covered openings
must be designed for the specified above wind loads

EARTHQUAKE DESIGN DATA
Lateral Force Resisting Systems using Equivalent Force Procedure
Mapped Spectral Response - Ss:6.60 %g, S1:3.10 %g
Seismic Hazard / Use Group: Group 1
Seismic Performance / Design Category: A (See Bolt Tightening Note Above)
Seismic Snow Load: 0.00 psf
Seismic Importance: 1.000
Soil Profile Type: Stiff soil (D, 4)
Design Spectral Response - Sds: 0.0000, Sd1: 0.0000

Ordinary Steel Moment Frames
Frame Redundancy Factor:1.0000
Framing R-Factor: 3.0000, Frame Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W
Ordinary Steel Concentric Braced Frames
Brace Redundancy Factor:1.0000
Bracing R-Factor: 3.0000, Brace Seismic Factor (%s): 0.0100, Design Base Shear = 0.0100 W

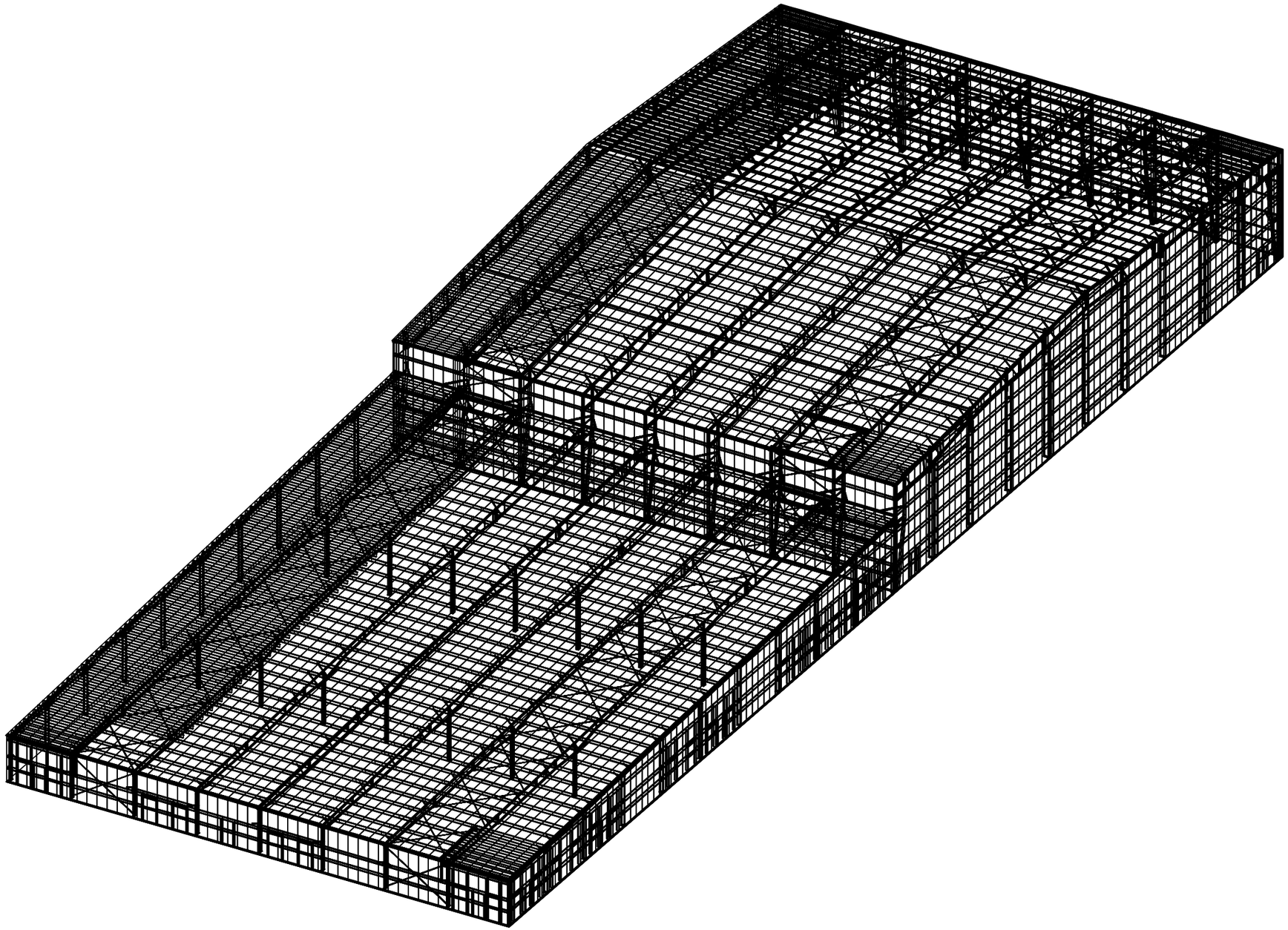
THE GENERAL CONTRACTOR AND/OR ERECTOR IS SOLELY RESPONSIBLE FOR ACCURATE, GOOD QUALITY WORKMANSHIP IN ERECTING THIS BUILDING IN CONFORMANCE WITH THIS DRAWING, DETAILS REFERENCED IN THIS DRAWING, ALL APPLICABLE ERECTION GUIDES, AND INDUSTRY STANDARDS PERTAINING TO PROPER ERECTION, INCLUDING THE CORRECT USE OF TEMPORARY BRACING.

COVER SHEET

BUILDER General Steel		JOB #
CUSTOMER		DATE 6/20/2007
LOCATION Green Bay, Wisconsin		DRAWN / CHECK
PROJECT .		PAGE 1
BUILDERS PO#		

5/2/2008 11:02:28

FILENAME:



Buildings C and D Perspective

REV	DATE	BY	DESCRIPTION

NTS

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	
JOB #	
DATE	6/20/2007
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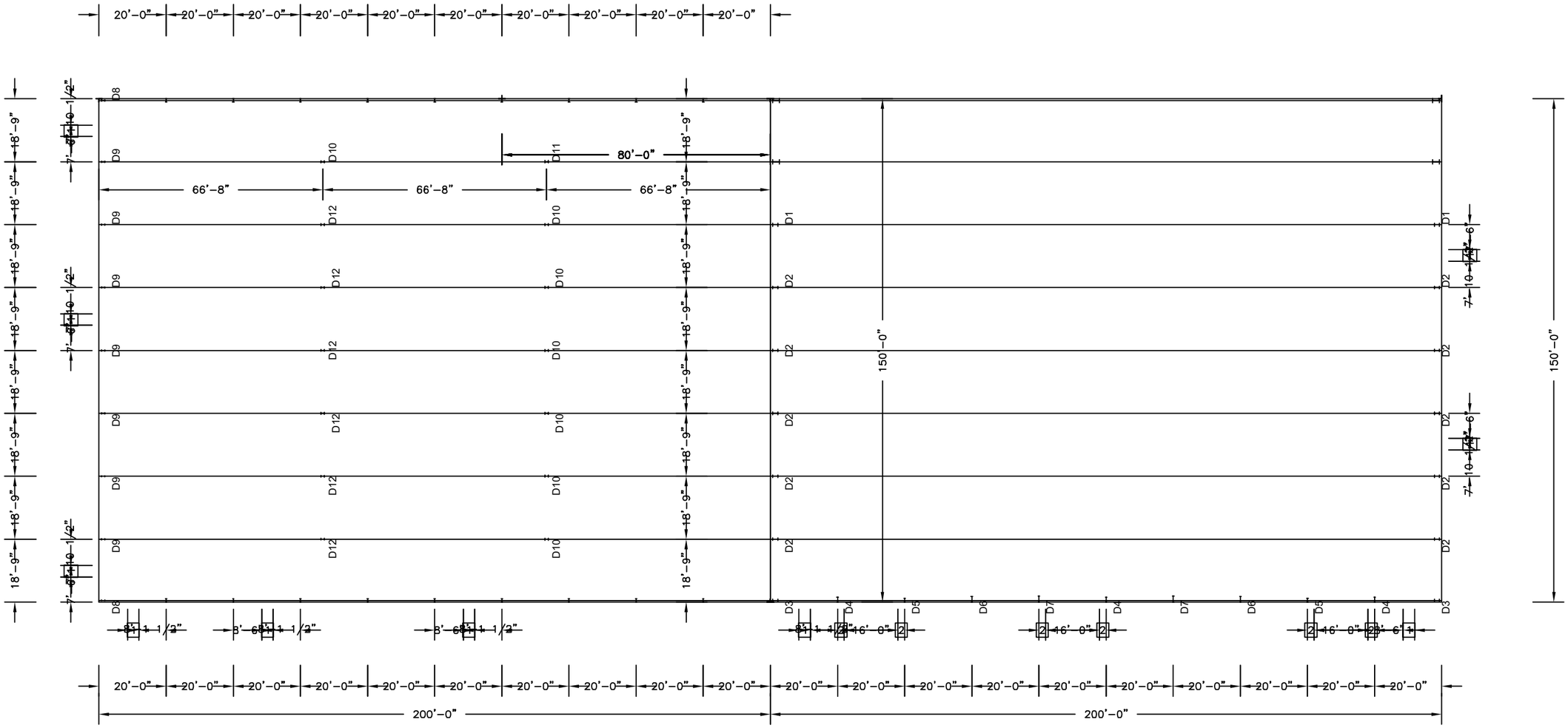


Buildings C and D Plan

2 2'-0"

1 3'-4 1/2"

☐Dimension Key

Finished Floor Elevation = 100'-0" (Unless Noted Otherwise)

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 13:27:03

Buildings C and D Plan

BUILDER General Steel

CUSTOMER

LOCATION Green Bay, Wisconsin

PROJECT .

BUILDER'S PO#

FILENAME:

JOB #

DATE 6/20/2007

DRAWN/CHECK

PAGE

Frame Clearances

Horiz. Clearance between members 1(CX007) and 17(CX008): 188'-7"

Horiz. Clearance between members 1(CX007) and 18(CX008): 188'-7"

Horiz. Clearance between members 2(CX007) and 17(CX008): 188'-7"

Horiz. Clearance between members 2(CX007) and 18(CX008): 188'-7"

Vert. Clearance at member 2(CX007): 26'-9"

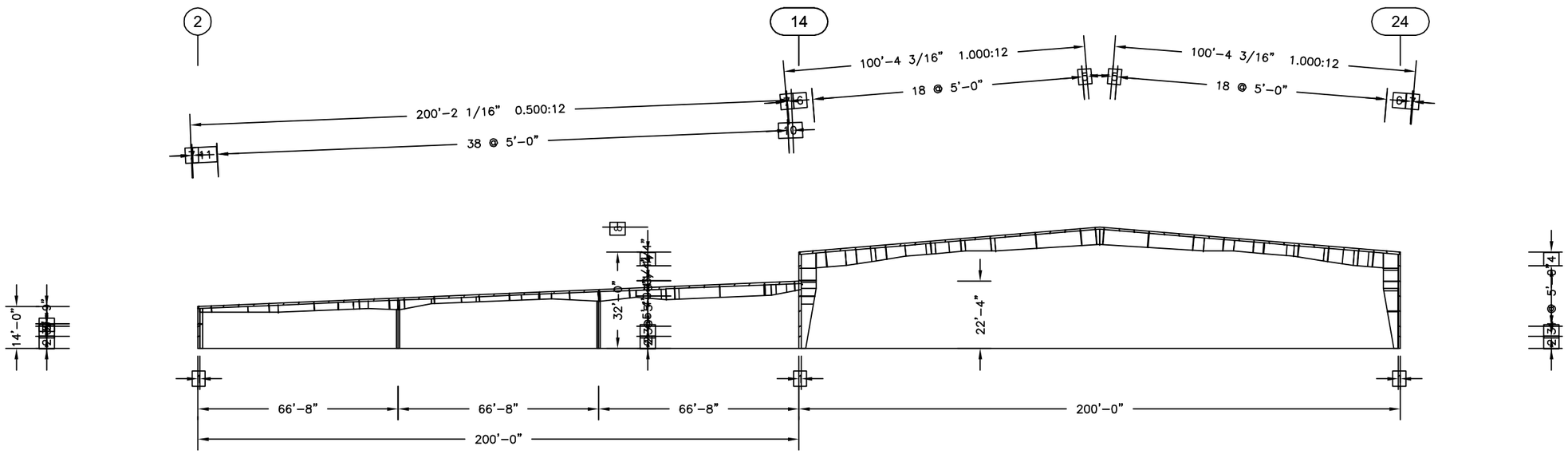
Vert. Clearance at member 17(CX008): 26'-9"

Vert. Clearance at member 1(CX017): 12'-0 7/8"

Vert. Clearance at member 16(ICX005): 12'-11 1/16"

Vert. Clearance at member 17(ICX004): 15'-8 3/8"

Finished Floor Elevation = 100'-0" (Unless Noted Otherwise)



Building C and D Frame Section

11 2 @ 4'-2 1/8"

10 1'-6 3/8"

9 9 3/4"

8 40'-4"

7 3 1/2"

6 2 @ 4'-3"

5 1'-6 11/16"

4 4'-6 3/4"

3 3'-5 1/4"

2 4'-0"

1 8 1/2"

☐Dimension Key

Shape Name = Building C Wall 2, Frame 5 , Shape = Building D Wall 2, Frame 5

1. USE 1/2 X 1 1/2 A325 SNUG TIGHTENED BOLTS FOR PURLIN TO FRAME, GIRT TO FRAME, AND GIRT TO CLIP CONNECTIONS UNLESS NOTED OTHERWISE.
2. SLOT REINFORCEMENT PLATES NEED NOT BE LOCATED ON THE SAME SIDE OF THE WEB AS THE HILLSIDE WASHER.

REV	DATE	BY	DESCRIPTION

NTS

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Building C and D Frame Section

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	
JOB #	
DATE	6/20/2007
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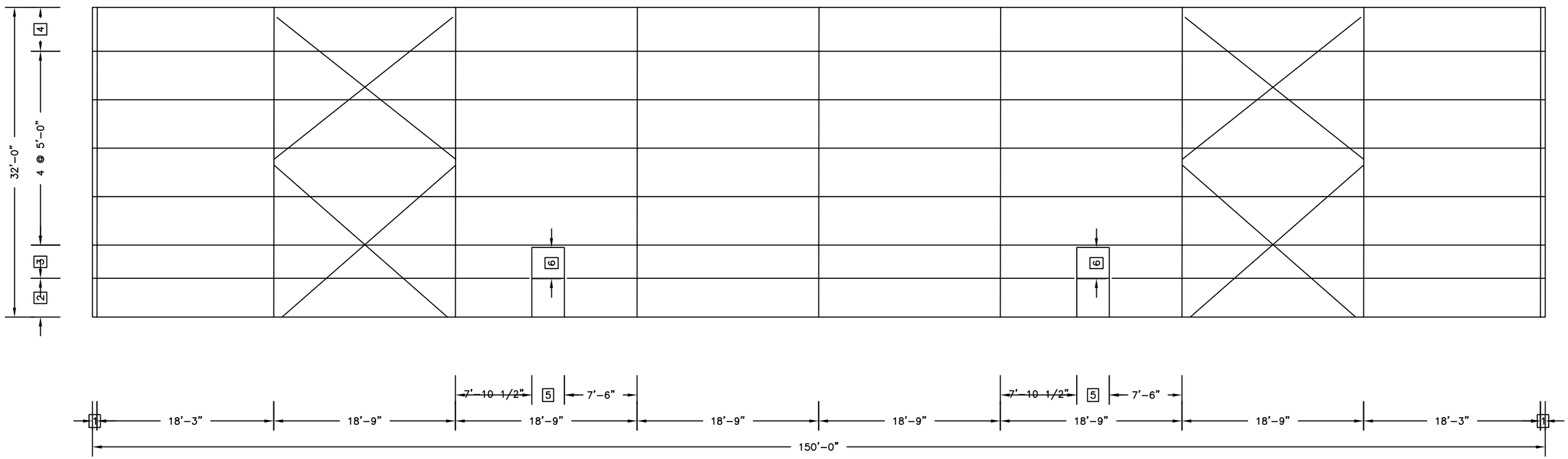

Building C Sidewall B Secondary

6 3'-2 1/4"

5 3'-4 1/2"

4 4'-6 3/4"

3 3'-5 1/4"

2 4'-0"

1 6"

☐Dimension Key

Shape Name = Building C, Wall = 4

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 15:03:27

Building C Sidewall B Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
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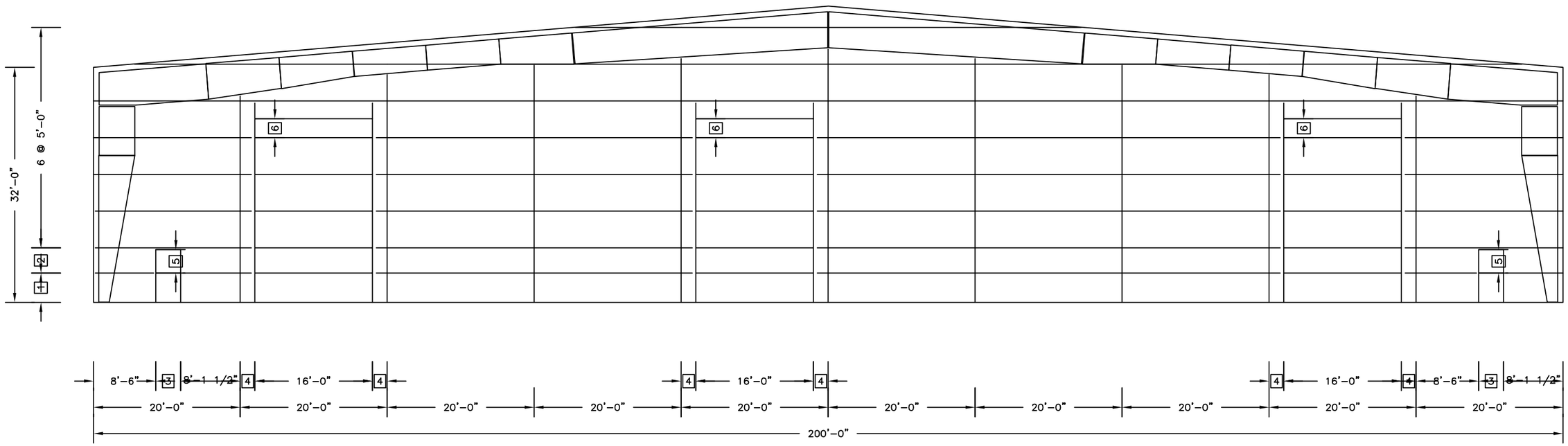

Building C Endwall C Secondary

6 2'-6 3/4"

5 3'-2 1/4"

4 2'-0"

3 3'-4 1/2"

2 3'-5 1/4"

1 4'-0"

☐Dimension Key

Shape Name = Building C, Wall = 1

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 15:02:04

Building C Endwall C Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
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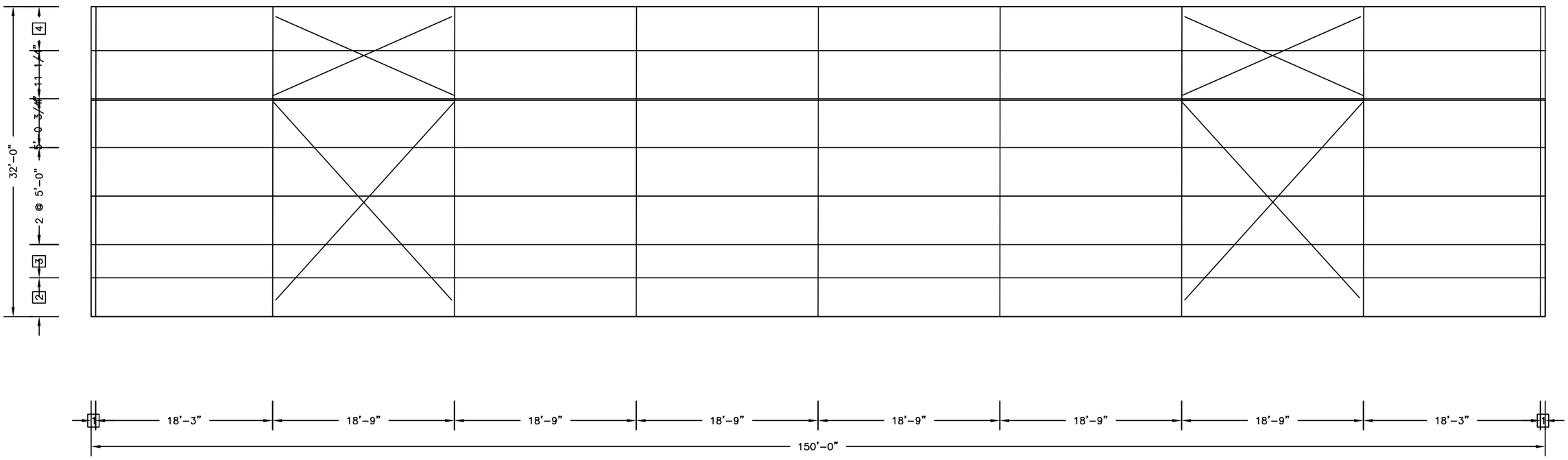

Building C Sidewall D Secondary

4 4'-6 3/4"

3 3'-5 1/4"

2 4'-0"

1 6"

☐Dimension Key

Shape Name = Building C, Wall = 2

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 15:02:55

Building C Sidewall D Secondary

BUILDER General Steel

CUSTOMER

LOCATION Green Bay, Wisconsin

PROJECT .

BUILDER'S PO#

FILENAME:

JOB #

DATE 6/20/2007

DRAWN/CHECK

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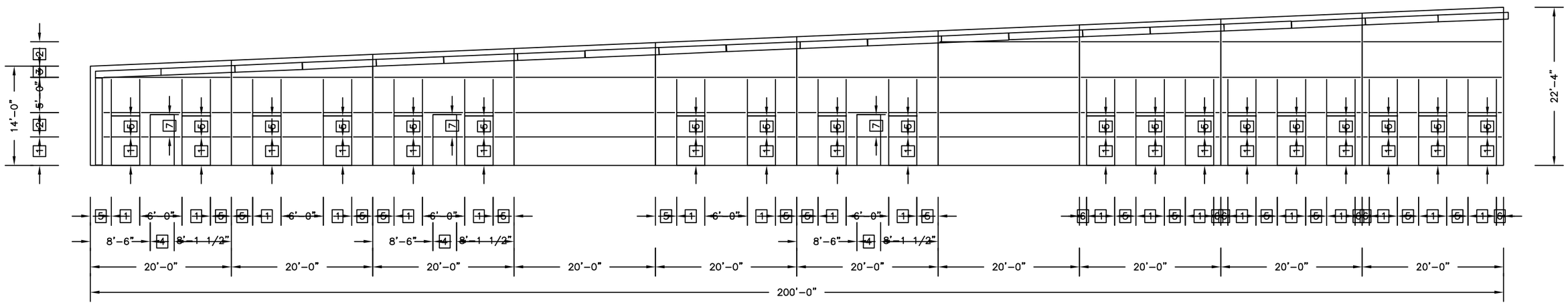

Building D Endwall C Secondary

7 3'-2 1/4"

6 1'-0"

5 3'-0"

4 3'-4 1/2"

3 1'-6 3/4"

2 3'-5 1/4"

1 4'-0"

☐Dimension Key

Shape Name = Building D, Wall = 1

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

5/2/2008 15:26:11

Building D Endwall C Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
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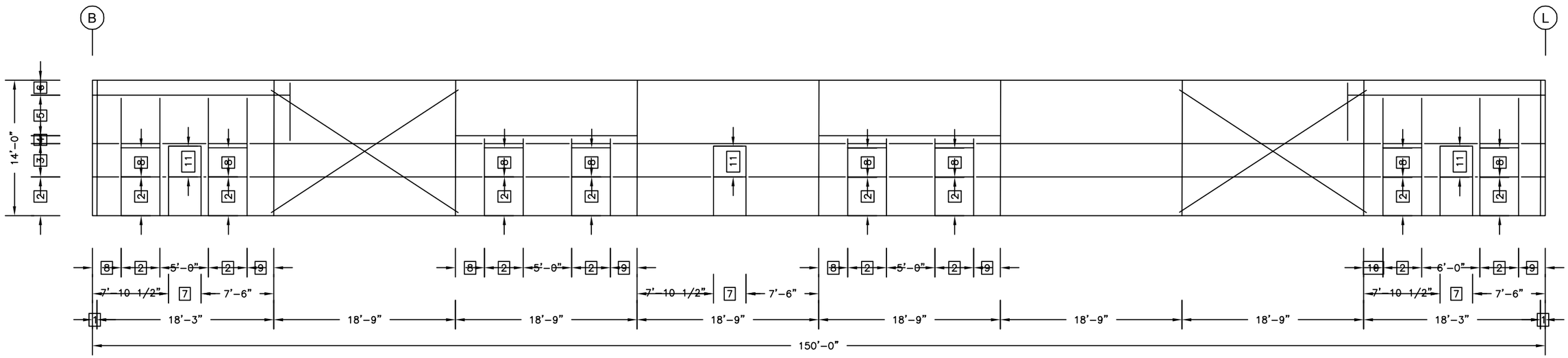

Building D Sidewall D Secondary

11 3'-2 1/4"

10 2'-0"

9 2'-9"

8 3'-0"

7 3'-4 1/2"

6 1'-6 3/4"

5 4'-2 1/4"

4 9 3/4"

3 3'-5 1/4"

2 4'-0"

1 6"

☐Dimension Key

Shape Name = Building D, Wall = 2

1. UNLESS NOTED, USE 1/2 X 1 1/2 A-325 SNUG TIGHTENED BOLTS FOR GIRT LAP, GIRT TO FRAME, FLANGE BRACE TO FRAME, FLANGE BRACE TO GIRT, JAMB AND HEADER CONNECTIONS.
2. WIND AND FLANGE BRACING ARE AN INTEGRAL PART OF THE WALL STRUCTURAL SYSTEM AND SHOULD BE PROPERLY INSTALLED PRIOR TO ERECTION OF WALL AND ROOF SHEETS. REMOVAL OR ALTERATION OF WALL BRACING WITHOUT PRIOR AUTHORIZATION IS PROHIBITED.

REV	DATE	BY	DESCRIPTION

NTS

Building D Sidewall D Secondary

BUILDER	General Steel
CUSTOMER	
LOCATION	Green Bay, Wisconsin
PROJECT	.
BUILDER'S PO#	
FILENAME:	

JOB #	
DATE	6/20/2007
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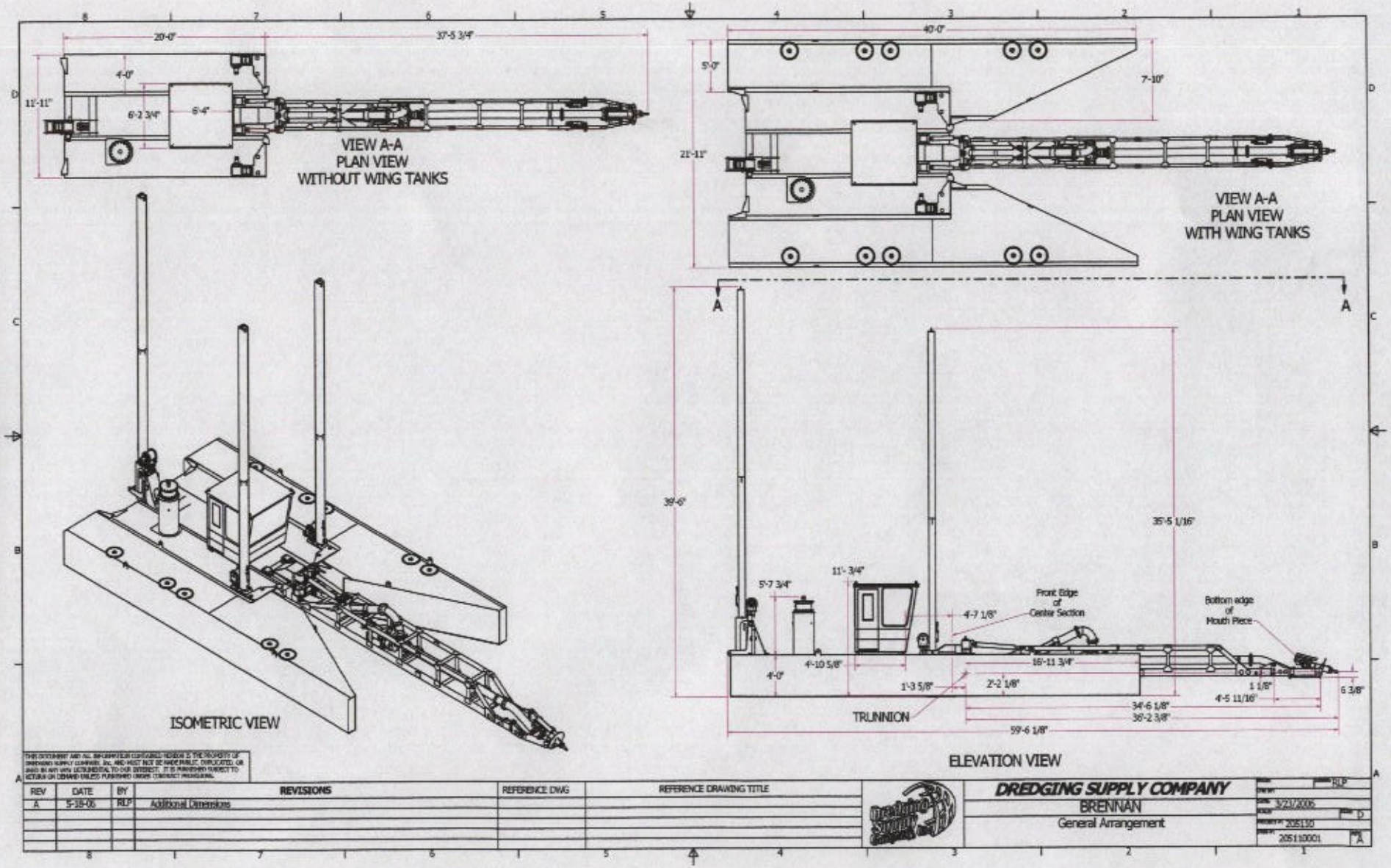
ATTACHMENT D-6

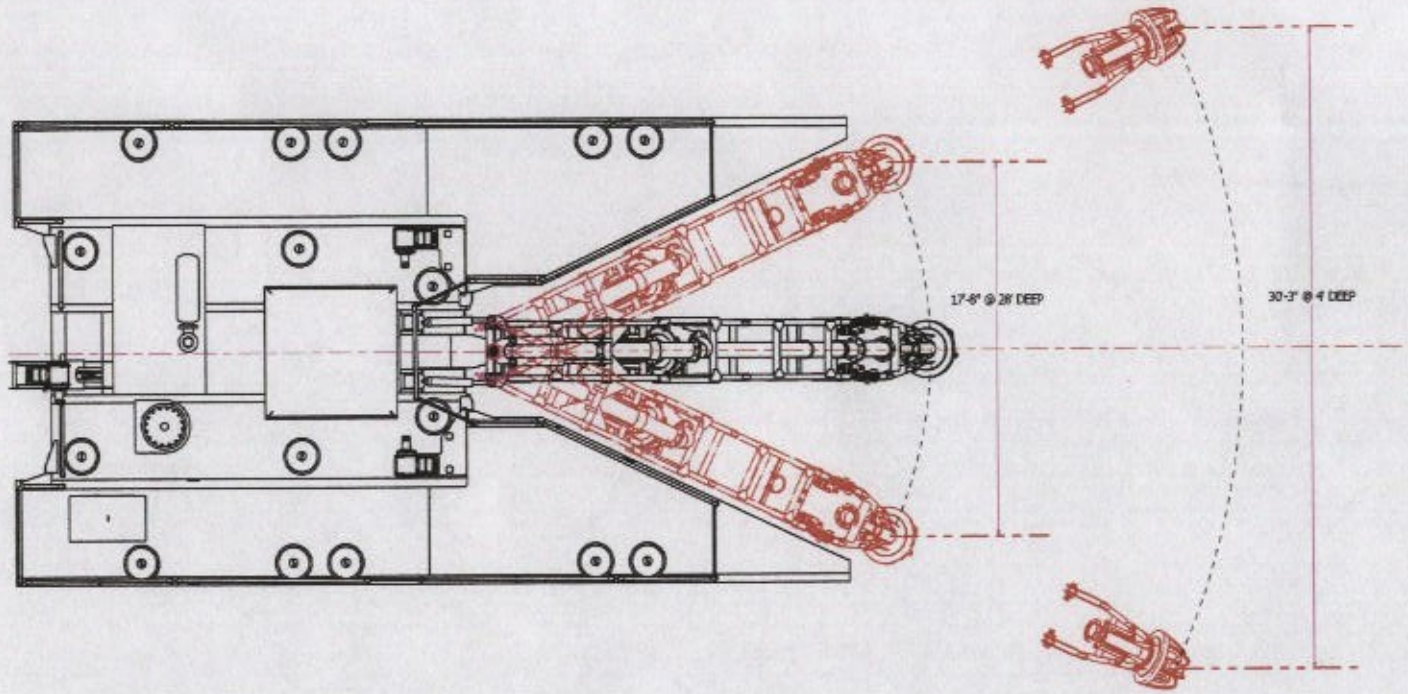
DREDGING EQUIPMENT DOCUMENTS

Appendix C-6

Dredge Equipment

WACKER


20'-0"
37'-5 3/4"
4'-0"
11'-11"
6'-2 3/4"
6'-4"
VIEW A-A
PLAN VIEW
WITHOUT WING TANKS
40'-0"
5'-0"
7'-10"
21'-11"
VIEW A-A
PLAN VIEW
WITH WING TANKS
A
A
39'-6"
35'-5 1/16"
11'- 3/4"
5'-7 3/4"
4'-7 1/8"
Front Edge
of
Center Section
Bottom edge
of
Mouth Piece
4'-10 5/8"
16'-11 3/4"
4'-0"
1'-3 5/8"
2'-2 1/8"
1 1/8"
6 3/8"
4'-5 11/16"
34'-6 1/8"
36'-2 3/8"
TRUNNION
59'-6 1/8"
ISOMETRIC VIEW
ELEVATION VIEW
REV
DATE
BY
REVISIONS
REFERENCE DWG
REFERENCE DRAWING TITLE
A
5-18-06
RLP
Additional Dimensions
DREDGING SUPPLY COMPANY
BRENNAN
General Arrangement
RLP
3/23/2006
D
205110
205110001
A



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DREDGING SUPPLY COMPANY

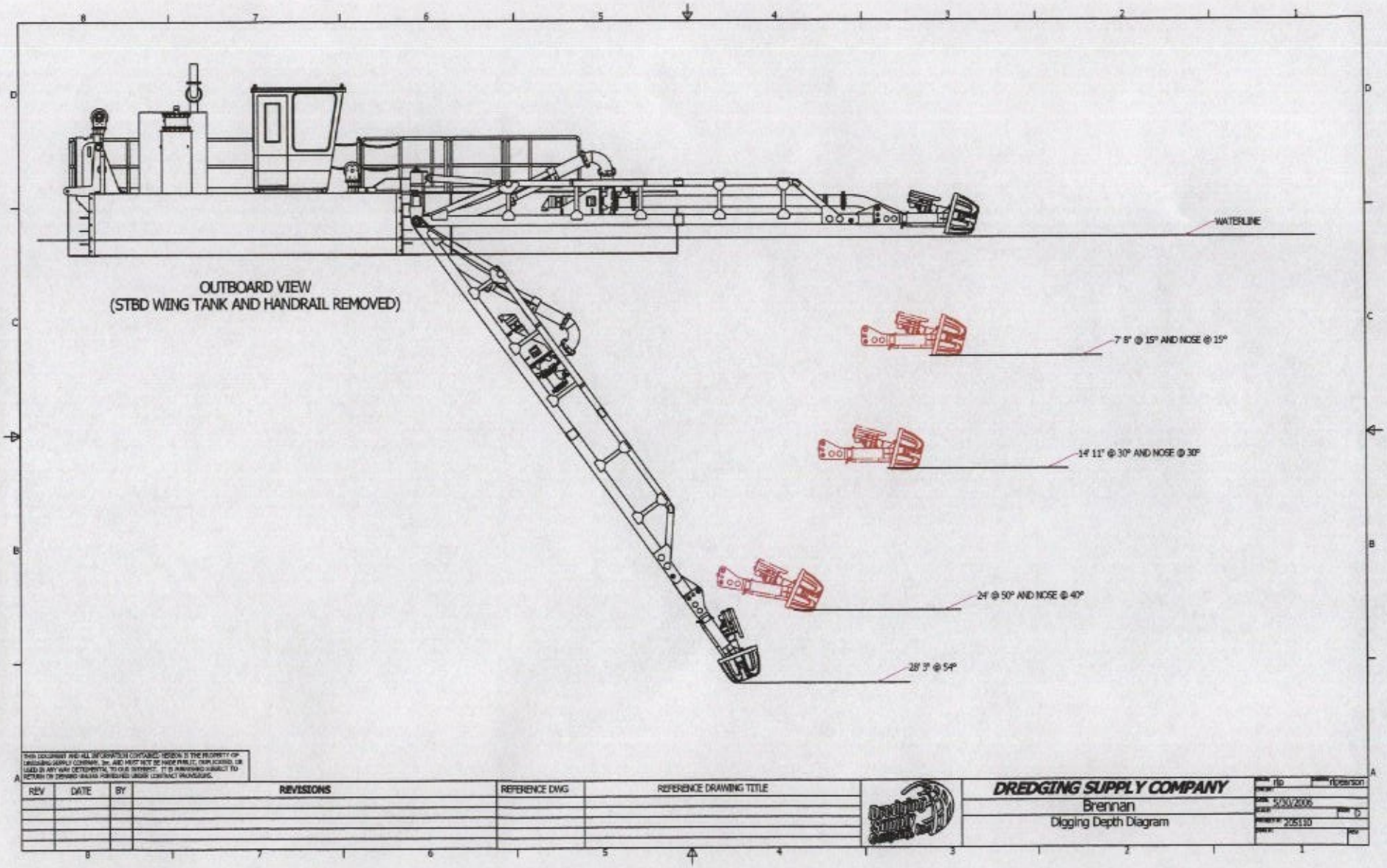
Brennan

Digging Width Diagram

DRAWN: rlp CHECKED: rdelapon

DATE: 5/30/2006 SCALE: D

PROJECT #: 205110


OUTBOARD VIEW
(STBD WING TANK AND HANDRAIL REMOVED)
WATERLINE
7' 8" @ 15° AND NOSE @ 15°
14' 11" @ 30° AND NOSE @ 30°
24' @ 50° AND NOSE @ 40°
28' 3" @ 54°
REV
DATE
BY
REVISIONS
REFERENCE DWG
REFERENCE DRAWING TITLE
DREDGING SUPPLY COMPANY
Brennan
Digging Depth Diagram
rlp
rlpearson
5/30/2006
D
205110

MORAY - DREDGE SPECIFICATIONS

GENERAL

OVERALL LENGTH	57-6"
TRANSPORTATION WIDTH	11'-11"
OPERATING WIDTH	21'- 11"
HULL DEPTH	4'
MEAN OPERATING DRAFT (WITH FUEL)2'-9"	
FUEL CAPACITY	500 gallons
DRY WEIGHT *(ESTIMATED)*	59,500 lb

OPERATING CONDITIONS:

MINIMUM DIGGING DEPTH	3'
MAXIMUM DIGGING DEPTH	25'

SWING WIDTH (SWINGING LADDER):

SWING WIDTH @ MINIMUM DIGGING DEPTH	19'-4"
SWING WIDTH @ MAXIMUM DIGGING DEPTH	13'
NOMINAL PUMP CAPACITY (WATER)	2000 gpm @ 185 TDH

Main Power:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3126B
MAXIMUM H.P. @ 2400 R.P.M.	275 H.P.
ENGINE COOLING	RADIATOR

RESIDENTIAL GRADE SILENCER. EPA & CARB Tier II Compliant

Cutter Module:

Sealed planetary drive with alloy cutter shaft and anti-friction bearings. 24" inside diameter 5-blade basket cutter with replaceable cast serrated edges

NOMINAL DRIVE TORQUE	31,512 in-lb
CUTTER FORCE	2,626 lb
CUTTER FORCE PER LINEAR INCH109 lb/in	
CUTTER SPEED	0-40
NOMINAL DRIVE POWER	20 HP
CUTTER RATING	20 H.P.
CUTTER SPEED VARIABLE	0 to 40 R.P.M.

Swing Cylinders (swing ladder mode):

Double acting hydraulic swing cylinder for swinging ladder operation

MODEL: Z40015136CCAZ (2)

Ladder Hoist Cylinder:

Double acting hydraulic ladder cylinders for ladder lifting operation

MODEL: Z40034332CCAZ

Stern Spud Kicker Cylinder:

Double acting hydraulic kicker cylinder for swinging ladder operation

MODEL: #S40006032SS

Dredge Pump:

Manufactured for DSC

SUCTION DIAMETER	8"
DISCHARGE DIAMETER	8"
IMPELLER DIAMETER	19 ½"
MAXIMUM PARTICLE CLEARANCE	3 ½"

Spud Hoist Winches:

Planetary spud winches with integral parking brake and API designed.

MANUFACTURER:	DSC
MODEL	RMLF091
WIRE ROPE LENGTHS	
Front Top:	65 ft. 8 in.
Front Bottom	53 ft. 1 in.
Kicker Top	66 ft. 8 in.
Kicker Bottom	53 ft. 5 in.

Electrical System:

- 24 VDC for starting, lighting, and controls.
- 12 VDC (8 amp maximum) for convenience and user furnished radios.
- All circuits fused for protection.
- Two 950 cold cranking amp batteries Capacities.
- Owner furnished AC generator.
- AC wiring in operator cab and for lighting.

Capacities:

FUEL	500 GAL.
HYDRAULIC	180 GAL.

Service Water Pump (Not furnished)

MANUFACTURER	Carver
SIZE	25X1X7L
MODEL	VERTICAL CANTILEVERED PUMP CAST IRON PROVIDED w/ NPT
DSC PART NUMBER	PP-00129
HYDRAULIC DRIVE MOTOR	CROSS
MODEL	40MH05-DACSC

Hydraulic System

Closed loop dredge pump circuit with infinite electronic speed control. Pressure compensated cutter, swing, and ladder/spud circuits for simultaneous operation. All circuits protected by suction strainer, return filters, and relief valves. The Moray dredge features a variable displacement hoisting and cutter hydraulic drive.

Control System

The DSC control system provides the dredge operator with a simple, ergonomic, and user-friendly interface to efficiently operate the dredge. The system is designed, manufactured, programmed, and tested in house by trained professionals with years of dredge experience. The heart of the system is its, performing automatic loop control, displaying pertinent information, and recording historical data.

The standard dredge control system protects against pump engagement and disengagement at high speed and locks out all hydraulic functions during start-up and control activation. The system also alarms on poor engine conditions and hydraulic and transmission problems. All of the alarmed conditions, along with the time and date, are logged; the last sixty-four alarms are retained for review.

The standard dredge control system provides electronic operation of the prime mover throttle; pump engagement, and all hydraulic speeds and directions. Hydraulic controls are ramped to prevent jarring when controls are started, stopped or reversed.

The standard dredge control system records and displays the operating hours of all major dredge systems including engine, dredge pump, cutter, swing winches, spud winches, and ladder winch. This data is useful for servicing and for managing dredge utilization.

Standard Features:

Fire Extinguishers (2) 5 Lbs. Abc

Handrails And Kick Rails

Cabin And Outdoors Lights

Early Warning Alarm System And Engine Shutdown System

Operator's Chair With Finger Tip Controls

Lighted Ring Buoy

Guards

Replaceable Edge Cutter

Optional Equipment

Air conditioning and Heater combination in lever room. Longer Spuds and bigger spud winches.

Custom articulated long ladder and ladder lifting and modified swinging system.

DESCRIPTION OF EQUIPMENT

The Moray - Dredge is a diesel powered pump system constructed to excavate and pump materials such as mud, silt, or sand from the bottom of a shallow body of water (up to 16 feet deep) through a pipeline to a disposal site some distance away from the dredge.

The following paragraphs describe the functions of the machinery located on the dredge. It is suggested that the reader refer to the drawings, which are enclosed, and the supplied machinery operating manuals while reading these sections.

Dredge Ladder

The dredge ladder consists of a structural steel frame that houses the dredge underwater pump, suction and discharge pipe, cutter and cutter motor and cutter drive. The ladder is supported at its aft end by trunnions and pins mounted on the ladder gimbal. It is supported midway by hydraulic cylinders, which are mounted between the ladder gimbal and the ladder. The cylinders are used to raise and lower the ladder. The dredge cutter is driven by a hydraulic motor/gearbox through a shaft with sealed bearings. A flexible rubber hose connects the dredge ladder discharge pipe elbow to the through hull discharge pipe to permit the ladder to pivot up and down, and swing side to side freely.

LADDER GIMBAL & LIFT CYLINDERS

Ladder Gimbal

The ladder gimbal consists of a hull structural section and ladder section connected together with a large steel pin. The hull gimbal, located at the forward end of the center section, remains stationary at all times. The ladder gimbal pivots from side to side to allow the dredge to operate in the swinging ladder mode. The swing gimbal houses the swing cylinders, the ladder trunnions, and the ladder lift hydraulic cylinders. For shipping, the ladder gimbal can be rigidly fixed to the hull gimbal by a locking bar between the ladder and the gimbal.

Dredge Pump

The pump consists of a custom DSC pump; bearings, bearing pedestal, and pump foundation. (See the pump section for more details of the pump arraignment).

Diesel Power Source

The Caterpillar 3126B diesel engine, which drives the hydraulics, and keeps the batteries charged, is radiator cooled. For more information on the engine system, refer to the accompanying Caterpillar manual.

Dredge Pump Piping

The suction piping consists of a long flanged suction pipe mounted on the pump clean out and a short flanged rubber suction hose between it and a flanged pipe to the mouth piece. The rubber hose allows the articulation and absorbs vibration.

The ladder discharge pipe consists of a flanged elbow at the pump with a supported, eight-inch I D, flanged, rubber discharge hose that connects a straight section of eight-inch ID pipe.

UNDERWATER PUMP

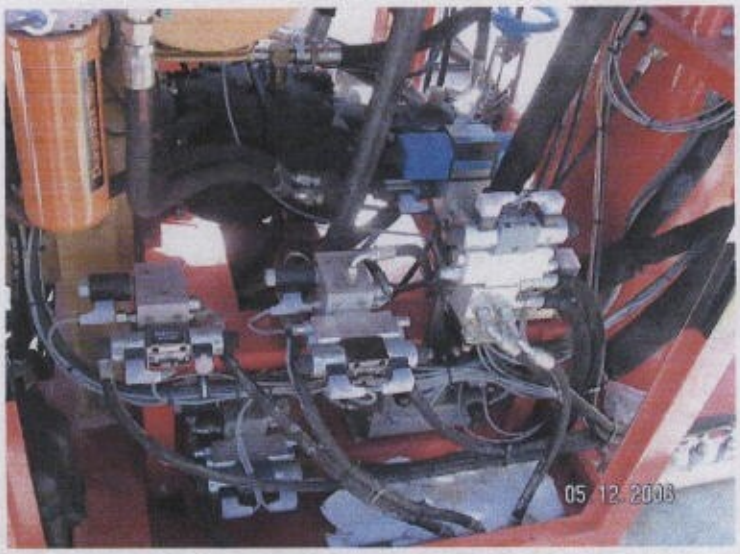
Spuds

In the swinging ladder mode, the dredge spud system consists of two square digging spuds located at the front of the hull and one square, kicking spud located at the stern of the hull. All three spuds are used to hold the dredge stable when it is operating in the swinging ladder mode. In swinging ladder operation, the kicker spud helps maintain hull stability during dredging. It also provides forward or backward movement to the hull. The spuds are raised and lowered by DSC custom hydraulic winches in a power-up power-down fashion to any depth without resetting pins.

Hydraulic Power System

Two hydraulic pumps mounted, in tandem, on a single pump drive behind the Cat. 3126, hydraulically powers the dredge's auxiliary functions and the dredge underwater pump. One pump powers the auxiliary functions, which include the dredge cutter, swing winches or cylinder, ladder lifting cylinder, spud winches and the kicker spud cylinder. The other pump is in a closed loop system that only drives the underwater dredge pump. This pump incorporates a system charge pump for the closed loop. The hydraulic system is protected from dirt and contamination by a filtered breather cap, in-tank suction strainer and return filter. All hydraulic circuits have pressure gages and relief valves to protect from spikes and large hydraulic loads. The hydraulic tank has a thermometer, sight gage, a low-level sensor alarm, and a low-level shutdown device.

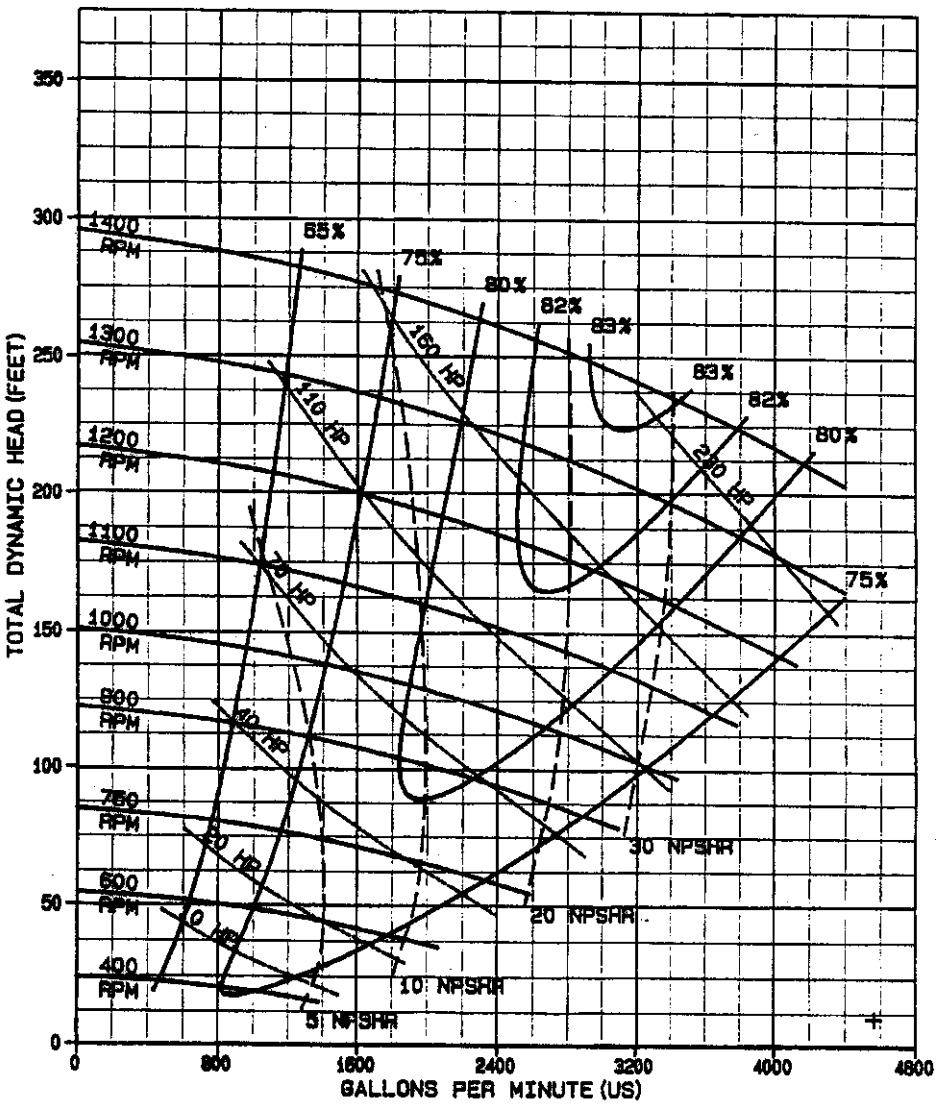
NOTE: The hydraulic tank filler cap must be on and tight to keep the tank pressurized or the hydraulic pumps will be severely damaged. After an extended shut down or if the hydraulic tank has been opened, the engine must be operated at a low speed for ten minutes to re-establish the pressure in the hydraulic tank before resuming full speed operation.



HYDRAULIC VALVES

DREDGE PUMP CURVE

DREDGE PUMP	Vane Diameter 19.75"	Free Passage 3.5x3.0"	Dredging Supply Company, Inc.
Clear Water Performance The effects of specific gravity, viscosity and solids on performance with slurry must be accounted for. Alternate choice for frame size or seal type may also have some effects.	Frame Size 3 Seal Type P	Curve Number E 8H-87 Test Number B300 -93	



10" x 8" Booster Unit
Preliminary Specifications

presented to:

J.F. BRENNAN CO., INC.
820 BAINBRIDGE · LACROSSE, WI 54603 PHONE: 608/784-7173 FAX: 608/785-2090 info@jfbrennan.com

October 2007

Prime Mover

CATERPILLAR

Caterpillar C-9 industrial diesel engine, radiator cooled with residential grade silencer and a continuous rating of 275 bhp @ 1800-2200 rpm. EPA & CARB Tier 3 compliant, Caterpillar premium gages, alarms, and shutdown systems

Dredge Pump Reduction Gear/drive

Twin Disc marine gear complete with Centa torsional coupling, electronic selector valve and gear cooler. The reduction gear is close-coupled to the Caterpillar engine with a stub/output shaft. The stub/output shaft is coupled to the dredge pump shaft through an elostomer style coupling.

Dredge Pump – *with cleanout*

metso

Suction diameter	10" (8")
Discharge diameter	8"
Impeller diameter	24"

Skid

Structural Base Type	Heavy-duty structural WF beam
Enclosure Type	Roof only

Service Pump

To be provided by JF Brennan

Miscellaneous

Batteries and battery cases
Machinery guards
Fire extinguisher
Wash down system
Gages

Booster Control Package:
The booster control package consists of a PLC, touch screen operator interface, transmitters and enclosure with mounting brackets. The sensors that will be supplied are discharge pressure and inlet pressure. The booster panel will have start/stop switches for the main pump and service water pump. The panel also has a booster mode switch and a touch screen. The touch screen will display data, alarms and it allows the operator to change control and alarm set points. The booster has an auto and manual mode. The auto mode is controlled off the inlet pressure and discharge pressure and the manual mode allows you to control the booster manually.

Coatings
Engine enclosure and equipment skids:

1. Blast all steel SSPC-SP6. Blast to achieve 1- to 2- mils profile as determined with a surface profile comparator
2. First coat; 1-3 mils (dry film thickness) Epoxy (Oxide red)
3. Second coat; 4-6 mils (dry film thickness) Epoxy (Pearl Grey)
4. Finish coat: 4-6 mils (dry film thickness) Epoxy (Pearl Gray)

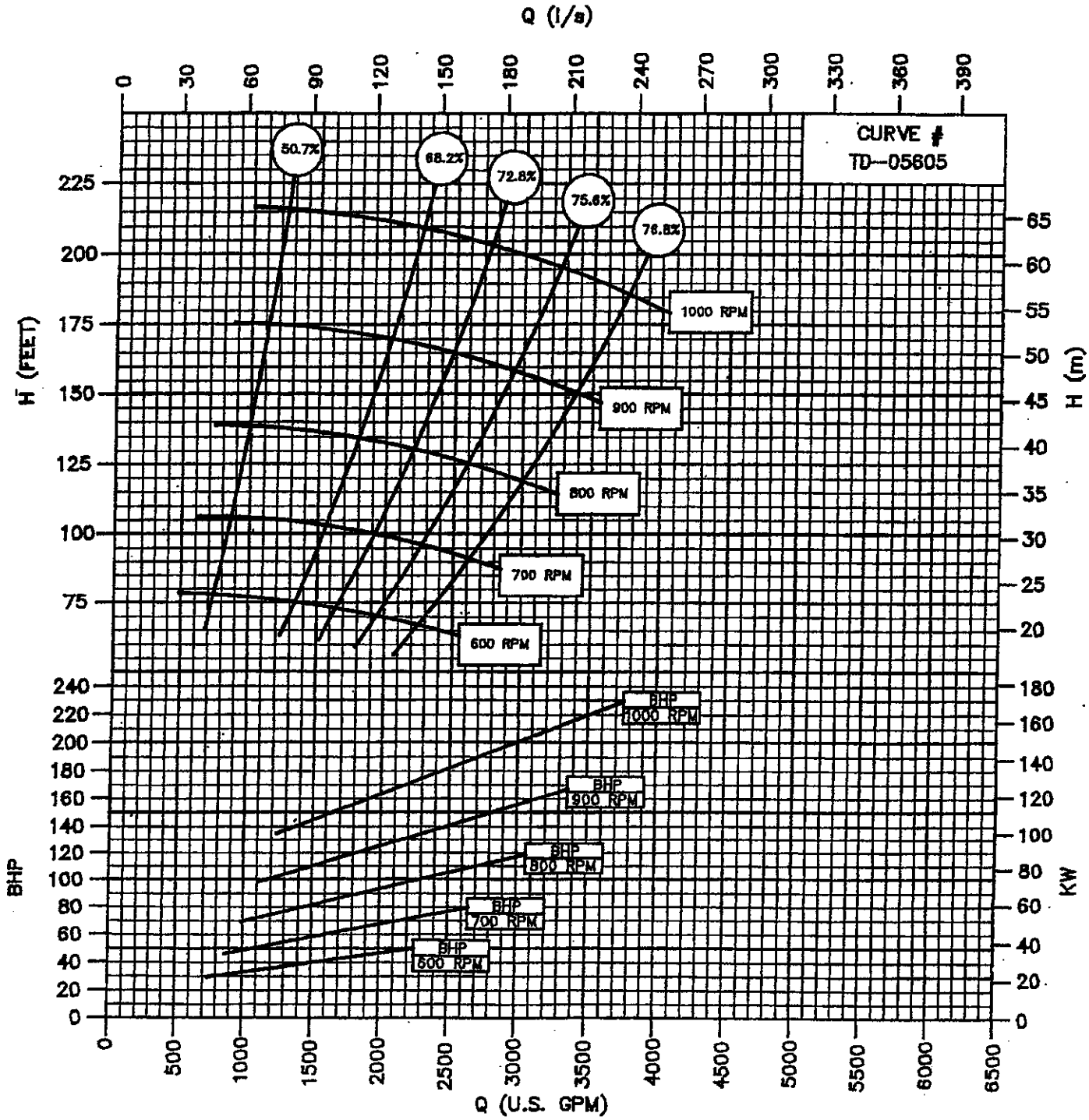
Building Standards
Dredges manufactured by Dredging Supply Company, Inc. are designed and built using the following regulations as our guidelines:

- Rules for Building and Classing Steel Vessels for Service on Rivers and Inland Coastal Waterways by the American Bureau of Shipping, 1997, RNC2-8, Corr1,2.
- Manual of Steel Construction, Ninth Edition by the American Institute of Steel Construction.
- Joint Industrial Council Hydraulic Standards T2.24.1 - 1990.
- Structural Welding Code - Steel ANSI/ANS D1.1-2004 by the American Welding Society and the American National Standards Institute.
- Mining Safety and Health Act.
- Occupational Safety and Health Act.
- Surface Preparation Specifications Steel Structures Painting Council No. 91-08.
- National Electrical Code Handbook, 2002.

Note: ***Specifications may change due to continual product improvement***

6. 15. 2004

PUMP MODEL	SIZE	IMPELLER # F-6125/FL-602		CASE# H-8118/H-890	
8" H-24	8 X 10	TYPE	VANES	VANE ø	MAX PARTICLE
		CLOSED	3/4	24.00 IN	4.00 IN
PERFORMANCE FOR WATER @ 1.0 SG @ 68°F/20°C				610 MM	102 MM
CORRECTIONS MUST BE MADE FOR HEAD AND EFFICIENCY LOSSES FROM MIXTURE SPECIFIC GRAVITY AND SOLIDS EFFECT. CONSULT FACTORY				MAX.SPEED	TEST# A 24.0
				1114 RPM	DATE 11/13/89



SERVICE
SPILL
KIT

December 24, 2007

To: **Vic Buhr**
JF Brennan

From: **Bob Wetta**
Dredging Supply Co.

The graphs below are based on the following data:

The top graphs in each series represents two (2) 8" Moray dredges with eight (8) additional boosters – each Moray with a flow rate of 650 GPM flowing into a common 8" discharge pipe.

The bottom graphs in each series represents one (1) 8" Moray dredge with eight (8) additional boosters – the single Moray with a flow rate of 650 GPM.

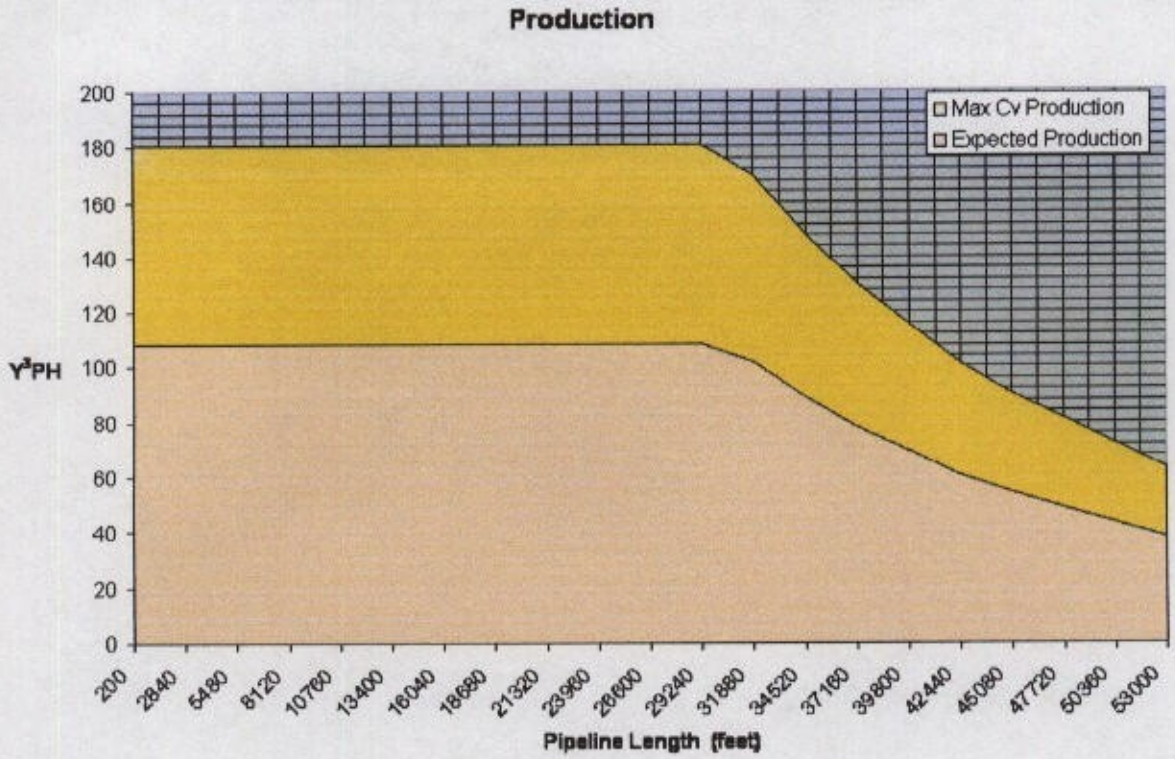
The material is representative of a well-graded very fine sand. While the production rates may look higher than what is expected to be achieved, we based the production on being able to maximize the concentration of solids. It is understood that the production rate will be significantly less than what is represented, which allows data to say that the pumping hydraulic calculations are achievable by the equipment options.

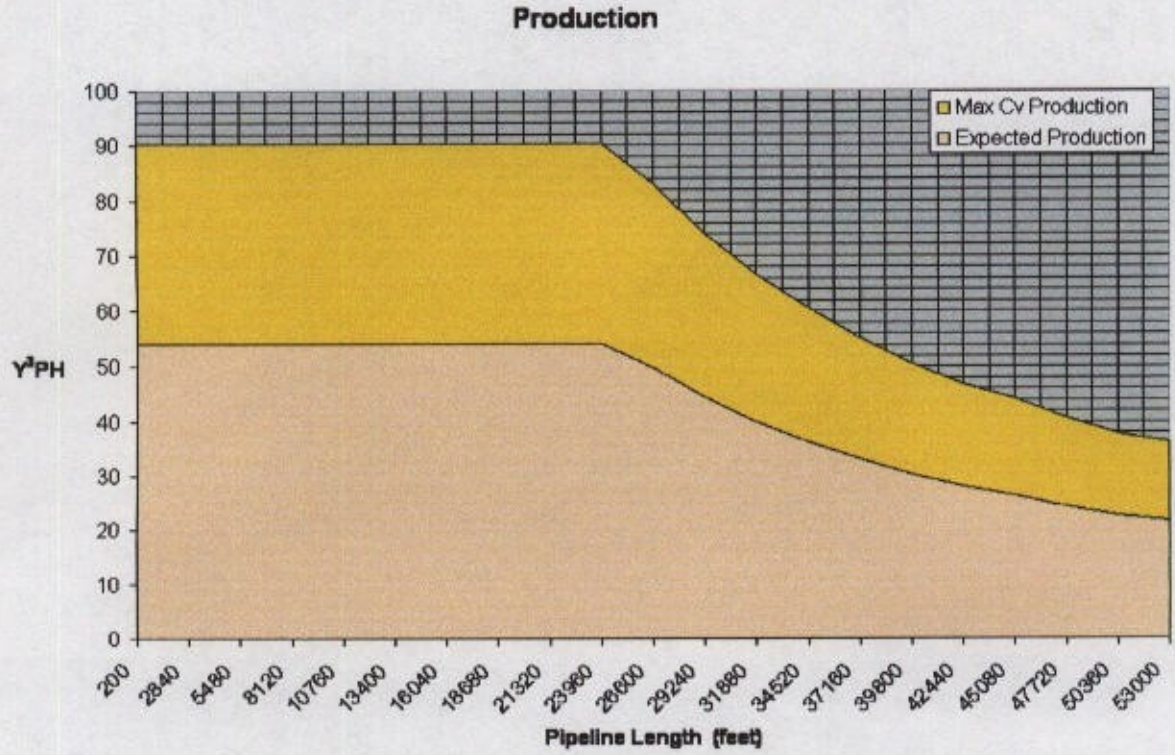
You find in the graphs the major difference is in the maximum horsepower requirements. With the single Moray, the high horsepower requirement based on the maximum conditions is due to the inefficiency of the booster pumps. This is only expected in the event that one of th moray dredges is down and you must operate with a single dredge. However, the 53,000 feet of discharge line can still be achieved with these conditions.

Again I want to point out that this data was used to maximize production in order to look at the hardest pumping conditions to see if the equipment selections will work.

Please get back to me at your convenience if you need any additional details.

Bob Wetta


Production
Max Cv Production
Expected Production
Y³PH
200
180
160
140
120
100
80
60
40
20
0
200
2840
5480
8120
10760
13400
16040
18680
21320
23960
26600
29240
31880
34520
37160
39800
42440
45080
47720
50360
53000
Pipeline Length (feet)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Max Cv Production
Expected Production
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10760
13400
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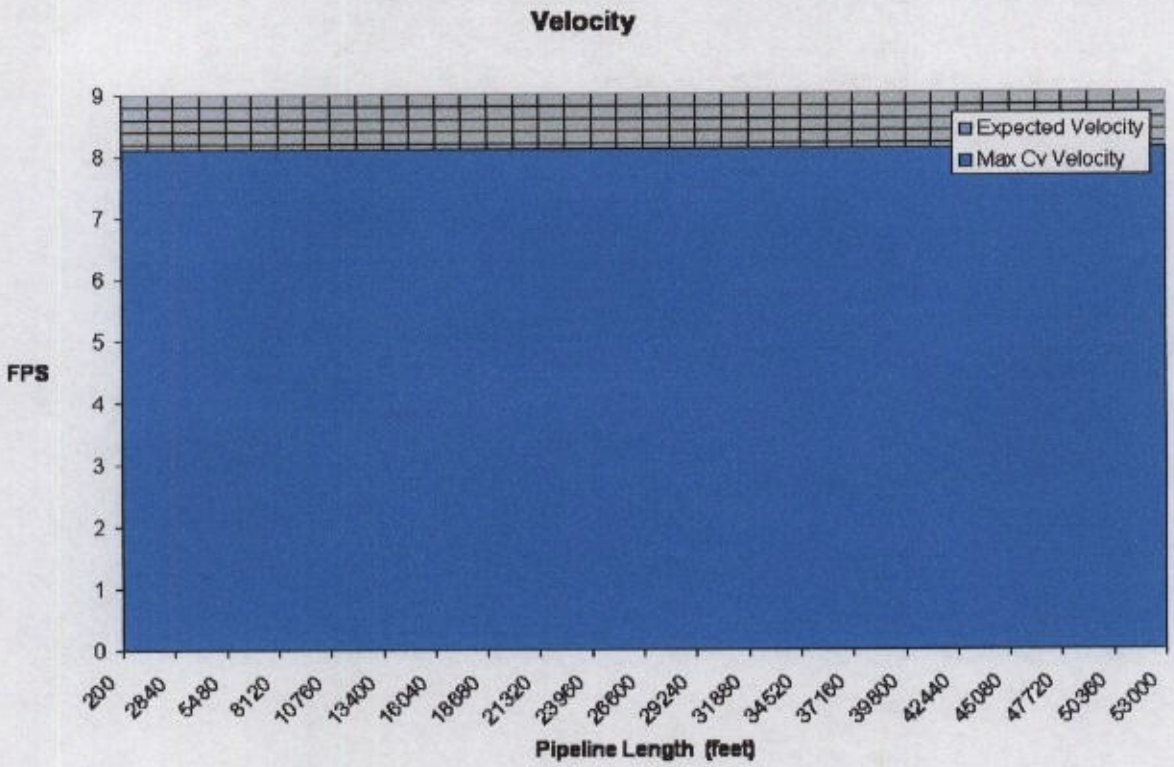
Pipeline Length (feet)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8
7
6
5
4
3
2
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0
Expected Velocity
Max Cv Velocity
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10760
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16040
18680
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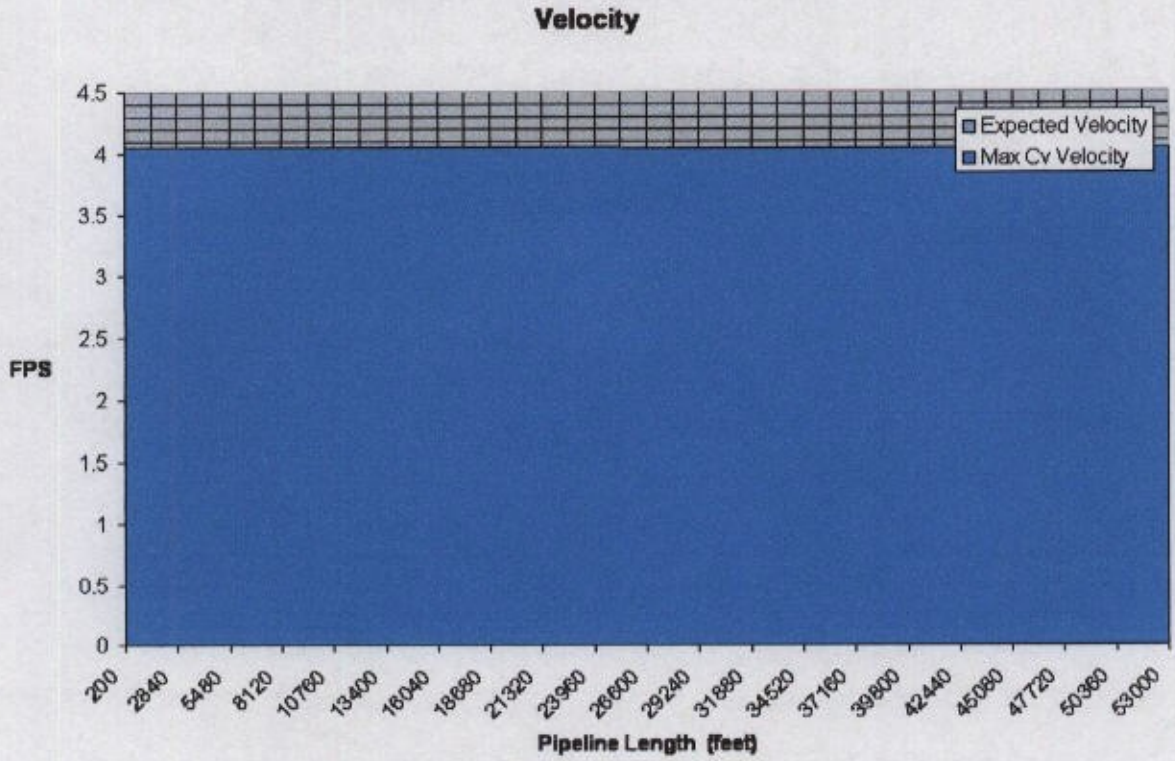
Pipeline Length (feet)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3.5
3
2.5
2
1.5
1
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0
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Max Cv Velocity
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2840
5480
8120
10760
13400
16040
18680
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31880
34520
37160
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45080
47720
50360
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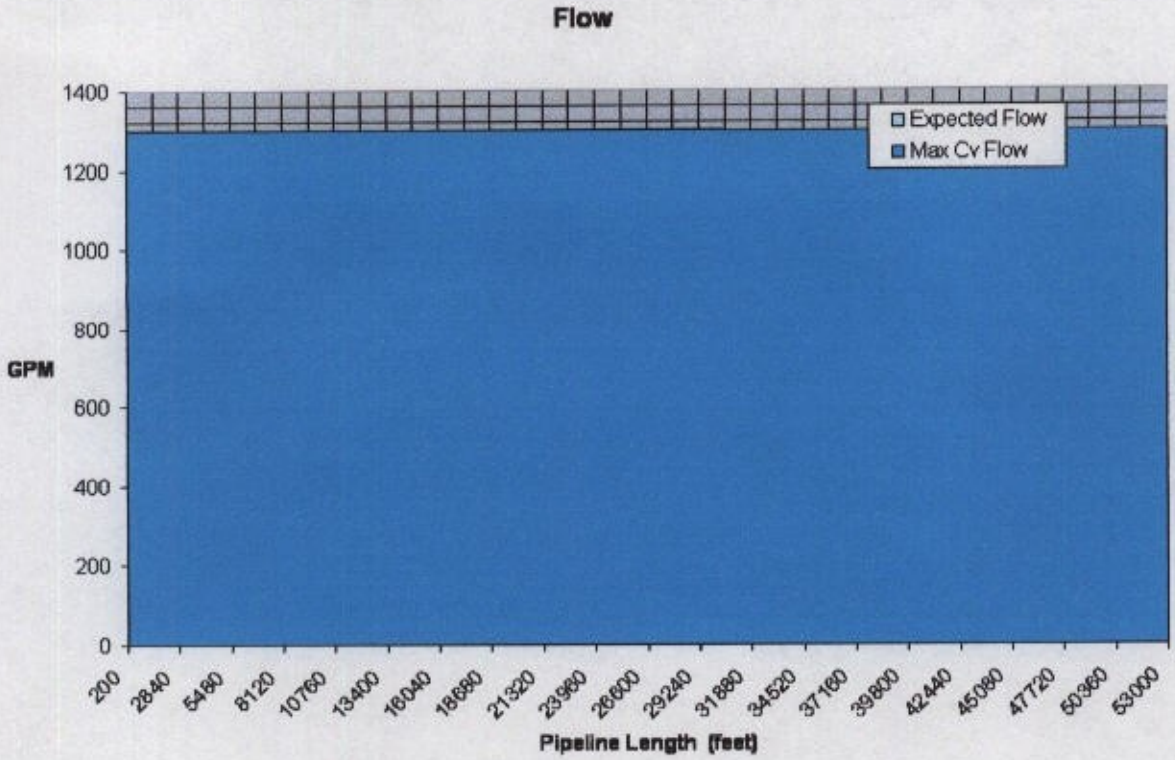
Pipeline Length (feet)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1200
1000
800
600
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200
0
GPM
Expected Flow
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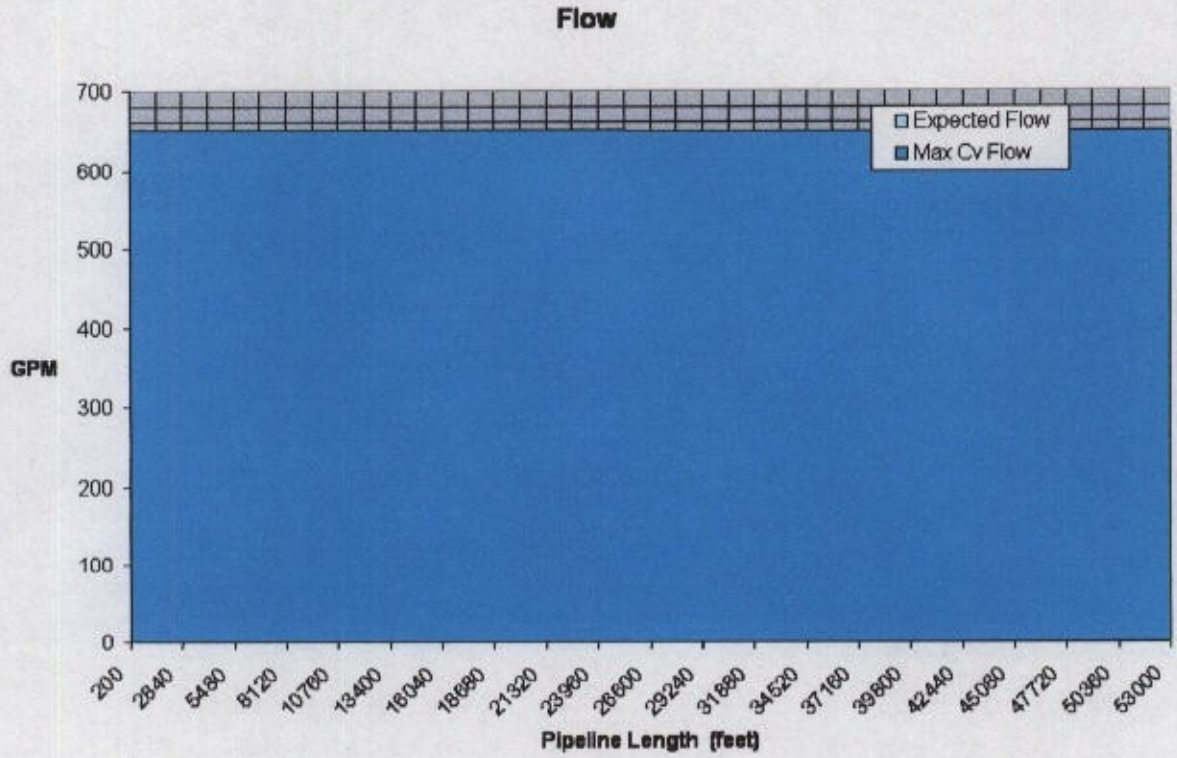
Pipeline Length (feet)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GPM
Expected Flow
Max Cv Flow
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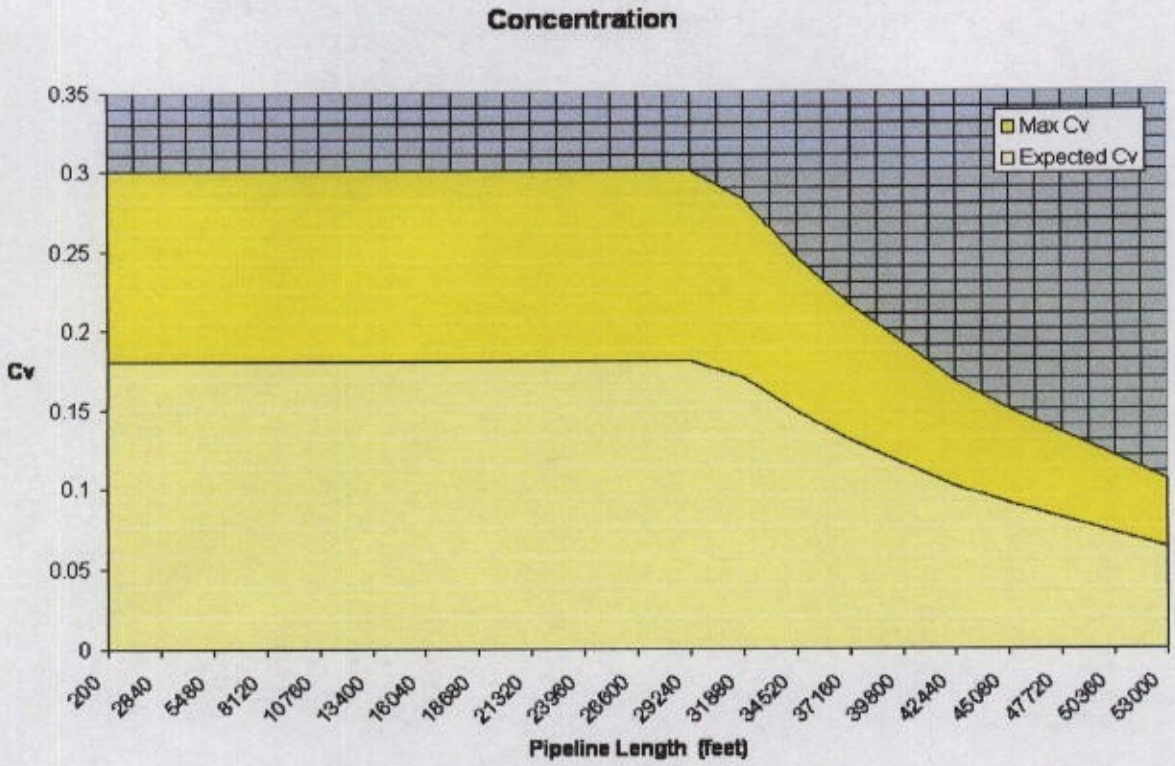
Pipeline Length (feet)


Concentration
Max Cv
Expected Cv
Cv
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0.3
0.25
0.2
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0.1
0.05
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200
2840
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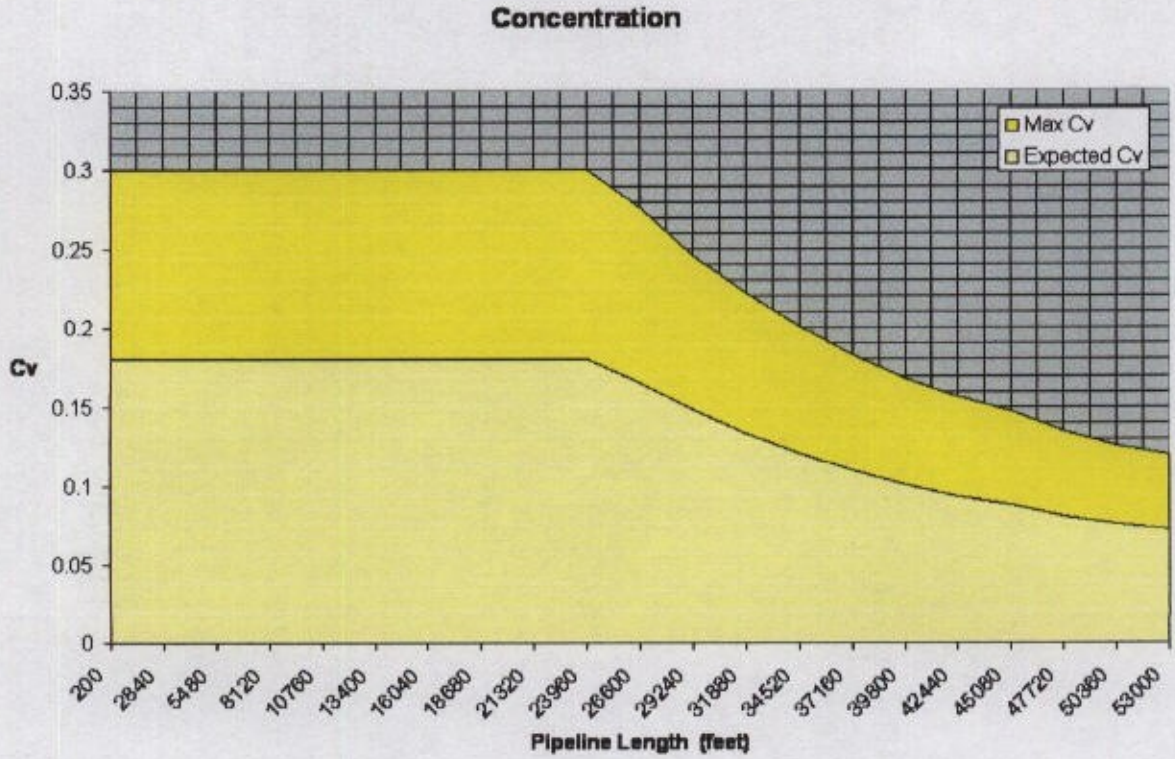
Pipeline Length (feet)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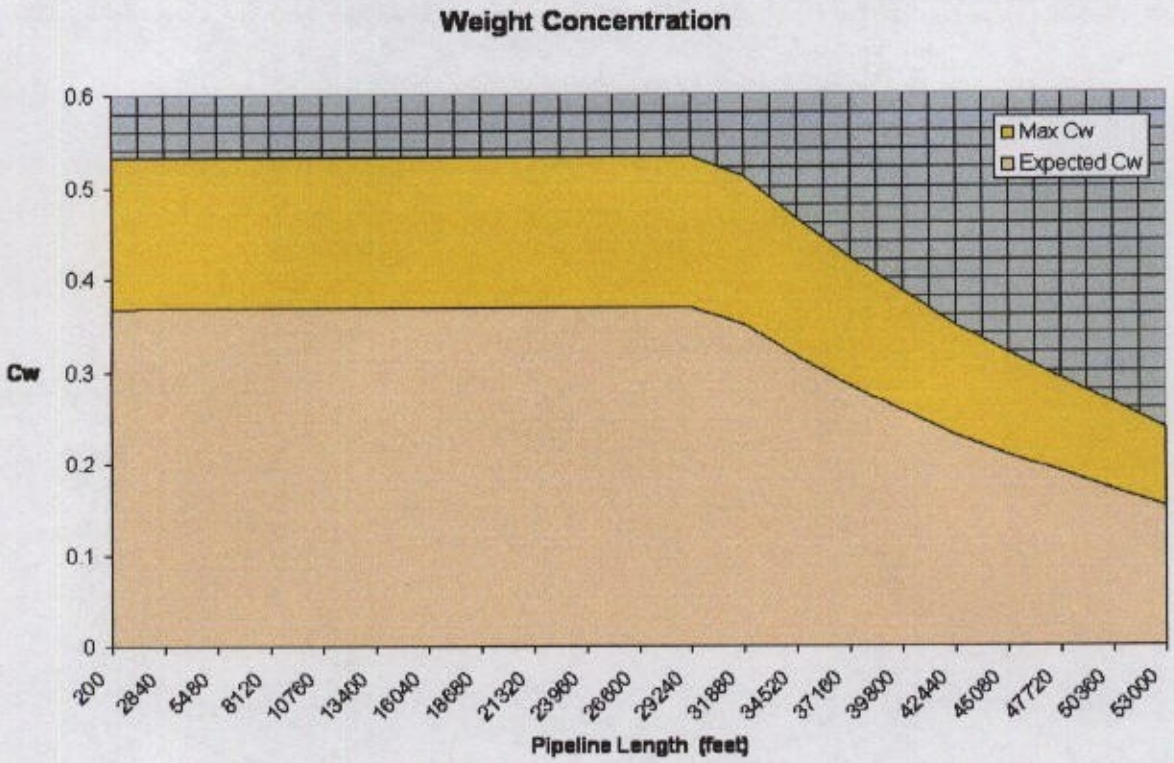
Pipeline Length (feet)


Weight Concentration
Max Cw
Expected Cw
Cw
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0
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13400
16040
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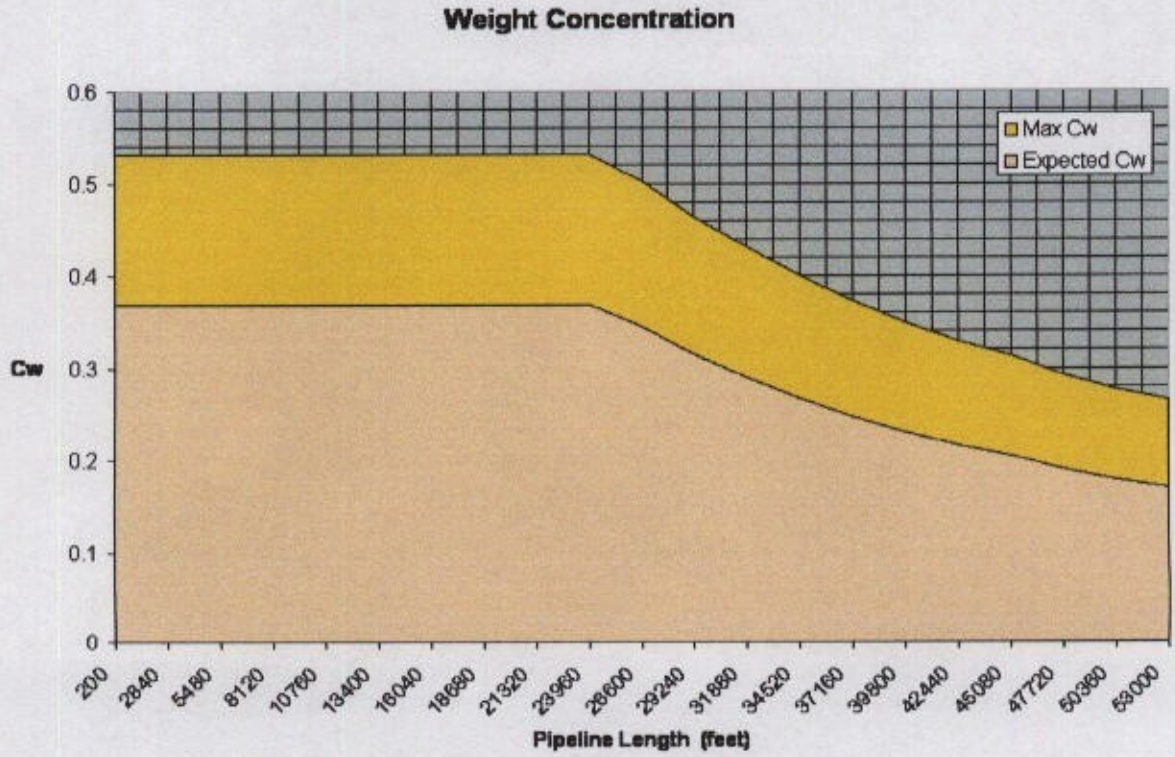
50360
53000
Pipeline Length (feet)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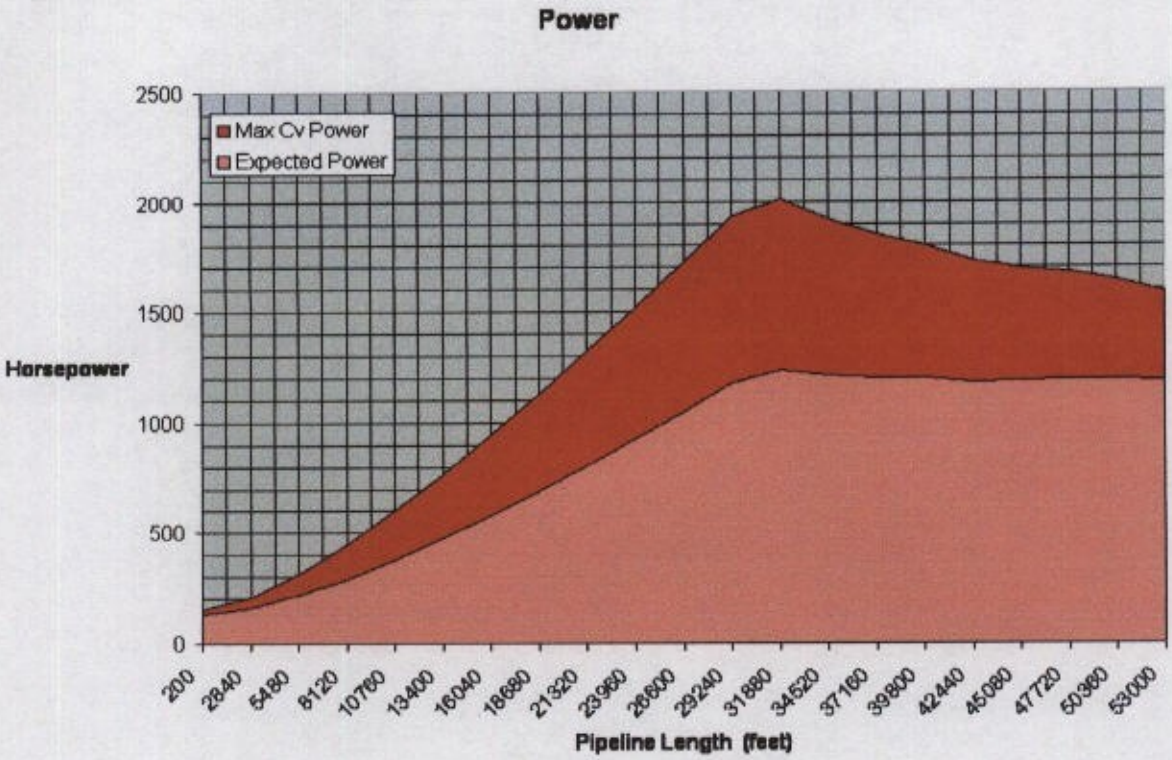
53000
Pipeline Length (feet)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Max Cv Power
Expected Power
Horsepower
2500
2000
1500
1000
500
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2840
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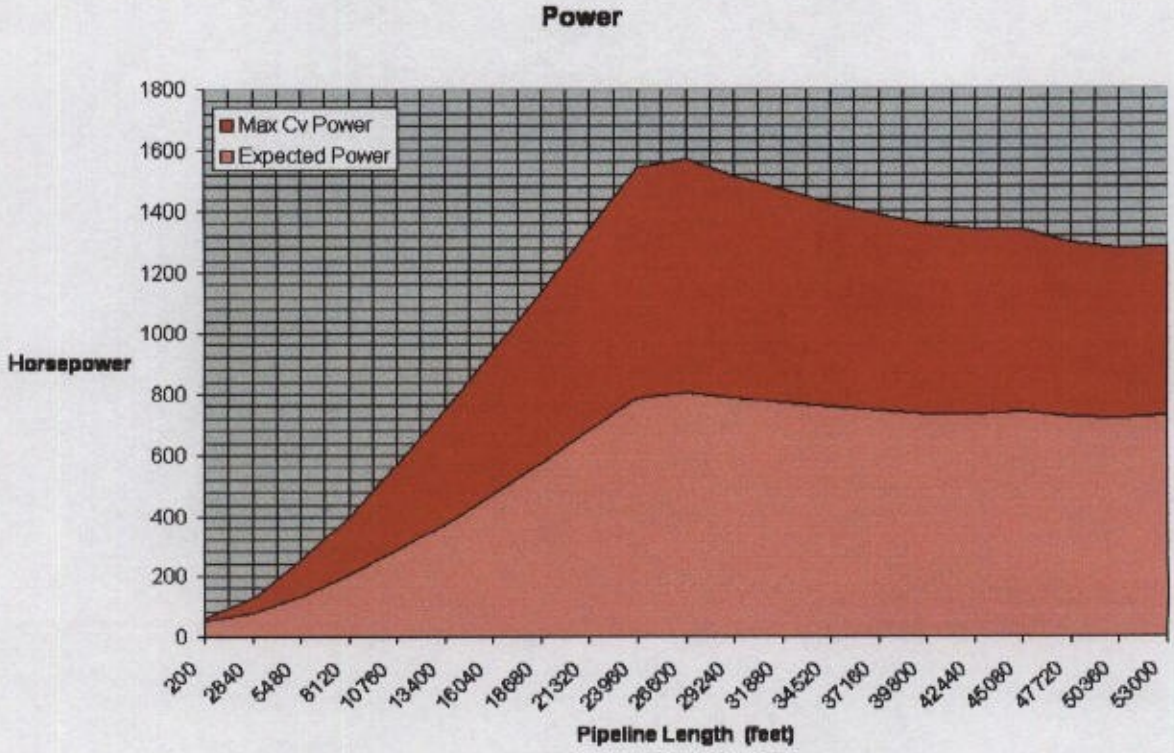
Pipeline Length (feet)


Power
Max Cv Power
Expected Power
Horsepower
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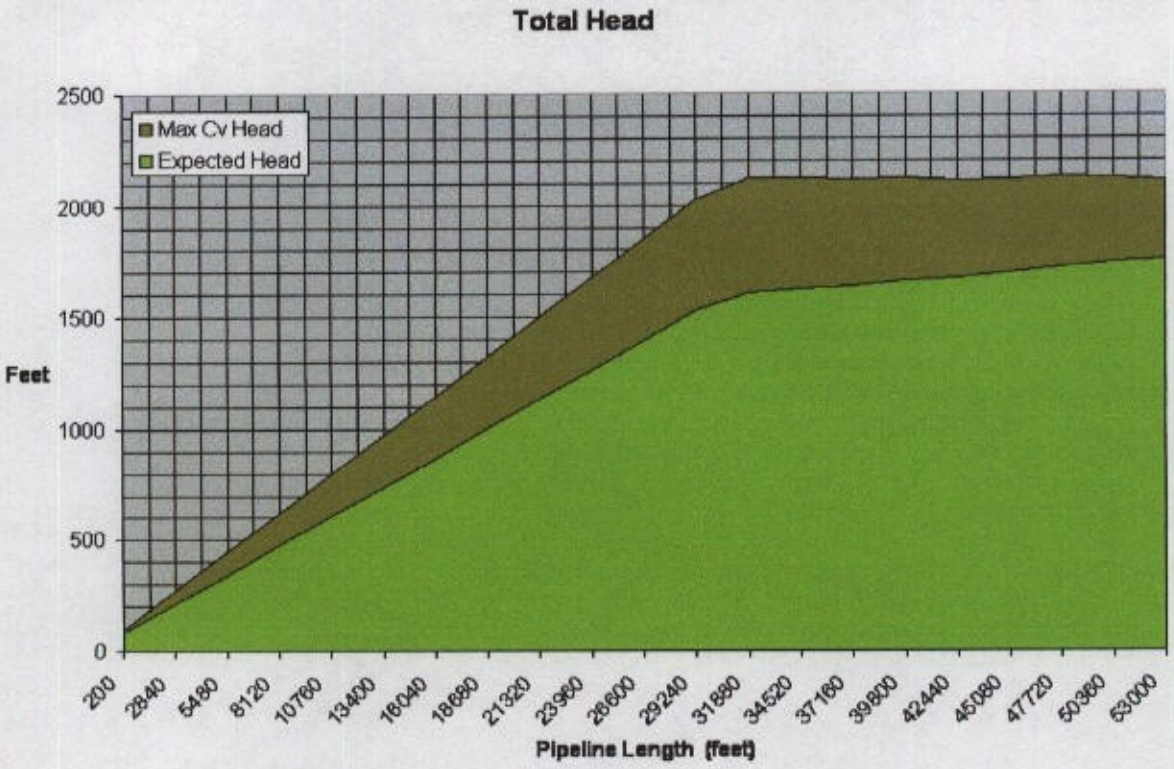
Pipeline Length (feet)


Total Head
Max Cv Head
Expected Head
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2500
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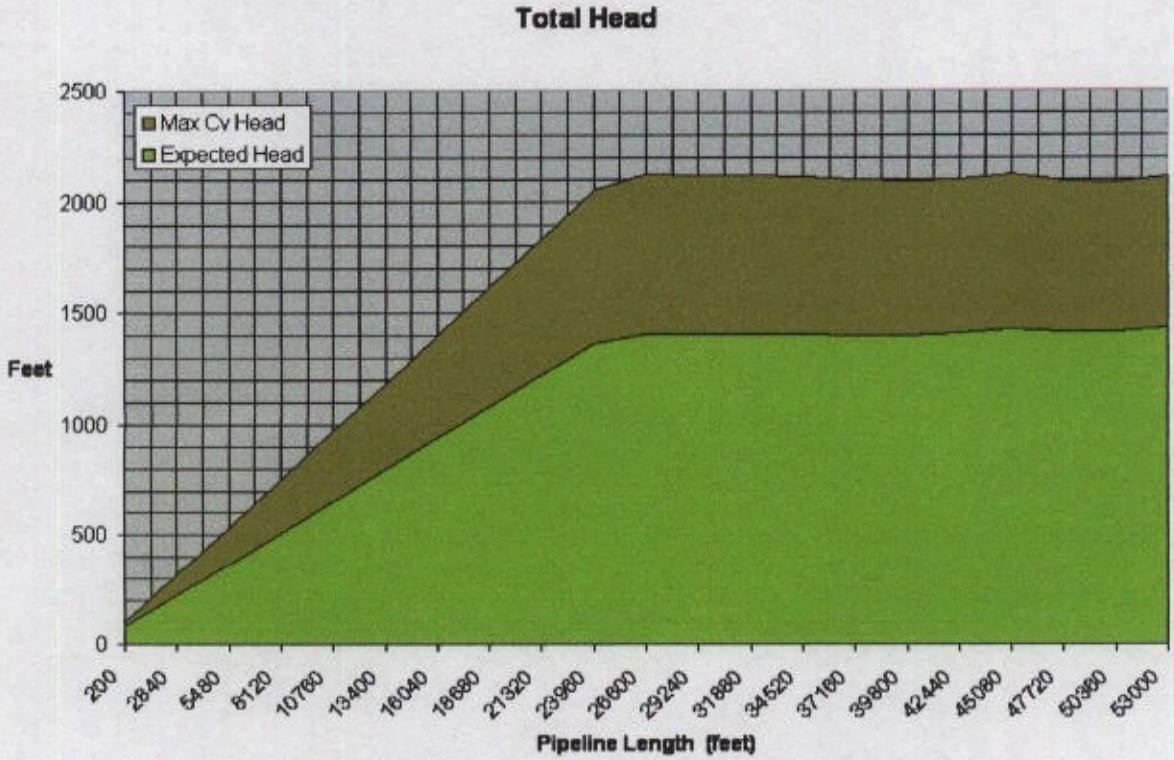
Pipeline Length (feet)


Total Head
Max Cv Head
Expected Head
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2500
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16040
18680
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50360
53000
Pipeline Length (feet)

PERFORMANCE PIPE
A Division of Chevron Phillips Chemical Company LP

DIPS Size and Dimension Data

PE3608 (PE3408)

DriscoPlex® Municipal & Industrial & Energy Series/DIPS Pipe Data

Pressure Ratings are calculated using 0.50 design factor for HDS at 73°F as listed in PPI TR-4 for PE 3608 materials.
Temperature, Chemical, and Environmental use considerations may require use of additional design factors.

Pressure Rating		255 psi DR 7.3			200 psi DR 9.0			160 psi DR 11.0			130 psi DR 13.5			
DIPS Pipe Size	Nominal OD (in)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	IPS Pipe Size
4"	4.800	0.658	3.405	3.72	0.533	3.670	3.11	0.436	3.876	2.61	0.356	4.045	2.17	4"
6"	6.900	0.945	4.897	7.68	0.767	5.274	6.44	0.627	5.571	5.39	0.511	5.817	4.48	6"
8"	9.050	1.240	6.421	13.22	1.006	6.917	11.07	0.823	7.305	9.28	0.670	7.630	7.70	8"
10"	11.100	1.521	7.875	19.90	1.233	8.486	16.65	1.009	8.961	13.95	0.822	9.357	11.59	10"
12"	13.200	1.808	9.367	28.13	1.467	10.090	23.55	1.200	10.656	19.73	0.978	11.127	16.40	12"
14"	15.300	2.096	10.856	37.79	1.700	11.696	31.64	1.391	12.351	26.51	1.133	12.898	22.02	14"
16"	17.400	2.384	12.346	48.89	1.933	13.302	40.91	1.582	14.046	34.29	1.289	14.667	28.49	16"
18"	19.500	2.671	13.837	61.38	2.167	14.906	51.40	1.773	15.741	43.07	1.444	16.439	35.77	18"
20"	21.600				2.400	16.512	63.05	1.964	17.436	52.85	1.600	18.208	43.91	20"
24"	25.800				2.867	19.722	89.97	2.345	20.829	75.38	1.911	21.749	62.64	24"
30"	32.000							2.909	25.833	115.97	2.370	26.976	96.35	30"
†36"	38.300							3.482	30.918	166.15	2.837	32.286	138.04	†36"
†42"	44.500										3.296	37.512	186.34	†42"

Pressure Rating		100 psi DR 17.0			80 psi DR 21.0			65 psi DR 26.0			50 psi DR 32.5			
DIPS Pipe Size	Nominal OD (in)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	IPS Pipe Size
4"	4.800	0.282	4.202	1.75	0.229	4.315	1.44							4"
6"	6.900	0.406	6.039	3.62	0.329	6.203	2.97	0.265	6.338	2.42	0.212	6.451	1.95	6"
8"	9.050	0.532	7.922	6.22	0.431	8.136	5.11	0.348	8.312	4.17	0.278	8.461	3.36	8"
10"	11.100	0.653	9.716	9.37	0.529	9.979	7.69	0.427	10.195	6.27	0.342	10.375	5.06	10"
12"	13.200	0.776	11.555	13.24	0.629	11.867	10.87	0.508	12.123	8.87	0.406	12.339	7.15	12"
14"	15.300	0.900	13.392	17.80	0.729	13.755	14.60	0.588	14.053	11.90	0.471	14.301	9.61	14"
16"	17.400	1.024	15.229	23.03	0.829	15.643	18.88	0.669	15.982	15.39	0.535	16.266	12.42	16"
18"	19.500	1.147	17.068	28.91	0.929	17.531	23.71	0.750	17.910	19.34	0.600	18.228	15.60	18"
20"	21.600	1.271	18.905	35.49	1.029	19.419	29.10	0.831	19.838	23.74	0.665	20.190	19.16	20"
24"	25.800	1.518	22.582	50.63	1.229	23.195	41.51	0.992	23.697	33.85	0.794	24.117	27.32	24"
30"	32.000	1.882	28.010	77.86	1.524	28.769	63.84	1.231	29.390	52.10	0.985	29.912	42.04	30"
†36"	38.300	2.253	33.524	111.55	1.824	34.433	91.45	1.473	35.177	74.61	1.178	35.803	60.18	†36"
†42"	44.500	2.618	38.950	150.60	2.119	40.008	123.44	1.712	40.871	100.75	1.369	41.598	81.25	†42"

Pipe weights are calculated in accordance with PPI TR-7. Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flows. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification.
†OD available upon special request -- Check with your performance Pipe contact for availability of dimensions not listed.

September 2006 Supercedes all previous publications
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TECHNICAL NOTE PP 750-TN-05
BUTT FUSION JOINING PROCEDURES
For DriscoPlex® Municipal/Industrial/Energy Piping Products

This bulletin has been developed to assist those responsible to for the Butt-Fusion joining of Performance Pipe products in Municipal, Industrial and Energy applications. For more specific fusion information; safety requirements, saddle (sidewall) fusion procedures, socket fusion procedures and Federal regulations for gas pipe joining, please refer to Performance Pipe Bulletin PP 750, "Heat Fusion Joining Procedures and Qualification Guide."

These procedures are in alignment with Plastic Pipe Institute's (PPI) TR-33 Generic Butt Fusion Joining Procedures.

OVERVIEW

In heat fusion joining, mating surfaces are prepared by cleaning and facing, simultaneously melted with a hot-plate heater, the heater is removed, and the melted surfaces are pressed together and held under pressure. As the molten materials cool, they mix and fuse into a permanent, monolithic joint.

SET-UP PARAMETERS

HEATING TOOL SURFACE TEMPERATURE — MINIMUM 400°F – MAXIMUM 450°F (204 – 232°C)

Heating tool surfaces must be up to the specified temperature before you begin. All points on both heating tool surfaces where the surfaces will contact the pipe must be within the prescribed minimum and maximum temperatures. Heating tool surfaces must be clean.

INTERFACE PRESSURE — minimum 60 psi – maximum 90 psi (414 – 621 kPa; 4.14 – 6.21 bar)

Interface pressure is used to calculate a fusion joining pressure value for hydraulic butt fusion machines or manual machines equipped with a torque wrench. For hydraulic machines, the interface pressure, the fusion surface area, the machine's carriage cylinder size and internal drag pressure, and if necessary, the pressure needed to overcome external drag resistance, are used to calculate hydraulic fusion joining pressure gauge settings. The equipment manufacturer's instructions are used to calculate this value. ***Interface pressure and fusion machine hydraulic fusion joining pressure gauge settings are not the same!***

PROCEDURE

1. ***Secure.*** Clean the inside and outside of the component (pipe or fitting) ends by wiping with a clean, dry, lint-free cloth or paper towel. Align the component ends in the machine. ***Do not force pipes into alignment against open fusion machine clamps.*** Component ends should protrude past the clamps enough so that facing will be complete. Bring the ends together and check high-low alignment. Adjust alignment as necessary by tightening the high side down. Make sure clamps are properly secured to prevent slippage of the component ends.

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June 2005 Supercedes all previous publications
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Performance Pipe, a division of
Chevron Phillips Chemical Company LP

PO Box 269006
Plano, TX 75025-9006

Phone: 800-527-0662
Fax: 972-599-7348

2. ***Face.*** Place the facing tool between the component ends, and face them to establish smooth, clean, parallel mating surfaces. If stops are present, face down to the stops. Remove all shavings from pipe ends after facing. ***Do not touch the component ends with your hands after facing.***

3. ***Align.*** Bring the component ends together, check alignment and check for slippage against fusion pressure. Look for complete contact all around both ends with no detectable gaps, and outside diameters in high-low alignment.

4. ***Melt.*** Verify that the heating tool is maintaining the correct temperature. Place the heating tool between the component ends, and move the ends against the heating tool. The initial contact should be under moderate pressure to ensure full contact. Hold the ends against the heating tool ***without force***.

   Beads of melted polyethylene will form against the heating tool at the component ends. When the proper melt bead size is formed, quickly separate the ends, and remove the heating tool.

   Table 1 Approximate Melt Bead Size

Pipe Size	*Approximate Melt Bead Size*
2" –4"	1/8" – 3/16"
4" –12"	3/16" – 1/4"
12" -24"	1/4" – 7/16"
24" –54"	7/16"- 9/16"

5. ***Join.*** Immediately after heating tool removal, *QUICKLY* inspect the melted ends, then bring the ends together applying the correct joining force, using 60-90psi interfacial pressure. ***Do not slam.*** The correct joining force will form a double bead that is rolled over to the surface on both ends.

6. ***Hold.*** Hold joining force against the ends until the joint is cool. The joint is cool enough for *GENTLE* handling when the double bead is cool to the touch. Cool for about 30-90 seconds per inch of pipe diameter.

- Heavier wall thickness pipes may require longer cooling times.

7. ***Inspect.*** On both sides, the double bead should be rolled over to the surface, and be uniformly rounded and consistent in size all around the joint.

It is a common practice and accepted industry "Rule of Thumb" when fusing pipes of unlike DR's, to fuse a maximum mismatch of one SDR. For example, this would allow fusion of DR 11 pipe to DR 9 or DR-11 to DR 13.5. A successful fusion may be accomplished without the need of any change in the actual fusion procedure.

Per ASTM, Standard Dimension Ratio, SDR, value is when the outside diameter divided by the minimum wall thickness equals one of the following values:

5.0	6.0	7.0	9.0	11.0	13.5	17	21.0	26.0	32.5

The terms DR and SDR are often used interchangeably.

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For more information and technical
assistance contact:

Performance Pipe, a division of
Chevron Phillips Chemical Company LP
P.O. Box 269006
Plano, TX 75026-9006
800.527.0662

Members Of: PLASTICS·PIPE·INSTITUTE

NOTICE: This data sheet provides typical physical property information for polyethylene resins used to manufacture PERFORMANCE PIPE polyethylene piping products. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for piping products. Some of these typical physical property values were determined using compression molded plaques. Values obtained from tests of specimens taken from piping product can vary from these typical values. Performance Pipe has made every reasonable effort to ensure the accuracy of this data sheet, but this data sheet may not provide all necessary information, particularly with respect to special or unusual applications. The data sheet may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most recent edition.

Another quality product from Chevron Phillips Chemical Company LP The Woodlands, Texas

Before using the piping product, the user is advised and cautioned to make its own determination and assessment of the safety and suitability of the piping product for the specific use in question and is further advised against relying on the information contained herein as it may relate to any specific use or application. It is the ultimate responsibility of the user to ensure that the piping product is suited and the information is applicable to the user's specific application. This data sheet provides typical physical property information for polyethylene resins used to manufacture the piping product. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for the piping product. These typical physical property values were determined using compression-molded plaques prepared from resin. Values obtained from tests of specimens taken from the piping product can vary from these typical values. Performance Pipe does not make, and expressly disclaims, all warranties, of merchantability or fitness for a particular purpose, regardless of whether oral or written, express or implied, allegedly arising from any usage of trade or from any course of dealing in connection with the use of information contained herein or the piping product itself. The user expressly assumes all risk and liability, whether based in contract, tort or otherwise, in connection with th

For more information and technical assistance contact:

Performance Pipe, a division of
Chevron Phillips Chemical Company LP
P.O. Box 269006
Plano, TX 75026-9006
800.527.0662

SUGGESTED INDUSTRIES AND APPLICATIONS

Potable Water Mains	Horizontal Directional Drilling (HDD)	Marine Service
Sliplining	Water transmission Lines	Pipe Bursting
Industrial Water Mains	Ash, Tailings & Abrasives	Mining
Municipal Water Utilities	Open-cut and Bury	Culverts
Rural Water Distribution	River Crossings	Plow-in
Mun. & Ind. Sewer	Trenchless Technologies	Crude oil
Fire Main Piping	Rural Water Distribution	Plow-in

Butt Fusion Conditions

- 60-90 psig (4.14-6.21 bar) interfacial fusion pressure.
- 400-450° (204-232°C) heater surface temperature range.
- Please refer to Performance Pipe's PE3608 (PE3408) fusion procedure, Bulletin PP 750.

Available Sizes

- ¾" through 54" IPS
- 4" through 36" DIPS

Specification Data

The resin, pipe and fitting listed may comply with one or more of the standards below.

Applicable Standards	DriscoPlex® Pipe Series	PE3608 (PE3408)	PE4710 (d_f)
ASTM F714, NSF 61, ASTM D3035	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
AWWA C906, AWWA C901	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
FMA, AWWA, F714	1500, 1600	0.5	—
API 15LE, ASTM D2513	6400	0.5	0.63

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DriscoPlex®
PE3608 / (PE3408) Pipe
Pipe and Fittings Data Sheet

Typical Material Physical Properties of DriscoPlex® PE3608 / (PE3408)

High Density Polyethylene Materials

Pipe Tests	Unit	Test Procedure	Typical Value
Material Designation	—	PPI TR-4	PE3608
Cell Classification	—	ASTM D3350	345464C
Pipe Properties			
Density	gms / cm^3	ASTM D1505	0.955 (black)
Melt Index Condition 190 / 2.16	gms / 10 minutes	ASTM D1238	0.08
Hydrostatic Design Basis 73°F (23°C)	psi	ASTM D2837	1600
Hydrostatic Design Basis 140°F (60°C)	psi	ASTM D2837	800
Color: UV Stabilizer [C] [E]	—	ASTM D3350	Min 2% carbon Black Color UV Stabilizer
Material Properties			
Flexural Modulus 2% Secant - 16:1 span; depth, 0.5 in / min	psi	ASTM D790	>110,000
Tensile Strength at Yield	psi	ASTM D638 Type IV	3200
Elongation at Break 2 in / min., Type IV bar	%	ASTM D638	>700
Elastic Modulus	psi	ASTM D638	>150,000
Hardness	Shore D	ASTM D2240	62
PENT	hrs	ASTM F1473	>100
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	256
Brittleness Temperature	°F	ASTM D746	-103
Thermal Expansion	in / in / °F	ASTM D696	1.0×10^{-4}

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PIPELINE WEIGHT AND BUOY ASSEMBLY

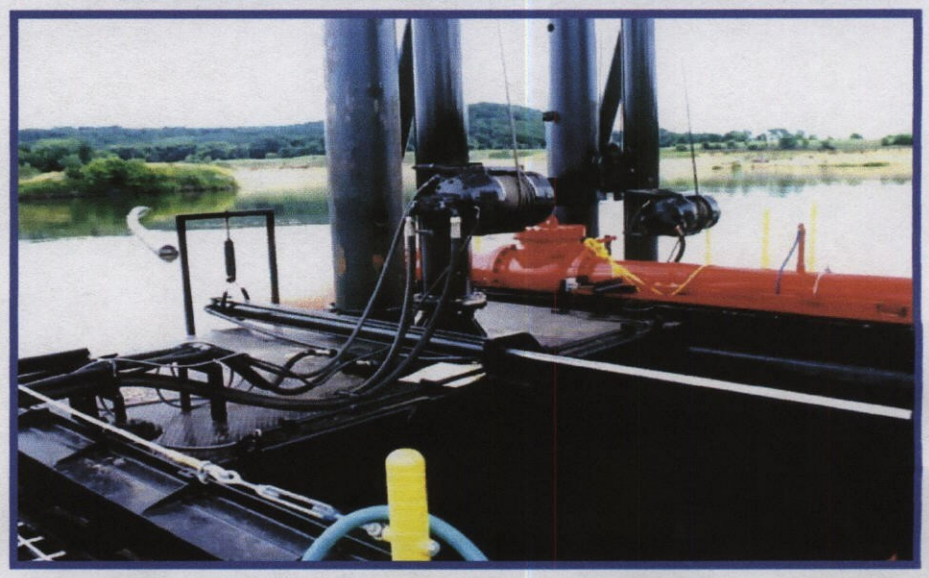
BRENNAN

MARINE PROFESSIONALS
LA CROSSE, WI

EQUIPMENT:
12" HYDRAULIC DREDGE
"Mark Anthony II"

Features:

- Type: Cutter-head
- Functions: Swinging ladder or conventional mode
- Overall Size
  - Length - 113'
  - Width - 29'
  - Draft- 3'
- Working Capacity
  - Maximum Depth of Cut -
  - 26' Swinging ladder
  - 40' Conventional mode
- Swing Width - 150' Maximum
- Hydraulic Pump - Above waterline



Benefits:

- **Versatility** - Operates in swinging ladder & conventional modes
- **Cost Effective** - Pumping capacity of larger dredges
- **Portability** - Reduced mobilization costs
- **Environmentally Sensitive** - Both the size of dredge and the operating oils used respond to most environmental concerns.

BRENNAN MARINE PROFESSIONALS

820 Bainbridge St., LaCrosse, WI 54603 Phone:608-784-7173 Fax:608-785-2090 www.jfbrennan.com

Dredging Supply Company, Inc.

BARRACUDA SPECIFICATIONS

GENERAL:

OVERALL LENGTH (WITH LADDER EXTENSION)	113 FT.
OVERALL WIDTH (OPERATIONAL MODE)	29 FT. 3 IN.
HULL DEPTH	5 FT.
HEIGHT - OVERALL (LESS SPUDS AND SPUD FRAMES)	19 FT. 10 IN.
MEAN DRAFT (WITH FUEL EST.)	22 IN.
LADDER LENGTH (WITH EXTENSION & CUTTER)	47 FT. 6IN.
SPUD LENGTH (EACH STERN SPUD INCLUDES POINT)	58 FT
SPUD SIZE (STERN SPUDS)	20 IN. Diameter
SPUD LENGTH (EACH BOW SPUD, INCLUDES POINT)	42 FT. 6 IN.
SPUD SIZE (BOW SPUDS)	16 IN. X16 IN Tub.
TOTAL DREDGE DRY WEIGHT - EST.	325,000 LB

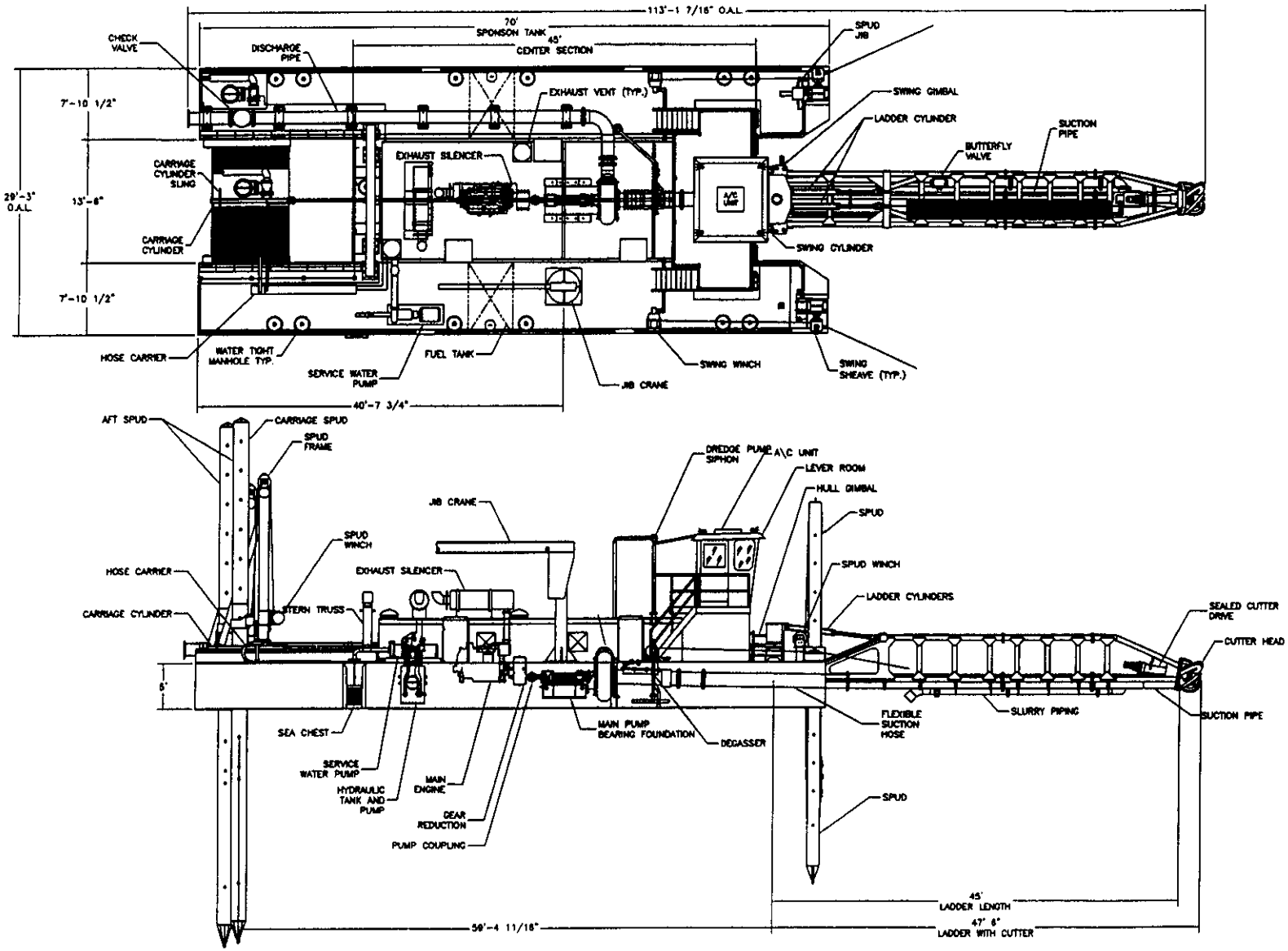
OPERATING CONDITIONS:

DIGGING DEPTH

MINIMUM	3'
MAXIMUM (conventional mode w/ extension)	41'

MAXIMUM CUT OF DREDGE (SINGLE CUT)

@ MINIMUM DIGGING DEPTH (SWINGING LADDER)	24'
@ MAXIMUM DIGGING DEPTH (SWINGING LADDER)	18'
@ MINIMUM DIGGING DEPTH (conventional w/extension)	150'



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NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

BARRACUDA DREDGE

J. F. BRENNAN

GENERAL ARRANGEMENT

DRAWN NJG

DESIGN NJG

APP BY

SCALE 3/16"=1'-0" DATE 5/15/99

PROJECT 99020

DWG NO. 9902001F REV F

@ MAXIMUM DIGGING DEPTH (conventional w/extension)	122'

PRIME MOVER:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3412 E-Series
MAXIMUM H.P @ 2100 R.P.M.	860 H.P.
SERIAL NUMBER	4CR01037

AUXILIARY ENGINE:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3306DITA
MAXIMUM H.P @ 2200 R.P.M.	300 H.P.
SERIAL NUMBER	64Z27195

CUTTER MODULE:

CUTTING FORCE	8,794 LB
OPERATING TORQUE	203,500 IN-LB
CUTTING FORCE PER LINEAR INCH	204 LB/IN
CUTTER DIAMETER	43"
SHAFT DIAMETER	5"
CUTTER RATING	90 H.P.
CUTTER SPEED VARIABLE	0 - 28 R.P.M.

SWING WINCHES:

MANUFACTURER	Pullmaster
MODEL	H18
LINE PULL (1ST LAYER)	18,000 LB
LINE SPEED (1ST LAYER)	121 FT/MIN
WIRE	9/16"
DRUM CAPACITY	310'

LADDER HOIST CYLINDERS (2):

MANUFACTURER	Hydro-Line
MODEL	N5C 70X75.3
EXTENDING FORCE	65,000 LB
RETRACTING FORCE	125,000 LB

DREDGE PUMP:

MANUFACTURER	Svedala Tomas
MODEL	P40-WD-L4V
SERIAL NUMBER	3-16274
SUCTION	12"
DISCHARGE	12"
IMPELLER DIAMETER	40"

DREDGE PUMP REDUCTION GEAR

MANUFACTURER	Rexnord
MODEL	B280-44VS-DC-3.375
RATIO	3.313:1
SERIAL NUMBER	H99X-08421-A1

DREDGE PUMP CLUTCH

MANUFACTURER	Wichita
MODEL	ATD214H-DUCTIL IRON

BOW SPUD WINCHES:

MANUFACTURER	DSC
MODEL	DSC-095
LINE PULL	4,000 LB
LINE SPEED (1ST LAYER)	100 FT/MIN
WIRE SIZE	9/16 IN.

STERN SPUD WINCHES

MANUFACTURER	Pullmaster
MODEL	H18
LINE PULL (1ST LAYER)	18,000 LB
LINE SPEED (1ST LAYER)	122FT/MIN
WIRE	9/16"
DRUM CAPACITY	310'

ELECTRICAL SYSTEM:

BATTERY (24 VDC)

STANFORD AC GENERATOR mounted on the auxiliary engine. 120/208 ACV three phase, 60Hz

CAPACITIES:

FUEL	3,000 GAL
HYDRAULIC	455 GAL

STANDARD AND CUSTOM FEATURES:

SIPHON PRIMING SYSTEM

OPERATOR'S CHAIR

FIRE EXTINGUISHERS (2) 5 LBS. ABC

LIGHTED RING BUOY

HANDRAILS AND KICK RAILS

ELECTRONIC DEPTH GAUGE

ELECTRONIC PROPORTIONAL CONTROL

GUARDS

EARLY WARNING ALARM SYSTEM AND ENGINE SHUTDOWN SYSTEM

CABIN LIGHTS

BILGE PUMP - ELECTRIC

REPLACEABLE EDGE CUTTER

DREDGE WASH DOWN SYSTEM

HI-CAPACITY SERVICE PUMP

HYDRAULIC PUMP/ENGINE CLUTCH DISCONNECT

PUMP/ENGINE REDUCTION GEAR (NO BELTS REQUIRED)

PAINT: HULL - BLAST WITH COAL TAR EPOXY PAINT

SUPERSTRUCTURE AND STRUCTURAL - BLAST WITH

PRIMER AND TOP COAT OF PAINT

CARRIAGE SPUD SYSTEM

CUTTER ROTATING RING

STERN PULLING EYES

TOUCH SCREEN COMPUTER WITH OPERATING GAUGE DISPLAY SOFTWARE.

JOYSTICK SWINGING AND LADDER OPERATION

OPTIONAL TOGGLE SWITCH AND KNOB FOR SWING CONTROL

AIR CONDITIONED AND HEATED LEVER ROOM

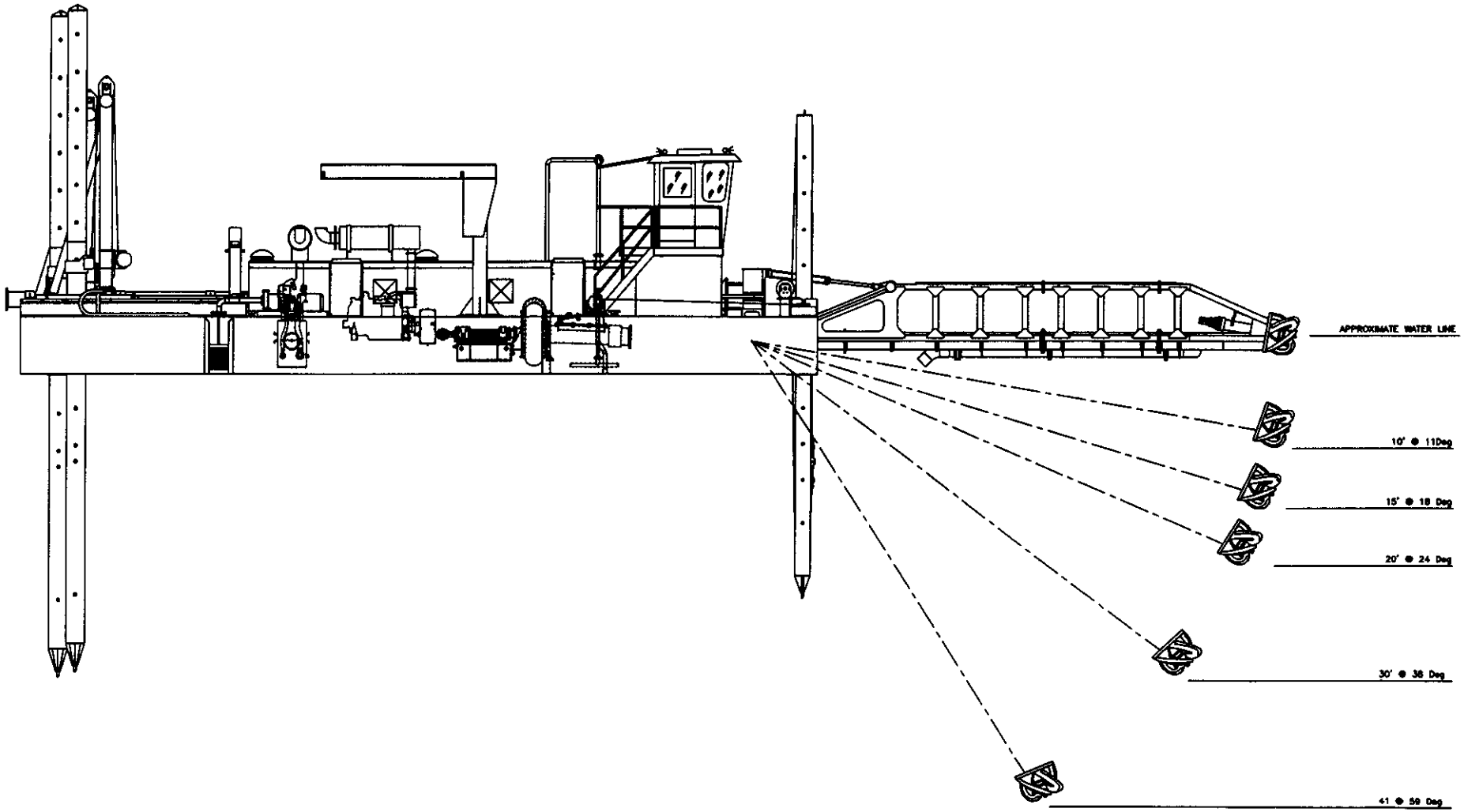
RANGE DIAGRAMS

DIGGING DEPTH DIAGRAM DWG. 99020121A

MAXIMUM SWINGING LADDER SWING DWG. 99020122

MAXIMUM SWING CONVENTIONAL MODE (Hull Grounded) DWG. 99020123

MAXIMUM SWING (Conventional Mode) DWG. 99020124



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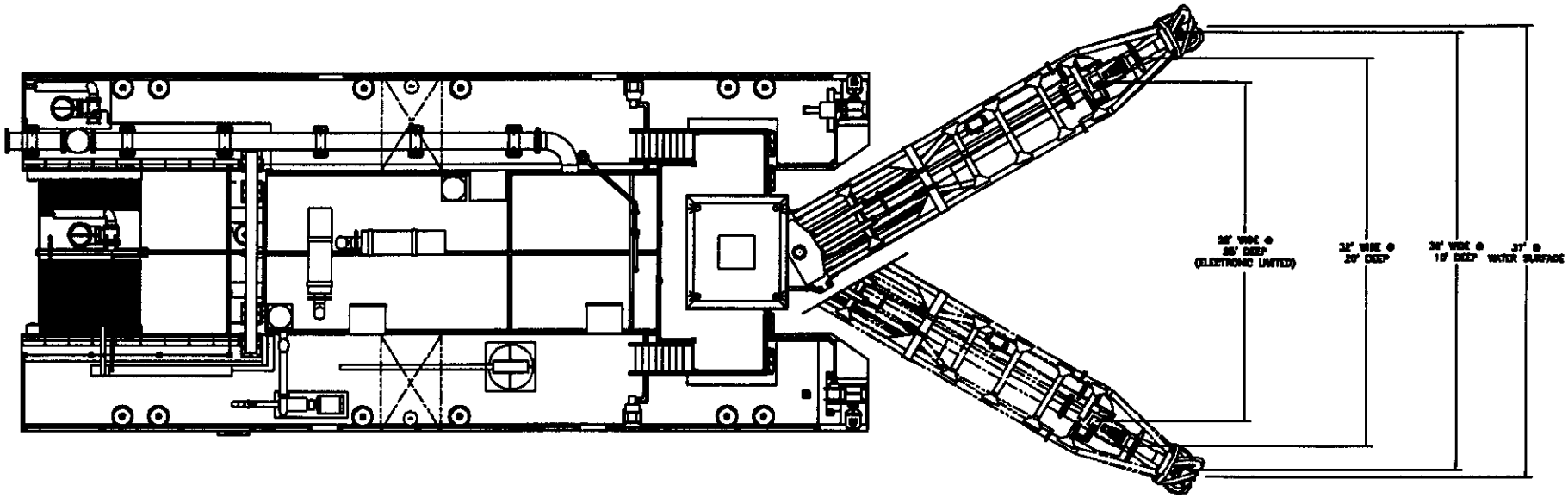
NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY,Inc.

J. F. BRENNAN MOD. BARRACUDA

DIGGING DEPTH DIAGRAM

DRAWN/DESIGN MC
CHECKED wjb
APP'D
SCALE N.T.S.
DATE 9/17/99
PROJECT 99020
DWG NO. 99020121A
REV B



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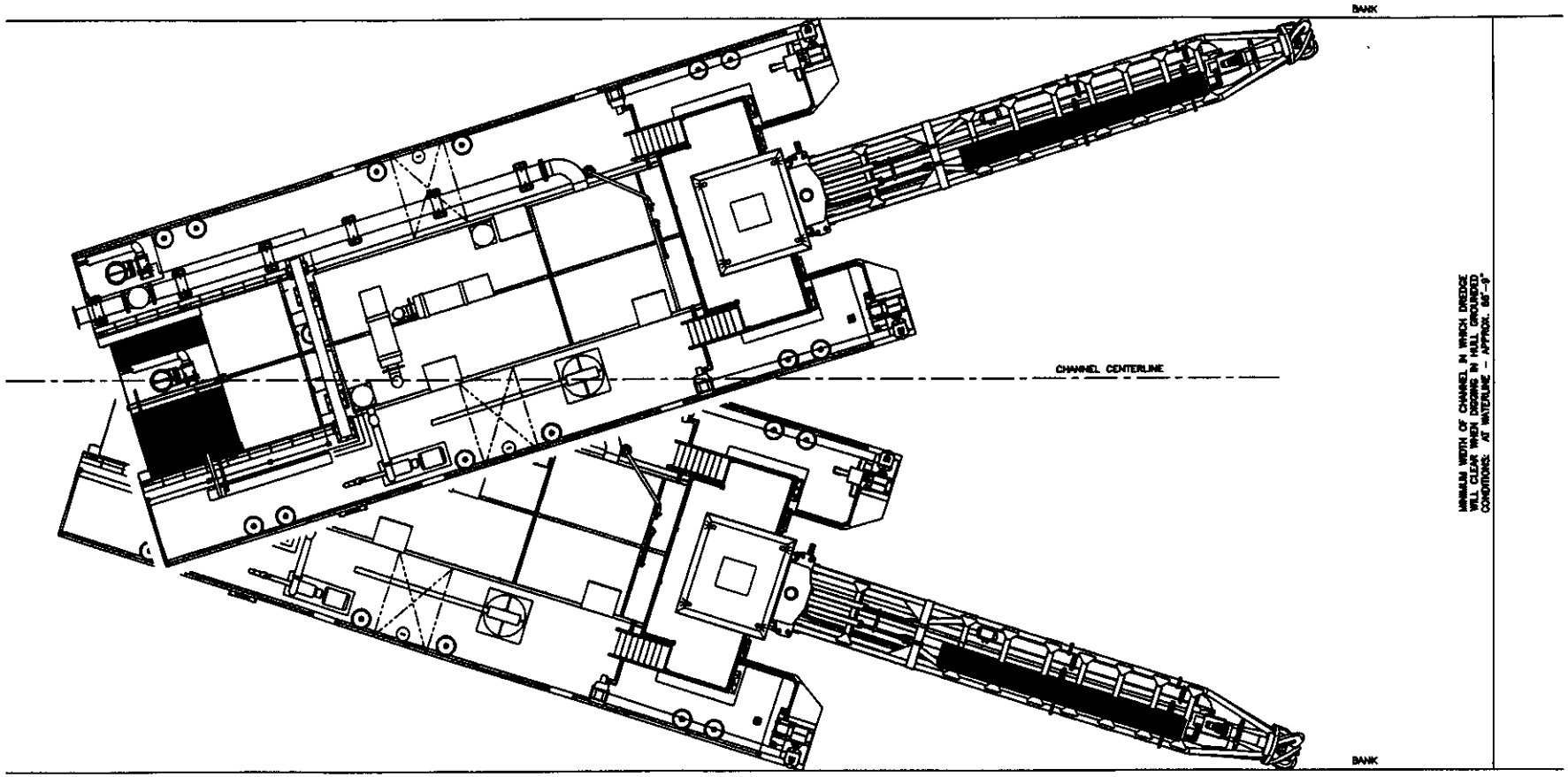
NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.
J. F. BRENNAN MOD. BARRACUDA
MAXIMUM SWING
(SWINGING LADDER MODE)

99020122



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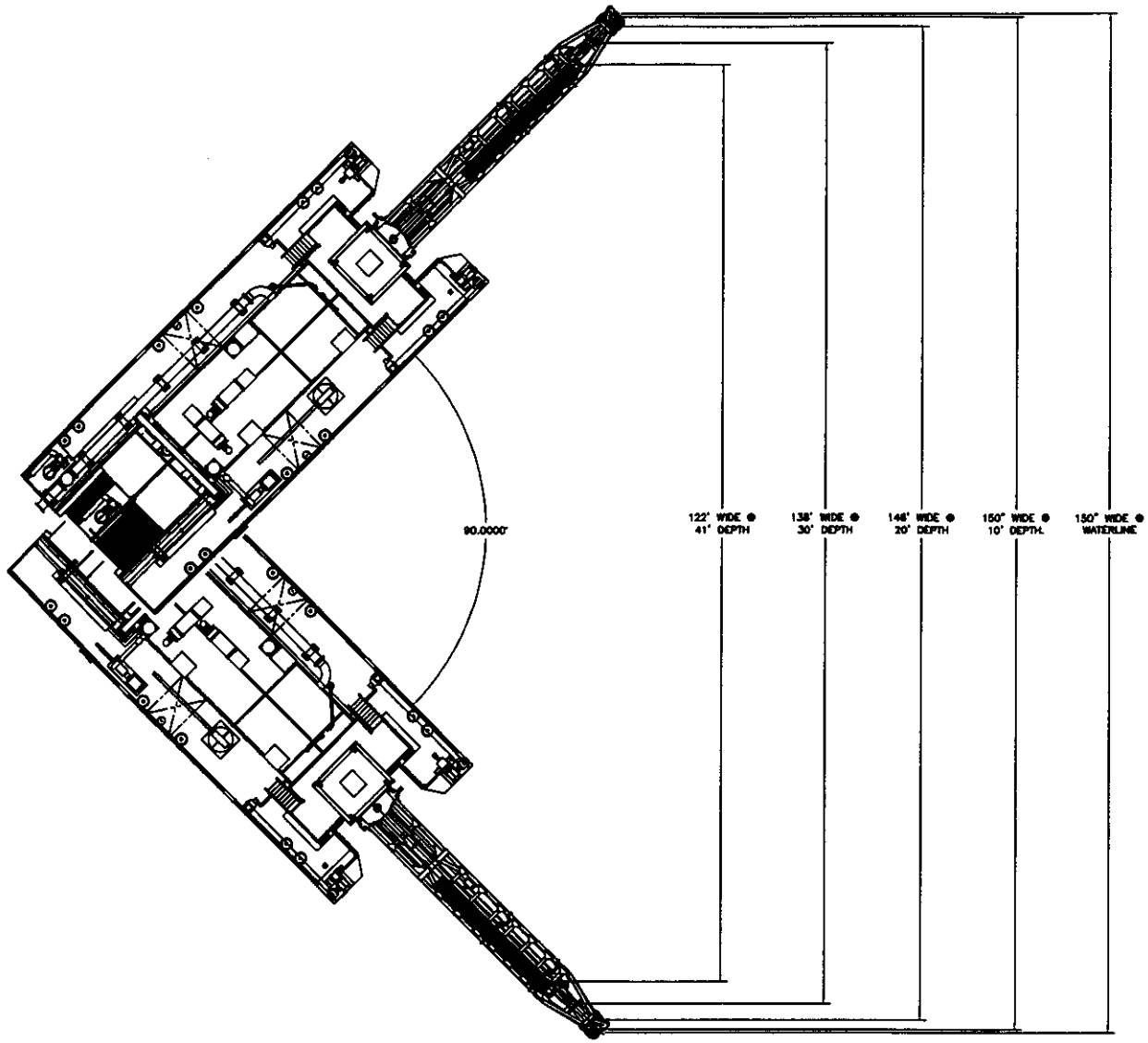
DREDGING SUPPLY COMPANY, Inc.
J. F. BRENNAN MOD. BARRACUDA

MINIMUM SWING (CONVENTIONAL MODE)
HULL GROUNDED

DRAWN BY: WJB
CHK: JJM
APP: JAF
SCALE: N.T.S.
DATE: 8/14/99
PROJECT: 99020
DWG NO: 99020123
REV



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NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

MAXIMUM SWING
(CONVENTIONAL MODE)

DRAWN WJB
JJM
CHK WJB
APP PK WJB
DATE 8/21/99
SCALE N.T.S.
PROJECT 99020
DWG NO. 99020124
REV A

DREDGE SWING CHART

Swing Chart

	CONVENTIONAL	SWINGING LADDER
Ladder Length(plus cutter)	47.5	37.5
Spud to Trunion	59.5	
Trunion Height above Water	-0.5	-0.5

DEPTH	Ladder Angle With Extention	Dredge Length With Extention	Ladder Angle Without Extention	Dredge Length Without extention
0	-0.76	107	-0.76	97
5	5.44	107	6.89	97
10	11.54	106	14.67	96
15	17.77	105	22.75	94
20	24.24	103	31.33	92
25	31.05	100	40.79	88
41	58.50	84		

SWINGNING LADDER

30DEG OFF CENTER Ladder without extension

Depth (without extension)	WIDTH
0	37
5	37
10	36
15	35
20	32
25	28

Limited to 25' deep in swinging lader mode

Only the short ladder may be used in swinging ladder mode

SWING CHART (Conventional mode w/extension)

DEGREES SWING = THE TOTAL SWING FROM PORT TO STARBOARD CUT LIMITS

DEPTH	10	20	25	41
DEGREES SWING	WIDTH	WIDTH	WIDTH	WIDTH
10	18	18	17	15
20	37	36	35	29
30	55	53	52	44
40	73	70	69	58
45	81	79	77	65
50	90	87	85	71
55	98	95	93	78
60	106	103	100	84
65	114	110	108	91
70	122	118	115	97
75	129	125	122	103
80	136	132	129	108
85	143	139	135	114
90	150	145	142	119

SWING CHART (CONVENTIONAL MODE WITHOUT THE EXTENSION)

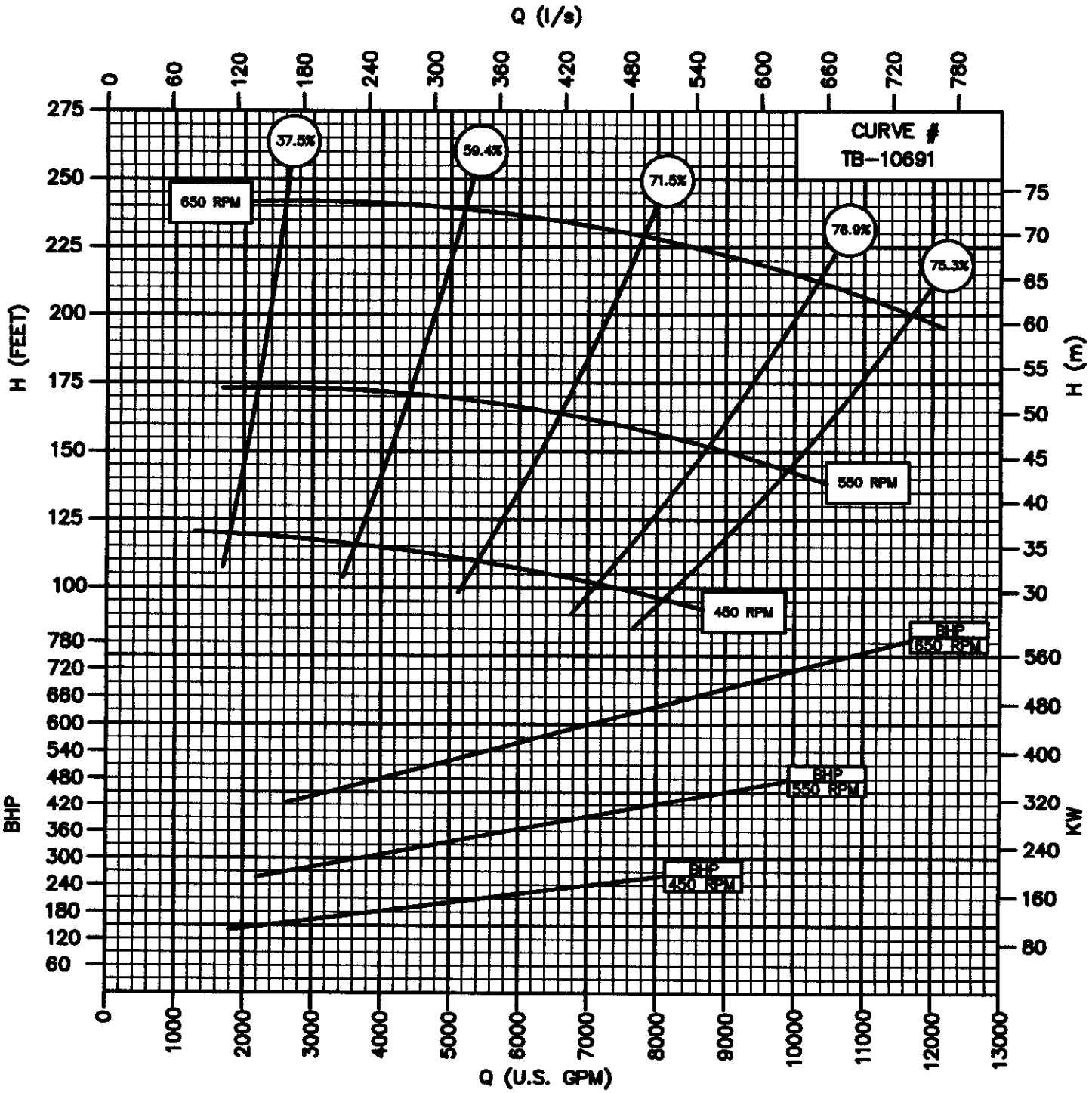
DEPTH	10	15	20	25
DEGREES SWING	WIDTH	WIDTH	WIDTH	WIDTH
10	17	16	16	15
20	33	33	32	31
30	50	49	47	45
40	66	64	63	60
45	73	72	70	67
50	81	80	77	74
55	88	87	85	81
60	96	94	92	88
65	103	101	98	94
70	110	108	105	101
75	117	115	111	107
80	123	121	118	113
85	129	127	124	119
90	135	133	129	124

SVEDALA
PUMPS & PROCESS

THOMAS DIVISION
BIRMINGHAM ALABAMA, U.S.A.

P.O. BOX 96
BIRMINGHAM, AL 35201
PHONE (205) 599-6600
FAX (205) 599-6610

PUMP MODEL	SIZE	IMPELLER # L12632RH		CASE# L1277	
12" L40	12 X 14	TYPE	VANES	VANE ø	MAX PARTICLE
		CLOSED	3	40.00 IN	8.375 IN
PERFORMANCE FOR WATER @ 1.0 SG @ 68° F/20° C				1016 MM	212.7 MM
CORRECTIONS MUST BE MADE FOR HEAD AND EFFICIENCY LOSSES FROM MIXTURE SPECIFIC GRAVITY AND SOLIDS EFFECT. CONSULT FACTORY				MAX.SPEED	TEST#
				668 RPM	DATE



14" x 12" Booster Unit
Preliminary Specifications

presented to:

J.F. BRENNAN CO., INC.
820 BAINBRIDGE • LACROSSE, WI 54603 PHONE: 608/784-7173 FAX: 608/785-2090 info@jfbrennan.com

October 2007

Prime Mover

Caterpillar C15 ACERT industrial diesel engine, radiator cooled with residential grade silencer and a continuous rating of 440 bhp @ 1800-2200 rpm. EPA & CARB Tier 3 compliant, Caterpillar premium gages, alarms, and shutdown systems

Dredge Pump Reduction Gear/drive

Twin Disc marine gear complete with Centa torsional coupling, electronic selector valve and gear cooler. The reduction gear is close-coupled to the Caterpillar engine with a stub/output shaft. The stub/output shaft is coupled to the dredge pump shaft through an elostomer style coupling.

Dredge Pump – ***with cleanout***

Suction diameter	14"
Discharge diameter	12"
Impeller diameter	36"

Skid

Structural Base Type	Heavy-duty structural WF beam
Enclosure Type	Roof only

Service Pump

To be provided by JF Brennan

Miscellaneous

Batteries and battery cases
Machinery guards
Fire extinguisher
Wash down system
Gages

Booster Control Package:
The booster control package consists of a PLC, touch screen operator interface, transmitters and enclosure with mounting brackets. The sensors that will be supplied are discharge pressure and inlet pressure. The booster panel will have start/stop switches for the main pump and service water pump. The panel also has a booster mode switch and a touch screen. The touch screen will display data, alarms and it allows the operator to change control and alarm set points. The booster has an auto and manual mode. The auto mode is controlled off the inlet pressure and discharge pressure and the manual mode allows you to control the booster manually.

Coatings
Engine enclosure and equipment skids:

1. Blast all steel SSPC-SP6. Blast to achieve 1- to 2- mils profile as determined with a surface profile comparator
2. First coat; 1-3 mils (dry film thickness) Epoxy (Oxide red)
3. Second coat; 4-6 mils (dry film thickness) Epoxy (Pearl Grey)
4. Finish coat: 4-6 mils (dry film thickness) Epoxy (Pearl Gray)

Building Standards
Dredges manufactured by Dredging Supply Company, Inc. are designed and built using the following regulations as our guidelines:

- Rules for Building and Classing Steel Vessels for Service on Rivers and Inland Coastal Waterways by the American Bureau of Shipping, 1997, RNC2-8, Corr1,2.
- Manual of Steel Construction, Ninth Edition by the American Institute of Steel Construction.
- Joint Industrial Council Hydraulic Standards T2.24.1 - 1990.
- Structural Welding Code - Steel ANSI/ANS D1.1-2004 by the American Welding Society and the American National Standards Institute.
- Mining Safety and Health Act.
- Occupational Safety and Health Act.
- Surface Preparation Specifications Steel Structures Painting Council No. 91-08.
- National Electrical Code Handbook, 2002.

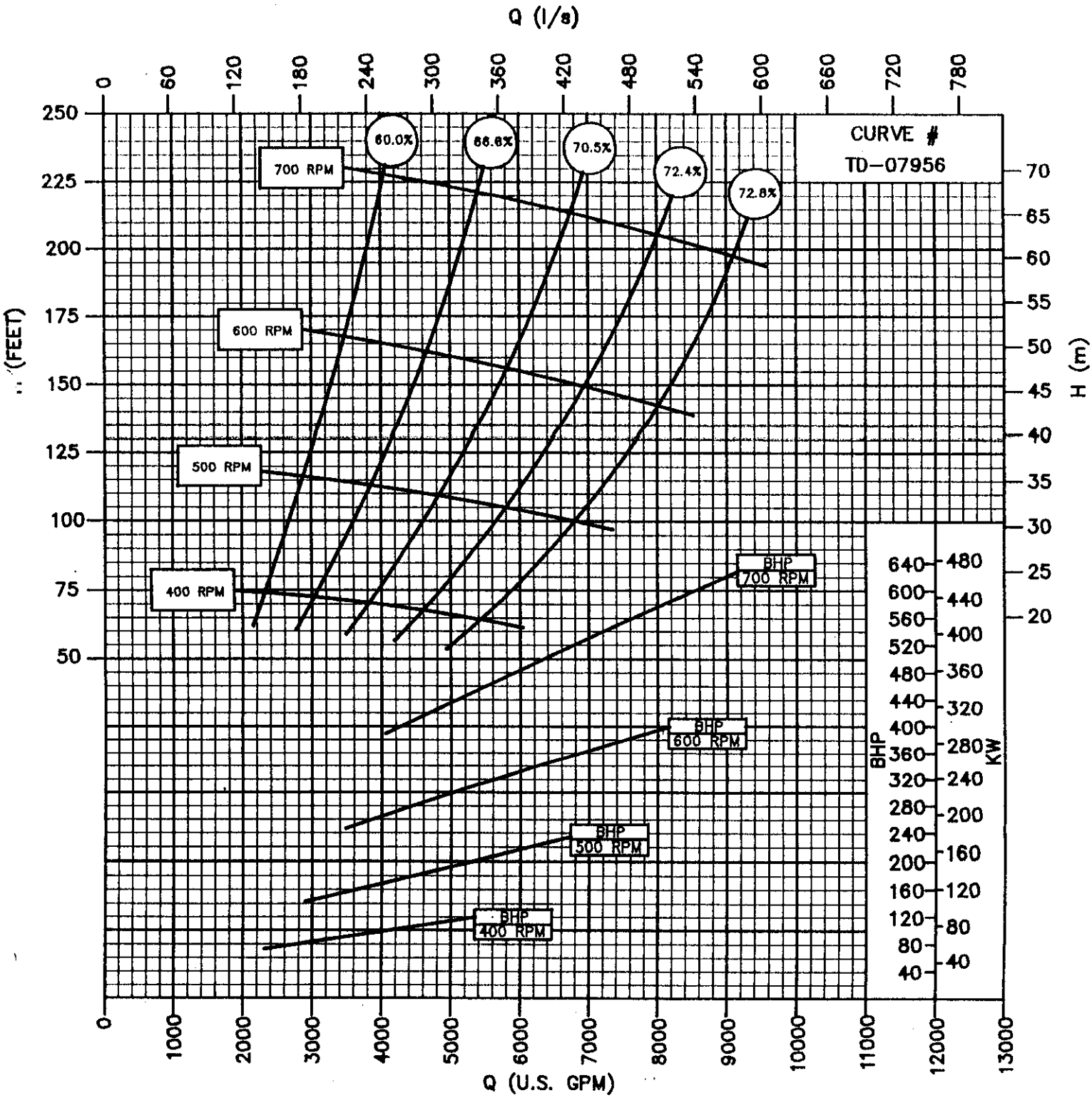
Note: ***Specifications may change due to continual product improvement***

DENVER THOMAS INC.

BIRMINGHAM AL, U.S.A.

P.O. BOX 96
BIRMINGHAM, AL 35201
PHONE (205) 599-6600
FAX (205) 599-6610

PUMP MODEL	SIZE	IMPELLER # J-1020		CASE# L-1284	
12" L-36	12 X 14	TYPE	VANES	VANE ø	MAX PARTICLE
		CLOSED	4	36.00 IN	4.875 IN
PERFORMANCE FOR WATER @ 1.0 SG @ 68° F/20° C				914 MM	124 MM
CORRECTIONS MUST BE MADE FOR HEAD AND EFFICIENCY LOSSES FROM MIXTURE SPECIFIC GRAVITY AND SOLIDS EFFECT. CONSULT FACTORY				MAX.SPEED	TEST# B 52.0
				710 RPM	DATE 11/13/89



05.12.2005

PERFORMANCE PIPE
A DIVISION OF CHEVRON PHILLIPS CHEMICAL COMPANY LP

IPS Size and Dimension Data

PE3608 (PE3408)

DriscoPlex® Municipal & Industrial & Energy Series/IPS Pipe Data

Pressure Ratings are cslculated using 0.50 design factor for HDS at 73°F as listed in PPI TR-4 for PE 3608 materials.
Temperature, Chemical, and Environmental use considerations may require use of additional design factors.

Pressure Rating		100 psi DR 17.0			80 psi DR 21.0			65 psi DR 26.0			50 psi DR 32.5			
IPS Pipe Size	Nominal OD (in)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	IPS Pipe Size
1 1/4"	1.660													1 1/4"
1 1/2"	1.900													1 1/2"
2"	2.375	0.140	2.078	0.43										2"
3"	3.500	0.206	3.063	0.93										3"
4"	4.500	0.265	3.938	1.54	0.214	4.046	1.26							4"
6"	6.625	0.390	5.798	3.34	0.315	5.957	2.73	0.255	6.084	2.23	0.204	6.193	1.80	6"
8"	8.625	0.507	7.550	5.65	0.411	7.754	4.64	0.332	7.921	3.79	0.265	8.063	3.05	8"
10"	10.750	0.632	9.410	8.78	0.512	9.665	7.21	0.413	9.874	5.87	0.331	10.048	4.75	10"
12"	12.750	0.750	11.160	12.36	0.607	11.463	10.13	0.490	11.711	8.26	0.392	11.919	6.67	12"
14"	14.000	0.824	12.253	14.91	0.667	12.586	12.22	0.538	12.859	9.96	0.431	13.086	8.05	14"
16"	16.000	0.941	14.005	19.46	0.762	14.385	15.96	0.615	14.696	13.01	0.492	14.957	10.50	16"
18"	18.000	1.059	15.755	24.64	0.857	16.183	20.19	0.692	16.533	16.47	0.554	16.826	13.30	18"
20"	20.000	1.176	17.507	30.41	0.952	17.982	24.93	0.769	18.370	20.34	0.615	18.696	16.41	20"
22"	22.000	1.294	19.257	36.80	1.048	19.778	30.18	0.846	20.206	24.61	0.677	20.565	19.86	22"
24"	24.000	1.412	21.007	43.81	1.143	21.577	35.91	0.923	22.043	29.30	0.738	22.435	23.62	24"
26"	26.000	1.529	22.759	51.39	1.238	23.375	42.14	1.000	23.880	34.39	0.800	24.304	27.74	26"
28"	28.000	1.647	24.508	59.62	1.333	25.174	48.86	1.077	25.717	39.88	0.862	26.173	32.19	28"
30"	30.000	1.765	26.258	68.45	1.429	26.971	56.12	1.154	27.554	45.78	0.923	28.043	36.93	30"
32"	32.000	1.882	28.010	77.86	1.524	28.769	63.84	1.231	29.390	52.10	0.985	29.912	42.04	32"
34"	34.000	2.000	29.760	87.91	1.619	30.568	72.06	1.308	31.227	58.81	1.046	31.782	47.43	34"
36"	36.000	2.118	31.510	98.57	1.714	32.366	80.78	1.385	33.064	65.94	1.108	33.651	53.20	36"
42"	42.000	2.471	36.761	134.16	2.000	37.760	109.97	1.615	38.576	89.71	1.292	39.261	72.37	42"
48"	48.000	2.824	42.013	175.23	2.286	43.154	143.65	1.846	44.086	117.18	1.477	44.869	94.56	48"
54"	54.000				2.571	48.549	181.75	2.077	49.597	148.33	1.662	50.477	119.70	54"

Performance Pipe can produce to specialized pipe dimensions. Check with your Performance Pipe contact for availability of dimensions not listed.

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TECHNICAL NOTE PP 750-TN-05
BUTT FUSION JOINING PROCEDURES
For DriscoPlex® Municipal/Industrial/Energy Piping Products

This bulletin has been developed to assist those responsible to for the Butt-Fusion joining of Performance Pipe products in Municipal, Industrial and Energy applications. For more specific fusion information; safety requirements, saddle (sidewall) fusion procedures, socket fusion procedures and Federal regulations for gas pipe joining, please refer to Performance Pipe Bulletin PP 750, "Heat Fusion Joining Procedures and Qualification Guide."

These procedures are in alignment with Plastic Pipe Institute's (PPI) TR-33 Generic Butt Fusion Joining Procedures.

OVERVIEW

In heat fusion joining, mating surfaces are prepared by cleaning and facing, simultaneously melted with a hot-plate heater, the heater is removed, and the melted surfaces are pressed together and held under pressure. As the molten materials cool, they mix and fuse into a permanent, monolithic joint.

SET-UP PARAMETERS

HEATING TOOL SURFACE TEMPERATURE — MINIMUM 400°F – MAXIMUM 450°F (204 – 232°C)

Heating tool surfaces must be up to the specified temperature before you begin. All points on both heating tool surfaces where the surfaces will contact the pipe must be within the prescribed minimum and maximum temperatures. Heating tool surfaces must be clean.

INTERFACE PRESSURE — minimum 60 psi – maximum 90 psi (414 – 621 kPa; 4.14 – 6.21 bar)

Interface pressure is used to calculate a fusion joining pressure value for hydraulic butt fusion machines or manual machines equipped with a torque wrench. For hydraulic machines, the interface pressure, the fusion surface area, the machine's carriage cylinder size and internal drag pressure, and if necessary, the pressure needed to overcome external drag resistance, are used to calculate hydraulic fusion joining pressure gauge settings. The equipment manufacturer's instructions are used to calculate this value. ***Interface pressure and fusion machine hydraulic fusion joining pressure gauge settings are not the same!***

PROCEDURE

1. ***Secure.*** Clean the inside and outside of the component (pipe or fitting) ends by wiping with a clean, dry, lint-free cloth or paper towel. Align the component ends in the machine. ***Do not force pipes into alignment against open fusion machine clamps.*** Component ends should protrude past the clamps enough so that facing will be complete. Bring the ends together and check high-low alignment. Adjust alignment as necessary by tightening the high side down. Make sure clamps are properly secured to prevent slippage of the component ends.

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PO Box 269006
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Fax: 972-599-7348

2. ***Face.*** Place the facing tool between the component ends, and face them to establish smooth, clean, parallel mating surfaces. If stops are present, face down to the stops. Remove all shavings from pipe ends after facing. ***Do not touch the component ends with your hands after facing.***

3. ***Align.*** Bring the component ends together, check alignment and check for slippage against fusion pressure. Look for complete contact all around both ends with no detectable gaps, and outside diameters in high-low alignment.

4. ***Melt.*** Verify that the heating tool is maintaining the correct temperature. Place the heating tool between the component ends, and move the ends against the heating tool. The initial contact should be under moderate pressure to ensure full contact. Hold the ends against the heating tool ***without force***.

   Beads of melted polyethylene will form against the heating tool at the component ends. When the proper melt bead size is formed, quickly separate the ends, and remove the heating tool.

   Table 1 Approximate Melt Bead Size

Pipe Size	*Approximate Melt Bead Size*
2" –4"	1/8" – 3/16"
4" –12"	3/16" – 1/4"
12" -24"	1/4" – 7/16"
24" –54"	7/16"- 9/16"

5. ***Join.*** Immediately after heating tool removal, *QUICKLY* inspect the melted ends, then bring the ends together applying the correct joining force, using 60-90psi interfacial pressure. ***Do not slam.*** The correct joining force will form a double bead that is rolled over to the surface on both ends.

6. ***Hold.*** Hold joining force against the ends until the joint is cool. The joint is cool enough for *GENTLE* handling when the double bead is cool to the touch. Cool for about 30-90 seconds per inch of pipe diameter.

- Heavier wall thickness pipes may require longer cooling times.

7. ***Inspect.*** On both sides, the double bead should be rolled over to the surface, and be uniformly rounded and consistent in size all around the joint.

It is a common practice and accepted industry "Rule of Thumb" when fusing pipes of unlike DR's, to fuse a maximum mismatch of one SDR. For example, this would allow fusion of DR 11 pipe to DR 9 or DR-11 to DR 13.5. A successful fusion may be accomplished without the need of any change in the actual fusion procedure.

Per ASTM, Standard Dimension Ratio, SDR, value is when the outside diameter divided by the minimum wall thickness equals one of the following values:

5.0	6.0	7.0	9.0	11.0	13.5	17	21.0	26.0	32.5

The terms DR and SDR are often used interchangeably.

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Members Of: PLASTICS·PIPE·INSTITUTE

NOTICE: This data sheet provides typical physical property information for polyethylene resins used to manufacture PERFORMANCE PIPE polyethylene piping products. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for piping products. Some of these typical physical property values were determined using compression molded plaques. Values obtained from tests of specimens taken from piping product can vary from these typical values. Performance Pipe has made every reasonable effort to ensure the accuracy of this data sheet, but this data sheet may not provide all necessary information, particularly with respect to special or unusual applications. The data sheet may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most recent edition.

Another quality product from
Chevron Phillips Chemical Company LP
The Woodlands, Texas

Before using the piping product, the user is advised and cautioned to make its own determination and assessment of the safety and suitability of the piping product for the specific use in question and is further advised against relying on the information contained herein as it may relate to any specific use or application. It is the ultimate responsibility of the user to ensure that the piping product is suited and the information is applicable to the user's specific application. This data sheet provides typical physical property information for polyethylene resins used to manufacture the piping product. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for the piping product. These typical physical property values were determined using compression-molded plaques prepared from resin. Values obtained from tests of specimens taken from the piping product can vary from these typical values. Performance Pipe does not make, and expressly disclaims, all warranties, of merchantability or fitness for a particular purpose, regardless of whether oral or written, express or implied, allegedly arising from any usage of trade or from any course of dealing in connection with the use of information contained herein or the piping product itself. The user expressly assumes all risk and liability, whether based in contract, tort or otherwise, in connection with th

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800.527.0662

SUGGESTED INDUSTRIES AND APPLICATIONS

Potable Water Mains	Horizontal Directional Drilling (HDD)	Marine Service
Sliplining	Water transmission Lines	Pipe Bursting
Industrial Water Mains	Ash, Tailings & Abrasives	Mining
Municipal Water Utilities	Open-cut and Bury	Culverts
Rural Water Distribution	River Crossings	Plow-in
Mun. & Ind. Sewer	Trenchless Technologies	Crude oil
Fire Main Piping	Rural Water Distribution	Plow-in

Butt Fusion Conditions

- 60-90 psig (4.14-6.21 bar) interfacial fusion pressure.
- 400-450° (204-232°C) heater surface temperature range.
- Please refer to Performance Pipe's PE3608 (PE3408) fusion procedure, Bulletin PP 750.

Available Sizes

- ¾" through 54" IPS
- 4" through 36" DIPS

Specification Data

The resin, pipe and fitting listed may comply with one or more of the standards below.

Applicable Standards	DriscoPlex® Pipe Series	PE3608 (PE3408)	PE4710 (d_f)
ASTM F714, NSF 61, ASTM D3035	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
AWWA C906, AWWA C901	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
FMA, AWWA, F714	1500, 1600	0.5	—
API 15LE, ASTM D2513	6400	0.5	0.63

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DriscoPlex®
PE3608 / (PE3408) Pipe
Pipe and Fittings Data Sheet

Typical Material Physical Properties of DriscoPlex® PE3608 / (PE3408)

High Density Polyethylene Materials

Material Designation	—	PPI TR-4	PE3608
Cell Classification	—	ASTM D3350	345464C
Pipe Properties			
Density	gms / cm^3	ASTM D1505	0.955 (black)
Melt Index Condition 190 / 2.16	gms / 10 minutes	ASTM D1238	0.08
Hydrostatic Design Basis 73°F (23°C)	psi	ASTM D2837	1600
Hydrostatic Design Basis 140°F (60°C)	psi	ASTM D2837	800
Color: UV Stabilizer [C] [E]	—	ASTM D3350	Min 2% carbon Black Color UV Stabilizer
Material Properties			
Flexural Modulus 2% Secant - 16:1 span; depth, 0.5 in / min	psi	ASTM D790	>110,000
Tensile Strength at Yield	psi	ASTM D638 Type IV	3200
Elongation at Break 2 in / min., Type IV bar	%	ASTM D638	>700
Elastic Modulus	psi	ASTM D638	>150,000
Hardness	Shore D	ASTM D2240	62
PENT	hrs	ASTM F1473	>100
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	256
Brittleness Temperature	°F	ASTM D746	-103
Thermal Expansion	in / in / °F	ASTM D696	1.0×10^{-4}

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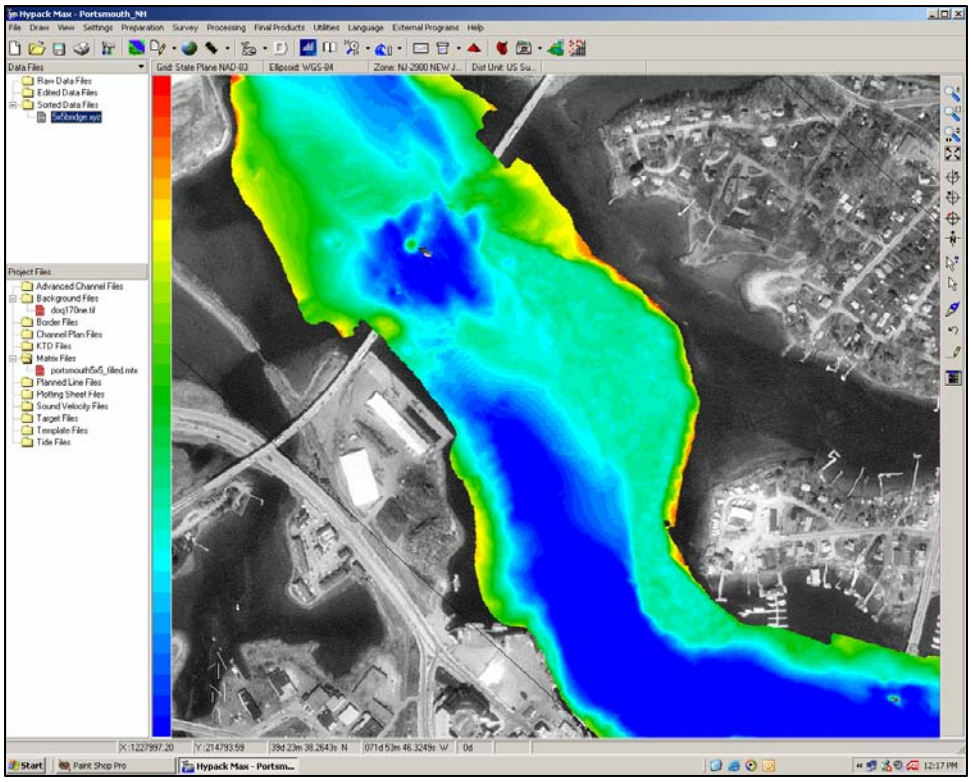
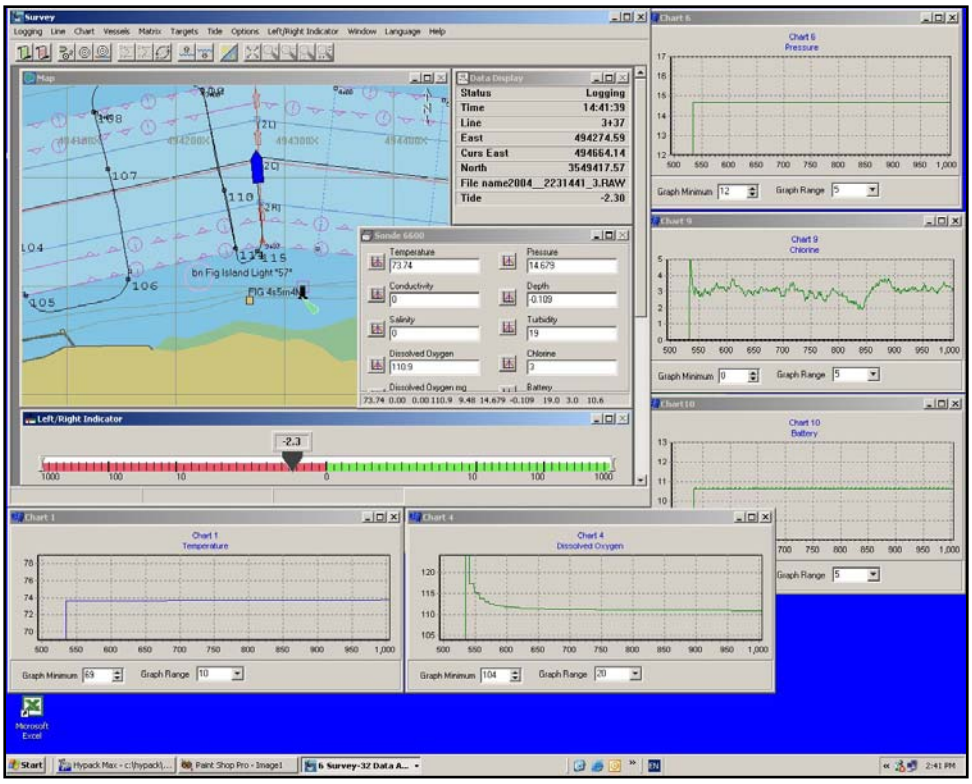
PIPELINE WEIGHT AND BUOY ASSEMBLY

Appendix C-6

Survey and Geodetic Control Equipment



HYPACK® screen with GeoTIFF background and multibeam sounding matrix.
[Data courtesy USACE New England District]



The SURVEY program of HYPACK® collecting data from the YSI Sonde 6600.

HYPACK®

HYPACK® is a Windows™-based software package used primarily for hydrographic surveying and data processing.

It is optimized to run under:

- Windows 2000™
- Windows XP™

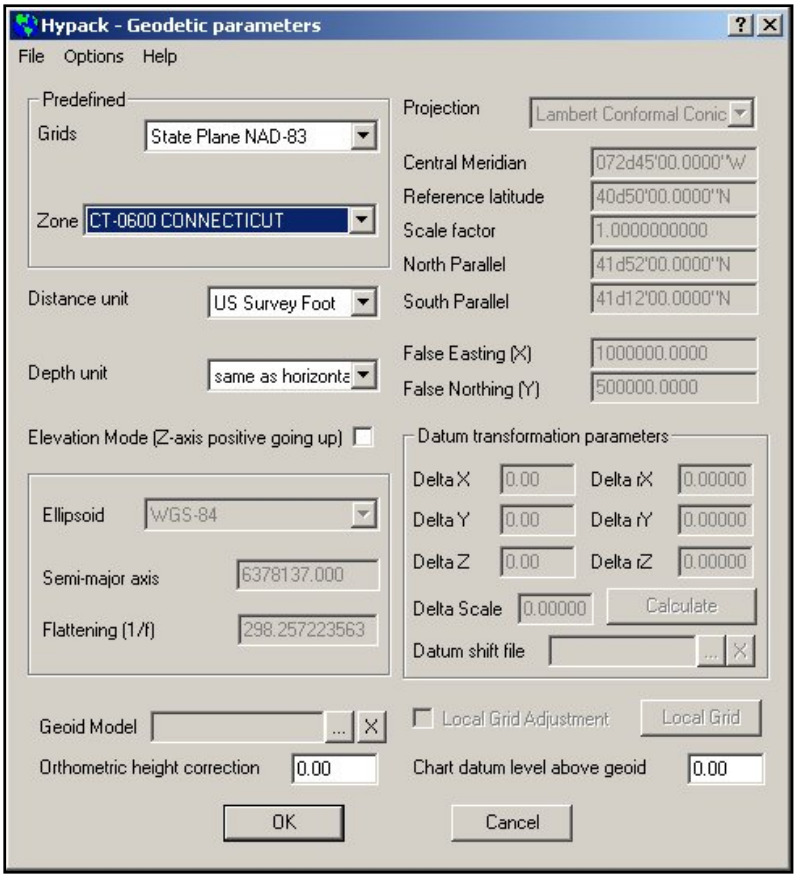
HYPACK® performs all of the tasks necessary to complete your survey from beginning to end.

- Geodetic Parameters
- Planned Line Design
- Equipment Configuration
- Data Collection supporting over 200 sensors
- Data Processing
- Tides and Sound Velocity
- Sounding Reduction
- Export to DXF/DGN
- Plotting of Smooth Sheets
- Volumes by Section
- Volumes by Surface Model
- Contouring to DXF
- 3D Visualization
- Side Scan Collection and Processing
- ACDP Collection and Display

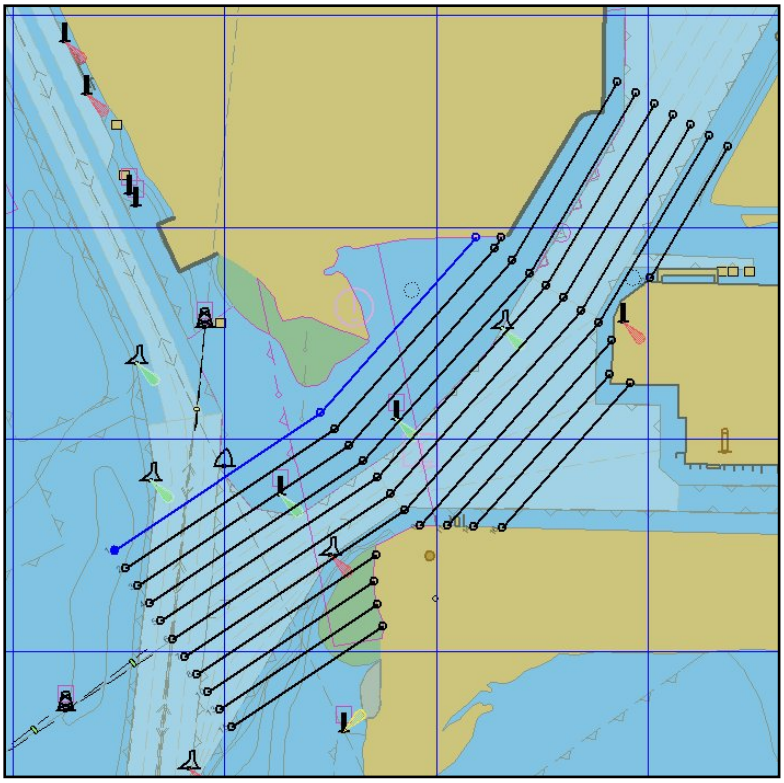
The optional HYSWEEP® module allows for the configuration, calibration, collection and processing of multibeam and multiple transducer sonar systems.

The DREDGEPACK® version allows you to maximize the efficiency of your dredge operations by tracking and maintaining a history of where the cutting tool has passed and how deep it was.

HYPACK®, HYSWEEP® and DREDGEPACK® are all developed by HYPACK, Inc.



The GEODETIC PARAMETERS program allows you to quickly specify the geodesy for each survey project.



GEODETIC PARAMETERS program from HYPACK®.

Geodesy

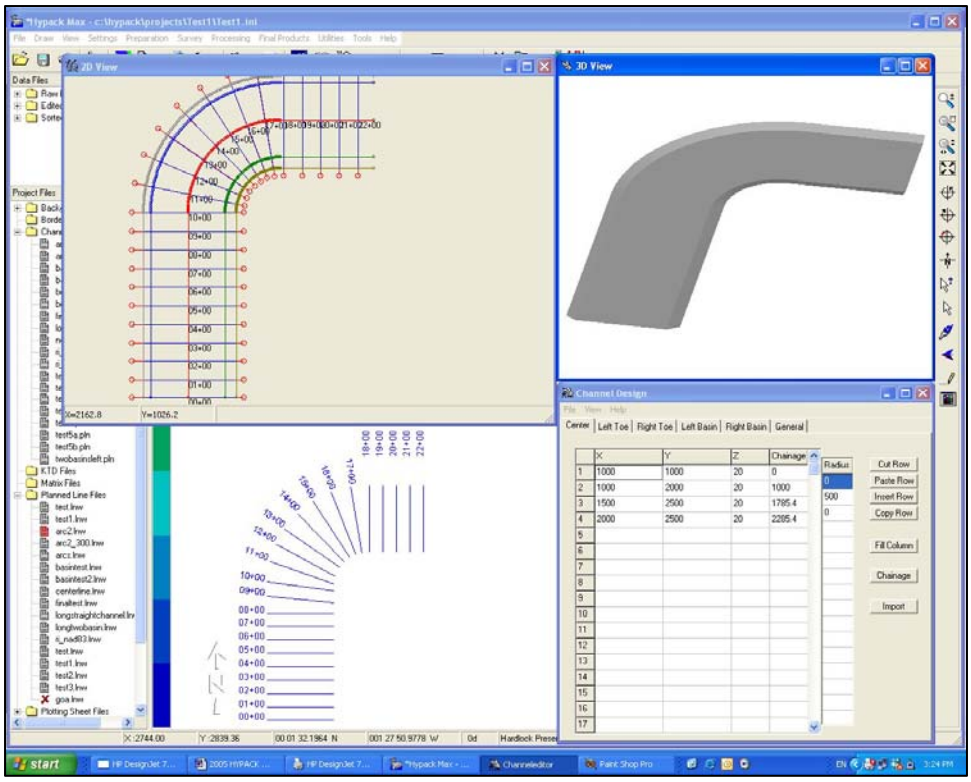
HYPACK® allows you to quickly configure your geodetic parameters for each project.

- National grids are pre-defined and available from a list.
- National datum transformation models are available for the USA, UK and France.
- Users can determine a 3 or 7-parameter transformation based on local test points.
- All standard projections used in hydrographic surveying are available.
- Users can also configure their parameters to utilize GPS on a local survey grid.
- Entire projects can be converted from an old to a new geodetic basis.

Planned Lines

You can quickly create planned lines for your survey.

- Manually enter X-Y or Lat-Long waypoints for your planned lines.
- Use the cursor to set waypoints.
- Create offsets from one of several methods.
- Import planned lines created in your CAD/GIS package (*.DXF).
- Generate 3-D planned lines that contain your channel toe-point and top-of-bank info.
- Clip planned lines to your exact area, using a HYPACK Border file.
- Planned lines can have:
    - 2 or more segments
    - Straight or curved segments



The CHANNEL DESIGN program creates 3-D planned lines with information on the channel centerline, toe lines and top of bank lines.

CHANNEL DESIGN

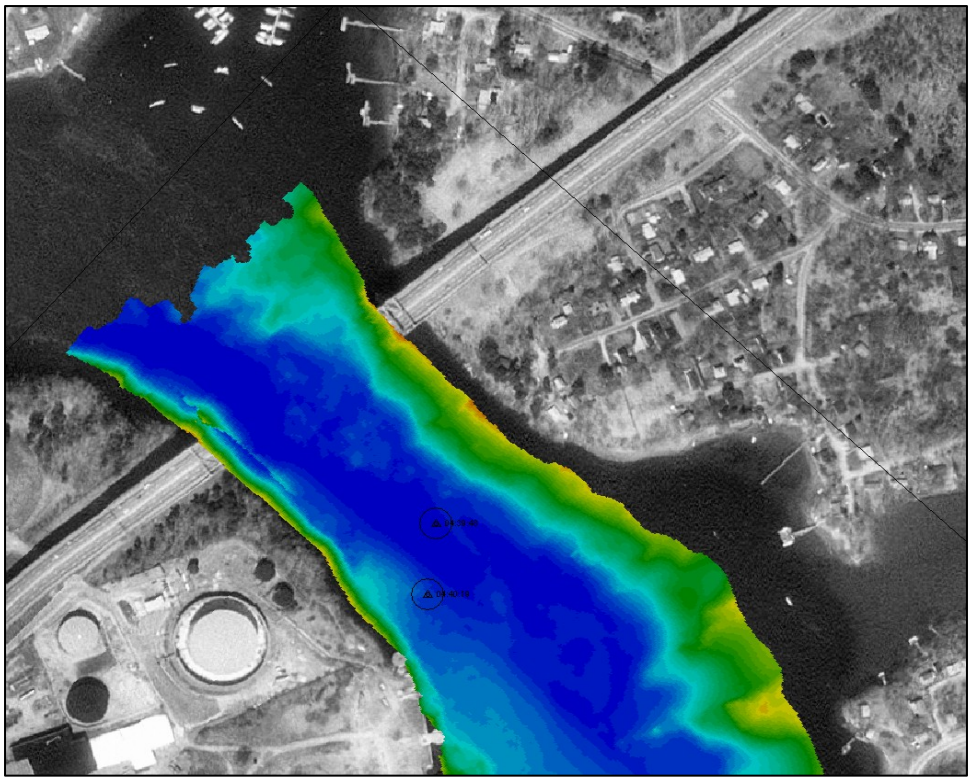
CHANNEL DESIGN is a special HYPACK® program that allows you to create planned lines by entering the channel geometry.

By entering info for:

- Left toe line and side slope.
- Centerline waypoints, chainage, and depth.
- Right toe line and side slopes.
- Turning basins.

…CHANNEL DESIGN can generate planned lines at user-defined intervals. Each line will contain the cross-sectional design profile at the section.

CHANNEL DESIGN has been recently upgraded to handle curved centerlines.



A matrix file showing color-coded multibeam depth data superimposed over a GeoTIF.
[Data courtesy USACE New England District]

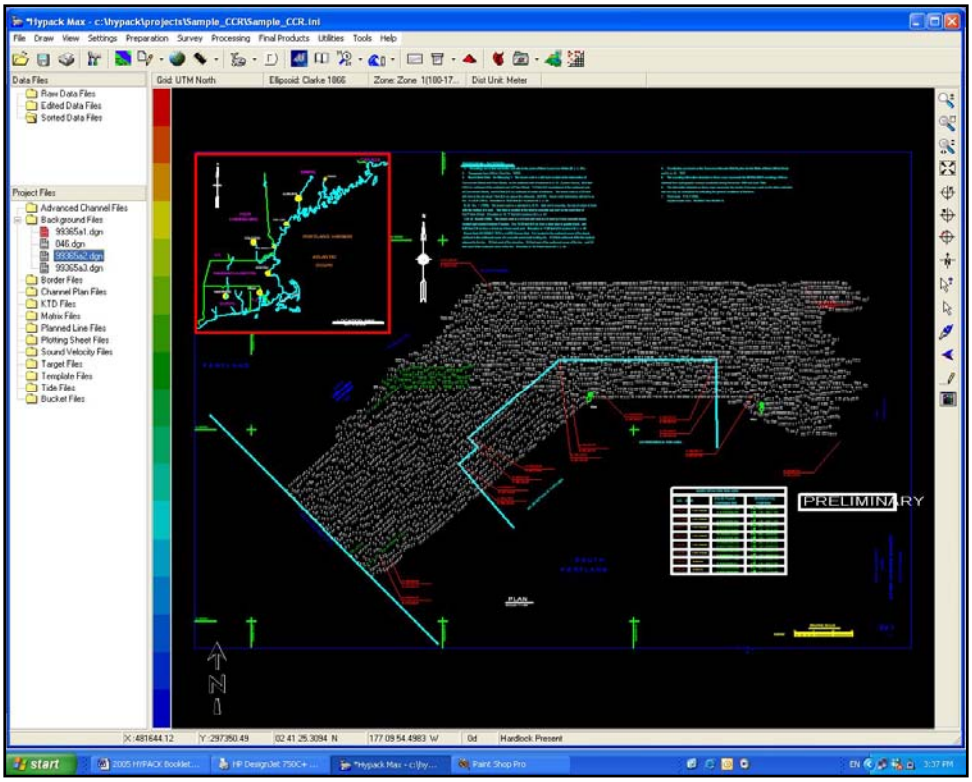
Matrix Files

A Matrix file (*.MTX) allows you to display real time bottom coverage and to quickly display the bottom depth info in a color scheme of your selection.

MTX files can be filled with pre-existing survey data or can be filled in real time with single beam, multiple transducer or multibeam sounding info.

In post-processing the MAPPER program allows you to select which depth is used to represent each 'cell' of the matrix:

- Minimum depth
- Maximum depth
- Depth closest to cell center
- Average depth
- Median depth
- Depth above or below strike value



One of HYPACK®'s strengths is in its import and export to CAD. The above screen capture shows a Microstation DGN file in MAX.

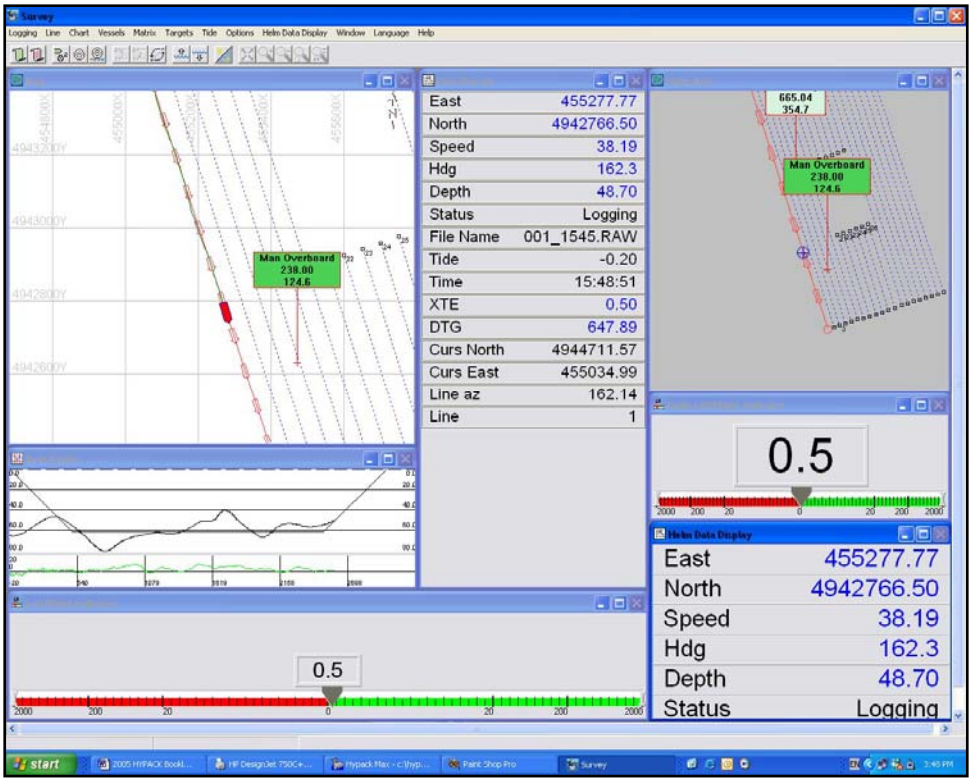
CAD/GIS Support

A majority of our clients want to be able to import their CAD/GIS information and display it in HYPACK® during survey design, data collection and generation of final products.

HYPACK® allows the display of several different background formats:

- DXF/DGN
- S-57/S-63
- OrthoTIF, GeoTIF
- BSB, UKHO ARCS
- Vector Product Format
- SHP from ArcInfo

HYPACK® also provides several tools to export data files and project files to both DXF and Microstation DGN.



The SURVEY program showing standard windows with separate windows intended for the helmsman monitor.

SURVEY

The SURVEY program of HYPACK® supports many kinds of devices.

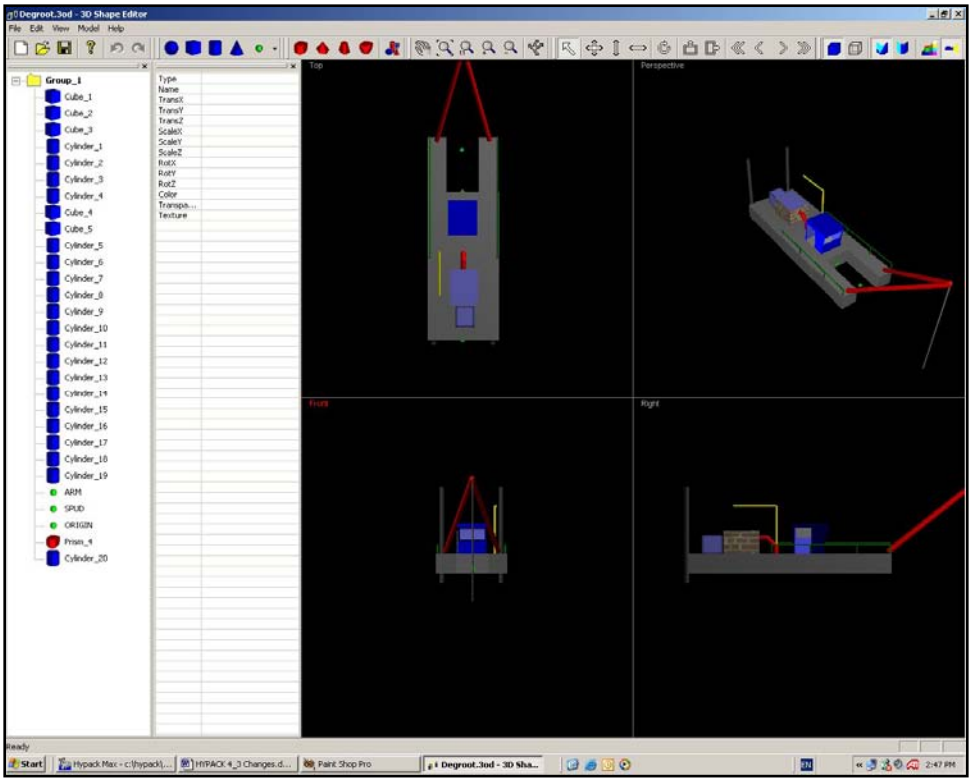
- RTK, DGPS and GPS systems
- Range-Azimuth
- Range-Range
- USBL
- ROV Transponders
- Single beam and Dual Frequency echosounders
- Heave-Pitch-Roll sensors
- Gyros and magnetic compass
- Magnetometers
- Environmental sensors

SURVEY provides windows for the Area Map, Data Display, Left-Right Indicator, Boat Profile and duplicate windows for the helm monitor.

HYPACK®'s SURVEY program was the first to support real time RTK TIDES.

The Shared Memory Area of SURVEY allows you to:

- Generate custom messages for other devices.
- Transmit survey info and graphics across the network, serial connections or to data file.



The 3D SHAPE EDITOR (3DSE) program allows you to create the exact shape of your vessel and display it in the 3DTV program.

Vessel Display

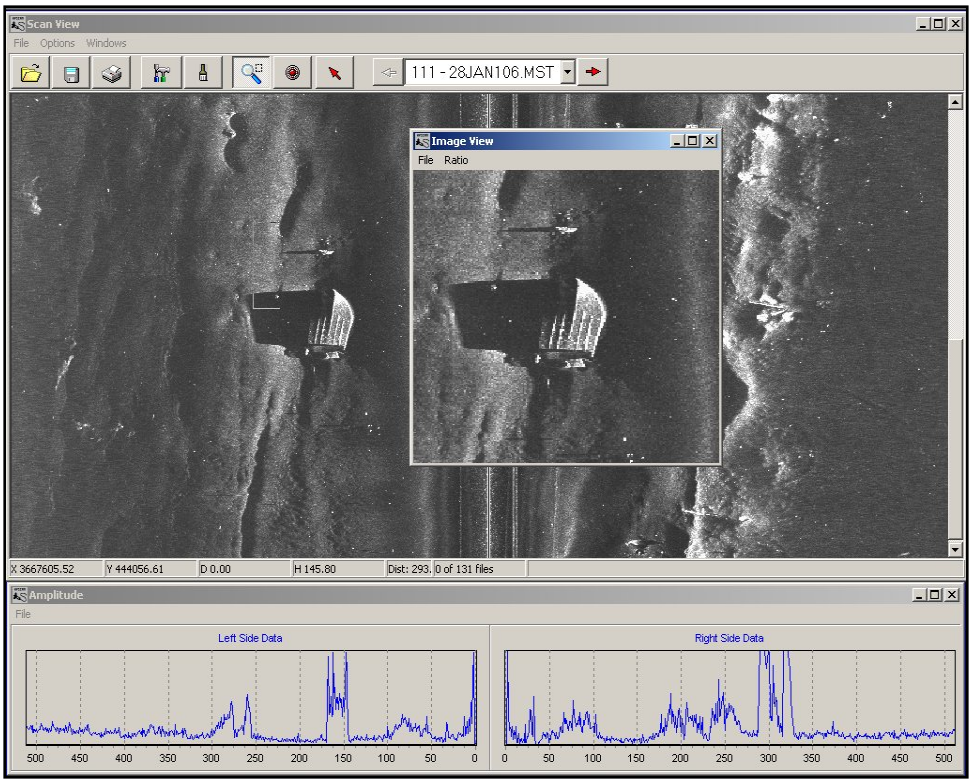
HYPACK® provides tools for the display of both 2-dimensional and 3-dimensional vessel shapes.

The BOAT SHAPE EDITOR is used to create 2-D shapes that are displayed in the plan view (Area Map) of SURVEY.

The 3D SHAPE EDITOR is used to create 3-D vessels that can be displayed in real time in the 3D TERRAIN VIEWER (3DTV) program.

The vessel perimeter and the location of all sensors are relative to a 'boat origin' established by the user.

This means you can have the exact perimeter of your vessel, dredge or work barge displayed in its exact location in real time.



Side scan data collected with Marine Sonics PCScan program displayed in the SIDE SCAN MOSAIC program. [Data courtesy Marine Sonics]

SIDE SCAN

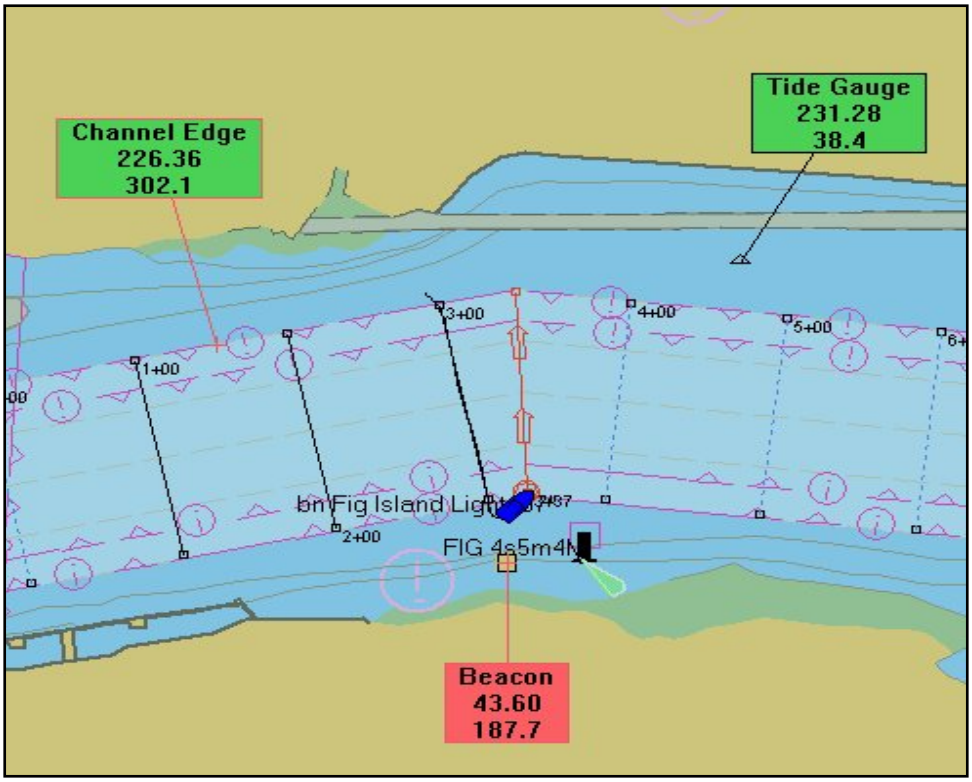
The collection and mosaicing of side scan data is now an integral part of HYPACK®.

The SIDE SCAN SURVEY program allows for the collection of digital and analog side scan data.

Target analysis can be performed in real time or in post-processing.

The SIDE SCAN MOSAIC program allows you to generate a mosaic from data collected in the HYPACK SURVEY program or from many XTF file formats. The resulting mosaic is saved to a GeoTIF format.

The SIDE SCAN routines can also process the backscatter intensity data from many multibeam systems to generate interesting mosaics.

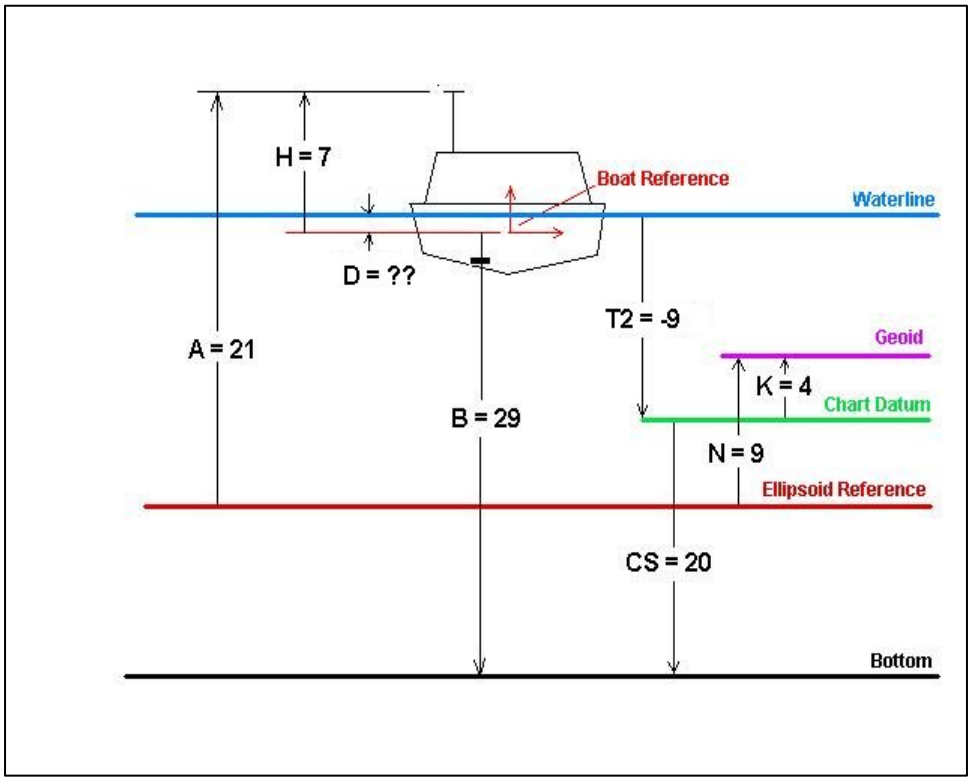


The new 'alarm' style targets in SURVEY constantly show the distance and bearing from the boat to the target.

Targets

A target is an X-Y position of interest to the user. Targets can be used to mark aids to navigation or locations of bottom samples or any point of interest.

- Targets can be created in advance in the TARGET EDITOR.
- Targets can be marked in real time by hitting the F5 key in SURVEY. Targets can then be 'offset' based on a range and bearing.
- The new-style 'alarm' target provides a color-coded box that displays the name, distance-to-vessel and bearing-to-vessel info. The color of the alarm target changes color based on the distance to the vessel.

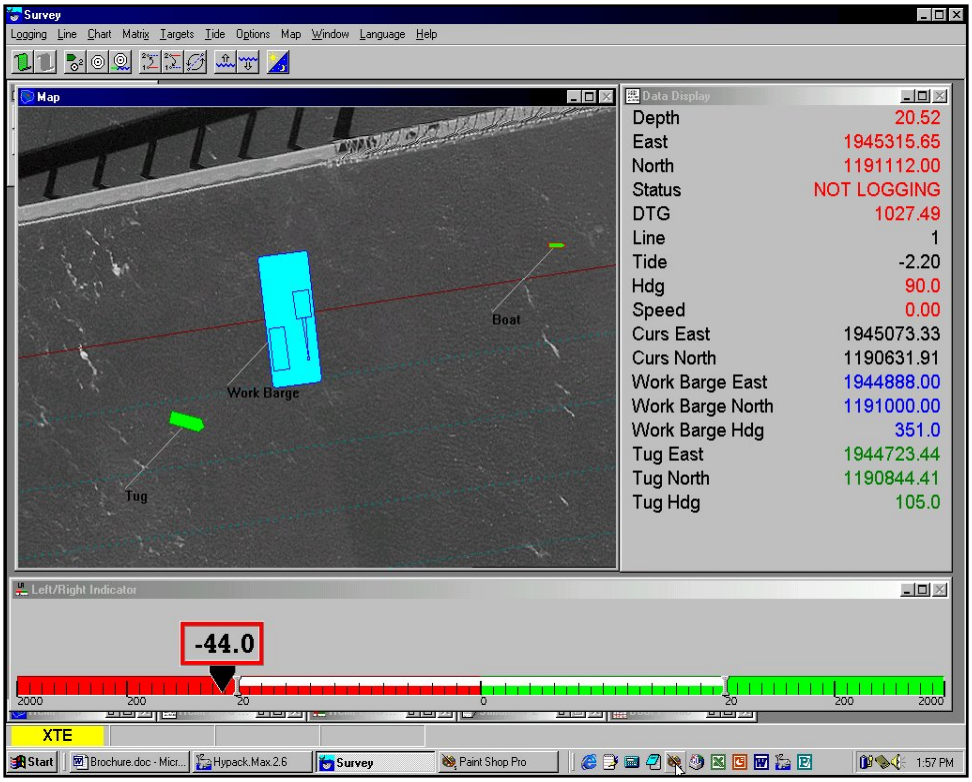


Using the elevation of the RTK antenna to determine the real time water-level correction is one of several tide correction methods available in HYPACK®.

Water Level Corrections

HYPACK® has several ways to generate water level corrections:

- Telemetry tide gauges can be integrated directly into SURVEY.
- Users can manually enter corrections in SURVEY.
- Users can create a tide correction table during post-processing and apply those corrections.
- Users can generated predicted tide corrections based on high water and low water times and heights or by using harmonic constituents.
- HYPACK worked together with the US Army Corps of Engineers to pioneer the use of RTK GPS to determine real time water levels.

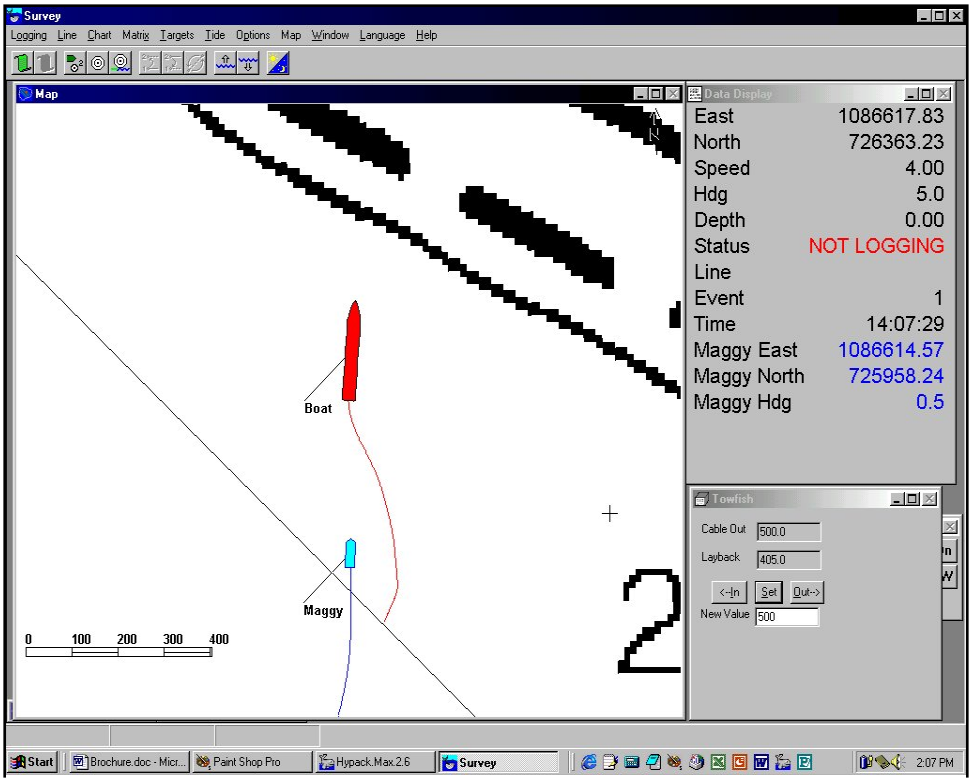


A work barge with two vessels in SURVEY.
[Background file courtesy USACE Rock Island]

Multiple Vessel Support

SURVEY can track up to eight separate vessels.

- Each vessel can be assigned its own shape and color attributes.
- Names of vessels can be attached to the shapes.
- Information from each vessel is available for display in the Data Display window of SURVEY.
- Info in the data display is color-coded to match the vessels color attribute.
- Any vessel can be designated the 'Main' vessel that is used to generate distance-to-go, cross-track-error and other navigation parameters.

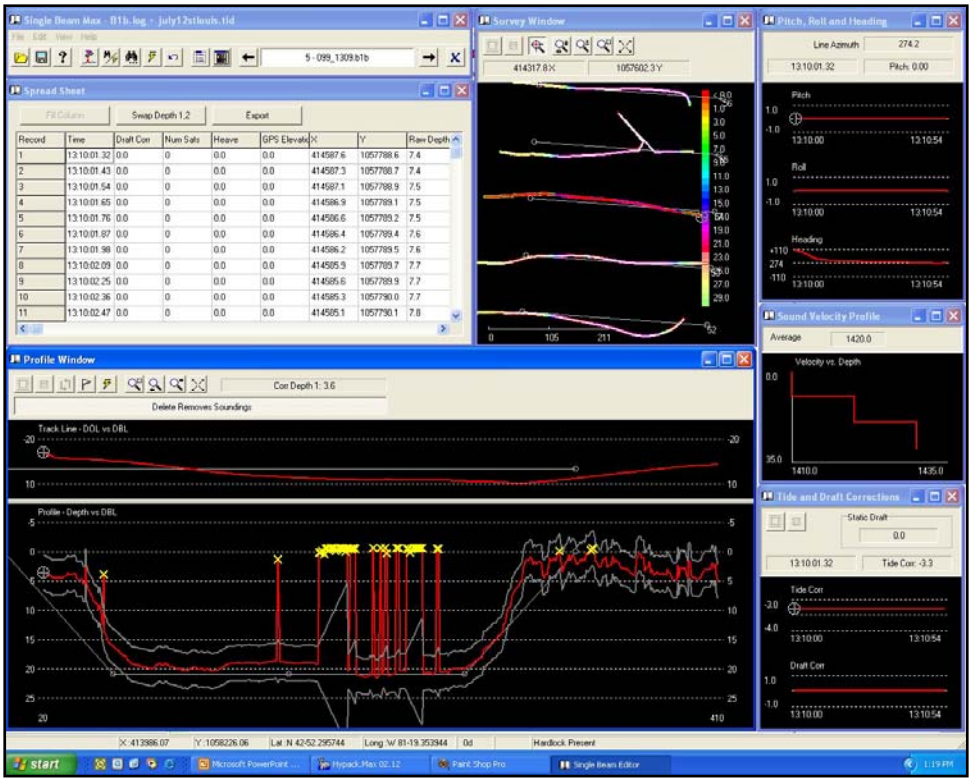


A vessel with a towed magnetometer in SURVEY.

ROV & Towfish Support

HYPACK®'s SURVEY program can simultaneously track, display and record the position and sensor information from your main vessel and towfish.

- Acoustic systems such as Trackpoint, Trackpoint LXT and Nautronic ATS are supported.
- USBL systems have been integrated.
- For short tows, the user can apply a manual layback, based on the amount of cable.
- The towfish or ROV can be designated as the 'Main' vessel. This means that all navigation parameters (Cross track error, distance to go, etc.) are based on the fish or ROV position.

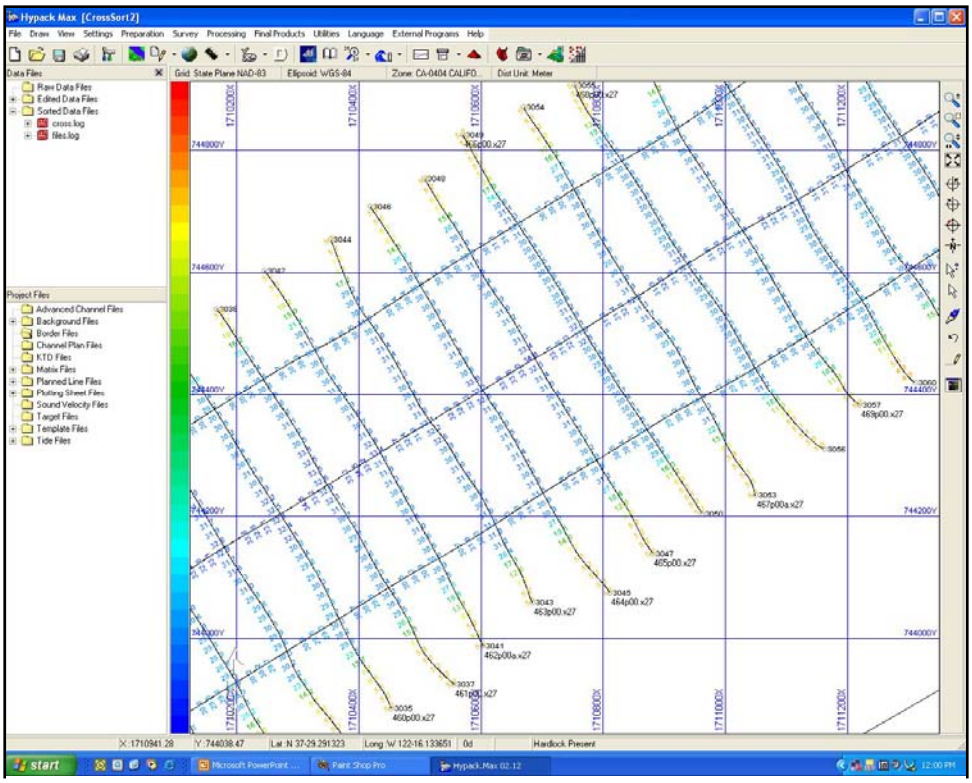


The SINGLE BEAM EDITOR allows you to quickly review, edit and save your single beam and dual frequency data.

SINGLE BEAM EDITOR

The SBMAX program provides a powerful graphical interface for editing your single beam and dual frequency sounding data.

- Loads and displays and entire day's work in seconds.
- Applies water level corrections, standard or RTK Tides.
- Permits smoothing of track lines and RTK Tidal corrections.
- Displays depth profiles based on distance along line or time.
- Configurable spreadsheet shows all survey info for each data point and can be output to ASCII TXT.
- Automated filters quickly eliminate outliers.

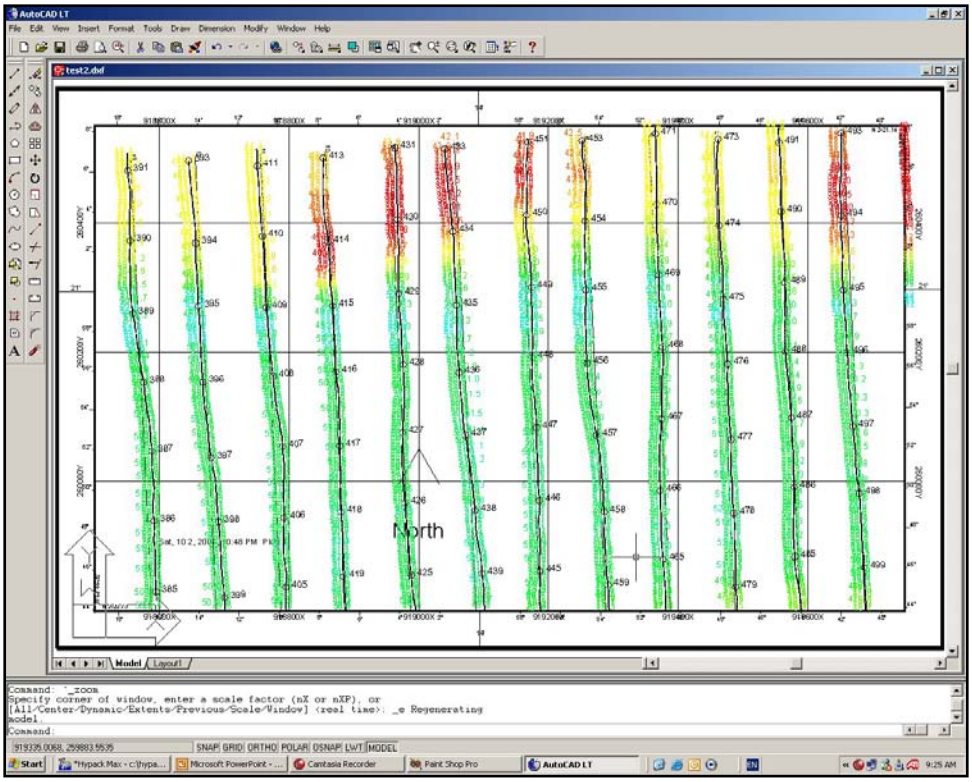


Sounding selection programs allow you to eliminate overwrites and to prepare your data set for plotting and export to CAD.

Sounding Selection Programs

HYPACK® contains several programs to help you reduce your final data set.

- SORT: Creates a cartographic data set that guarantees the minimum or maximum soundings will be saved.
- CROSS SORT: Selects soundings to prevent overwrites at where lines intersect.
- MAPPER: A binning program used to reduce multibeam data.
- SOUNDING REDUCTION: Creates a subset of XYZ data points that accurately models the original data set.



The EXPORT TO CAD program converts HYPACK data to DXF and DGN formats.
[Data courtesy USACE Jacksonville]

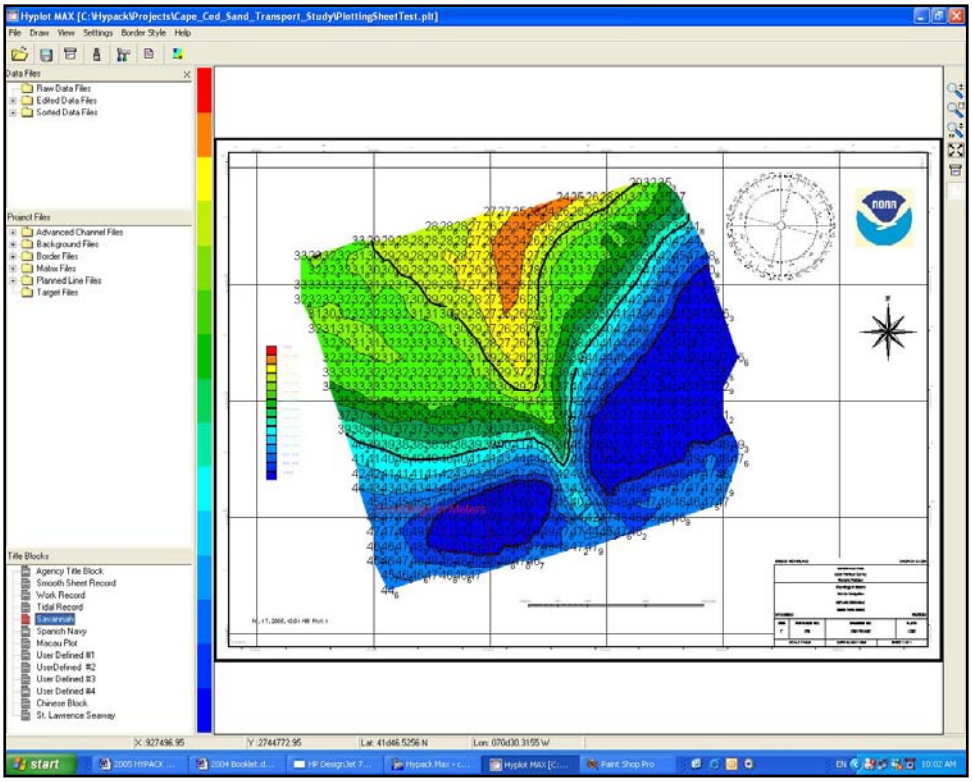
EXPORT TO CAD/GIS

HYPACK® has all the tools you will need to transfer your hydrographic survey data into AutoCAD, ArcInfo, Terramodel, Microstation and other CAD/GIS packages.

The EXPORT TO CAD program allows you to send the following items directly to DXF or DGN:

- Soundings
- Track lines
- Planned lines
- Projection grids and labels
- Matrix Files
- Channel Plan Files
- Border Files

The CROSS SECTION AND VOLUMES program also allows the user to export sections to DXF.



The HYPLOT program is used to generate smooth sheets and can also export borders, compass roses, scale bars, soundings and other items directly to DXF.

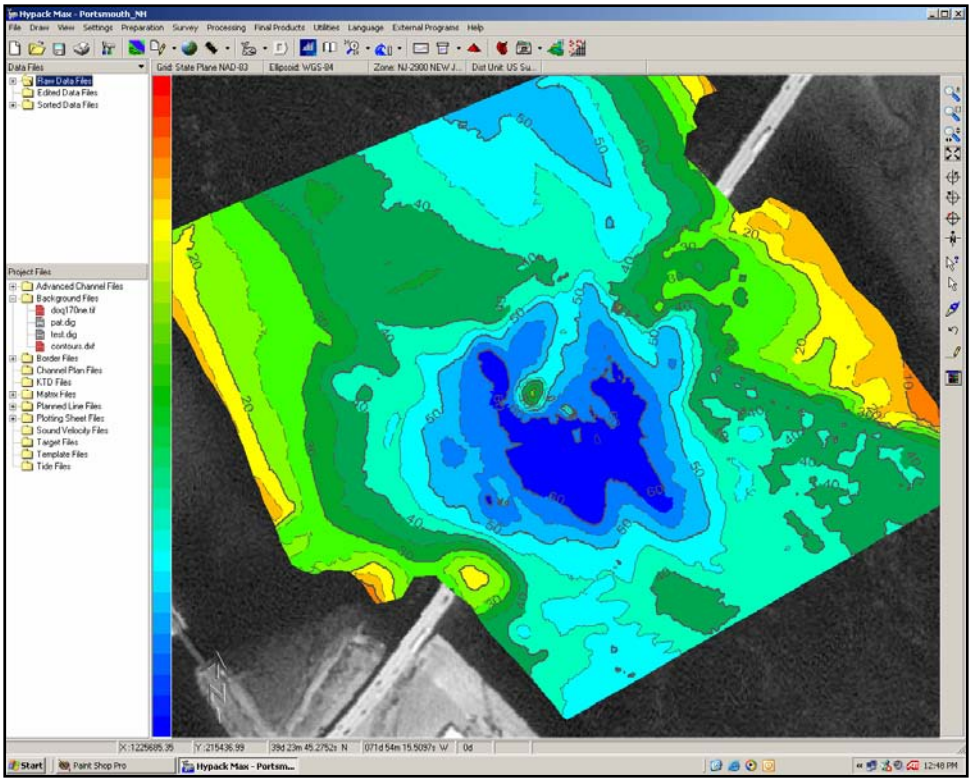
Plotting Smooth Sheets

HYPACK® has a powerful plotting program named HYPLOT that outputs high-quality plots to any Windows™ printer-plotter.

Plotting sheet limits and scales are defined in the PLOTTING SHEET EDITOR.

HYPLOT has some great features:

- A WYSIWYG display.
- Several border options including IHO.
- The ability to zoom in and preview your plot.
- Import of user supplied graphics (BMP and JPG).
- Compass roses, scale bars and default title blocks.
- Drag and drop to move plot features.
- Plotting of contour lines and solid fills.

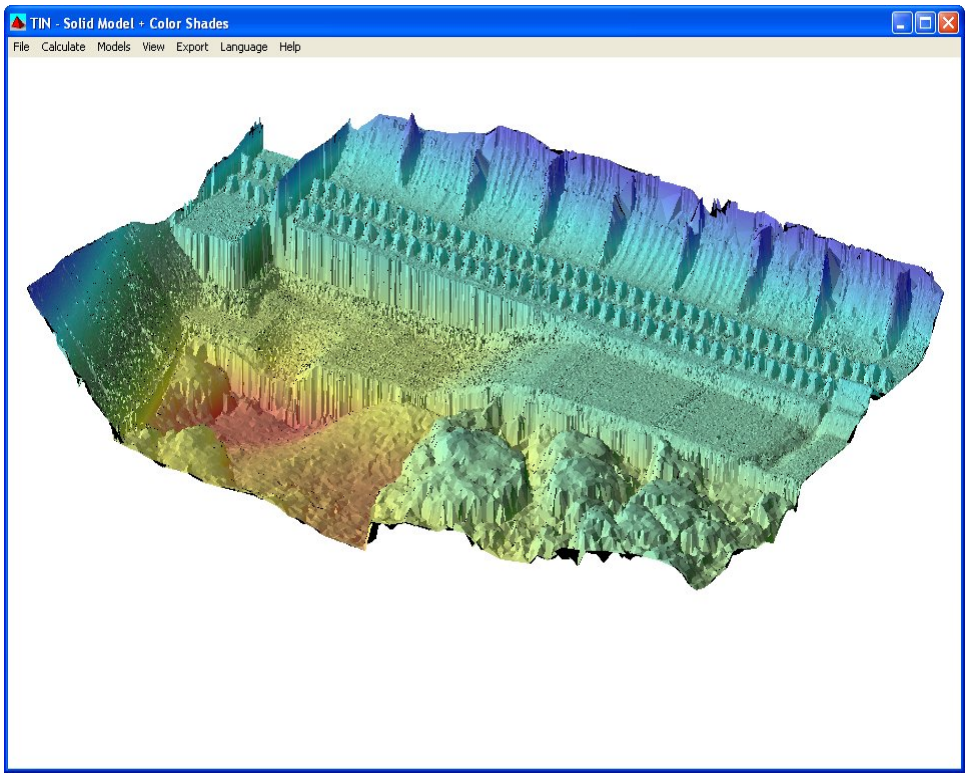


Solid filled contours with labels superimposed over a GeoTIF in HYPACK®

CONTOURING

DXF Contours are generated in the TIN MODEL program of HYPACK®.

- Contours are saved to DXF format, allowing for easy import into your CAD/GIS application.
- Contours can be either lines, labeled lines, and/or solid color fills.
- The TIN MODEL program accepts any HYPACK® data file or data collected in any application, provided it is in an ASCII XYZ format.
- Users can control the line weight, style, color and labeling option for each contour line.

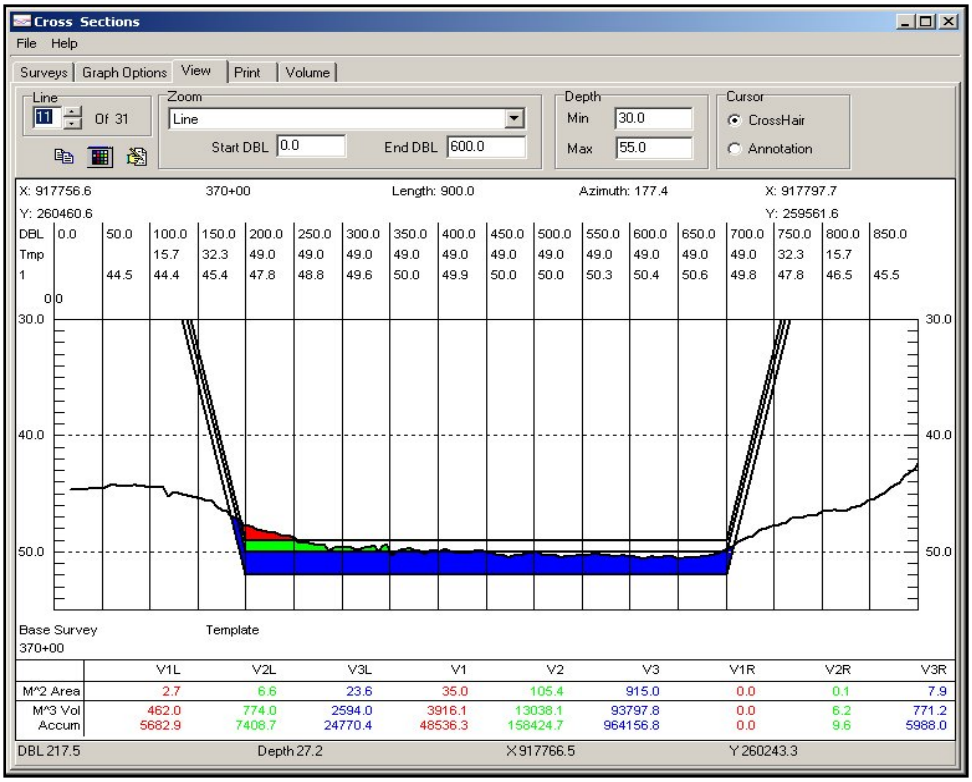


A TIN Model of Bonneville Dam.
[Data courtesy David Evans and Assocs., Portland, OR]

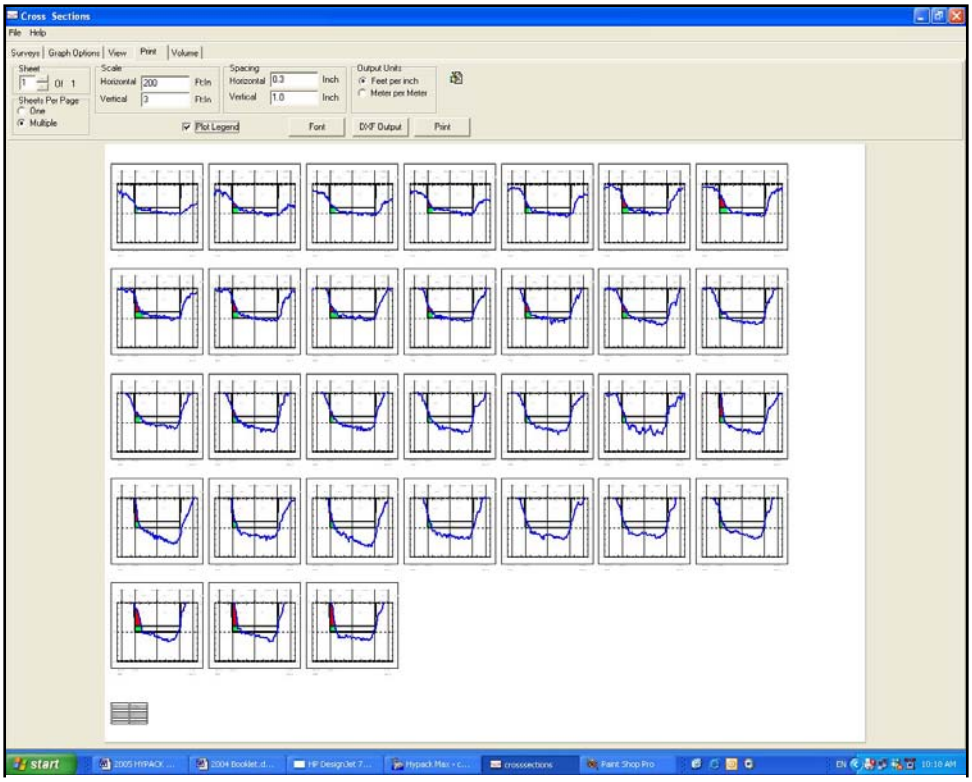
TIN MODEL

The TIN MODEL is a powerful tool that creates surface models (Triangulated Irregular Networks) of your survey data.

- Models can be viewed in gray-scale or color from any angle and perspective.
- Models can be printed to any Windows™ printer or plotter.
- Models can also be saved to BMP or JPG for import into documents.
- The TIN MODEL contains powerful volume routines to compute volumes for single beam or multiple transducer or multibeam data sets:
    - TIN to Level
    - TIN vs. Channel
    - TIN vs. TIN
    - Volume by sections.



A display of a sectional profile showing the depth profile and the design template in the CROSS SECTIONS AND VOLUMES program. [Data courtesy USACE Buffalo]



A series of sections ready for plotting on a large format plotter.

CROSS SECTIONS AND VOLUMES

The CROSS SECTIONS AND VOLUMES (CS&V) program of HYPACK® is the most versatile volume computation program in the industry.

CS&V computes volume quantities by determine the area of material in segments above the design, overdepth and supergrade templates.

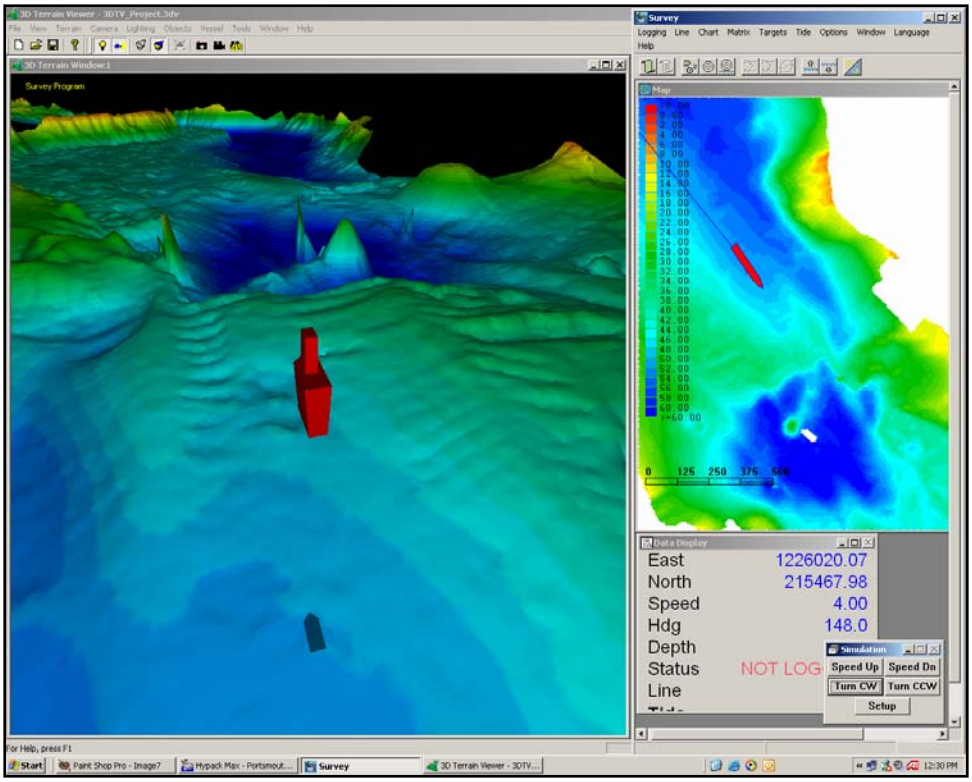
Available methods include:

- AEA 1 – Standard Average End Area (AEA) report as used by USACE.
- AEA2 – Standard AEA with contour dredging computation in overdepth.
- AEA3 – Standard AEA report for a Pre-Dredge versus Post-Dredge computation.
- Philadelphia Pre-Dredge and Post-Dredge – AEA method with special provisions for box cuts.
- Jacksonville Pre-Dredge and Post-Dredge – Special treatment of side slope material.
- Savannah – Specially formatted AEA report.
- Standard HYPACK – Improved method for non-parallel lines where material is stacked on the inside or outside of the turn.
- CHEC 1 and CHEC 2 – Methods developed for Chinese National standards.
- Panama City – Generates ENG 80 report format.
- GLDD 1 and 3 – Special routine for treatment of side slope material

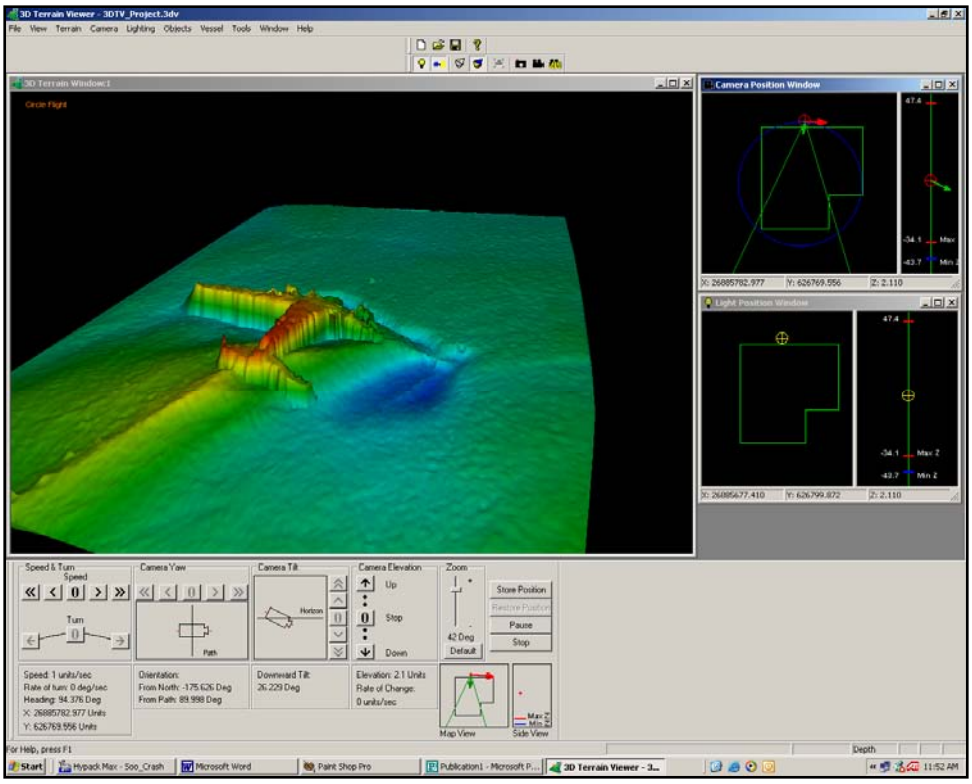
CS&V generates ASCII TXT reports for each method selected.

Sections and results can be sent to any Windows™ printer or plotter device.

- Plot one sections.
- Plot all sections each to their own page.
- Plot as many sections as you can fit on a page.



3DTV working in conjunction with the SURVEY program. The 3-D vessel shape is positioned and oriented based on real time info coming from SURVEY.



Viewing a plane using 'Circle Mode' in 3DTV.
[Data courtesy USACE – Sault Ste. Marie, MI]

3D TERRAIN VIEWER (3DTV)

The 3DTV program creates stunning visual representations of your survey data.

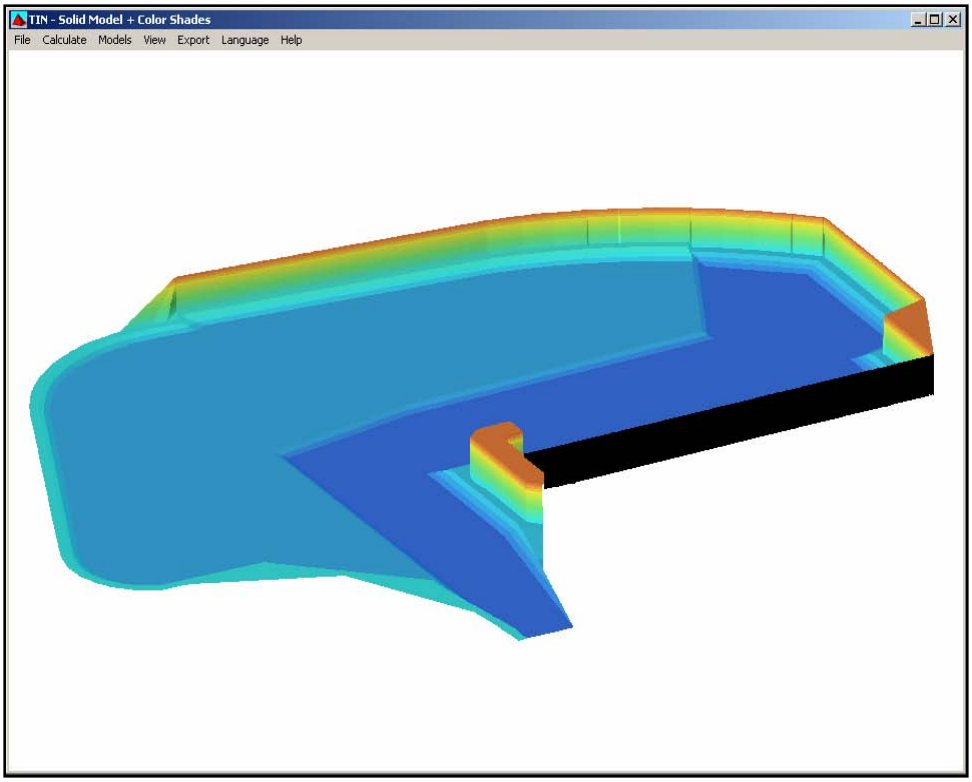
3DTV can read any HYPACK® LOG or XYZ data file to generate the surface model of the bottom.

The user can position the 'camera' using one of the following methods:

- Manual Flight: The user can position the camera and has complete control over its movements and direction.
- LNW Flight: The camera travels along a planned line file created in HYPACK®. The user can point the camera to the left or right of the planned line, but cannot move the camera off the line.
- Circle Flight: The camera travels around the perimeter of a user drawn circle. The camera always points towards the center of the circle. (Shown in the bottom figure.)
- SURVEY Mode: The camera is positioned and oriented relative to the vessel position and heading as supplied by the SURVEY program. (Shown in the top figure.)

The real time water level can also be displayed in different levels of transparency while in SURVEY mode.

Users can also display a channel design file, using the *.CHN files created in the ADVANCED CHANNEL DESIGN program.



A complex dredging plan created in the ADVANCED CHANNEL DESIGN program.

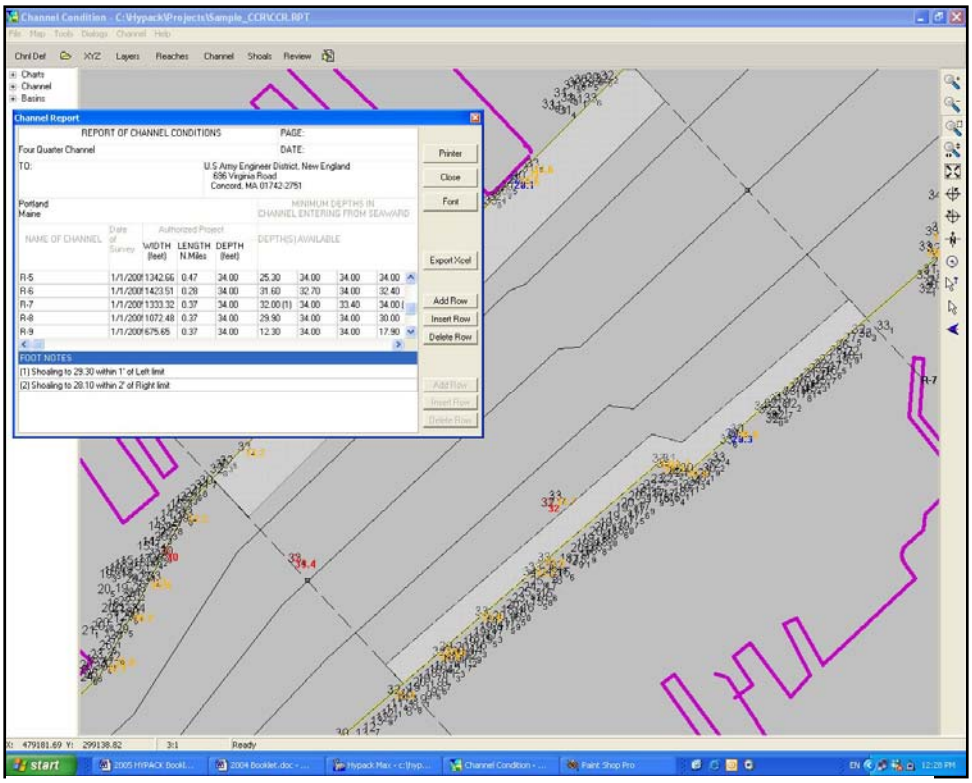
ADVANCED CHANNEL DESIGN (ACD)

ACD allows user to create an exact dredging plan for complex areas.

The channel files (*.CHN) created in ACD can be loaded in DREDGEPACK® to generate a real time cross sectional design profile based on the position of the digging tool.

The channel files can also be imported into 3DTV so the user can see exactly how the channel bottom relates to the design channel.

In ACD, the user enters X-Y-Z node information and then joins the nodes into planar faces.



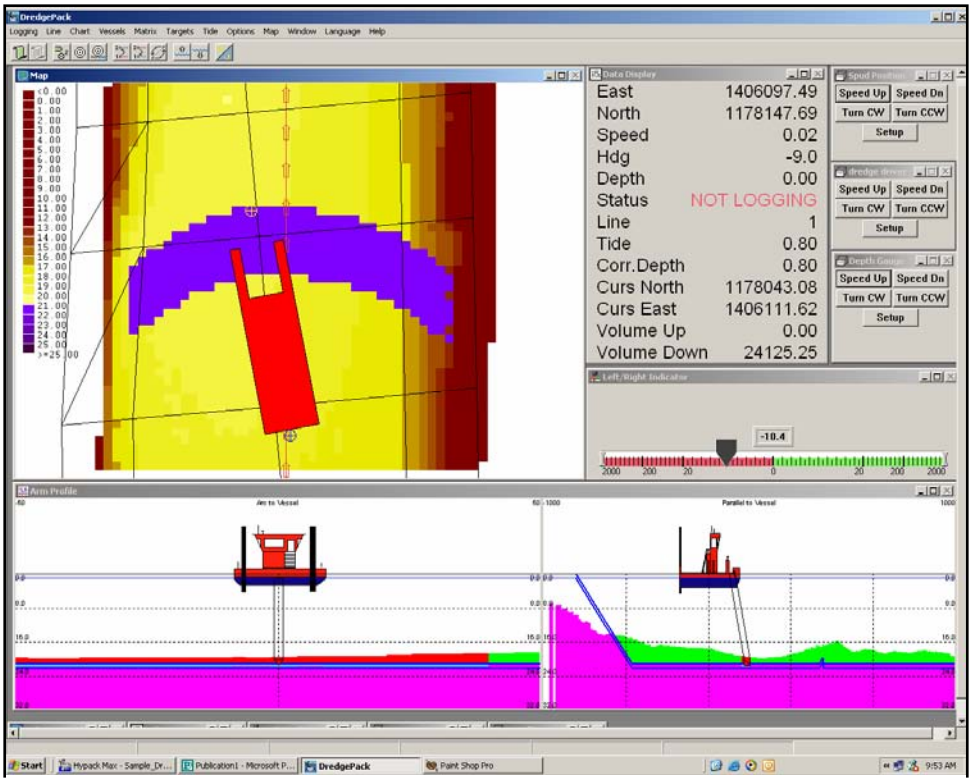
Determine shoal depths per channel segment in CHANNEL CONDITION REPORTER.

CHANNEL CONDITION REPORTER (CCR)

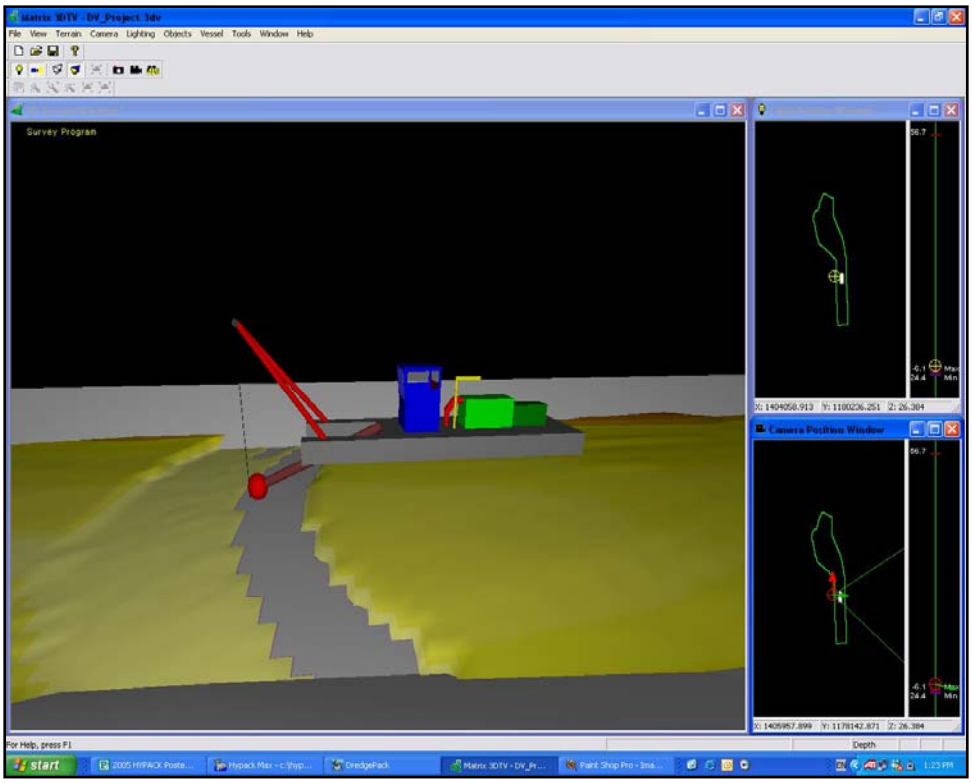
CCR is a specialty program, designed for the US Army Corps of Engineers to meet Federal requirements of certifying the minimum depth at different reaches of a channel.

In the design phase of CCR, the user defines the channel lines and divides the channel into 'reaches'.

In the shoal phase of CCR, the user imports their latest survey data and CCR determines the minimum (controlling) depth for each segment of each reach. It then generates a report, as per the NOAA format, that can be printed or exported to EXCEL.



A screen capture from DREDGEPACK® showing arc and longitudinal sections.



3DTV in SURVEY MODE, showing the position of the dredge and the digging tool relative to the design channel (gray) and the as-surveyed bottom.

DREDGEPACK®

DREDGEPACK® is a specialty version of HYPACK® that is designed to operate on the bridge of dredges, excavators and derricks.

DREDGEPACK® maximizes the digging efficiency by providing real time information as to how deep the dredge is currently digging and how deep is the dredge plan at their current location.

The cross sectional profile views show:

- The As Surveyed Surface
- The As Dredged Surface
- The Channel Design Profile.

Profiles can be generated:

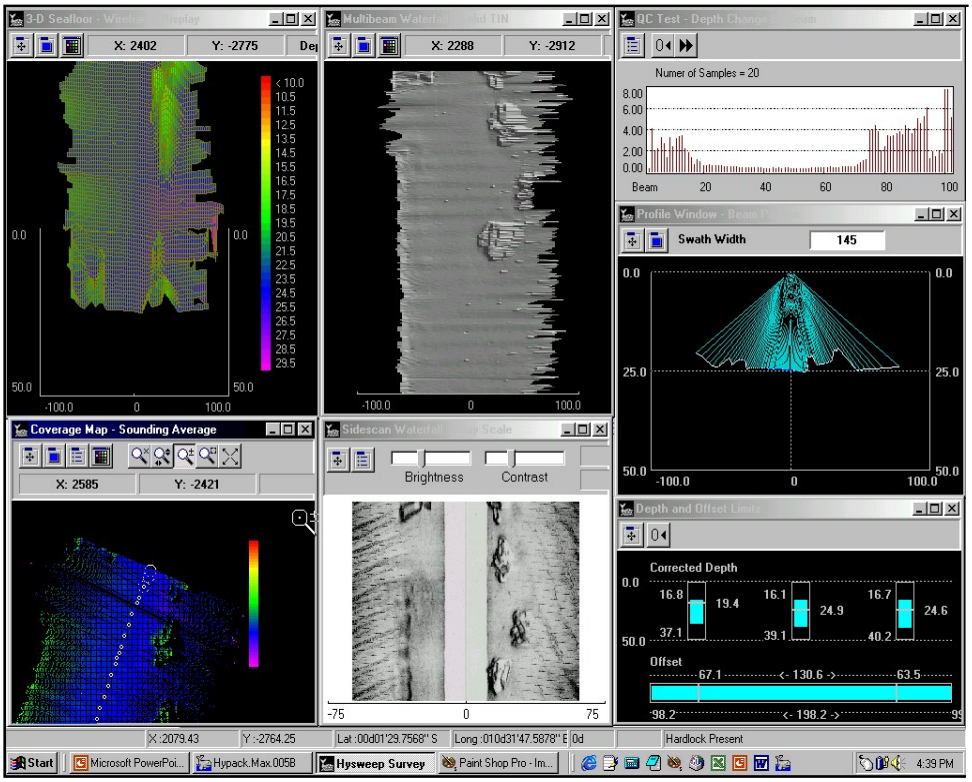
- Parallel to the vessel
- Perpendicular to the vessel
- Parallel to the planned line
- Perpendicular to the planned line.
- Along an arc (cutter suction swing)

DREDGEPACK® can access multiple matrix files, allowing you the detail needed when dredging long channels. The matrix file can show the depth that the cutting tool was at as it passes through each cell.

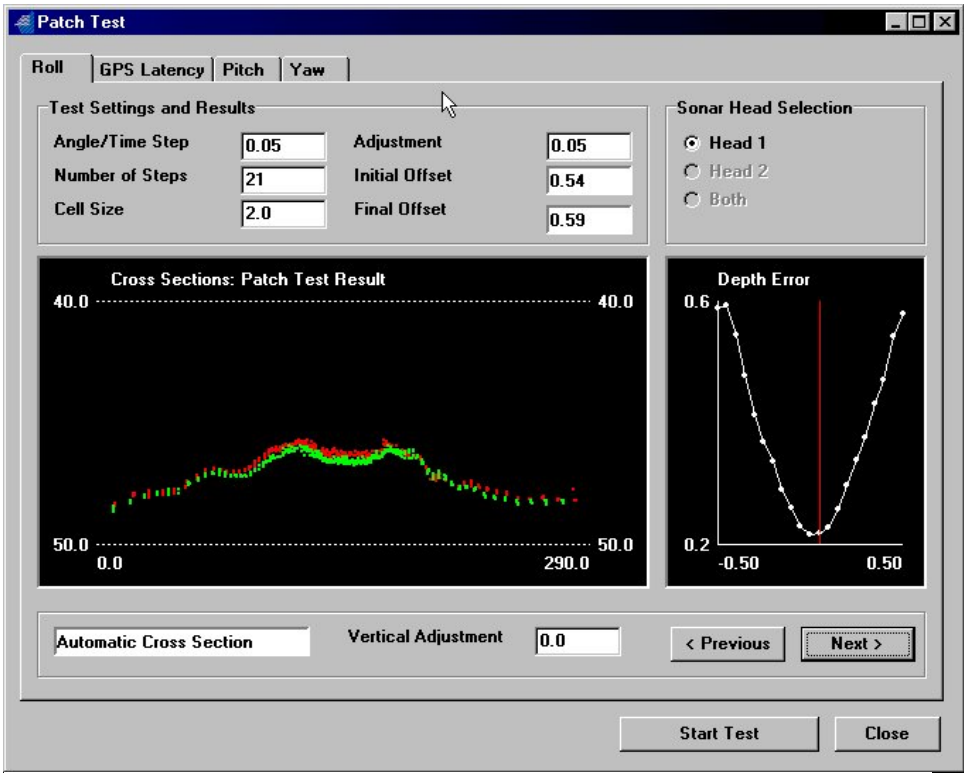
DREDGEPACK® supports the following dredge types:

- Cutter Suction
- Hopper
- Excavators
- Cranes & Derricks.

DREDGEPACK® can also be set up to track bucket 'drops' or 'placements', allowing you to generate a precise diagram to show capping operations.



The HYSWEEP® SURVEY program, providing real time feedback during the collection of multibeam data.



The 'Patch Test' portion of HYSWEEP® allows users to determine the exact alignment of their equipment.

HYSWEEP® SURVEY

The HYSWEEP® option to HYPACK® adds the ability to calibrate, log and edit data from multibeam and multiple transducer sonar systems.

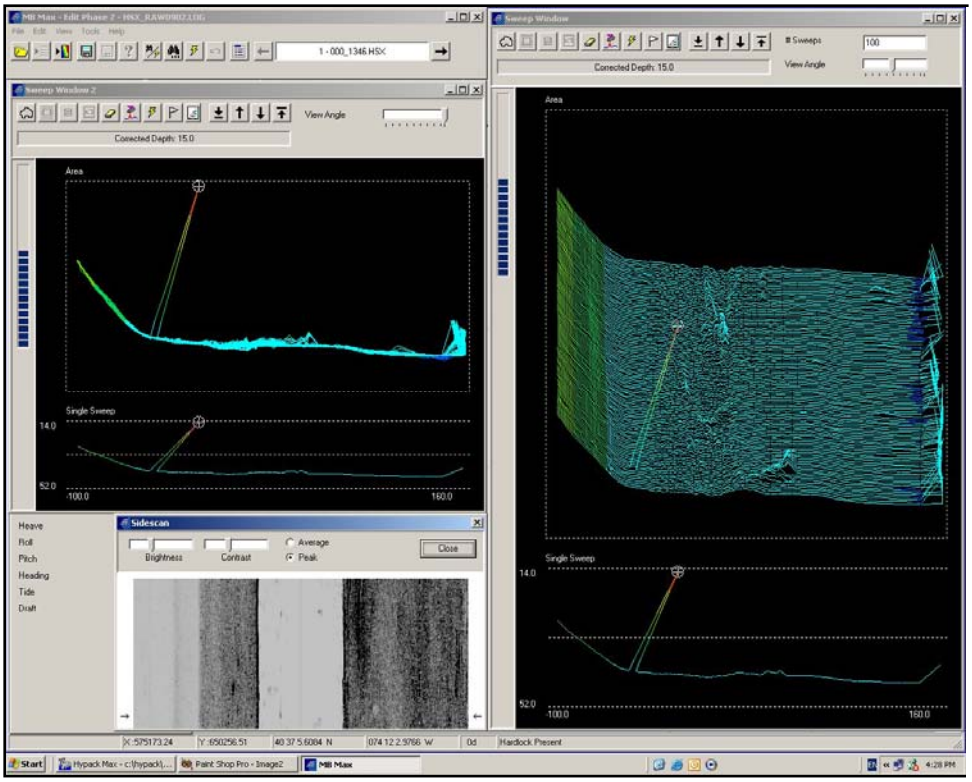
- Integrates multibeam sonars from:
  - Atlas
  - Benthos
  - Elac/Seabeam
  - Odom
  - Reson
  - Simrad
  -
- Provides for real-time display of:
  - Bottom coverage
  - Swath wire frames
  - Swath TIN surface
  - QC information
  - Side scan
  - Nadir beam to single beam comparison.

HYSWEEP® CALIBRATION

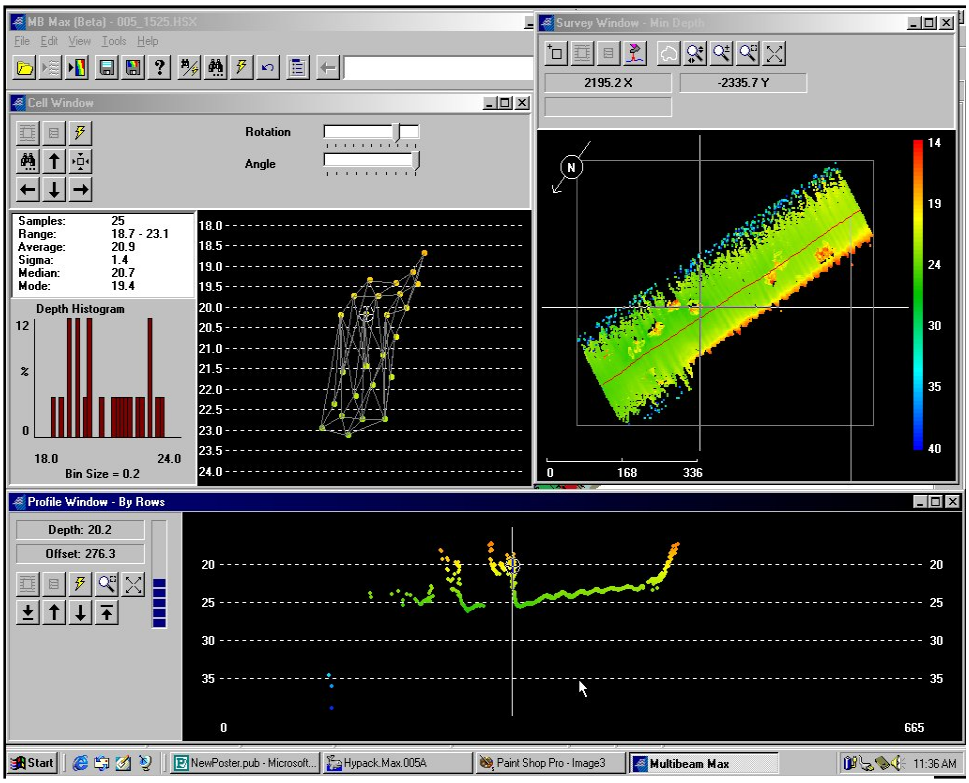
HYSWEEP® provides tools to allow you to quickly and accurately calibrate the orientation of your multibeam transducer and the time delays between the sonar and positioning system.

- The Patch Test function inside the MBMAX multi-beam editor computes the following errors from a set of test lines:
  - Roll
  - Pitch
  - GPS Latency
  - Yaw
- Data that has already been collected can be corrected for alignment and delay errors.
- System calibration should be a matter of hours, not days.

HYSWEEP® EDITING (MBMAX)



Stage 2 Editing in MBMAX now allows for dual Sweep windows, allowing you to view the data in different perspectives.



Stage 3 editing of MBMAX performs statistical filtering

The MBMAX program is allows you to edit your multibeam and multiple transducer data.

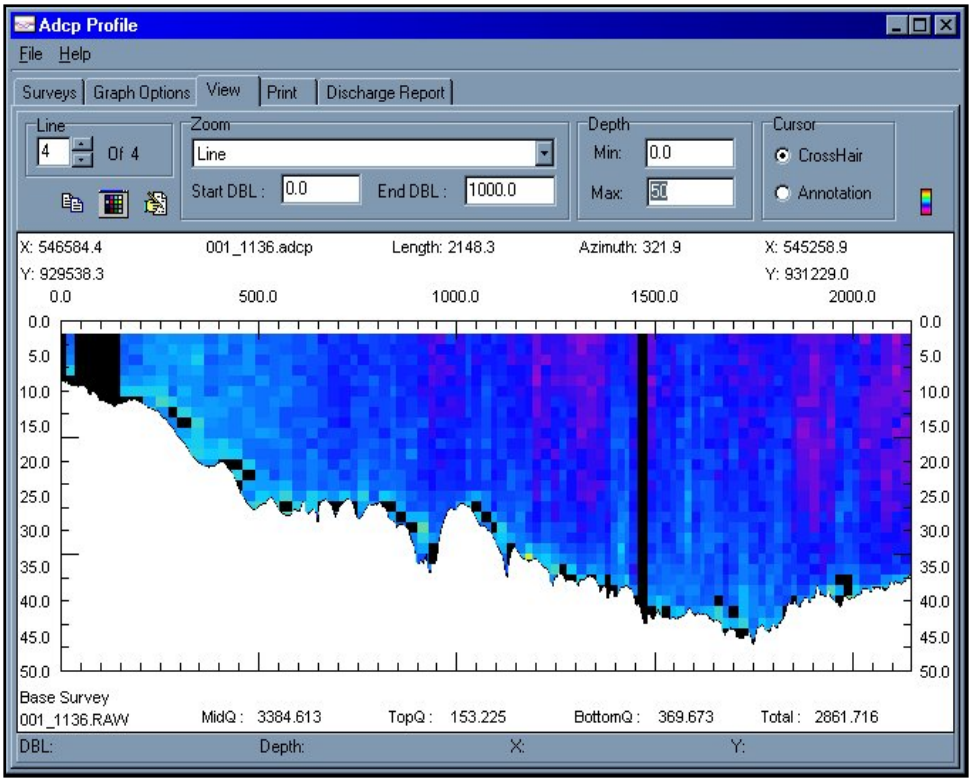
- MBMAX allows you to enter a tide correction file or to use water level corrections determined by RTK GPS elevations.

- The first stage of editing in MBMAX allows you to review and edit:
    - Vessel tracklines
    - Heave-pitch-roll
    - Gyro
    - Tide
    - Draft
    - Sound Velocity

- The second stage of editing takes you to the Sweep Editor. During this stage, you can visually review each line and graphically edit or apply automated filters to each line. Filters include:
    - Min/Max Depth
    - Spike
    - Overhang/Undercut Topography
    - Sonar Quality Flag
    - Port/Starboard Beam Angle Limits
    - Specific Beams

- During the third stage of editing, data from all multibeam lines is combined and displayed. Statistical filters can now be applied based on the surrounding multibeam data points. Displays include:
    - Survey window
    - Profile window
    - Cell window

- The third stage also contains the calibration (Patch Test) and System Performance tools to judge the overall quality of your multibeam system.

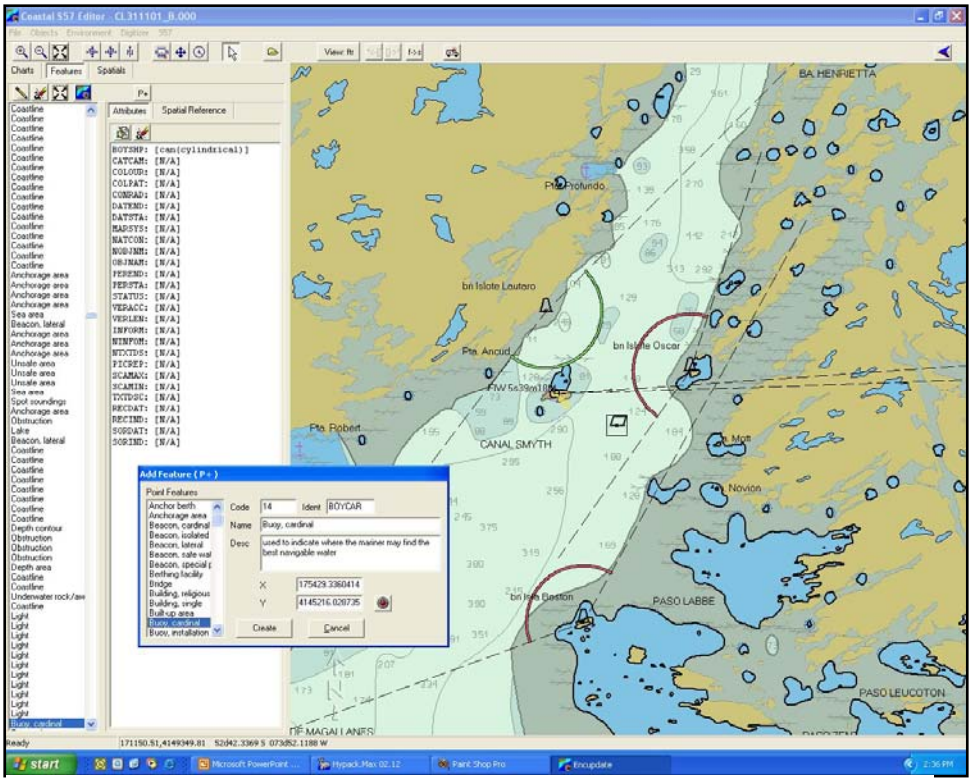


The ADCP Profile program of HYPACK® processes ADCP data to generate cross-sectional flow profiles.

ADCP SUPPORT

HYPACK® now supports ADCP sensors from RD Instruments. The following programs are included in MAX:

- **ADCP Logger:** Runs simultaneous with SURVEY. Allows you to 'deploy' and log ADCP data from the RD Instruments Workhorse and Rio Grande ADCPs.
- **ADCP Profiles:** Combines velocity data from the ADCP files with cross sectional data from the edited HYPACK files. Provides color-coded flow diagrams and overall flow values.
- **ADCP to DXF:** Allows you to export DXF current vectors at selected depth levels for import of velocity data to CAD/GIS.



The ENCEdit program is designed to modify S-57 charts by allowing you to add, delete, move and re-attribute features. ENCEdit is not a part of HYPACK®.

ENCEdit

ENCEdit is sold separately from HYPACK®. It is designed to allow users to modify existing S-57 charts by adding, moving, deleting, and re-attributing chart objects.

MiniIENC

The MiniIENC program is also sold separately from HYPACK®. This program was designed under the direction of the US Army Corps of Engineers. It automatically updates S-57 charts by removing old sounding data, entering new soundings, re-contouring, and saving the updated S-57 data to a new chart.

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fax +44(0)1793 827984
e-mail: lsmith@del-norte.co.uk

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Dragon & Elephant Ent. Co.	Taiwan
E.K. Boustead Inc.	Philippines
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Elmar	Italy
Envir. Tech. Co.,LTD.	Thailand
eTrac	USA
Gemini Positioning Systems	Canada
Geoceano	Chile
Geosys Ltda.	Uruguay
Geotech Mercantile Corp.	Philippines
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Hadi Hazzazi Est.	Saudi Arabia
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Intersat Radio	Romania
Irtisaal Enterprises	Pakistan
Kongsberg Simrad	Norway
Knudsen Engineering	Canada
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Navicom Marine	Denmark
Odom Hydrographic Systems	USA
PEISE, c.a.	Venezuela
Pertec	South Africa
Ren Star Instrumentation	Malaysia
Reson, Inc.	USA
Ross Laboratories	USA
Sea and Land Technologies	Singapore
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Seatronics Ltd.	UAE
Specialty Devices	USA
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Tecnica Carvallo, S.A	Panama
Unique Systems	UAE

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SeaBat 8124

Multibeam Echosounder System

SeaBat 8124

- **200kHz frequency**
- **120° swath coverage**
- **80 beams**
- **Amplitude/phase bottom detect**
- **100% coverage for condition and pay quantities**

Specially designed for harbor and river surveys, the SeaBat 8124 is ideal for condition and pay quantity surveys in support of dredging operations.

Operating at 200kHz, the SeaBat 8124 multibeam echosounder successfully penetrates the suspended material inherent in dredging operations to accurately measure a profile of the bottom that is 3.5 times the measured water depth. High accuracy, even on the outer beams, is assured by an advanced bottom detection system that incorporates both the amplitude and phase detection methods.

The SeaBat 8124 is a lightweight and portable system—the transducer array is only about 1 square foot in size (30.48cm), which maximizes installation flexibility. Choose temporary or permanent installations, on the hull or over-the-side, on large dredges or small survey vessels operating with limited draft.

Based upon the proven design and architecture of the SeaBat 8100 Series, the SeaBat 8124 is controlled by an intuitive point-and-click menu and monitored by a real-time color display.

SeaBat 8124

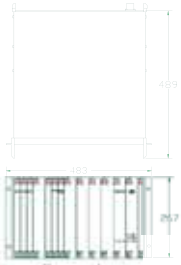
Multibeam Echosounder System

SYSTEM PERFORMANCE		
Frequency:	200kHz	
Range Resolution:	1cm	
Swath Coverage:	120°	
Min/Max Range:	0.5/750m	
Number of Beams:	80	
Along-Track Beamwidth:	1.5°	
Across-Track Beamwidth:	1.5°	
Accuracy:	IHO Compliant	
Operational Speed:	Up to 12 knots	
Max. Update Rate:	30Hz	
Transducer Depth Rating:	100m	

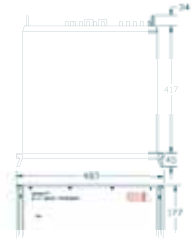
INTERFACE		
System Supply:	115V/230V 50/60Hz, 200W max	
Video Display:	SVGA, 800 x 600, 72Hz	
System Control:	Trackball or from Ethernet	
Data Output:	10MB Ethernet	
Data Uplink:	High-speed digital coax with fiber-optic option	
Temperature:		
	Operating:	0° to +40°C
	Storage:	-30° to +55°C

MECHANICAL INTERFACE	
Dimensions (HWD):	
Transducer Array:	430 x 320 x 65mm
Processor:	177 x 483 x 417mm
Transceiver:	267 x 483 x 489mm
Weight:	
Transducer Array:	8.3kg (dry) / 4.6kg (wet)
Processor:	20kg
Transceiver:	13.6kg

OPTIONS
Side-scan upgrade
Sound velocity profiler
24DC power supply for SeaBat 81-P Processor



Transceiver



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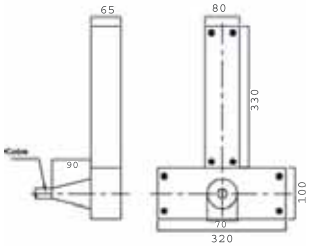

Transducer Array

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For Acoustical Measurement Accuracy please refer to www.reson.com or contact sales.

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E-mail: info@reson.nl

www.reson.com

Version: B023 070509/ US

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Multibeam Echosounder System

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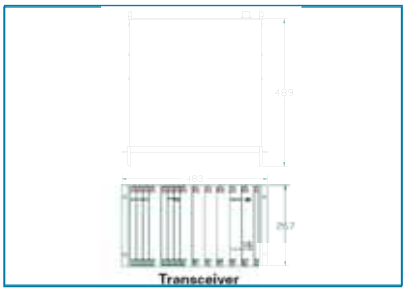
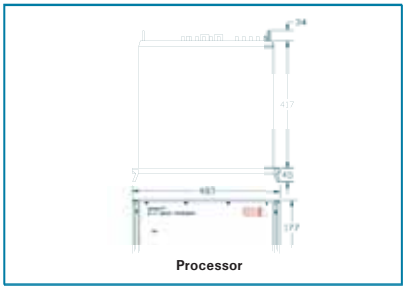
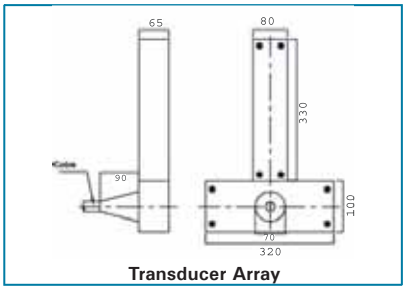
24DC power supply for SeaBat 81-P Processor


Transceiver


Processor



Transducer Array

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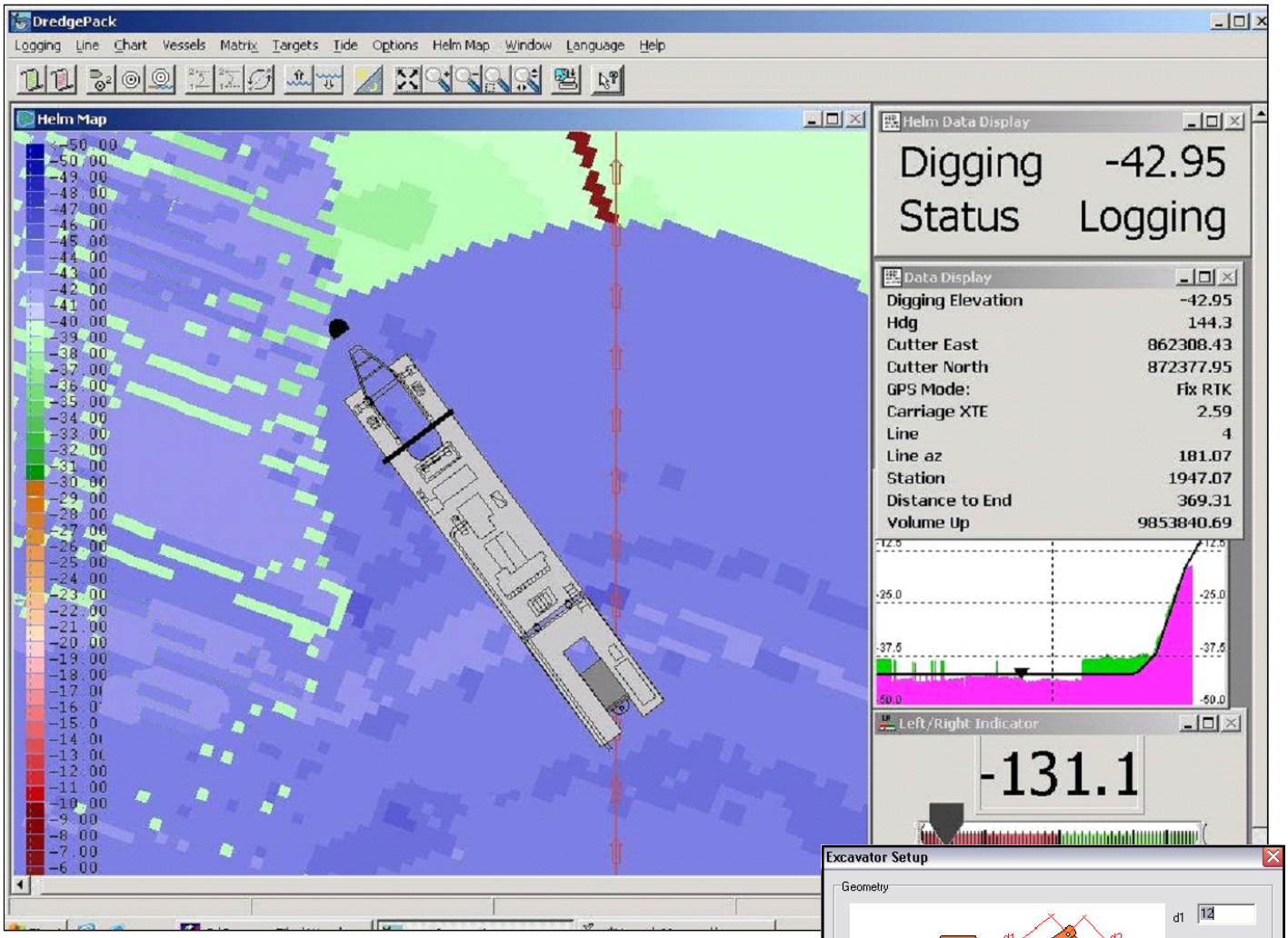
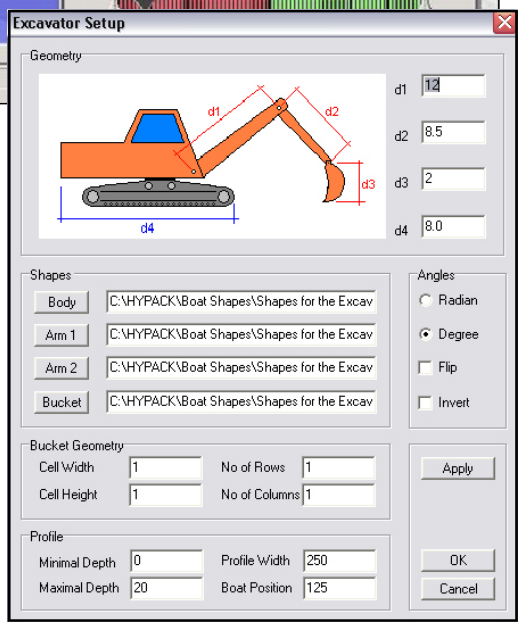
Version: B023 070510 / A4

DREDGEPACK®

Real Time Dredging Information

for Excavators and Cutter Suction, Hopper and Bucket Dredges





- **Precise digging over complex plans**
- **Real time visualization:**
  - **Plan view**
  - **Sectional views**
  - **3DTV Perspective view**
- **Work in depth or elevation mode.**
- **Satisfies USACE Silent Inspector requirements.**
- **OPC Network capable.**

DREDGEPACK® provides operators with precise digging information, showing the exact position of your dredge and digging tool in your channel. Using any XYZ file of survey data, the program creates the 'As Surveyed' surface that represents your starting point. An 'As Dredged' surface is then modified based on the position and depth of the cutting tool.

DREDGEPACK® provides real time cross section information, showing the 'As Surveyed' and 'As Dredged' sections against the Channel Plan section. This allows for precise digging on side slopes and in complex channel areas.

Real time sections in **DREDGEPACK®** can be:

- Perpendicular to Vessel
- Perpendicular to Centerline
- Parallel to Vessel
- Parallel to Centerline
- Arc Profile (Using Spud to Tool distance as arc radius.)

DREDGEPACK® also provides real time output to satisfy reporting requirements. The USACE Silent Inspector requirements are a standard part of the software. It can output selected parameters to a radio modem or across a network, making the operational parameters available to other systems.

DREDGEPACK® is a special adaptation of HYPACK®, one of the most widely-used hydrographic surveying packages in the world. It contains all of the modules necessary to:

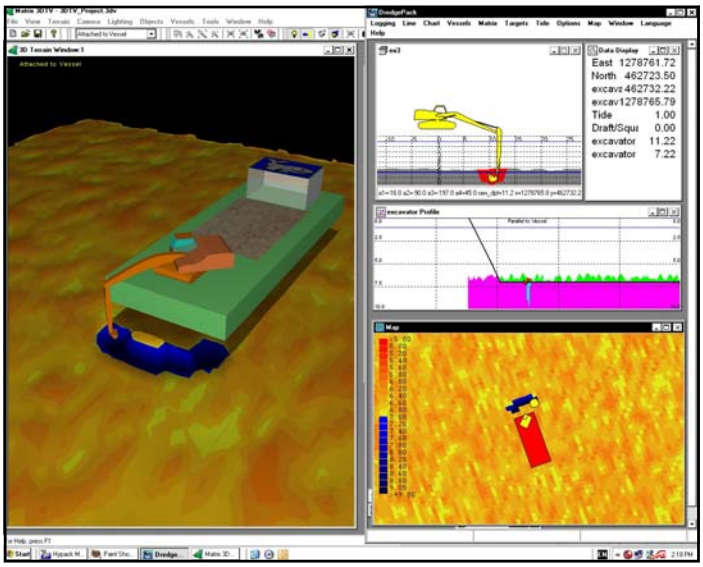
- Define your project geodesy
- Configure the hardware on the dredge
- Create the 'As Surveyed' surface
- Create your channel design plan
- Perform real time monitoring and visualization

DREDGEPACK® has been successfully installed on:

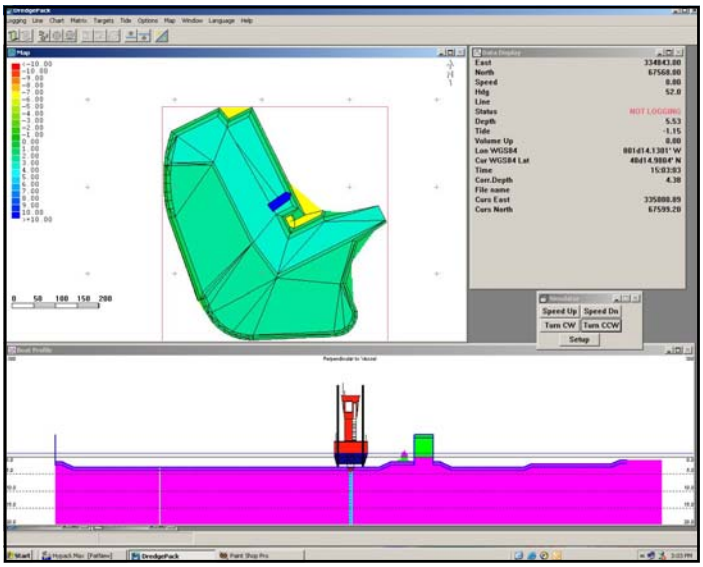
- Hopper dredges
- Cutter suction dredges
- Vacuum dredges
- Clamshell and bucket dredges
- Excavators

HYPACK, Inc.

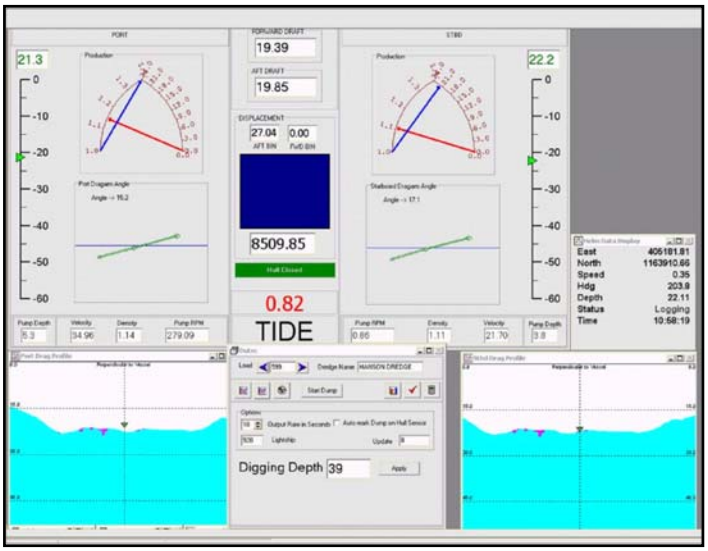
56 Bradley St.
Middletown, CT 06457 USA
Web: www.hypack.com
Sales: sales@hypack.com
Phone: 860-635-1500
Fax: 860-635-1522



3D Visualization with an excavator integrated in DREDGEPACK®.



A real time cross section through the complex dredging plan.

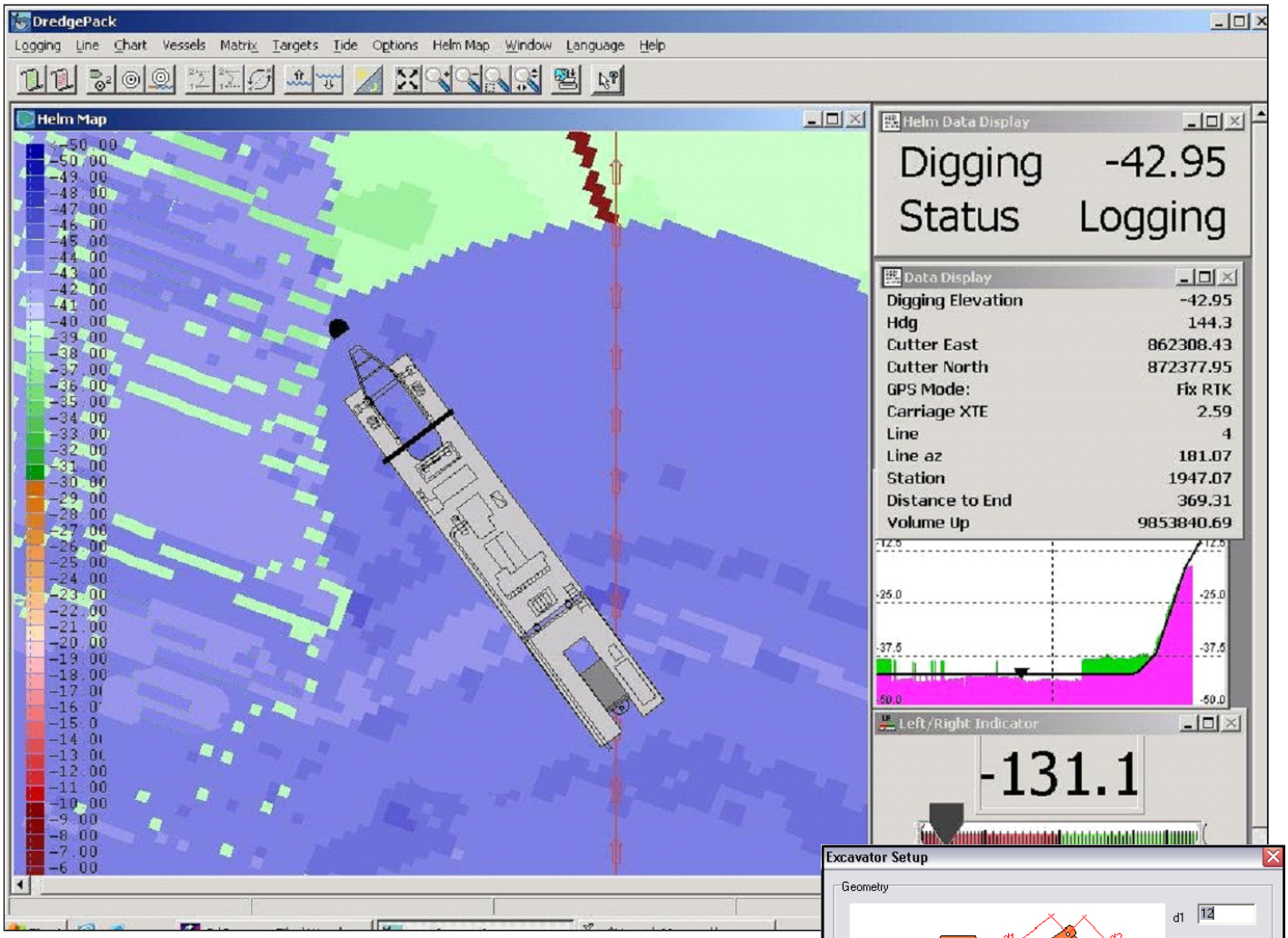


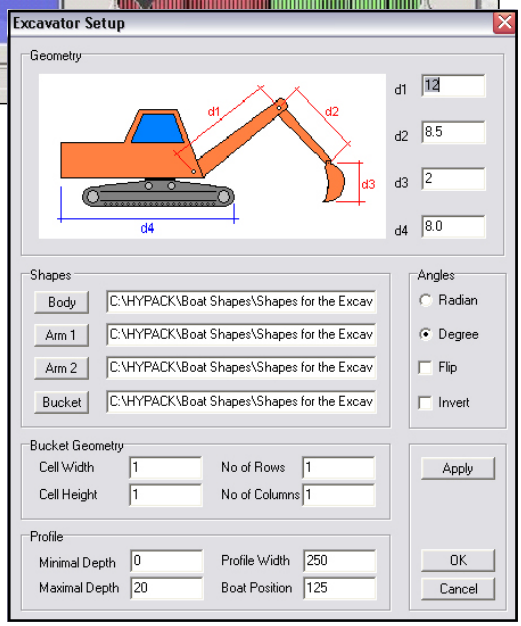
Customized display for hopper dredge using OPC Network.

DREDGEPACK®

Real Time Dredging Information

for Excavators and Cutter Suction, Hopper and Bucket Dredges





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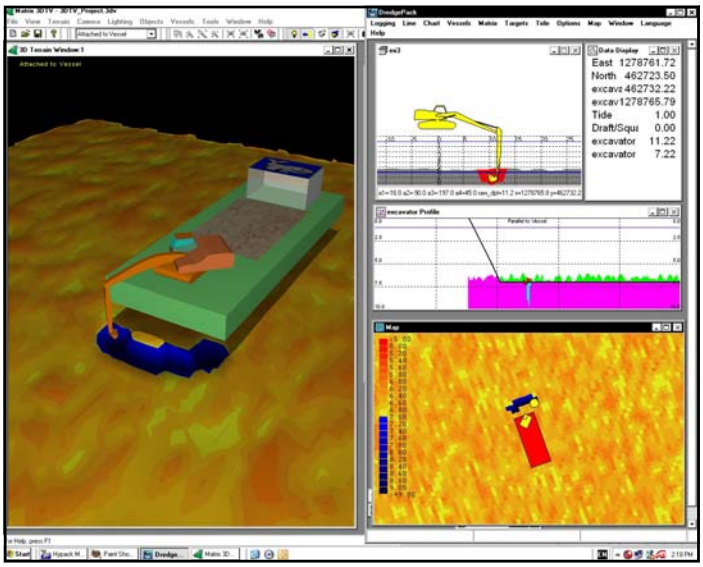

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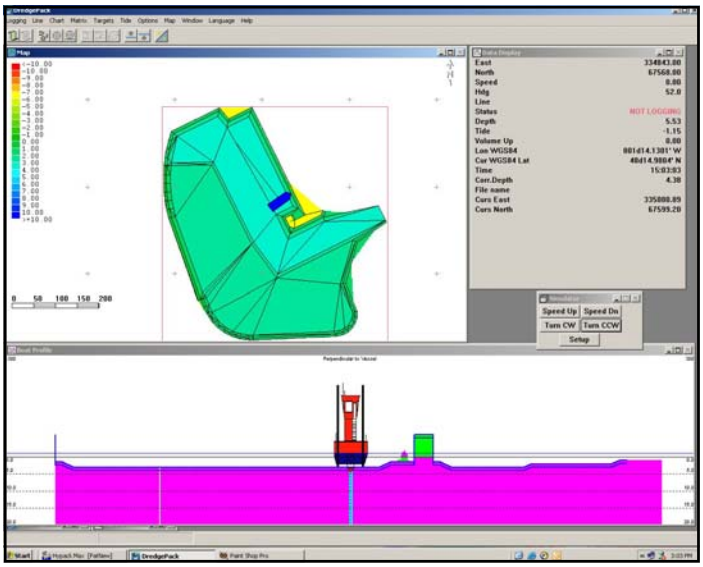

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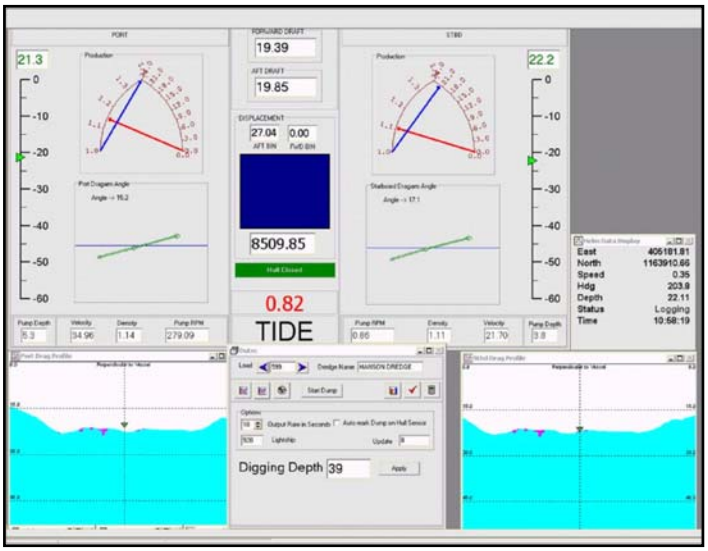

Customized display for hopper dredge using OPC Network.

Fledermaus

Features	Fledermaus Standard	Fledermaus Professional
Available across a wide variety of platforms , eg. Windows, Mac & Linux	✓	✓
Specially designed interface for exploring multiple data sets simultaneously in a 3D scene	✓	✓
Explore very large data sets easily with ShiftScapeTM rendering engine	✓	✓
All datasets are geo-referenced and displayed in 3D space	✓	✓
Navigate the 3D scene using the BAT, a 6-degrees-of-freedom input device	*(Optional)*	*(Optional)*
Record flight-paths and generate movies (output MPEG or raw frames)	✓	✓
Visualization displayed in split-screen stereo mode (e.g. for GeoWalls)	✓	✓
Visualization displayed with 3D stereo graphics hardware	✓	✓
Generate a digital terrain model from ungridded data	✓	✓
Display surfaces with a realistic shading including cast shadow	✓	✓
Visualize sub-bottom seismic profiles in the same 3D view as the bathymetric DTM and draped sidescan	✓	✓
Output screen captures and map sheets	✓	✓
Ability to drape sidescan, backscatter, charts, and other imagery into DTM	✓	✓
Analyze data sets with profiles, histograms, contours, slope and surface differences	✓	✓
Import gridded data, imagery, points, lines, solid models, and seismic data in a variety of different formats	✓	✓
Import data for Area-Based Editing from a variety of multi-beam formats including GSF, CARIS HDCS, SHOALS, HTF, etc.		✓
State-of-the-art QC tools for all types of bathymetric data		✓
Powerful editor for multi-beam, lidar data and single-beam data via PFM		✓
Auto-processing of multi-beam data with CUBE (combined Uncertainty and Bathymetric Estimator)		✓
Advanced statistical computations and checks for multibeam surveys		✓
Real-time tracking of ROV, AUV, or any Vessel		✓
Interactively plan routes for pipelines or cables		✓

"3D Visualization – more than just a pretty picture"

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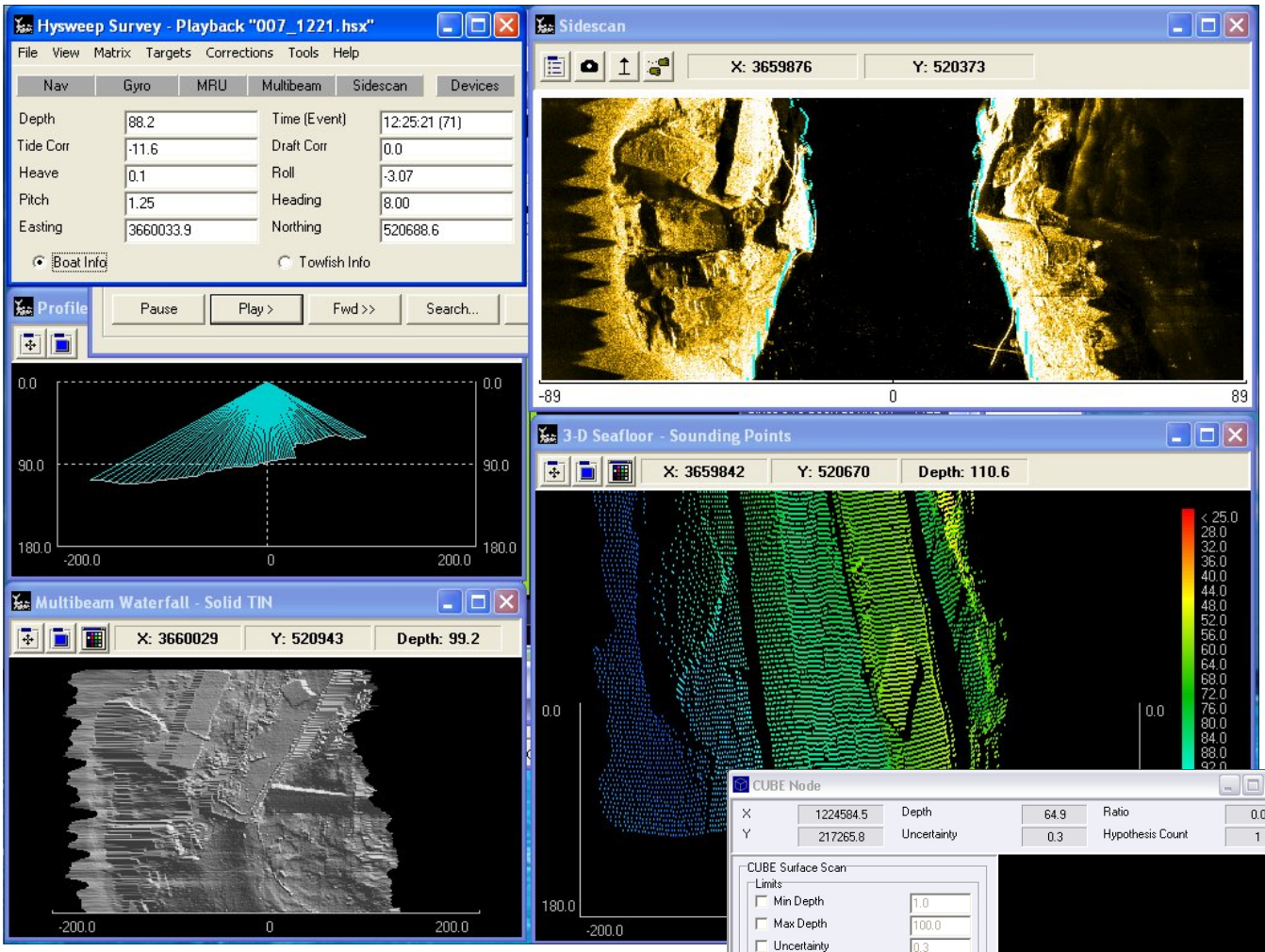
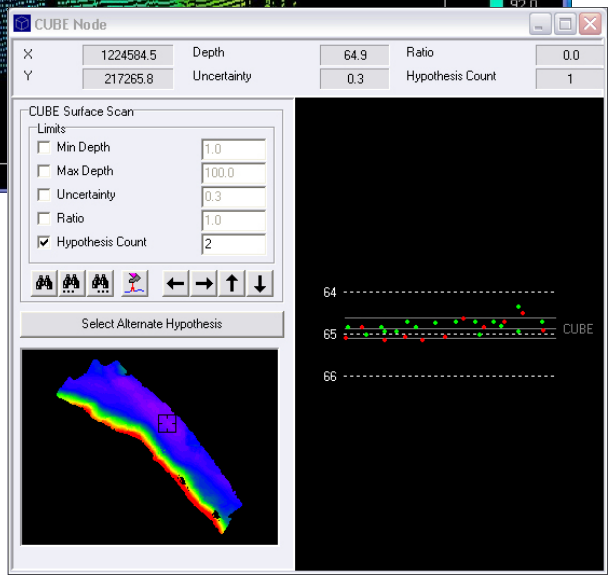
HYSWEEP®

Calibration, Collection, Editing and Performance Testing of Multibeam Systems in HYPACK®





HYSWEEP now contains the CUBE data cleaning algorithm, licensed from UNH-CCOM as a standard feature.

Supports:

- Atlas Fansweep
- Atlas Hydrosweep MD2
- Benthos C3D
- Geoacoustics Geoswath+
- Imagenex DeltaT
- Odom Echoscan II
- Odom Miniscan
- Reson 7125
- Reson 8124
- Reson 8124/8125
- Reson 9001
- Reson 9003
- Ross Smart Sweep
- Seabeam 1000 Series
- Seabeam 2100
- Simrad EM1002
- Simrad EM2000
- Simrad EM3000/3002
- Simrad SM2000
- Tritech SeaKing

HYSWEEP® is an optional module of HYPACK® that integrates multibeam and multiple transducer sonar systems. It provides programs for:

- System alignment and calibration
- Multibeam data collection and review
- Multibeam data editing
- QC and performance testing

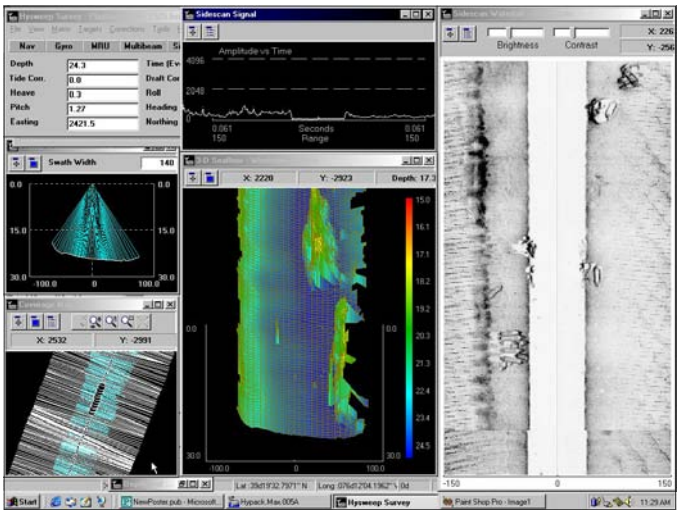
System Alignment: Using the integrated 'Patch Test' in HYSWEEP®'s MULTIBEAM EDITOR, you can quickly determine the exact mounting angles and time delays for both single and dual-head multi-beam sonar systems. Your system calibration takes hours, not days.

Data Collection and Review: HYSWEEP® SURVEY runs simultaneous with the HYPACK® SURVEY program. It performs all data collection, logging and time tagging while providing graphics for data visualization, bottom coverage and quality control.

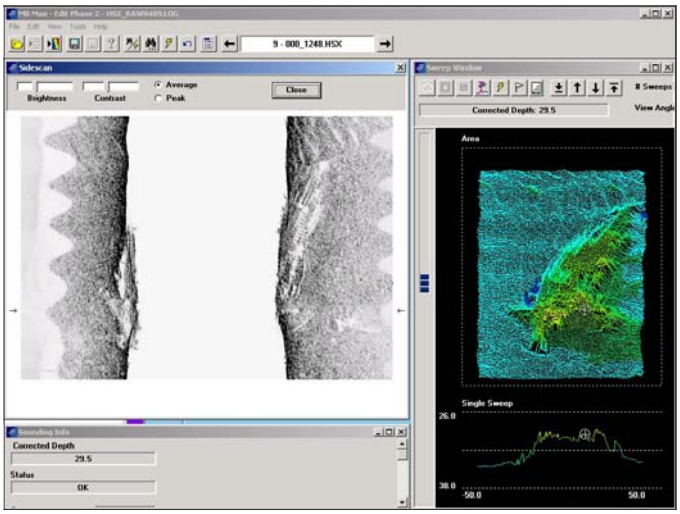
Multibeam Data Editing: HYSWEEP® provides powerful tools to review your data, apply geometric and statistical filtering methods to remove outliers and saves your editing session at any time. The MULTIBEAM EDITOR applies tidal corrections (both conventional and RTK tides) and sound velocity corrections to your data.

QC and Performance Testing: HYSWEEP® contains the Performance Test, as required by the U.S. Army Corps of Engineers. It provides a statistical summary of the repeatability of your system and justifies the use of wider beam angles for different surveys and bottom conditions. HYSWEEP® generates statistical comparisons between multibeam and single beam surveys, allowing you to determine the differences between the two data sets.

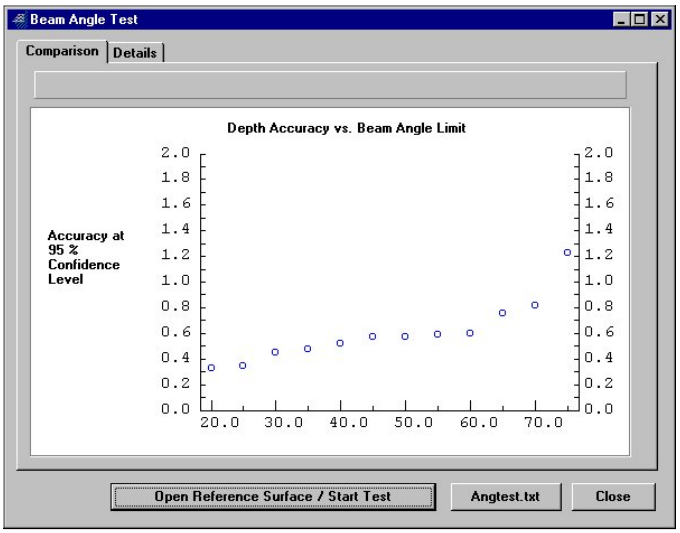
CUBE Integration: A new feature in HYSWEEP® is the integration of the 'CUBE' multibeam data cleaning algorithm licensed from the University of New Hampshire's Center for Coastal and Ocean Mapping. HYCUBE generates error models of your multibeam data set and outputs cleaned statistical and actual data sets.



Real time collection display from HYSWEEP® SURVEY.



Editing swath data with backscatter imagery displayed in the MULTIBEAM EDITOR of HYSWEEP®.



The Performance Test results from HYSWEEP® show the repeatability of your system versus beam angle.

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Phone: (860)-635-1500
Web: www.hypack.com
Sales: sales@hypack.com

	HYPACK®	HYPACK® LITE	HYPACK® SURVEY	HYPACK® OFFICE	HYSWEEP®	HYSWEEP® OFFICE	HYPACK® & HYSWEEP®	HYPACK® SURVEY & HYSWEEP®	HYPACK® OFFICE & HYSWEEP® OFFICE	DREDGEPACK®
HYPACK® Shell	✓	✓	✓	✓			✓	✓	✓	✓
Geodetic Parameters	✓	✓	✓	✓			✓	✓	✓	✓
Geodetic Utilities	✓	✓	✓	✓			✓	✓	✓	✓
CHANNEL DESIGN (CD)	✓	✓	✓	✓			✓	✓	✓	✓
ADVANCED CHANNEL DES.	✓	✓	✓	✓			✓	✓	✓	✓
SINGLE BEAM LATENCY	✓	✓	✓	✓			✓	✓	✓	
Support File Editors	✓	✓	✓	✓			✓	✓	✓	✓
HYPACK® SURVEY	✓	✓	✓				✓	✓		
DREDGEPACK										✓
Tide Correction Routines	✓	✓	✓	✓			✓	✓	✓	✓
Sound Velocity Corrections	✓	✓	✓	✓			✓	✓	✓	✓
Shared Memory Routines	✓	✓	✓	✓			✓	✓	✓	✓
Single Beam Editor—SBMAX	✓	✓		✓			✓		✓	
Sounding Selection	✓	✓		✓			✓		✓	
EXPORT TO CAD	✓	✓		✓			✓		✓	
HYPLOT (Plotting)	✓			✓			✓		✓	✓
CROSS SECTIONS & VOLUMES	✓			✓			✓		✓	
TIN MODEL	✓			✓			✓		✓	✓
Digitizing Programs	✓	✓		✓			✓		✓	✓
Metadata (Corpsmet95)	✓	✓		✓			✓		✓	
3DTV	✓	✓		✓			✓		✓	✓
Matrix 3DTV	✓	✓					✓			✓
ADCP Programs	✓	✓		✓			✓		✓	
ENCEdit	✓	✓	✓	✓			✓	✓	✓	
Multibeam (MB) Data Collection					✓		✓	✓		
MB Data Processing MBMAX					✓	✓	✓	✓	✓	
MB Performance Test					✓	✓	✓	✓	✓	
MB vs SB Comparison					✓	✓	✓	✓	✓	
MB Calibration (Patch Test)					✓	✓	✓	✓	✓	
SSS Data Collection	✓	✓	✓				✓	✓		
SSS Mosaic & Targeting	✓			✓			✓		✓	

HYPACK® Packages

HYPACK®: Our standard package. It has everything you need to design your survey, collect your single beam data, process it and generate final products, such as contours, plotting sheets, output for CAD, fly-throughs, cross sections and volumes. The side scan sonar collection and processing modules are now standard features. It does not contain the modules for multibeam data collection and multibeam processing. You'll need a HYSWEEP® module for that.

HYPACK® LITE: This is our single beam package designed for users who will perform their final product work in a CAD-GIS package. It contains all of the programs necessary to design your survey, collect the data, process it and export it to DXF/DGN for import into your CAD-GIS package.

HYPACK® SURVEY: This package allows you to outfit additional survey vessels at a lower cost. It contains the programs for survey design and single beam data collection. It excludes the programs for editing the data or for generating final products. You will still need a HYPACK® or HYPACK® OFFICE license to process your data.

HYPACK® OFFICE: This is the 'office' version of HYPACK®. It allows you to perform all of the features of HYPACK® package with the exception of the data collection. You can use it to set up additional processing stations in your office or for supervising the processing of your survey data.

HYSWEEP®: This is the module for the collection and processing of multibeam data. HYSWEEP® requires a HYPACK® license (above). As your agency moves from single beam to multibeam surveying, you can just upgrade your package to multibeam by purchasing a HYSWEEP® license.

HYSWEEP® OFFICE: This package contains the multibeam modules that relate to processing of the multibeam data. The package is intended for office use. It does not include the HYSWEEP® SURVEY program and requires a HYPACK® license.

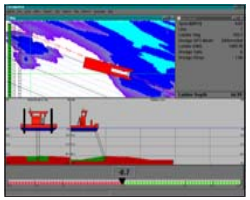
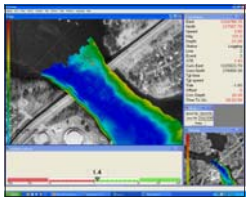
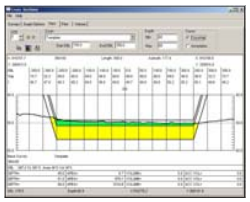
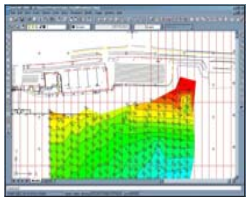
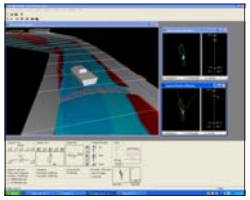
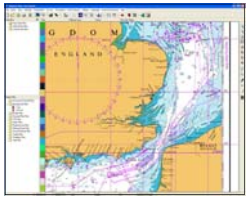
HYPACK® and HYSWEEP®: Everything you need to be able to design your survey, collect data (both single beam and multibeam), process it, and generate final products.

HYPACK® SURVEY and HYSWEEP®: The recommended combination when outfitting a new multibeam survey boat. You would be transferring the data to another location for processing.

HYPACK® OFFICE & HYSWEEP® OFFICE: This combination is recommended for your office and allows you to process both single beam and multibeam data all of the way to the final products.

DREDGEPACK®: A specially modified HYPACK® SURVEY package used onboard dredges to improve efficiency and to visualize the digging process. This is not a package for hydrographic surveying.

HYPACK® Features

Creating Planned Lines:
- Work in X-Y or Lat-Long
- Straight or curved segments
- Unlimited waypoints per line
- Automatically create 3-D profiles in CHANNEL DESIGN
- Import 2-D or 3-D planned lines from DXF.

Geodesy:
- All US State Plane zones and many national grids available from a drop down list.
- Compute and perform 3-parameter or 7-parameter transformations.
- Use CORPSCON (USA), OSTN-02 (UK) or French national transformation models. Transform is updated based on position of vessel in real time
- Grid conversion program converts between X-Y and Lat-Long
- Converts an entire project to a new geodetic basis.
- Supports using the RTK GPS vertical component for real time water level determination.

Surveying:
- Single or multiple vessel support
- Supports up to ten sensors simultaneously in standard version.
- Time tagging of data accurate to less than 8mSec on Windows™ XP and Windows 2000™.
- Separate Data Display, Area Map and Left-Right Indicator windows for the operator and the helm.
- Over 200 sensors supported including GPS, range-range, range-azimuth, echosounders, gyros, magnetometers, HPR, ...

Background Files Supported:
- S-57
- BSB
- DXF
- Microstation DGN
- UKHO ARCS
- GeoTIF (OrthoPhoto and Side Scan Overlays)
- VPF
- ArcInfo SHP

Single Beam Processing:
- Water level (tide) corrections using conventional and RTK tides.
- Sound velocity corrections
- Automated filtering and manual editing.
- Final data contains deleted records, allowing later restoration.
- Export to all available items to ASCII TXT format.

HYSWEEP®: Multibeam Module (Optional)
- Integrate almost all commercially available multibeam systems.
- Real time data collection, display and quality controls.
- Perform sensor alignment in hours using the Patch Test in the Multibeam Editor.
- Process data using the Multibeam Editor or HYCUBE.
- Determine overall system performance using the Performance Test in the Multibeam Editor
- Determine statistical comparison between single beam and multibeam test sets.
- Use your edited multibeam data in all of HYPACK®'s final product programs.
- Import XTF, GSF and XSE data.

Export to CAD:
- Converts HYPACK® data files to DXF or Microstation DGN
- Exports HYPACK data to ASCII.

Plotting Smooth Sheets:
- HYPLOT plots all HYPACK data files, including all supported background charts.
- WYSIWYG view allows users to easily activate and reposition smooth sheet features.
- Plots to any Windows™ printer/plotter device.

Cross Sections & Volumes:
- Display multiple historic cross sections on one graph.
- Computes volume quantities:
  - ◊ Single Survey
  - ◊ Pre-Dredge vs. Post-Dredge
- Supports most USACE methods:
  - ◊ Average End Area (AEA)
  - ◊ Philadlephia District
  - ◊ Jacksonville District
  - ◊ Savannah
  - ◊ Norfolk
  - ◊ Chinese AEA
  - ◊ Standard HYPACK
- Plots sections to any Windows™ printer/plotter device.

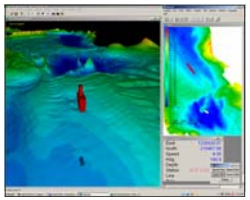
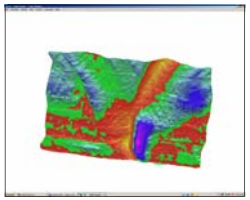
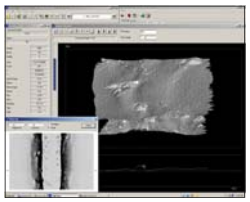
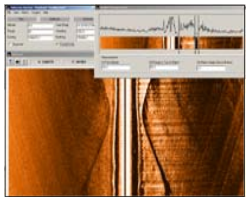
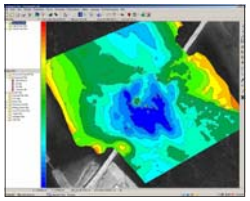
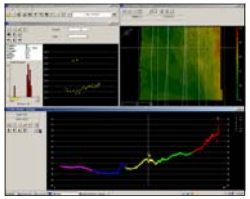
TIN MODEL:
- Generates DXF contours, labels and fills.
- Exports a gridded XYZ data set.
- Exports soundings along a planned line.
- Combines hydrographic and topographic data.
- Generates 3D models and color-code by depth.

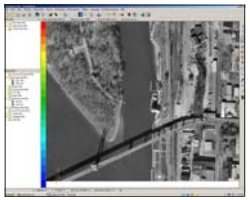
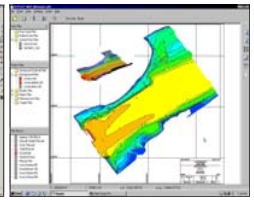
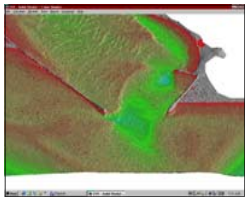
TIN MODEL (con't.):
- Compute volume quantities:
  - TIN vs. Level (Reservoir)
  - TIN vs. Channel
  - TIN vs TIN (Beach Erosion Studies)
  - Philadelphia method allows you to compute volume quantities with multibeam data and assign the quantities based on planned lines.

3D Terrain Viewer (3DTV):
- Create a fly-through from XYZ data sets.
- Accepts XYZ or MTX data sets.
- Positions the 'camera':
  - ◊ Manually (free flight).
  - ◊ Along a planned line.
  - ◊ In circle flight (around an object).
  - ◊ Using the position and heading of the vessel from the SURVEY program.
- Capture the screen to a BMP or the flight to an AVI file.

Side Scan Sonar Tools:
- A standard part of HYPACK®.
- Data collection provides for input from digital or analog side scan sonars.
- Flag and capture targets in real time or in post-processing.
- Create mosaics of side scan data.

ENCEdit:
- A standard module of HYPACK®.
- Perform real-time field verification of S-57 charts.
- Re-attribute, move, add or de-

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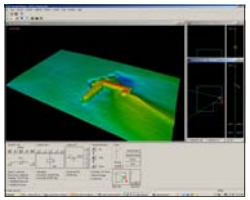
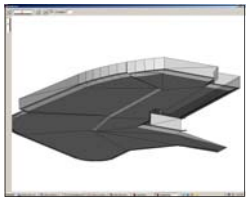
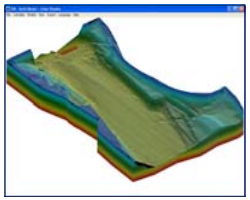




POSMV™ WaveMaster

Providing the Marine Industry with robust, reliable, and repeatable position and orientation solutions in all dynamics

POSMV WaveMaster

POSMV WaveMaster RM

SYSTEM COMPONENTS

POS Computer System (PCS)
A rugged, compact computer system contains the core POS processor and IMU interface electronics, plus two GPS receivers. The PCS provides all motion variables and timing data at high rate and/or provides motion compensation and georeferenceing data to all multibeam systems.

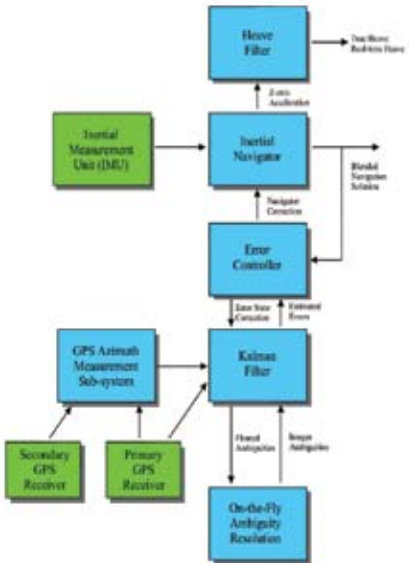
POS Inertial Measurement Unit
The system's primary sensor is a Ring Laser Gyro (RLG) manufactured by one of the world's experts in inertial technology. This high performance, low drift rate gyro ensures that the attitude data remains robust as the dynamics increase.

Primary and Secondary GPS Antennas
Dual frequency antennas for use with GAMS and RTK.

Accurate Position and Orientation Solution
POS MV™ WaveMaster maintains positoning accuracy under the most demanding conditions. With its high data update rate, the system delivers a full six degree-of-freedom position and orientation solution to provide the following:

- Position (latitude, longitude and elevation)
- Velocity (north, east and vertical)
- Attitude (roll, pitch and true heading)
- Heave (real-time & delayed)
- Acceleration Vectors
- Angular Rate Vectors

The new POS MV™ WaveMaster generates a tightly-integrated solution for survey vessels, which means the system's Inertial Navigator will provide continuous positioning information while surveying in areas where GPS reception is compromised by multipath and signal loss. Raw GPS data from as few as one satellite can now be processed directly within the WaveMaster.



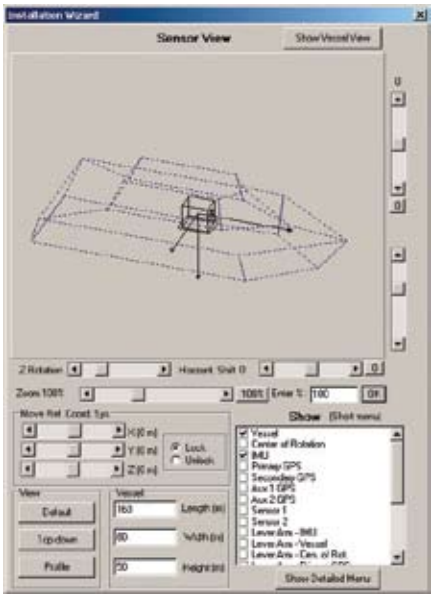
Tightly Coupled POS MV™ WaveMaster

Tightly-coupled integration offers the following advantages:

Advantage – Strengthens the system's ability to provide continuous, accurate data in areas with intermittent GPS reception
Advantage – Reduces position drift
Advantage – Enables almost instantaneous RTK re-acquisition (with internal RTK option)

WaveMaster Features and Benefits:

- Uses the latest GPS receiver technology from Trimble:
  - Maxwell™ chip technology
  - Everest™ multipath elimination technology
  - 10Hz raw observables for post-processing
  - Outstanding positioning performance and low elevation satellite tracking accuracy
- TrueHeave - Applanix's ground breaking delayed time heave processor
  - Removes processing artifacts but not real motion
  - Provides online quality measurement
- Faster CPU (700Mhz)
  - Low system loading allows for enhanced capabilities in the future
  - Runs at less than 10% of its total capacity to allow for upgrades and additional features
- TCP/IP protocol for raw data logging
  - Reliable logging of all raw data with microsecond-accurate time stamping
  - POSPac ready (for post-mission analysis)
- Firmware migration path
  - Access to new releases with new features as they become available
- New DC powered compact form-factor available
- New Graphical User Interface
  - Makes installation and setup intuitive
  - Reduces operator error



POS MV WaveMaster Graphical User Interface

APPLANIX
A TRIMBLE COMPANY

POS MV™ WaveMaster

POS MV WAVEMASTER MAIN SPECIFICATIONS (with Differential Corrections)

Roll, Pitch accuracy:	0.03° (1 sigma with GPS or DGPS) 0.02° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.06° (1 sigma) with 1 m antenna baseline, 0.03 (1 sigma) with 2 m baseline, 0.015 (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 2 m (1 sigma) depending on quality of differential corrections 0.02 - 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.05 m/s horizontal

POS MV WAVEMASTER DURING GPS OUTAGES

Roll, Pitch accuracy:	0.04° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 2° per hour
Position accuracy degradation:	3 m (1 sigma) for 30 s outages <10 m (1 sigma) for 60 s outages

PHYSICAL CHARACTERISTICS

Size POS MV WaveMaster

IMU	160mm x 160mm x 102mm
PCS	281mm x 165mm x 90mm
GPS Antenna (2)	187mm x 53mm

Size POS MV WaveMaster RM

IMU	160mm x 160mm x 102mm
PCS	432mm x 89mm x 356mm
GPS Antenna (2)	187mm x 53mm

Weight

	POS MV WaveMaster	POS MV WaveMaster RM
IMU	3.6kg	3.6kg
PCS	3.0kg	5.0kg
GPS Antenna	<0.5kg	<0.5kg

Power POS MV WaveMaster

IMU	Power provided by PCS
PCS	24vdc, 50 W (peak)
GPS Antenna	Power provided by PCS

Power POS MV WaveMaster RM

IMU	Power provided by PCS
PCS	110/230 Vac, 50/60 Hz, auto-switching 80 Watt
GPS Antenna	Power provided by PCS

ENVIRONMENTAL

Temperature Range (Operating)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Temperature Range (Storage)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Humidity

IMU	0-100% RH, Ingress Protection of 66
PCS	5-90% RH, non-condensing
GPS Antenna	0-100% RH

Ethernet (100 base-T)

Parameters	Time tag, status, position, attitude, heave, velocity, track and speed, dynamics, performance metrics, raw IMU data, raw GPS data
Display Port	Low rate (1 Hz) UDP protocol output
Control Port	TCP/IP input for system commands
Data Port 1	Real-time (up to 200 Hz) UDP protocol output
Data Port 2	Buffered TCP/IP protocol output for data logging to external device

Serial RS232 I/O

5 COM Ports	User assignable to: NMEA output (0-5), Binary output (0-5), Auxiliary GPS input (0-2), Base GPS correction input (0-2)

NMEA ASCII Output

Parameters	NMEA Standard ASCII messages: Position ($INGGA, $INGGK), Heading ($INHDT), Track and Speed ($INVTG), Statistics ($INGST), Attitude ($PASHR, $PRDID), Time and Date ($INZDA, $UTC).
Rate	Up to 50 Hz (user selectable)
Configuration	Output selections and rate individually configurable on each assigned com port.

High Rate Attitude Output

Parameters	User selectable binary messages: attitude, heading, speed
Rate	Up to 100 Hz (user selectable)
Configuration	Output selections and rate individually configurable on each assigned com port.

Auxiliary GPS Inputs

Parameter	NMEA Standard ASCII messages: $GPGGA, $GPGST, $GPGSA, $GPGSV. Uses Aux input with best quality.
Rate	1 Hz

Base GPS Correction Inputs

Parameter	RTCM 1, 9, 18, 19, CMR and CMR+ input formats accepted. Combined with raw GPS observables in tightly-coupled navigation solution.
Rate	1 Hz

Digital I/O

1PPS Output	1 pulse-per-second Time Sync output, normally high, active low pulse
Event Input (2)	Time mark of external events. TTL pulses > 1 msec width, rising or falling edge, max rate 200 Hz.

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APPLANIX
A TRIMBLE COMPANY

SG BROWN TSS

Dynamic Motion Sensors

DYNAMIC MOTION SENSORS

Features

- Dynamic roll and pitch accuracy to 0.25
- IP65 rated
- Solid state angular rate gyros
- High dynamic accuracy during vessel turns

Benefits

- DMSView intuitive control software
- User-configurable outputs
- Real-time digital outputs
- Compact and lightweight

The DMS range of motion sensors has been designed specifically for the motion measurement needs of the marine industry. The DMS-RP25 DP meets the requirements of the dynamic positioning industry for accurate vessel roll and pitch measurement. The unit provides accurate motion measurement in all sea conditions.

Incorporating an enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic manoeuvres, the solid state angular rate sensors offer reliability and a complimentary blending algorithm has proven that the DMS is the highest performance vertical reference unit ever produced by TSS.

The DMSView software programme is an intuitive Windows™ - based programme enabling installation, set-up and integrity checking, and monitoring of the sensor. The user can select from a series of frequently used data protocols or configure a bespoke output from a selection of variables.

The DMS-RP25 DP is IP65 rated. The sensor can be supplied in various configurations for integration with towed vehicles and other bespoke applications. As with all TSS systems, the DMS is certified to meet all current and anticipated European legislation for electromagnetic compatibility and electronic emissions.

TECHNICAL SPECIFICATIONS

TSS DYNAMIC MOTION SENSORS

Dynamic accuracy	Roll & Pitch
	0.25º
	Amplitude ±30º
Bandwidth	0 to 30 Hz
Data output rate (digital)	Up to 200 Hz
Available output parameters	Adjustable data packet output rate down to 1Hz Roll; pitch; angular rate X, Y, Z – acceleration X, Y, Z (body frame); angular rate east north, up – acceleration east, north, up (geographical frame); IMU temperature; surge; sway; sensor status; external speed; external heading; UTC time
Dimensions	172mm x 99mm diameter (excluding connector)
Weight	1.5Kg in air
Power supply	15-30 Vdc
Temperature range	0ºC to 55ºC
Power requirement	10-36V, <6.5W
Shock (survival)	30g peak 40ms half-sine
Vibration (operating)	30mm/s or 0.2mm, 7-300 Hz
Software interface (digital)	RS232 or RS422 (software selectable)
MTBF (computed)	50,000 hours
Warranty	12 months international warranty including parts & labour

Due to continuous development, specifications may vary from those listed above.

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SG BROWN TSS

www.tss-international.com

DMS/0705/Issue1

Appendix C-6

Buoys and Pipeline Markers

Regulatory Buoys and Channel Markers

Calm Water Reg. Buoy Model #410	***Deep Water Reg. Buoy Model #410-X***

(410 and 410-X also available in Channel Markers)

Specifications:

Molded-in color	White	White
Overall height	61-1/2"	71-1/2"
Can diameter	9"	9"
Base Diameter		
Height above waterline (foam line)	37"	44"
Weight	50 lbs.	58 lbs.
Galv. Steel eyebolt	1/2"	1/2"
Chain req'd to float upright	Yes	Yes

Floats

Horseshoe Buoys

Hurricane Boat Fenders

Industrial Floats and Buoys

Life Floats

Life Preservers and Work Vests

Life Rings

Life Ring Racks

Life Ring Cabinets

Lights

Lok-On Rope Floats

Man Overboard Lights

Man Overboard Poles and Mounts

Mast Buoys and Pick up Buoys

Mooring Buoys

Regulatory Buoys and Channel Markers

Safety Harnesses

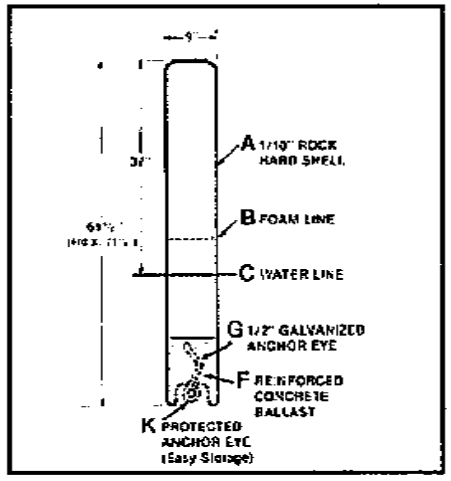
Sea Anchors

Sombrero Buoys

Trip Line and Anchor Marker Buoy

All Models:	***Accessories:***
• Shell: High density polyethylene • Internal foam: 2-3 LB density polyurethane foamed to waterline (foam filled upon request) • Internal Ballast: Reinforced concrete • Labels: 200 stock labels included in buoy price - no extra charge. • Special labels - call for quotation	• Reflective tape: Various colors (orange, red, green, silver) and widths available upon request • #9000 Jim-Buoy lights available for all models • Pickup eye • Radar reflection

#410



ATTACHMENT D-7

DWP EQUIPMENT DOCUMENTS

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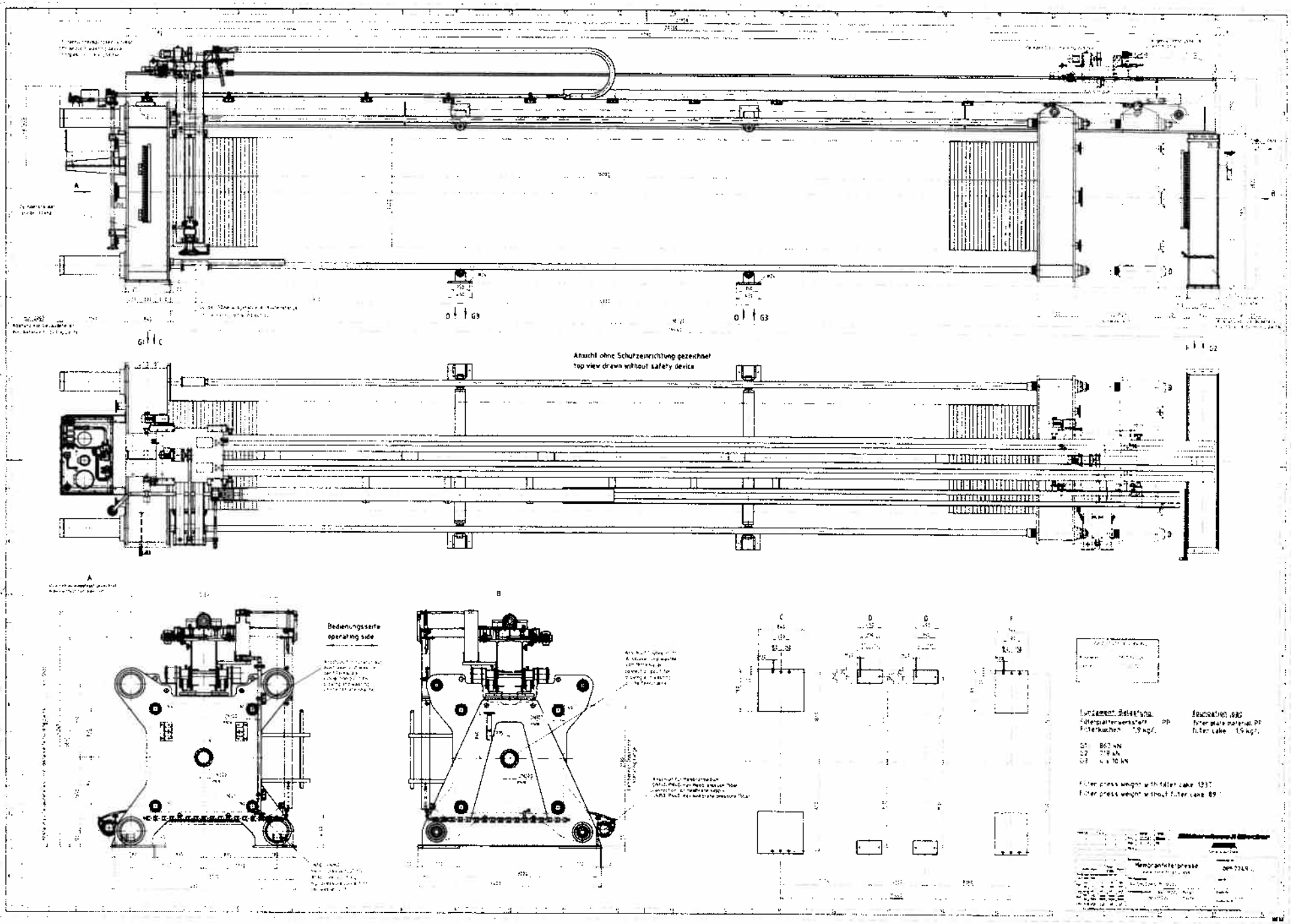
Appendix C-7

Dewatering Plant Equipment


Ansicht ohne Schutzeinrichtung gezeichnet
top view drawn without safety device
Bedienungsseite
operating side

ATTACHMENT D-8

WATER TREATMENT PLANT EQUIPMENT

Appendix C-8

Auto-Sampler Equipment

OUR NEWEST SAMPLER!

4700 Stationary Refrigerated Sampler

Forward thinking is evident from top to bottom in Isco's groundbreaking 4700 Sampler. Its rotationally molded construction, user-friendly controls, and workplace-savvy features make it the new choice for stationary sampling in both municipal and industrial wastewater applications.

Control and programming are fast, simple, and easily accomplished on-site. A unique slide-out bottle rack eliminates awkward stooping and bending to reach sample containers.

The controller actively regulates and displays the sample compartment temperature, and logs a one-minute average to confirm proper sample cooling. You can download the temperature record with a basic utility program such as *HyperTerminal*.

The tough, double-wall LLDPE cabinet shrugs off exposure to weather and harsh environments. It's filled from top to bottom with insulation for efficient, economical cooling even in hot, humid environments.

Heat-treated polyester powder coating protects the refrigeration system, ensuring long life and reliability in corrosive conditions.

Sampling modes

- Uniform time intervals – uniform sample volumes
- Uniform time intervals – flow-proportioned sample volumes
- Uniform sample volumes – flow-proportioned time intervals

Standard features

- Composite or sequential sampling
- -20° to 120° F operating range – without additional heaters
- Four digital alarm outputs
- 4-20 mA flow meter input
- Powerful compressor delivers energy-efficient, high-performance cooling

Weight (dry)	159 lbs.	72 kg
Dimensions: (H x W x D)	51 x 28 x 33 in	130 x 72 x 84 cm
Operating Temperature:	-20° to 120° F	-29° to 49° C
Controller Rating:	NEMA 4X, 6	IP67

For complete information and specifications, request Data Sheet #L-1141.

The 4700 is especially well suited for outdoor environments. Its roto-molded cabinet provides a degree of durability and insulation that's unmatched in the industry.

Appendix C-8

Effluent Tank Equipment

ModuStor

Free Standing or Anchored

Bolted Steel Round Tanks

ModuStor tanks are ideal for most liquid containment needs. They are available in diameters from 12' to more than 100' with capacities over 1,000,000 gallons. Installation time is reduced by utilizing low-cost modular components designed for rapid bolt-together assembly by unskilled workers using common hand tools. Welding and other field fabrication methods are eliminated.

Cost Range
Factory fabricated modular steel components, fast bolt-together assembly by unskilled workers, and minimal site prep combine to reduce overall ModuStor costs below those for welded steel counterparts. Furthermore, the ModuStor's bolted construction allows quick disassembly for relocation to a new site.

Site
ModuStor tanks can be erected on any firm surface such as gravel, compacted earth, concrete, or asphalt. They can be anchored to a 4' wide concrete apron or for shorter term projects, installed on gravel with unique corrosion resistant steel anchor plates. Interior area can be flat, slightly pitched or dished to ease emptying.

Liners
The large selection of premium liner materials available is chemically compatible with most commonly handled liquids. Lining materials include reinforced XR-5 and polypropylene.

Covers
Floating covers are fabricated from reinforced membrane materials including XR-5 and polypropylene. Covers, buoyed up by floatation logs, ride the fluid's surface and produce practically vapor-tight enclosures.

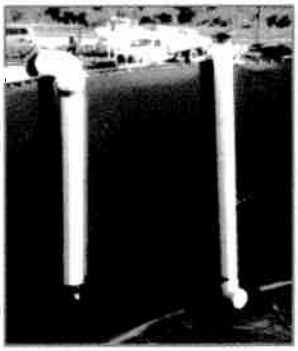
Leak Detection
Double liner leak detection systems are available.

Ladders
Ladders with or without platforms or cages are available.

General Specifications
Wall panels are G-90 mill galvanized steel sheet of varying thicknesses, ranging from 16 ga. to 10 ga. All girths are hot dip galvanized structural steel angle. Structural hardware is zinc plated steel, grade 5.

PIPING

Input, output and level equalization piping can be attached to ModuStor tanks by bottom or through-the-wall connections or over the top. Wall openings can be precut at the factory.

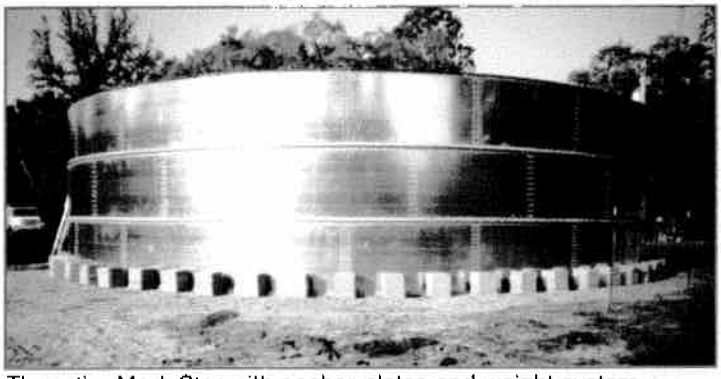


Customized Piping

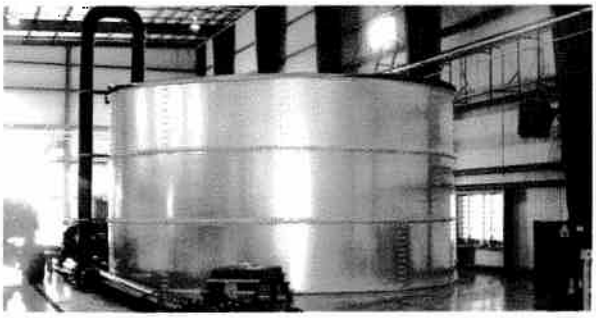
Typical through-the-wall piping connection with expansion joint

ANCHORING

Our unique anchor plate system anchors tanks without concrete footings, eliminates guy wires or other ground penetrations, a preferred system for short term use or where concrete footings are undesirable. ModuStor tanks can be anchor bolted to concrete ring foundations or used free-standing indoors.



Three tier ModuStor with anchor plates and weight system



Free Standing installation indoors

Anchor brackets bolted to concrete

Multiple two tier ModuStor tanks used for hazardous waste storage

ModuTank Inc. 41-04 35th Avenue, Long Island City, NY 11101
(800)245-6964 NY: (718)392-1112 FAX: (718)786-1008 WEB: www.modutank.com Email: info@modutank.com

April 23, 2008

VIA FAX (617) 457-8498
TEL (617) 457-8409
E MAIL joseph.francis@tteci.com

Mr. Joe Francis
Tetra Tech
133 Federal Street 6TH Fl
Boston MA 02110

Reference: **Quotation # 040208-P-180**

Dear Mr. Francis:

Thank you for your response to our quotation #040208-P-164 regarding a treated water holding tank for your Green Bay, Wisconsin project. We offer the following additional option as requested:

Item	Description	Unit Price*
1	Model **MS 4920** ModuStor 49' 1 3/4" dia x 20'0" ht 280,300 gallon capacity with 3" freeboard - galvanized steel structure - 45 mil reinforced polypropylene liner - 8 oz. geotextile liner underlay - Thru-the-Wall Piping Connections including steel wall panel with cutout – Wetted parts – No bolt penetrations – Expansion joint in Neoprene – Internal elbow in PVC Sch 40 6" (qty. 1) 8" (qty. 1) 12" (qty. 2) - mounting brackets for concrete ring wall installation	$112,215.00

*Freight terms: FOB, point of shipment.
Note: Freight charges subject to fuel surcharge differential at time of shipment.
Shipment schedule to be based upon your requirements.
Terms: 25% with order; 25% plus freight at time of shipment; balance Net 30.
All steel components, liners, covers, and piping accessories are warranted against defective materials and workmanship for one year from date of shipment. Defective parts will be repaired or replaced. Leaks caused by penetration of liner with piping connections or equipment or leaks caused by accidents or improper installation are not covered by the warranty. ModuTank Inc. is not liable for consequential damages due to cause. For critical applications tanks must be tested by purchaser before being placed into service, by filling them with clean water to check for liner integrity. Quotation does not include taxes, piping, piping connections, site preparation, or installation.

Appendix C-8

Carbon Filter Equipment

Equipment Bulletin

MODEL 10 MODULAR CARBON ADSORPTION SYSTEM

Description

The Calgon Carbon Model 10 is an adsorption system designed for the removal of dissolved organic contaminants from liquids using granular activated carbon. The modular design concept allows selection of options or alternate materials to best meet the requirements of the site and treatment application.

The Model 10 system is delivered as two adsorbers and a compact center piping network, requiring only minimal field assembly and site connections. An optional mounting skid is available to facilitate installation. The pre-engineered Model 10 design assures that all adsorption system functions can be performed with the provided equipment.

The process piping network for the Model 10 accommodates operation of the adsorbers in parallel or series (with either adsorber placed in first stage). The piping can also isolate either adsorber from the flow. This permits carbon exchange or backwash operations to be performed on one adsorber without interrupting treatment.

The unique internal cone under-drain design provides for the efficient collection of treated water and the distribution of backwash water. The internal cone also insures efficient and complete discharge of spent carbon from the adsorber. The Model 10 system is designed for use with Calgon Carbon's closed loop carbon exchange service. Using special designed trailers, spent carbon is removed from the adsorbers and returned to Calgon Carbon for reactivation. The trailers also recharge the adsorbers with fresh activated carbon.

System Specifications

Carbon Adsorbers

- Carbon steel ASME code pressure vessels
- Internal vinyl ester lining (nominal 35 mil) where GAC contacts steel, for potable water and most liquid applications
- Polypropylene slotted nozzles for water collection and backwash distribution

Standard Adsorption System Piping

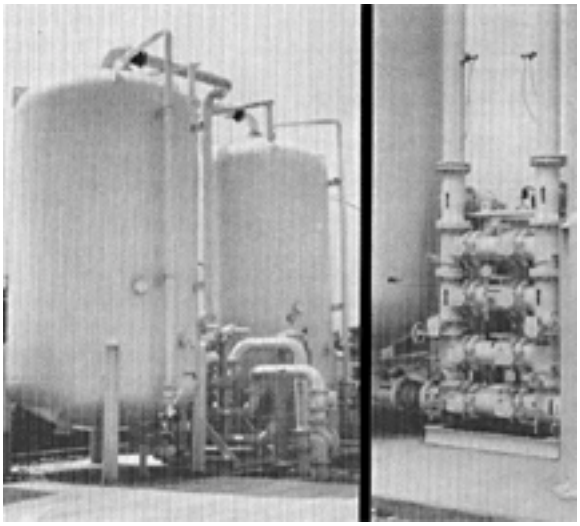
- Schedule 40 carbon steel process piping with cast iron fittings
- Full bore stainless stell ball valves for GAC fill and discharge
- PPL lined steel pipe for GAC discharge
- Cast iron buterfly valves for process piping

System External Coating

- Epoxy mastic paint system

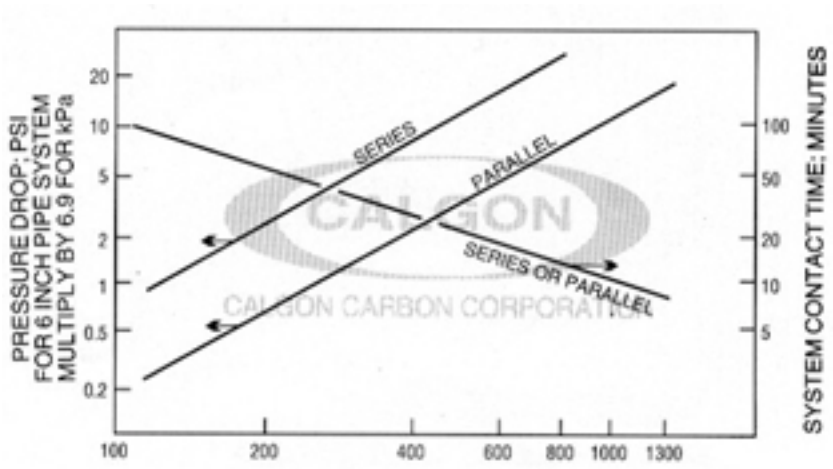
Available Options

- Unifying system skid
- In-bed water sample collection probes



Operating Conditions

Carbon per Adsorber	20,000 lbs. (9080 kg)
Pressure Rating	125 psig (862 kPa)
Pressure Relief	Graphite rupture disk (94 psig)
Vacuum Rating	14 psig
Temperature Rating	150°F maximum (65°C)
Backwash Rate	Typical 1000 gpm (30% expansion)
Carbon Transfer	Air pressure slurry transfer
Utility Air	100 scfm at 30 psig (reduce to 15 psig for trailer)
Utility Water	100 gpm at 30 psig
Freeze Protection	None provided; enclosure or protection recommended



Dimensions and Field Conditions

Adsorber Vessel Diameter	10 ft. (3050 mm)
Process Pipe	6 in. or 8 in.
Process Pipe Connection	125# ANSI flange
Utility Water Connection	3/4 in. hose connection
Utility air Connection	3/4 in. hose connection
Carbon Hose Connection	4 in. Kamlock type
Carbon Dry Fill	Top 8" nozzle
Backwash Connections	6 in. or 8 in. flange
Drain/vent Connection	6 in. or 8 in. flange
Adsorber Maintenance Access	20 in. round flanged man-way, 14 in. x 18 in. man-way below cone
Adsorber Shipping Weight	18,500 lbs. (empty) (8400 kg)
System Operating Weight	215,000 lbs. (97,610 kg)

Caution

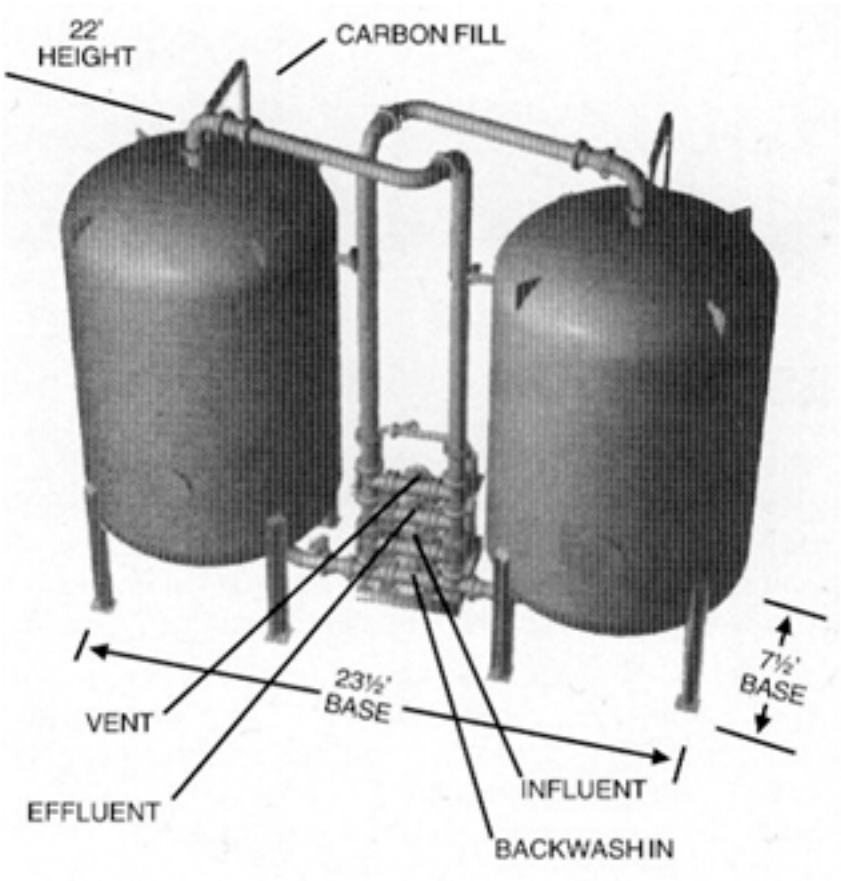
Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable federal and state requirements.

CALGON
CALGON CARBON CORPORATION

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, Pa 15230

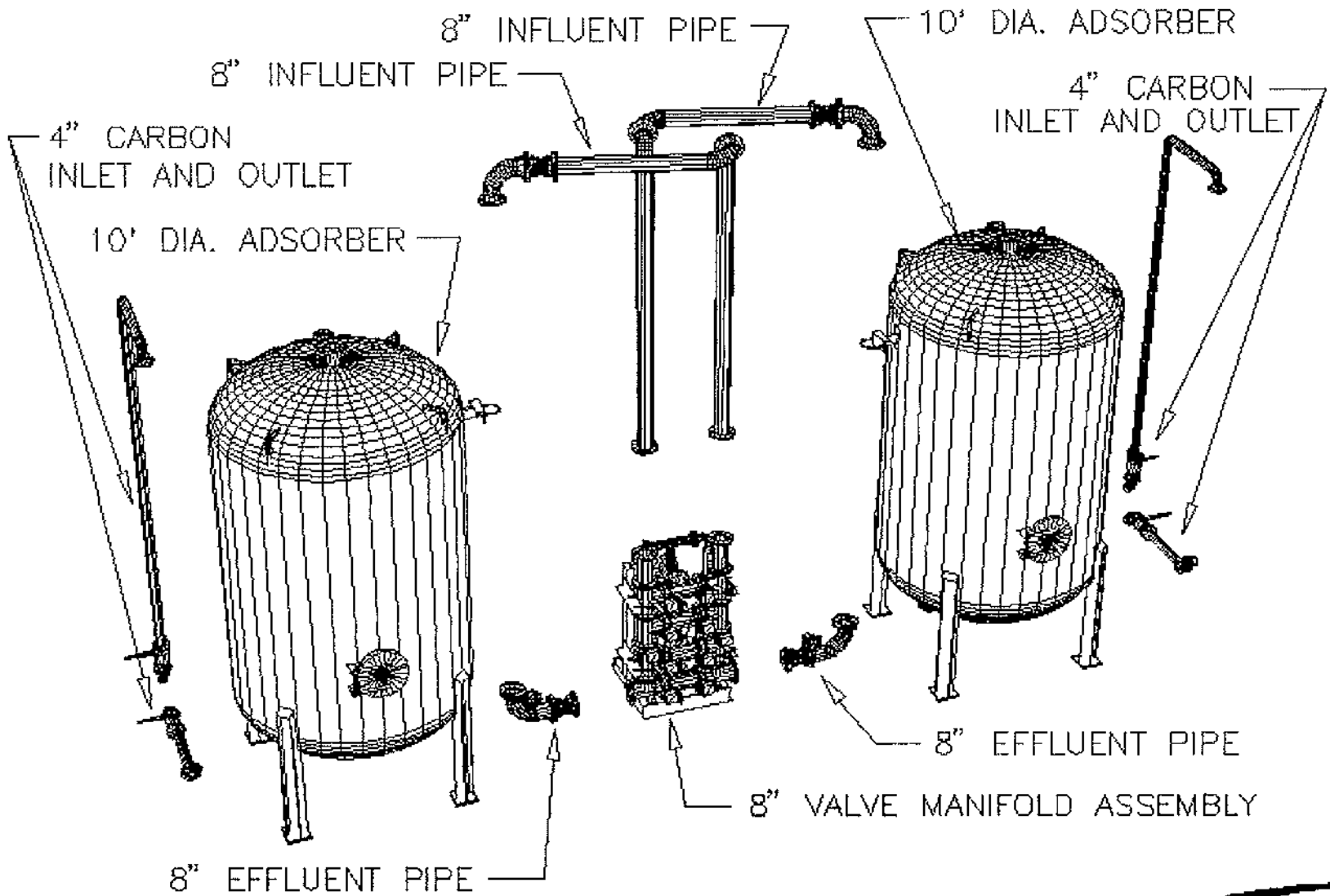
Chemviron Carbon
Zoning Industriel C
B-7181 Feluy, Belgium

Chemviron Carbon



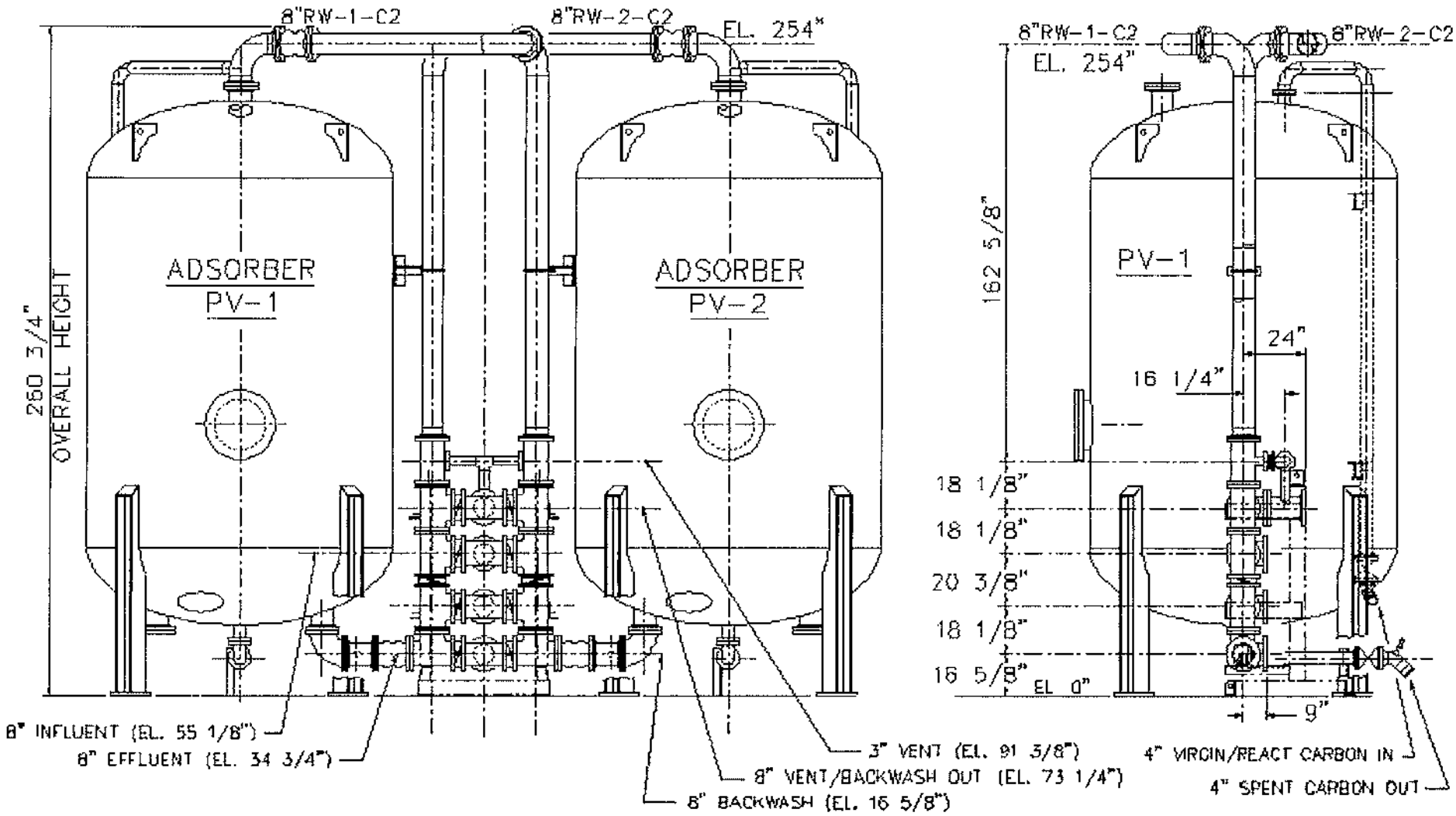
Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements.



Assembly Diagram
Modular 10 System

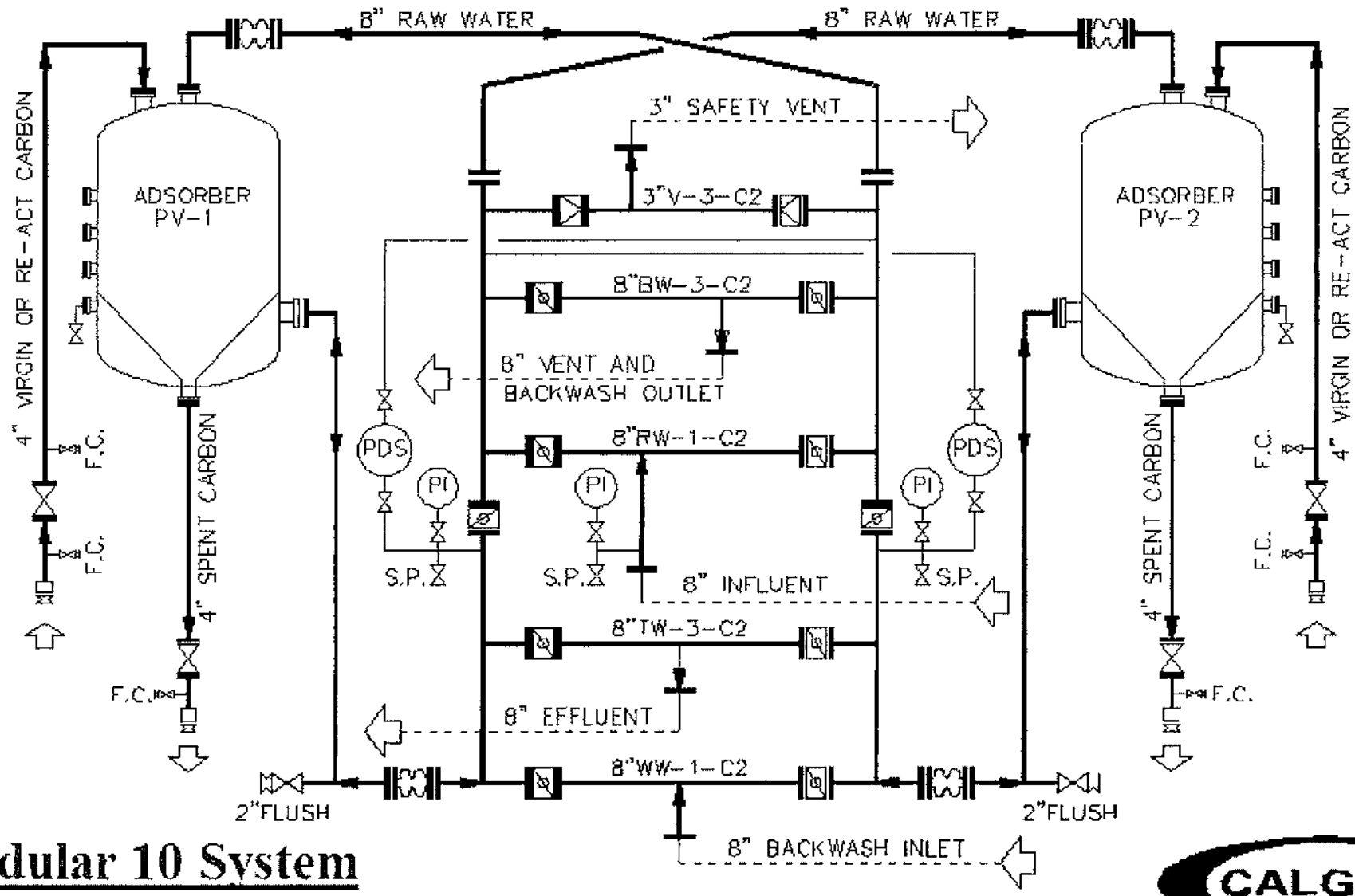
CALGON
CALGON CARBON CORPORATION



Modular 10 System Elevation View

CALGON

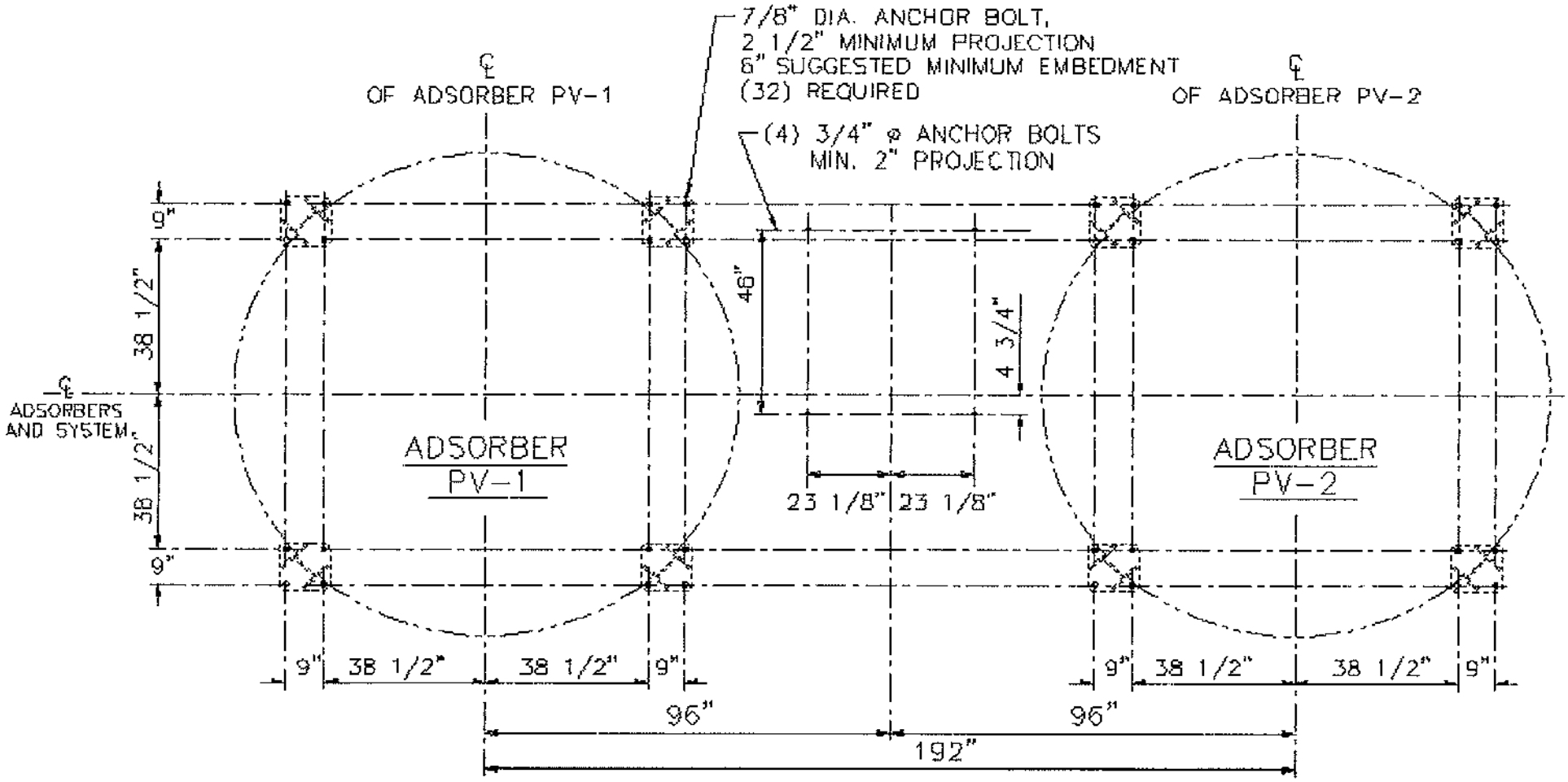
CALGON CARBON CORPORATION



Modular 10 System Flow Diagram

CALGON

CALGON CARBON CORPORATION

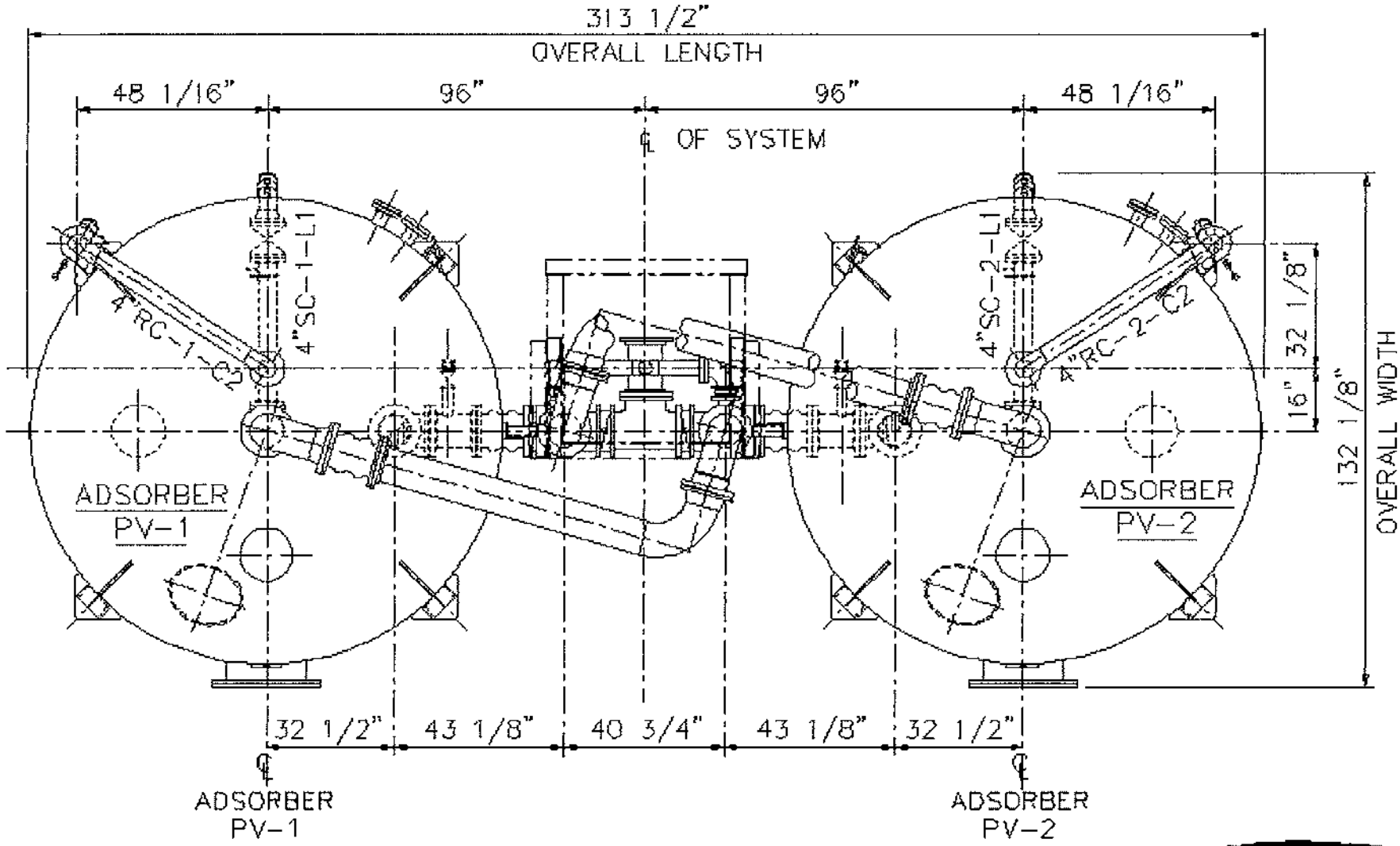


ANCHOR PATTERN SHOWN IS FOR ATTACHMENT OF VESSEL BASEPLATES TO A CONCRETE SLAB IN SIESMIC ZONE 4. THE TWO LARGE CENTER HOLES IN EACH BASEPLATE ARE FOR ATTACHMENT TO STEEL FRAMING.

Modular 10 System Footprint

CALGON

CALGON CARBON CORPORATION



Modular 10 System
Plan View

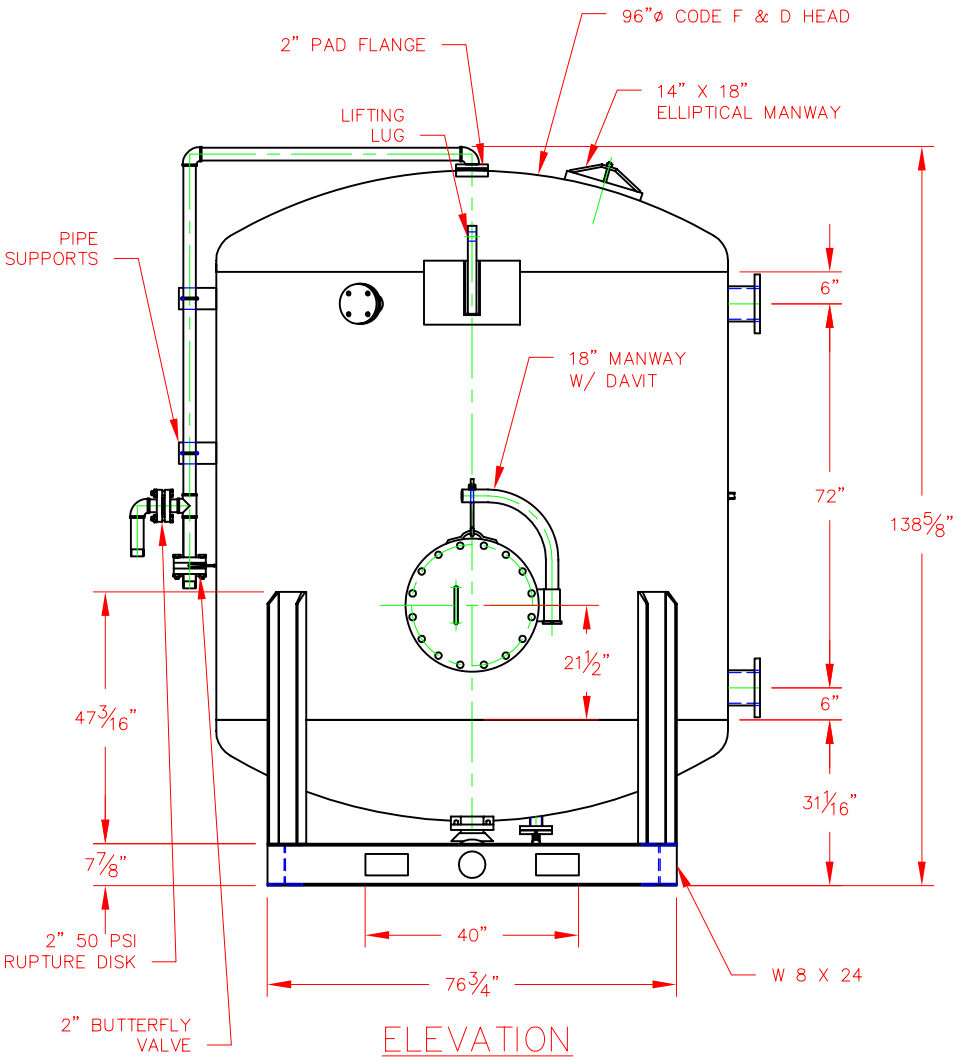
CALGON

CALGON CARBON CORPORATION

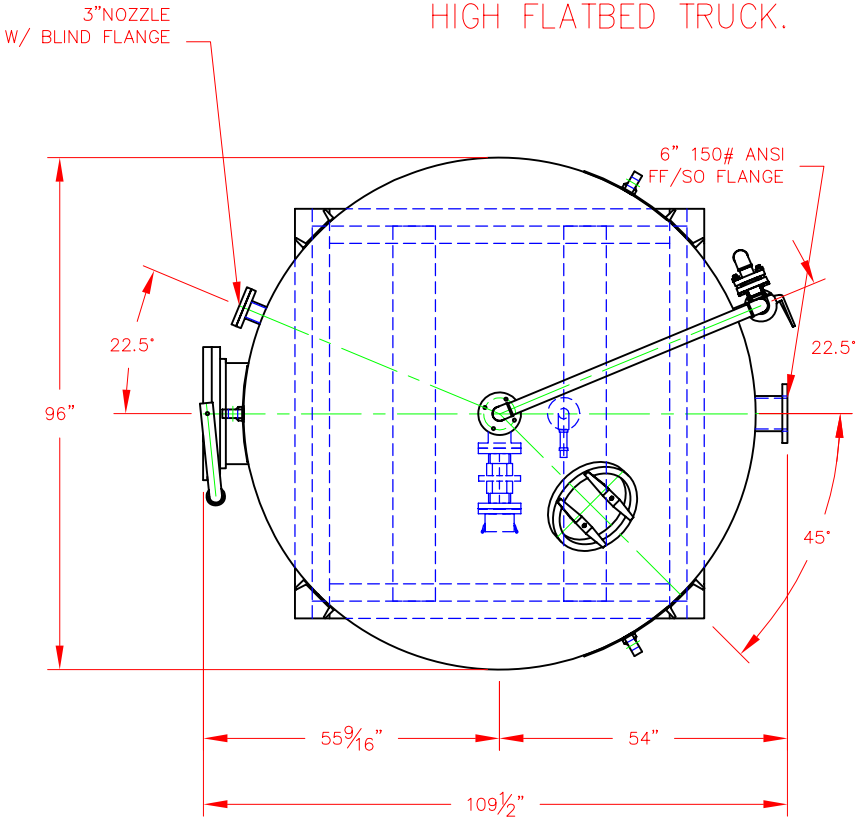
Appendix C-8

Multi-Media Filter Equipment

NOTE: SEE PLAN VIEW FOR CORRECT ORIENTATIONS.
VESSEL MUST SHIP ON 18" HIGH FLATBED TRUCK.



ELEVATION



PLAN

VESSEL STANDARDS

VESSEL MATERIALS : SA 516 70	LIQUID DRAIN ASSEMBLY : CARBON STEEL
LINING : HIGH SOLIDS EPOXY	VOLUME OF VESSEL : 400 FT^3
EXTERIOR PAINT : ACRYLIC ALKYD ENAMEL	STANDARD/MAX CARBON FILL : 8,000 LBS / 10,000 LBS
HEAD THICKNESS : 5/16" CODE F&D	SHIP WT. OPERATING WT.STD.FILL : 14,500 LBS / 26,000 LBS
SHELL THICKNESS : 5/16" 516 - 70	CARBON TYPE : 12 X 40
INTERNALS : PVC	MAX. OPERATING PRESSURE : 50 PSIG
ADSORBENT OUTLET ASSEMBLY : 14" X 18" MANWAY	MAX. OPERATING TEMP. : 140°F

NO.	REVISION	BY	DATE
1	REVISE CARBON WEIGHT	JB	1/20/04

PROJECT
STANDARD

PROJ. NO. SALES
P.O. NO.

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DESIGN BY	BL
CHKD. BY	BL
DATE	7/5/02
SCALE	NTS

TIGG corporation

C-500

DWG. NO. C-500-1001 REV. 1

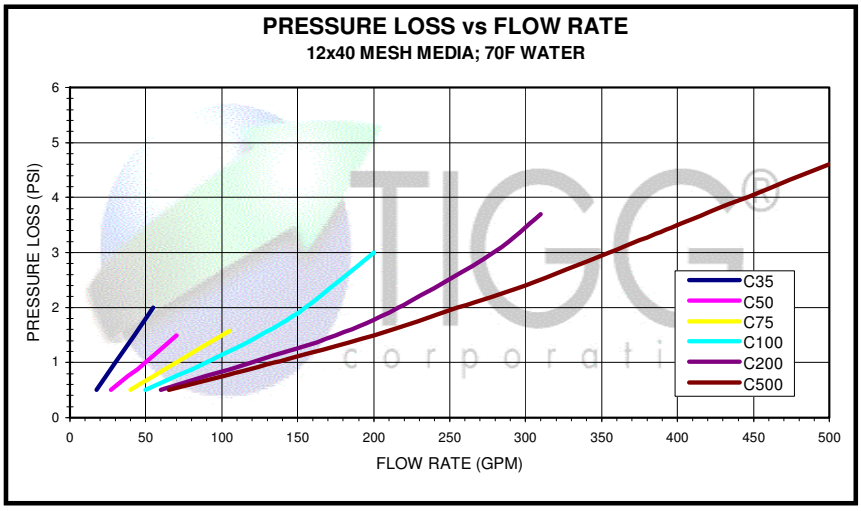
CANSORB®

STEEL VESSELS

MODEL	MAX FLOW (GPM)	MAX PRESS (PSIG)	MAX TEMP (deg F)	FLG. INLET / OUTLET (IN)	DIAMETER / HEIGHT (IN)	STANDARD ADSORBENT FILL (LBS)	MAXIMUM ADSORBENT FILL (LBS)	SHIPPING WEIGHT - STANDARD FILL (LBS)
C-35	60	30	115	2 / 2	38 / 83	660	875	1380
C-50	90	30	115	3 / 3	46 / 96	1000	1600	2040
C-75	140	30	115	3 / 4	57 / 98	2000	2500	3420
C-100	200	30	115	3 / 4	68 / 102	3000	3600	4790
C-200	310	30	115	4 / 6	85 / 118	6000	6725	8410
C-500	500	50	140	6 / 6	96 / 139	8000	10000	14500

NOTES:
1) Desired contact time may allow higher or lower flow rates.
2) Dry virgin activated or reactivated carbon provided as standard adsorbent.
3) Maximum adsorbent fill is based on a bed density of 27 lb/ft^3.
4) Maximum adsorbent fill can differ based on variable bed density and alternate adsorbents.
5) Vessels are available in higher-pressure ratings in accordance with ASME Section VIII.
6) Pressure drops are based on a dense packed bed of activated carbon.

The CANSORB Series Modular Adsorbers are fabricated of carbon steel and provided with a high solids epoxy lining. Where process conditions dictate, the vessels can be fabricated from other materials such as stainless steel. In addition, a different lining can be substituted for the high solids epoxy. Media discharge and drain lines are provided with ball valves. The liquid collection system is designed to promote even flow distribution and thus, efficient adsorbent utilization. The liquid outlet is designed to maintain a liquid level above the carbon bed. Manways are 18 inches in diameter for easy access. The vessels are provided with lifting lugs and fork channels. *Specifications and properties are subject to change without notice.*



C-200 ILLUSTRATION

TIGG corporation

800 Old Pond Rd., Suite 706
Bridgeville, PA 15017
(412) 257-9580 phone
(412) 257-8520 fax
www.tigg.com
info@tigg.com

Appendix C-8

Cartridge Equipment

CUNO
a 3M company

3M

CUNO High Flow Filtration Systems

High Flow Performance in a Compact Design

- Innovative technology to achieve flow rates up to 500 gpm per element
- Absolute-rated for consistent product quality
- Operator-friendly cartridge and housing system
- Unique design to reduce capital investment expenses

CUNO High Flow Filtration System

The CUNO High Flow Filtration System is an advanced design that uses 3M Innovation and CUNO's extensive filtration experience to deliver a high flow filter in a compact housing design. When compared to conventional cartridge systems, this system provides the following advantages:

High Flow Capability

The unique construction of CUNO High Flow Filters (patent pending) permits flow rates of up to 500 gpm in a single cartridge. The result? Fewer filter elements to accommodate your flow requirements. In fact, the CUNO High Flow Filtration System requires as few as one-tenth the number of elements as competitive 2.5" pleated cartridges (see Figure 1).

Compact Design

Using fewer elements combined with an outside-to-in flow path enables a reduction in the size of housing required for your application. The CUNO High Flow Housing takes up as little as one-half the size of competitive housings for a given flow rate. The result is lower capital investment costs and a compact footprint that saves valuable plant space (see Figure 1).

Ease of Use

The CUNO High Flow Filtration System is designed with ease-of-use in mind. From a user-friendly, ergonomically designed handle that makes cartridge installation and removal easier without the use of special tools or other hardware, to a unique "twist-to-lock" cartridge seating mechanism that provides a positive seal, the CUNO High Flow System facilitates easy operation and maintenance of your filter system.

CUNO High Flow Filter Applications
Industrial - Municipal Water, RO Prefiltration, Reclaimed Water, Coolants, Nozzle Protection, Boiler Condensate
Chemical - Quench Water, Aqueous Salt Solutions, Final Products
Petrochemicals - Waterflooding, Produced Water, Enhanced Oil Recovery, Completion Fluids, Amine Sweetening, Final Products
Electronics - RO Prefiltration, Process Water
Food & Beverage - Process Water
Pharmaceutical - Process Water

Features	Benefits
■ High flow capability of up to 500 gpm per cartridge	■ Reduced Filter Usage – minimizes product loss, labor, disposal costs, operator exposure, and downtime for filter change-out
■ Patent Pending Compound Radial Pleat design	■ High loading capacity for long life and lower cost filtration
■ Compact design	■ Smaller housing minimizes capital expense requirements ■ Reduces system footprint
■ Absolute rating	■ Reproducible effluent quality throughout the filter's life
■ Easy to Use	■ No special tools or hardware required for filter change-out – minimizes downtime ■ "Twist to lock" seating mechanism provides positive seal ■ Ergonomically designed handle – facilitates easy cartridge installation and removal
■ FDA compliant	■ Compatible in applications requiring direct food contact in food and beverage processing per 21 CFR.

CUNO High Flow Filter

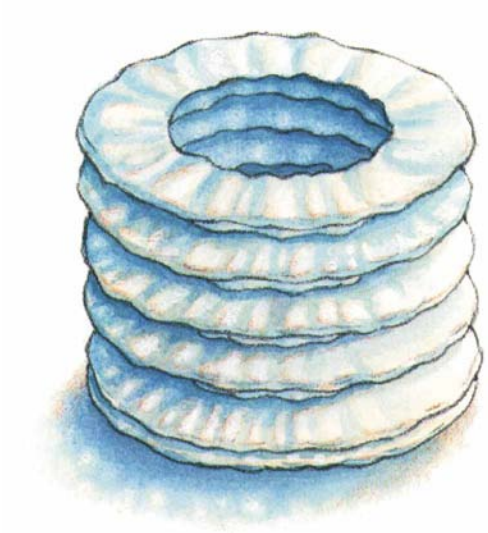
High Performance Media in an Innovative Design

CUNO High Flow Filters are designed using state-of-the-art technology, optimizing both performance and effluent quality to ensure customer satisfaction. The elements use a unique pleat design that results in a high usable filtering surface area per filter.

Radial pleat design

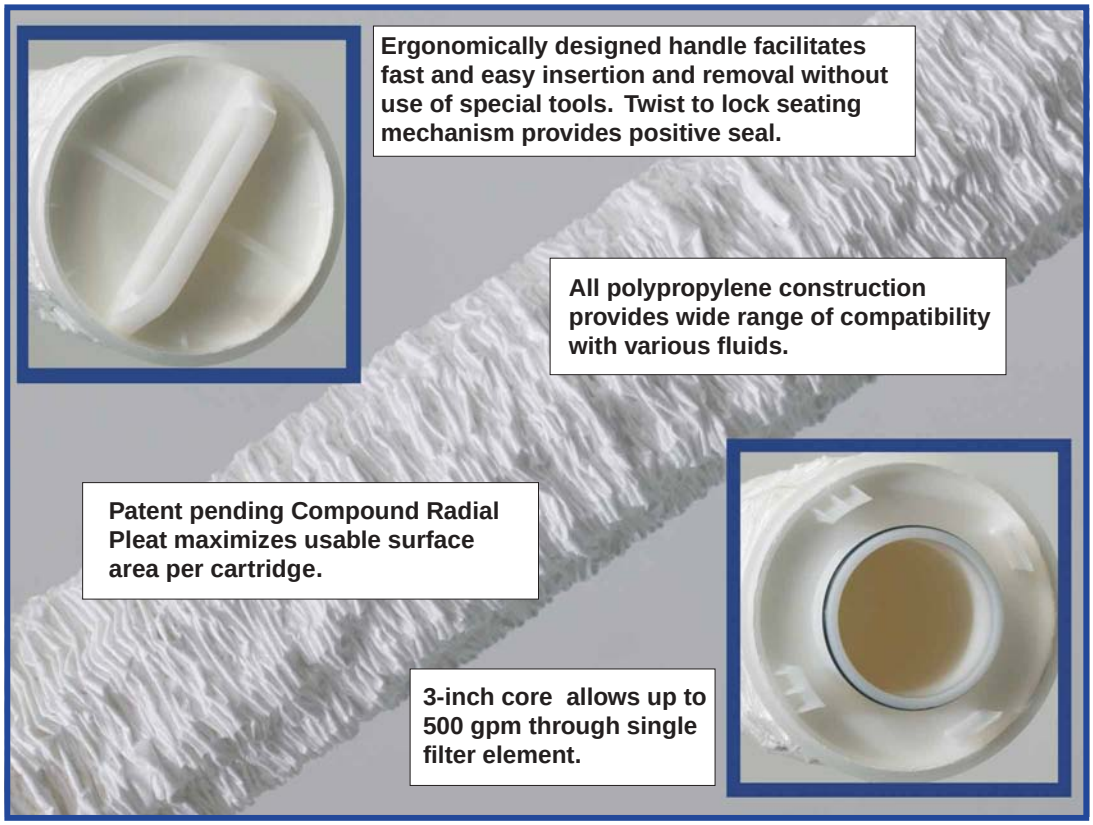
3M Innovation is at the heart of the CUNO High Flow Filter. A patent pending compound radial pleat design maximizes the usable surface area per filter. Blown microfiber forms the basis of the filter media, which is made to tightly controlled fiber diameter specifications to produce a media with absolute rated particle retention characteristics. Our unique manufacturing process embosses the media to produce a more uniform pleat pattern, which, in turn, allows greater utilization of the media by evenly distributing the fluid throughout the entire filter structure. This results in consistent particle retention in a compact, space-saving design.

Compound Radial Pleat design maximizes usable media surface area



Design Features

The CUNO High Flow Filter contains several features to combine high performance with easy operation.

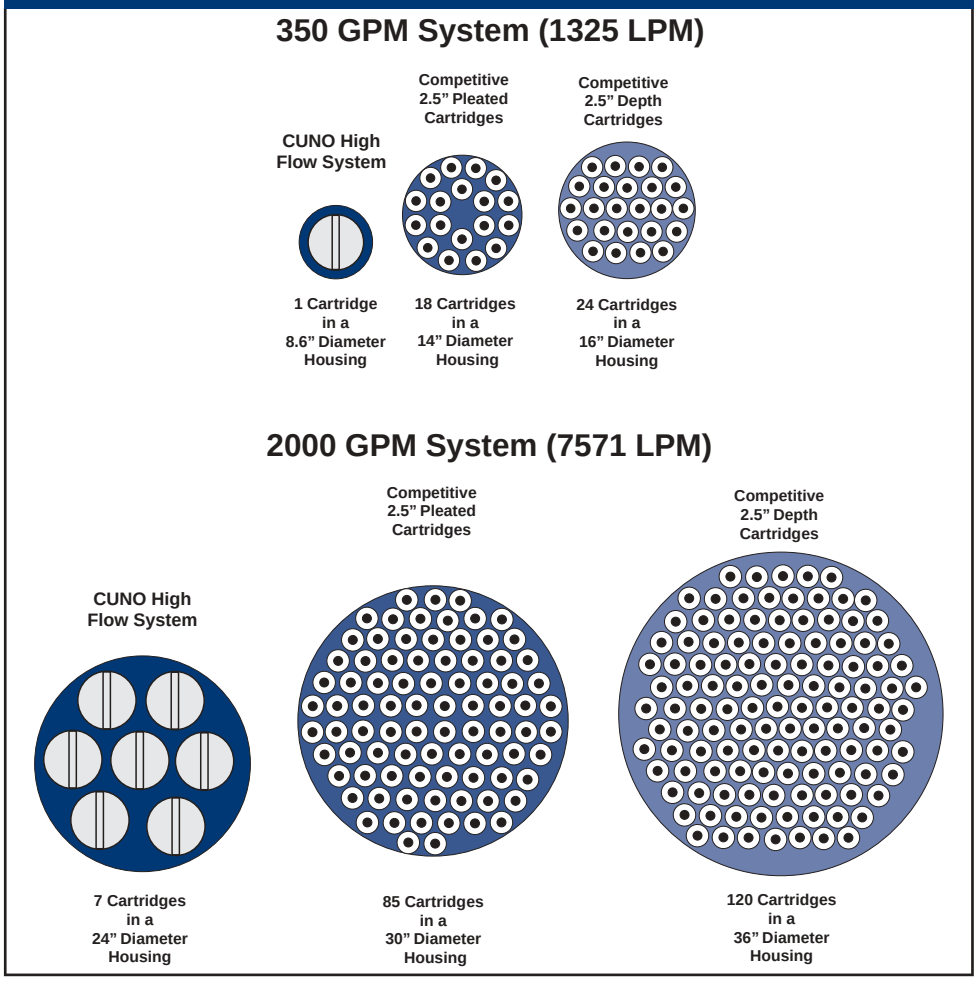


- A large diameter core allows up to 500 gpm through a single filter element.
- An ergonomically designed handle has been designed to facilitate fast and easy insertion and removal without the use of special tools. Cartridges are simply inserted over a built-in guide tube.
- The seating mechanism uses a “twist to lock” design to provide a positive seal.

Filter Comparison

Consider the following benefits of the CUNO High Flow System over competitive 2.5” cartridges in a 350 gpm (1325 lpm) and a 2000 gpm (7571 lpm) system*:

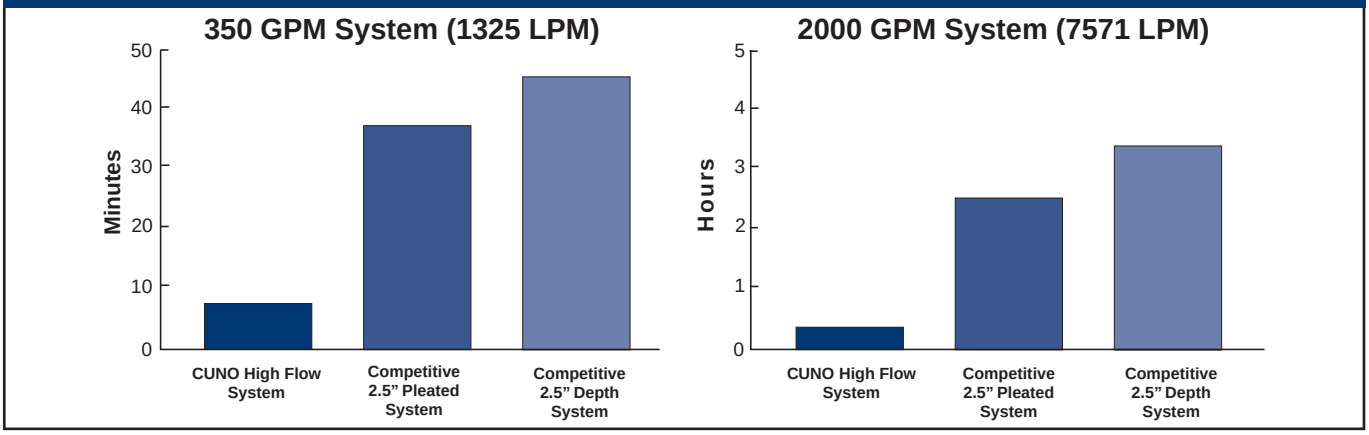
Figure 1 – Typical Cartridges Required & Housing Footprint Comparison



- The CUNO High Flow System requires 90% fewer cartridges as competitive 2.5" cartridge systems for a given flow rate.
- CUNO High Flow Housings are 33% to 50% smaller than competitively sized housings for a given flow rate.
- Fewer filters and a user-friendly housing design means faster change-outs than competitively sized systems.

* Comparison assumes fluid viscosity of 1 cp

Figure 2 – Typical Time/Labor for Change-Out



CUNO High Flow Filter Specifications and Operating Parameters

Materials of Construction

Filter Media **-** Each grade of the CUNO High Flow Filter is manufactured from meltblown FDA compliant polypropylene microfiber media, providing high particle removal efficiency with broad chemical compatibility. No adhesives, binders, or silicone are used in the manufacturing process. The raw materials composing these filters are FDA compliant according to CFR Title 21. All support layers and hardware are constructed with polypropylene.

O-rings **-** O-rings are available in a variety of materials to suit your applications, including the standard nitrile, Ethylene Propylene Rubber (EPR), silicone, and fluorocarbon.

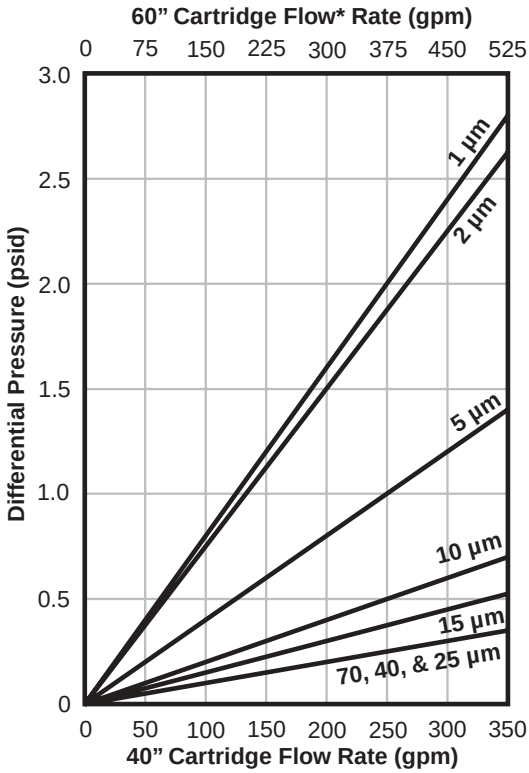
CUNO High Flow Filter Element Specifications

Parameter	Elements	
	40" High	60" High
Removal Ratings (microns)	1, 2, 5, 10, 15, 25, 40, and 70	
Flow vs. Differential Pressure	See Figure 3	
Filter Diameter (inches/cm)	6.5 / 16.5	
Filter Length (inches/cm)	40 / 101.6	60 / 152.4

Operating Parameters by Cartridge Length

Operating conditions	Elements	
	40" High	60" High
Maximum Operating Temperature (ºF / ºC)	160 / 71	
Maximum Recommended Flow Rate in water @ 70°F (gpm / lpm)	350 / 1325	500 / 1893
Maximum Forward Differential Pressure	50 psid @ 68°F (3.4 bar @ 20°C)	
Recommended Change-out Differential Pressure	35 psid @ 68°F (2.4 bar @ 20°C)	
Regulatory Status - All component materials of the CUNO High Flow polypropylene element are listed for food contact per 21 CFR.		

Figure 3 – Typical Cartridge Flow Rates



Fluid Compatibility

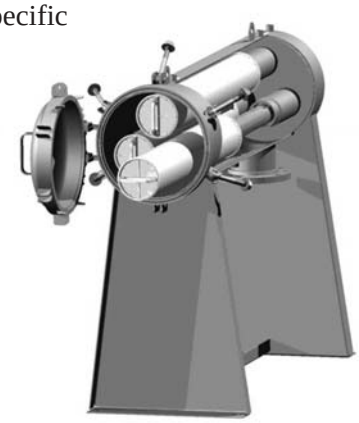
Chemical	Temperature	Chemical	Temperature	Chemical	Temperature
Acetic Acid 20%	160°F (71°C)	Hydrogen Peroxide	100°F (38°C)	Sodium Carbonate	160°F (71°C)
Alkanolamines	140°F (60°C)	Methyl Ethyl Ketone	70°F (21°C)	Sodium Hydroxide 70%	160°F (71°C)
Ammonium Hydroxide 10%	160°F (71°C)	Mineral Oil	70°F (21°C)	Sulfuric Acid 20%	160°F (71°C)
Bleach 5.5%	120°F (49°C)	Nitric Acid 20%	120°F (49°C)	Sulfuric Acid 70%	160°F (71°C)
Ethylene Glycol	160°F (71°C)	Potassium Hydroxide	140°F (60°C)	Urea	160°F (71°C)

The thermal and chemical resistance data presented in this brochure is for guidance only. Factors such as duration of exposure, fluid concentration, and temperature should also be considered. Thermal and chemical resistance should also be considered when choosing all materials exposed to fluids.

* estimated

CUNO High Flow Housings

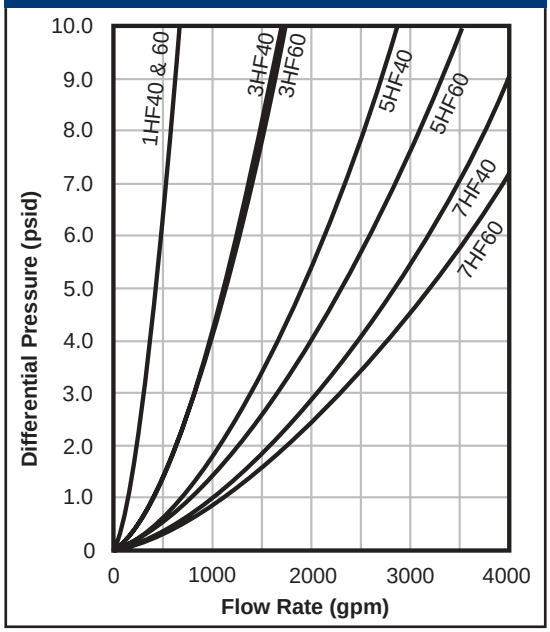
The CUNO High Flow Housings are specifically designed to deliver all of the system's benefits in a compact footprint. Housings are available in standard designs, as well as customizable configurations to suit your specific needs. All standard CUNO High Flow Housings are designed, manufactured, tested, and code stamped in accordance with ASME Section VIII, Division 1. Stainless steel housing external surfaces are glass-bead blasted for a consistent, easy care finish, while carbon steel units are painted.



The CUNO High Flow Housing is available in a variety of sizes to accommodate from 1 to 7 filter elements in both 40-inch and 60-inch lengths. Larger housings are available upon request. Housings are also available in horizontal or vertical configurations, depending on your needs. Choose the horizontal option to maximize ease of operation, or the vertical to minimize the system's footprint.

Features	
Horizontal	**Vertical**
■ ASME Code design	
■ Robust cartridge center-post design eliminates bulky support plates providing easy access to housing internals	
■ Hinged cover for easy element change-outs	■ User-friendly cover lifting device for easy element change-outs
■ Handles liquid at pressures and temperatures of up to 150 psig and 250 ºF	
■ Manufactured from 304 or 316L stainless steel for excellent corrosion protection (carbon steel option available in multi-element housing)	
■ Available for 40" and 60" element lengths	■ Available for 40" element lengths
■ Upstream and downstream gauge ports and drains	
Options	
■ Corrosion allowance for carbon steel housing – consult factory	
■ Choice of inlet/outlet flange size	

Figure 4 – Typical Housing Flow Rates



Housing Specifications

CUNO High Flow ASME Code Housing Specification

Model	Vessel Outside Diameter (in. / cm)	Material	Connection Size/Type (all ANSI flanges)		Recommended Maximum Flow (gpm / lpm) *		Maximum Pressure & Temperature	Approximate Shipping Weight (lb / kg)		
			40"	60"	40"	60"		40" Horiz.	40" Vert.	60" Horiz.
1HF	8 5/8 / 21.9	316L SS	4"	4"	350 / 1325	500 / 1893	150 psig @ 250ºF (10 bar@121 ºC)	340 / 154	305 / 138	375 / 170
3HF	16 / 40.6	Carbon steel, 304, or 316L SS	6"	8"	875 / 3312**	1500 / 5678		625 / 284	575 / 261	750 / 340
5HF	20 / 50.8		8"	10"	1550 / 5867**	2450 / 9274**		975 / 442	825 / 374	1150 / 522
7HF	24 / 61		10"	12"	2450 / 9274	3500 / 13249		1350 / 612	1250 / 567	1550 / 703
Larger housings available, consult factory										

* Pressure drop across cartridge not included (see Figure 3). ** Maximum flow rate based on nozzle size.

Housing Dimensions

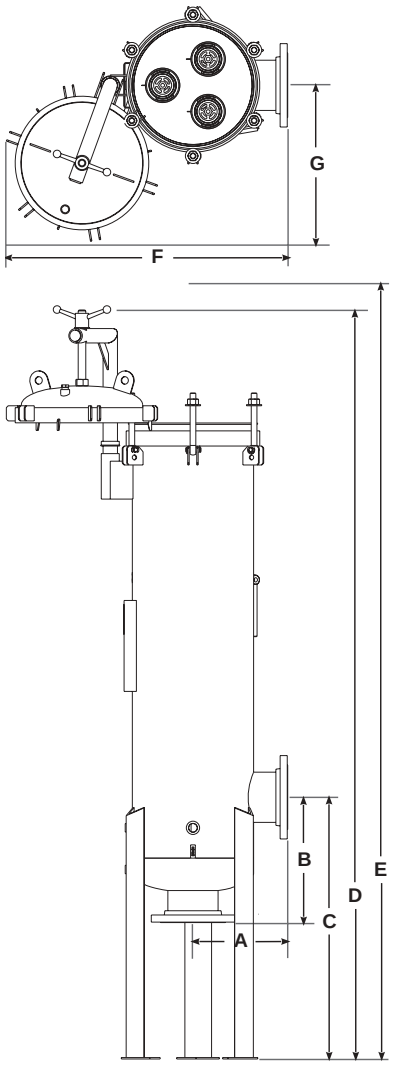
CUNO High Flow ASME Code Model Housing

Housing Model	Outside Diameter (in.)	Dimensions (inches)						
		A	B	C	D	E	F	G
Vertical Housing Models (available for 40" cartridges only)								
1HF40V	8 5/8	7 1/2	12 1/2	26 1/2	78 5/16	120	28 3/8	5 1/2
3HF40V	16	12 1/2	16 1/2	34 9/16	99 3/8	132	37 1/8	20 5/8
5HF40V	20	14 1/2	20 1/2	42 5/8	113	140	45	23 5/8
7HF40V	24	16 1/2	22 3/4	48 11/16	126	150	55	26
Horizontal Housing Models*								
1HF40H	8 5/8	35	7 1/2	12 1/2	64 1/4	108	24 1/2	12
1HF60H		35 9/16	7 1/2	12 1/2	84 1/2	150	24 1/2	12
3HF40H	16	40	12 1/2	16 1/2	73 1/8	115	30	21
3HF60H		40	12 1/2	18 1/2	97 1/4	156	30	21
5HF40H	20	40 15/16	14 1/2	20 1/2	81 3/4	120	36 1/2	25
5HF60H		40 15/16	14 1/2	21 1/4	103 3/4	160	36 1/2	25
7HF40H	24	47 1/32	16 1/2	22 3/4	87	124	40	30
7HF60H		47 7/16	16 1/2	24 5/8	108 11/16	165	40	30

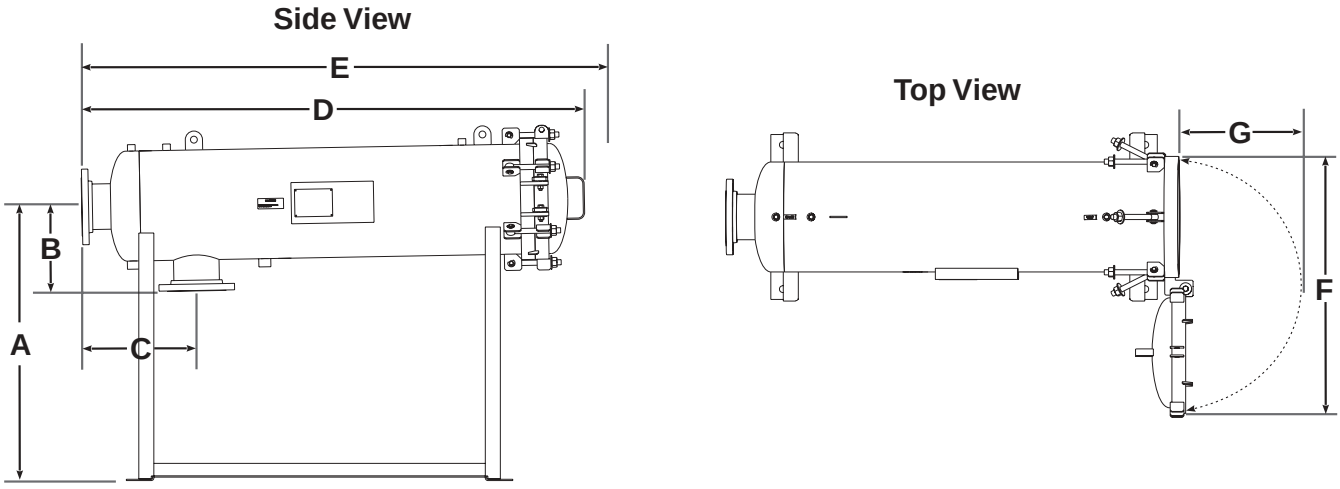
Housing Model	Outside Diameter (cm)	Dimensions (cm)						
		A	B	C	D	E	F	G
Vertical Housing Models (available for 101.6 cm cartridges only)								
1HF40V	21.9	19	31.7	66	198.9	317.5	72	13.9
3HF40V	40.6	31.75	42.06	87.78	252.41	322.58	94.29	52.38
5HF40V	50.8	36.67	52.22	108.26	287.02	351.79	114.3	60
7HF40V	61	41.91	60.96	136.36	320.04	381	139.7	66.04
Horizontal Housing Models								
1HF40H	21.9	86.3	18.8	32.3	163.1	276.8	62.2	30.4
1HF60H		100.4	18.8	48.2	198.1	363.2	62.2	30.4
3HF40H	40.6	101.6	31.5	42.38	185.73	292.1	76.2	53.3
3HF60H		101.6	31.1	47.30	247.01	406.4	73.6	53.3
5HF40H	50.8	103.9	36.8	52.7	207.6	317.5	92.7	63.5
5HF60H		103.9	36.8	54.6	263.5	419.1	92.7	63.5
7HF40H	61	119.4	40.7	58.8	220.9	330.2	101.6	76.2
7HF60H		120.4	41.7	63.2	276	381	101.6	76.2

* Sloped for drainage 1° to 3°

Vertical Housing



Horizontal Housing



CUNO High Flow Filter Element Ordering Guide

Filter Designation	Element Length (inches)	Material	Absolute Removal Rating (Microns)	O-Ring	Packaging Options (per box)
HF – High Flow	**40** – 40 in. **60** – 60 in.	**PP** - Polypropylene	**001** – 1 µm **002** – 2 µm **005** – 5 µm **010** – 10 µm **015** – 15 µm **025** – 25 µm **040** – 40 µm **070** – 70 µm	**A** – Silicone **B** – Fluorocarbon **C** – EPR **D** – Nitrile	**01** - 1 pack

CUNO High Flow ASME Code Housing Ordering Guide

Number of Filter Elements	Model	Size	Configuration	Housing Material	Gasket Material
1 **3** **5** **7**	**HF**	**40** – 40 in. **60** – 60 in.**	**H** – Horizontal **V** – Vertical **	**A** – Carbon Steel * **B** – 304 SS* **C** – 316L SS	**GA** – Silicone **GB** – Fluorocarbon **GC** – EPR **GD** – Nitrile

* Not available for single element (1-around) housing
** 60 inch vessel not available in vertical configuration

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WARRANTY

Seller warrants its equipment against defects in workmanship and material for a period of 12 months from date of shipment from the factory under normal use and service and otherwise when such equipment is used in accordance with instructions furnished by Seller and for purposes disclosed in writing at the time of purchase, if any. Any unauthorized alteration or modification of the equipment by Buyer will void this warranty. Seller's liability under this warranty shall be limited to the replacement or repair, F.O.B. point of manufacture, of any defective equipment or part which, having been returned to the factory, transportation charges prepaid, has been inspected and determined by the Seller to be defective. THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, AS TO DESCRIPTION, QUALITY, MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR ANY OTHER MATTER. Under no circumstances shall Seller be liable to Buyer or any third party for any loss of profits or other direct or indirect costs, expenses, losses or consequential damages arising out of or as a result of any defects in or failure of its products or any part or parts thereof or arising out of or as a result of parts or components incorporated in Seller's equipment but not supplied by the Seller.

a 3M company

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Appendix C-8

Process and Effluent Pumps Equipment

A B C E

Standard Centrifugal Pump

Basic Pedestal

Model VGH8D31 – B

Size 10” x 8”

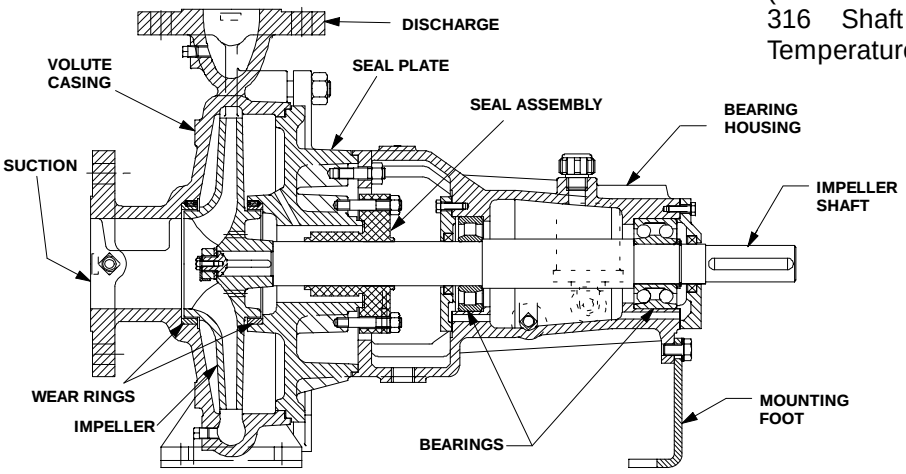
PUMP SPECIFICATIONS

Size: 10” x 8” (254 mm x 203 mm) Raised Face Flanges.
Casing: Ductile Iron. Maximum Operating Pressure 173 psi (12,2 kg/cm^2).*
Closed Type, Six Vane Impeller: Gray Iron No. 40. Handles 1 3/8” (35 mm) Diameter Spherical Solids.
Impeller Shaft: Steel No. 1045.
Bearing Housing: Gray Iron No. 25.
Replaceable Wear Rings: Gray Iron No. 25.
Seal Plate: Gray Iron No. 25.
Mounting Foot: Structural Steel Plate, Grade C.
Radial Bearing: Open Cylindrical Roller.
Thrust Bearing: Open Double Ball.
Bearing Lubrication: Oil.
Gaskets: Nitrile Rubber.
Hardware: Standard Plated Steel.

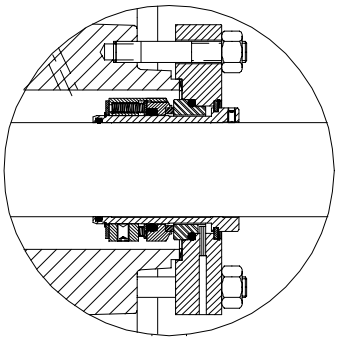
Standard Equipment: Bearing Housing Constant Level Oiler.

Optional Equipment: 10” NPT Suction Flange; 8” NPT Discharge Flange; Strainer; Bronze Impeller; Discharge Check Valve.

Seal Specifications
Cartridge Type, Mechanical, Self-Lubricated. Tungsten Carbide Rotating Face. Silicone Carbide Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel No. 316 Shaft Sleeve and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*



SEAL DETAIL



**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

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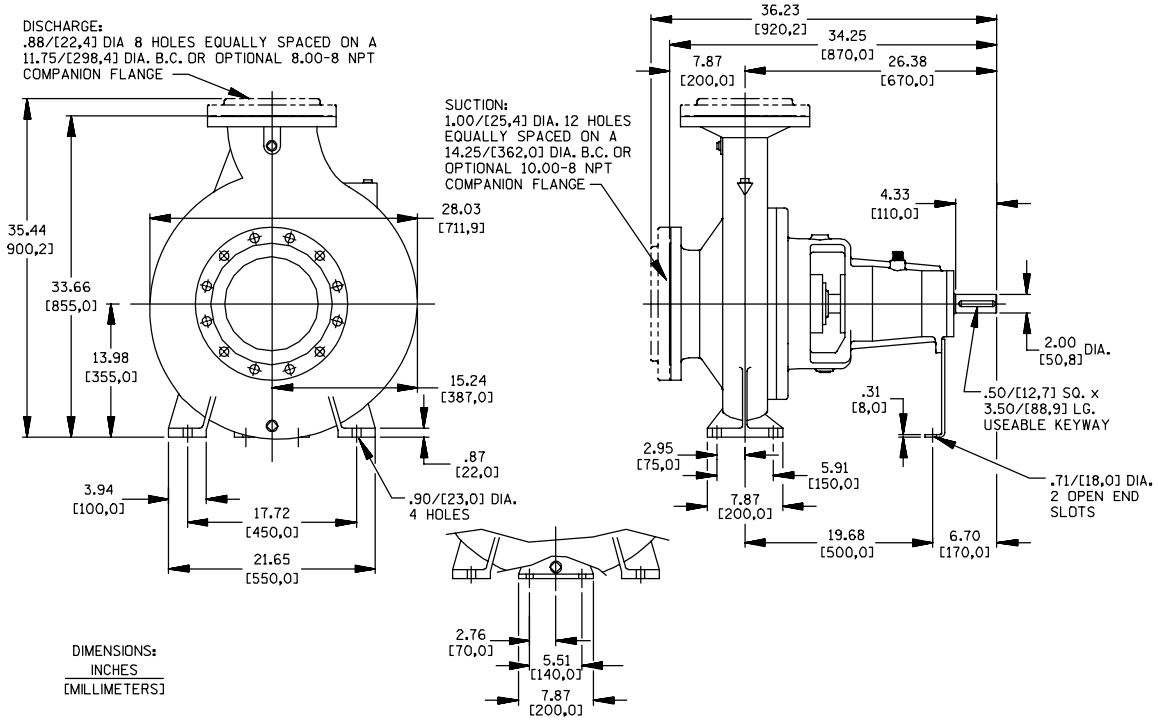
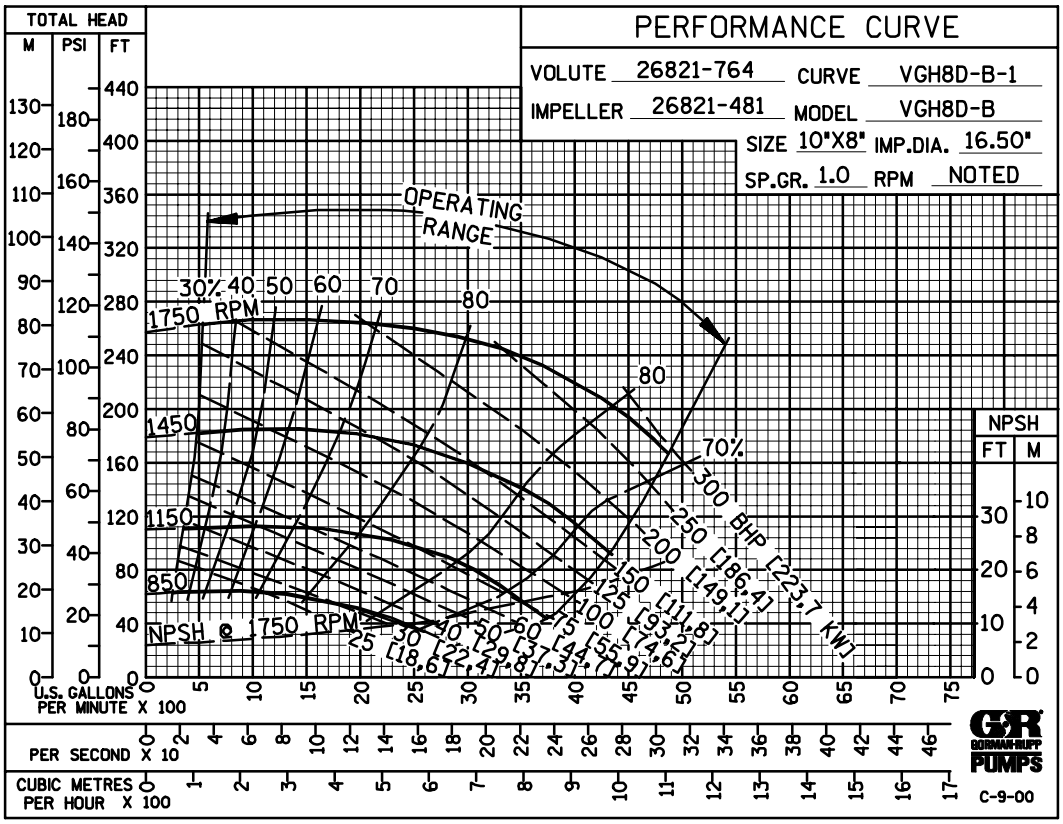
Specification Data	APPROXIMATE DIMENSIONS and WEIGHTS	NET WEIGHT: 705 LBS. (320 KGS.)
SECTION 70, PAGE 1551		SHIPPING WEIGHT: 755 LBS. (342 KGS.)
		EXPORT CRATE: 27.1 CU. FT. (0,77 CU. M.)





THE GORMAN-RUPP COMPANY ● MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED ● ST. THOMAS, ONTARIO, CANADA

Specifications Subject to Change Without Notice

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Appendix C-8

Bag Filter Equipment

Multi-Basket Strainers and Multi-Bag Filters

These multi-basket strainers and bag filters offer a wide range of flow capacities and contaminant-holding capabilities. They contain from 2 to 23 baskets.

To serve as a strainer, a unit is ordered with perforated stainless steel baskets (mesh-lined if desired). When ordered as a filter, it's fitted with perforated stainless steel baskets designed to hold disposable or cleanable filter bags. Industry-standard size bags are used: the standard 30 inch baskets accept bag size 2, the optional 15 inch baskets take size 1.

The standard pressure rating for all models is 150 psi. All housings can be supplied with an ASME code stamp, if required.

Features

- *Multiple housing styles available (standard, quick access, low profile, hinged)*
- *Permanently piped housings are opened without tools and without disturbing the piping*
- *Machined cover gasket groove provides positive O-ring sealing*
- *Carbon steel, 304 or 316 stainless steel construction housings*
- *Large-area, 30 inch deep, heavy-duty, 9/64 inch perforated baskets*
- *Easy to clean*
- *Low pressure drop*
- *Four cover seal materials: Buna N, Ethylene Propylene, Viton®, and Teflon®*
- *Pressure rating 150 psi*
- *Flanged connections for 2 through 12 inch pipe*
- *Vent, drain and gage connections*

Options

- *ASME code stamp*
- *Higher pressure ratings*
- *Corrosion allowances*
- *Steam jackets*
- *Special connection locations*
- *Bag hold down assembly (standard on QAC design)*
- *Inner baskets for dual-stage straining or filtering*
- *Cleanable wire mesh lined or perforated strainer baskets*
- *Special alloy materials*
- *Hydraulic cover lifting assembly*
- *Sanitary fittings*
- *Differential pressure indicators*

Duplex Systems

All multi-basket models described here are also available as duplex systems. Two units come piped together with valves to permit continuous use of either unit while servicing the other. One lever actuates all valves simultaneously or it can be ordered for automatic service. See page 63.

Rosedale Quick Access "QAC" Low Maintenance Filter/Strainer
COUNTERBALANCED COVER - Stops In Any Position
COVER SEAL
COVER HINGE MECHANISM
SECONDARY SAFETY RELEASE
POSITIVE BAG RESTRAINT
CLAMP RELEASE BAR
INLET
COVER SUPPORT ASSEMBLY
INLET DRAIN/VENT
PRIMARY RELEASE SAFETY LEVER
OUTLET
LOW PROFILE CLEARANCE
DRAIN

Choose Baskets That Strain or Filter

Whatever your needs dictate

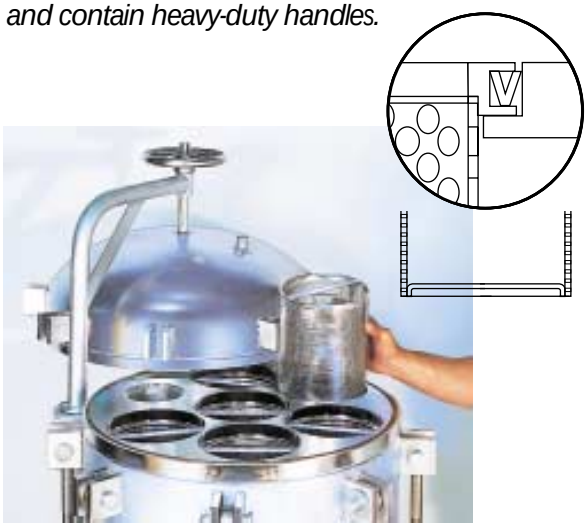
Strainer baskets are cleanable, reusable.

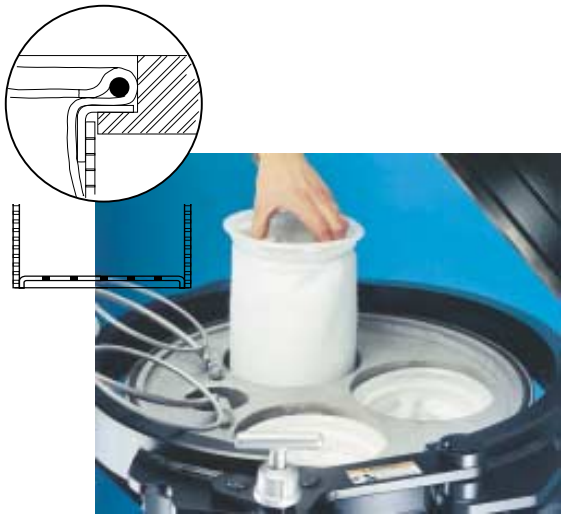
A seal is supplied on any strainer basket. It forms a seal between basket and housing to prevent dirty fluid bypass. Choose between various perforation sizes or wire mesh. Strainer baskets have flat, non-perforated bottoms and contain heavy-duty handles.

Filter bag baskets hold disposable filter bags.

Filter bags have an interference fit between the bags top rim and the housing causing a positive seal to prevent fluid bypass. Filter bag baskets have flat perforated bottoms.

Filter bags are available in a wide variety of felt, micro-fiber, monofilament and multifilament mesh materials. They are detailed completely on pages 126-128.





DUAL-STAGE– Dual-stage action will increase strainer or filter life and reduce servicing needs. This straining/filtering action can be achieved by ordering a second, inner basket. It is supported on the top flange of the outer basket. Both baskets can be utilized as strainers (with or without wire mesh linings), filter bag baskets, or a combination of strainer and bag basket.

Basket Data

Surface area of each 30 in. basket: 4.4 sq. ft. Volume of each 30 in. basket: 0.6 cu. ft.

Basket Construction

For cleanable strainer baskets, choose from the following perforation diameters: 1/4, 3/16, 9/64, 3/32, or 1/16 inch (for other not shown consult factory).

Any perforated basket can also be ordered lined with wire mesh. Stainless steel wire is used in mesh sizes 20, 30, 40, 50, 60, 70, 80, 100, 150, or 200.

Filter bag baskets, have standard 9/64 inch diameter perforations that are 51% open area. A wire mesh can also be utilized with bag baskets for two advantages:

1. *Fiber migration is minimized.*
2. *In the unlikely event of bag rupture, the wire mesh better contains the contaminant.*

Choose Housing Style

Designed to suit your requirements

The versatility of Rosedale Products provides a choice of several different designs.

- ***Quick Access Cover (QAC)*** *features a clamp and spring assisted hinged cover that is quick and easy to open and close with no tools required. This will significantly reduce change-out time and lower operating costs. The QAC is rated to 150 PSI and constructed to meet ASME code requirements. Built-in safety features ensure that the cover cannot be opened unless the internal pressure is first released. The QAC is offered with our low profile design making bags more accessible and easy to remove.*

- ***Low Profile Design (SLP) Housings*** *are compact and space saving, allowing for ease of bag change-out. Standard operating height is reduced, resulting in a safe design by eliminating platforms and ladders. The SLP is manufactured in any housing version, including our standard davit arm cover, QAC design, and spring assisted hinged cover.*

- ***Spring Assisted Hinged Cover (HLP)*** *opens and closes without effort. Simply loosen the swing bolts and lift the cover up to open. An automatic cover stop is provided. This design saves time by eliminating the labor intensive handwheel. It is offered standard with our low profile design, or can be ordered in the QAC design.*

- ***Standard Housing Design (STD)*** *is durable and economic. It includes a davit arm and handwheel to facilitate cover removal. It is our most versatile housing design offering a variety of options, including our low profile design.*

Quick Access Cover

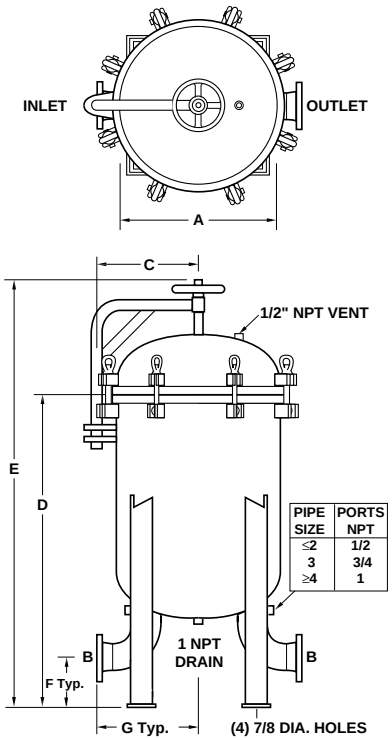
Low Profile Design

Standard Davit Arm

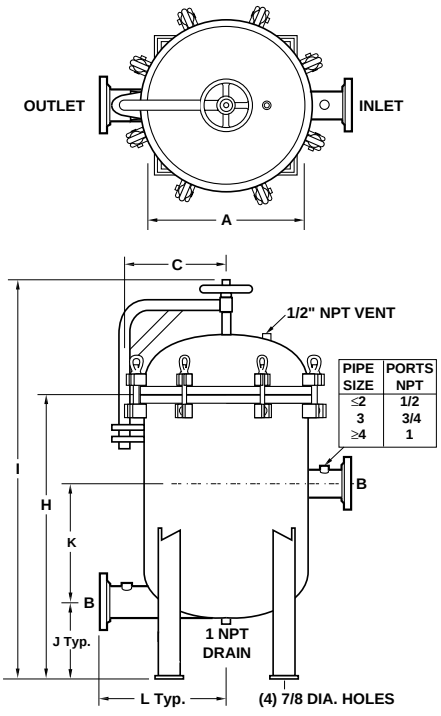
MODEL NUMBER & Dim. A	Pipe Sizes B	Leg Bolt Circle Dia.	Standard						Low Profile				
			C	D	E	F	G	Weight, lb (Approx)	H	I	J	K	L
16	2	14.0	10.9	40.1	57.1	4.50	10.5	400	37.9	54.9	8.00	15.0	13.0
	3			42.5	59.5	5.25	12.3	425	38.3	55.3	9.00	17.0	14.0
	4			44.9	61.9	6.00	14.0	450	N/A	N/A	N/A	N/A	N/A
18	2	16.0	11.9	40.5	58.0	4.50	11.1	450	39.6	58.5	8.00	15.0	14.0
	3			42.9	60.4	5.25	12.9	475	40.0	58.9	9.00	17.0	15.0
	4			45.3	62.8	6.00	14.6	500	N/A	N/A	N/A	N/A	N/A
22	2	20.0	14.0	41.4	60.0	4.50	11.9	485	39.5	58.0	8.00	15.0	16.0
	3			43.9	62.4	5.25	13.7	500	40.0	58.5	9.00	17.0	17.0
	4			46.2	64.7	6.00	15.4	515	39.5	58.0	9.00	19.0	18.0
	6			50.4	69.0	7.00	18.9	560	N/A	N/A	N/A	N/A	N/A
24	2	22.0	15.0	41.7	60.7	4.50	13.1	675	41.2	61.6	8.00	15.0	17.0
	3			44.1	63.1	5.25	14.8	700	41.6	62.0	9.00	17.0	18.0
	4			46.5	65.5	6.00	16.6	725	41.1	61.5	9.00	19.0	19.0
	6			50.7	69.7	7.00	20.1	750	N/A	N/A	N/A	N/A	N/A
30	2	28.0	18.0	42.8	63.3	4.50	15.2	635	41.3	61.9	8.00	15.0	20.5
	3			45.2	65.7	5.25	17.0	650	41.8	62.4	9.00	17.0	21.0
	4			47.6	68.1	6.00	18.7	665	41.3	61.9	9.00	19.0	22.5
	6			51.9	72.4	7.00	22.2	705	41.2	61.8	10.0	17.0	23.0
	8			56.4	76.8	8.25	25.7	850	N/A	N/A	N/A	N/A	N/A
36	3	34.0	21.0	46.4	68.4	5.25	18.8	840	43.3	64.5	9.00	17.0	24.0
	4			48.8	70.8	6.00	20.6	860	43.2	64.5	9.50	19.0	25.0
	6			53.1	75.1	7.00	24.1	870	43.2	64.4	10.5	17.0	26.0
	8			57.6	79.6	8.25	27.6	1010	43.2	64.4	11.5	17.0	27.0
	10			62.1	84.1	9.50	30.6	1150	N/A	N/A	N/A	N/A	N/A
42	4	40.0	24.0	50.0	73.5	6.00	22.6	1840	45.9	70.7	9.50	19.0	28.0
	6			54.3	77.8	7.00	26.1	1870	45.9	70.6	10.5	17.0	28.0
	8			58.8	82.3	8.25	29.6	1960	45.9	70.6	11.5	17.0	29.5
	10			63.3	86.8	9.50	32.6	2070	45.8	70.5	12.5	17.0	30.0
	12			68.0	91.5	11.0	36.1	2200	N/A	N/A	N/A	N/A	N/A
48	4	46.0	27.0	51.0	76.0	6.00	24.8	2015	46.5	71.5	9.50	19.0	32.0
	6			55.4	80.4	7.00	28.3	2075	46.4	71.4	10.5	17.0	32.0
	8			60.0	85.0	8.25	31.8	2200	46.4	71.4	11.5	17.0	32.5
	10			64.4	89.4	9.50	34.8	2350	46.4	71.4	12.5	17.0	33.0
	12			69.2	94.2	11.0	38.3	2530	N/A	N/A	N/A	N/A	N/A

Dimensions (IN)

(30-inch deep basket)



Standard

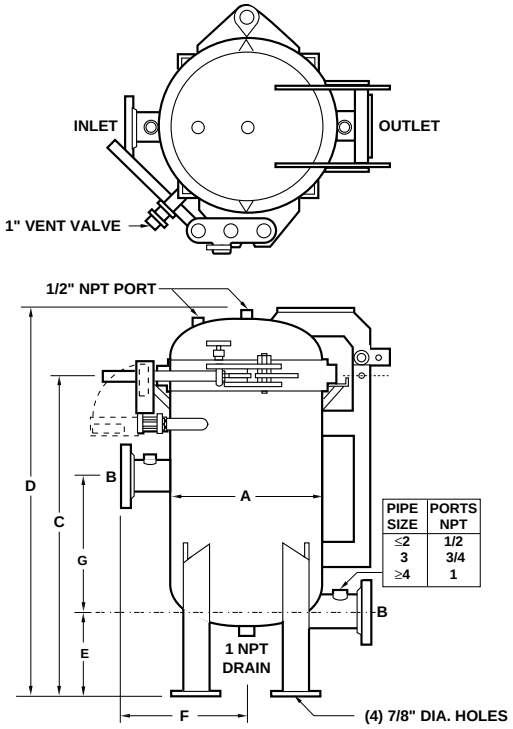


Low Profile

QAC Low Profile

MODEL NUMBER	A	Pipe Sizes B	Leg Bolt Circle Dia.	C	D	E	F	G
16 & 18	18	2	16.0	37.6	45.4	8.00	14.0	15.0
		3		38.1	45.9	9.00	15.0	17.0
22 & 24	24	2	22.0	41.2	49.9	8.00	17.0	15.0
		3		41.6	50.3	9.00	18.0	17.0
		4		41.1	49.8	9.00	19.0	19.0

Dimensions (IN)



QAC Low Profile

Model Selection (For all housings)

Model No.	Number of Baskets	Straining, Filtering Area, ft2	Nominal Flow Rate (gpm)**	Inlet/ Outlet Size (in)	Available Housing Styles
16	2	8.8	200	2,3,4*	Std,SLP,HLP,QAC
18	3	13.2	300	2,3,4*	Std,SLP,HLP,QAC
22	4	17.6	400	2,3,4,6*	Std,SLP,HLP,QAC
24	6	26.4	600	2,3,4,6*	Std,SLP,HLP,QAC
30	8	35.2	800	2,3,4,6,8*	Std,SLP,HLP
36	12	52.8	1200	2,3,4,6,8,10*	Std,SLP,HLP
42	17	74.8	1700	2,3,4,6,8,10,12*	Std,SLP,HLP
48	23	101.2	2300	2,3,4,6,8,10,12*	Std,SLP,HLP

*Not available on SLP, HLP, and QAC styles.

**Nominal flow rate is based on water @ 1 psi ΔP. For optimum filtering effectiveness, a maximum fluid velocity of 10 ft/sec should be maintained.

Pressure Drop Data

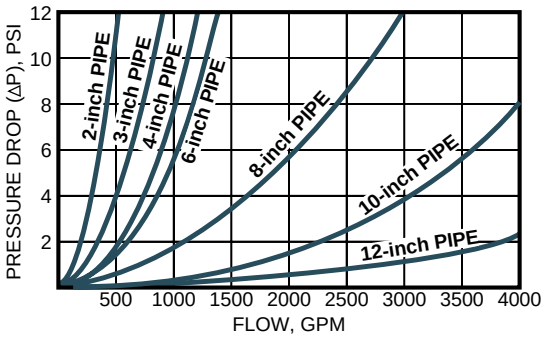
Basket strainers and bag filters are usually selected so that the pressure drop does not exceed 2 psi, when they are clean. Higher pressure drops may be tolerated when contaminant loading is low.

Determining housing pressure drop:

The pressure drops shown on the graph are reliable for all multi-basket housings, including strainer baskets or bag filter (perforated only or mesh lined). The pressure drop of any housing is governed by the size of the inlet and outlet, not the vessel itself.

1. *Using the desired pipe size and approximate flow rate, determine the basic pressure drop from the graph.*
2. *Multiply the pressure drop obtained in step 1 by the viscosity correction factor found in the accompanying table.*
3. *You now have the pressure drop for a clean multi-basket unit. If bag filters are to be employed, you must add the pressure drop they incur to get a true pressure drop for the assembly.*

Note: *Filter bags are specified separately. See pages 120-130.*



Recommended flow rates are based on housing only. Fluid viscosity, filter bag used, and expected dirt load should be considered when sizing a filter.

Viscosity Factors

CPS NUMBER	1	50	100	200	400	600	800	1000	2000
	(H_2O)								
	.65	.85	1.00	1.10	1.20	1.40	1.50	1.60	1.80

How To Order

Build an ordering code as shown in the example

Example: SLP-24-30-4F -1-150-C- B -S -M-20- C- 2P 1/16

Housings — Options — OPTIONAL INNER BASKET

HOUSING STYLE
- Standard (std) = **No Symbol**
- Standard Low Profile = **SLP**
- Quick Access Cover (16-24) = **QAC**
- Hinged Low Profile = **HLP**

MODEL NO.
- 16 = **16**, 30 = **30**
- 18 = **18**, 36 = **36**
- 22 = **22**, 42 = **42**
- 24 = **24**, 48 = **48**

BASKET DEPTH
- 15-in. = **15**
- 30-in. (std) = **30**

PIPE SIZE (FLANGED[1])
- 2-in. (Std,SLP,HLP16-48 / QAC 18 & 24) = **2F**
- 3-in.(Std, SLP, HLP 16-48 / QAC 18 & 24) = **3F**
- 4-in. (Std 16-48 / SLP, HLP 22-48 / QAC 24) = **4F**
- 6-in. (Std 22-48 / SLP, HLP 30-48) = **6F**
- 8-in. (Std 30-48 / SLP, HLP 36-48) = **8F**
- 10-in. (Std 36-48 / SLP, HLP 42 & 48) = **10F**
- 12-in. (Std 42, 48) = **12F**

OUTLET STYLE
- In-line, bottom (std) = **1**
- Side inlet/outlet (SLP, HLP, QAC) = **2**
- Side inlet/outlet, same side (SLP, HLP, QAC) = **4**

PRESSURE RATING[2]
- 150 psi (flanged) = **150**

HOUSING MATERIAL
- Carbon steel = **C**
- 304 stainless steel = **S**
- 316 stainless steel = **S316**

***COVER SEAL**
- Buna N = **B**
- Ethylene Propylene = **E**
- Viton® = **V**
- Teflon® Encapsulated Viton® = **TEV**
- Teflon® (solid white) = **TSW**

BASKET SEAL
- No seal = **N**
- Seal (only on strainer housings) = **S**

OPTIONAL INNER BASKET, MEDIA SIZE
Perforation diameters (for type 2P baskets)
1/4, 3/16, 9/64, 3/32, 1/16
Mesh sizes (for type 2M & 2BM baskets)
20, 30, 40, 50, 60, 70, 80, 100, 150, or 200

OPTIONAL INNER BASKET, TYPE
- **2B** = Filter bag basket, 9/64 perforations
- **2P** = Strainer basket, perforated metal
- **2BM** = Filter basket, mesh lined
- **2M** = Strainer basket, perforated, mesh lined

ASME CODE STAMP
- **C** = Code

BASKET, MEDIA SIZE No symbol if type B basket was selected
Perforation diameters (for type P baskets)
1/4, 3/16, 9/64, 3/32, 1/16
Mesh sizes (for type M & BM baskets)
20, 30, 40, 50, 60, 70, 80, 100, 150, or 200

BASKET, TYPE
- **PB** = Filter bag basket, 9/64 perforations
- **P** = Strainer basket, perforated metal
- **BM** = Filter bag basket, perforated, mesh lined
- **M** = Strainer basket, perforated, mesh lined
- **HWM** = Filter bag basket, heavy wire mesh

1. Flanges provided with the housing match the pressure rating of the vessel. Housings rated 150 psi have 150 class flanges. Housings rated 300 psi have 300 class flanges. Other styles and classes available. ANSI B16.5 Pressure-Temperature rating tables determine flange class for ASME code housings. Consult factory.
2. Higher pressure ratings available. Consult factory.

***Note:** The TEV and TSW cover seals are not available on the low profile QAC.

APPENDIX E

ADAPTIVE MANAGEMENT AND VALUE ENGINEERING PLAN

DRAFT

APPENDIX E

LOWER FOX RIVER REMEDIAL DESIGN
60 PERCENT DESIGN REPORT

ADAPTIVE MANAGEMENT AND VALUE ENGINEERING PLAN

Prepared for

Appleton Papers Inc.

Georgia-Pacific Consumer Products, LP

NCR Corporation

For Submittal to

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency

Prepared by

Anchor Environmental, L.L.C.

Tetra Tech EC, Inc.

June 2008

1 INTRODUCTION 1

2 VALUE ENGINEERING BACKGROUND 6

3 MONITORING AND ENGINEERING EVALUATIONS 7
3.1 CQAPP Monitoring 10
3.2 OMMP Monitoring 13
3.3 LTMP Monitoring 14

4 ADAPTIVE MANAGEMENT AND VALUE ENGINEERING RESPONSES 19
4.1 Management Alternatives 19
4.1.1 Continue Data Gathering and Evaluate Results 19
4.1.2 Initiate Adaptive Changes to Response Actions 19
4.1.3 Location-Specific Adaptations 20
4.2 Conduct Further Adaptive Management and Value Engineering 20
4.2.1 Streamline RD Process through Collaboration 20
4.2.2 Optimize RD and RA Sampling and Analysis 21
4.2.3 Optimize Dredging Design and Implementation 22
4.2.4 Optimize Dredge Residual Management 23
4.2.5 Optimize Sand Segregation and Re-use 25
4.2.6 Optimize Sediment Processing Operations and Materials/Services 26
4.2.7 Address Potential Future Lake Level Declines 26
4.2.8 Optimize Capping Design and Implementation 28
4.2.9 Other Adaptive Management Ideas 30

5 ADAPTIVE MANAGEMENT DECISION MAKING AND DOCUMENTATION 32

6 REFERENCES 35

List of Tables

Table 3-1 Strategies Used in Baseline Monitoring Program to Assure Effective Adaptive Management 15
Table 4-1 Preliminary Listing of Alternative Capping Material 30

List of Figures

Figure 1-1 Fox River OUs 2 to 5 Project Area 5

A/OT	Agency/Oversight Team
ARAR	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CQAPP	Construction Quality and Assurance Project Plan
cy	cubic yards
DCU	dredge certification unit
DMU	dredge management unit
GCL	geocomposite clay liner
HDPE	high-density polyethylene
LOS	level of significance
LTMP	Long Term Monitoring Plan
NRC	National Research Council
OMMP	Operations, Maintenance and Monitoring Plan
OU	Operable Unit
PCB	polychlorinated biphenyl
ppm	part per million
RA	Remedial Action
RAL	remedial action level
RAO	Remedial Action Objective
RD	Remedial Design
RI/FS	remedial investigation/feasibility study
RM	river mile
ROD	Record of Decision
SAP	sampling and analysis plan
SOP	standard operating procedure
SQT	sediment quality threshold
SWAC	surface weighted average concentration
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VE	value engineering
WDNR	Wisconsin Department of Natural Resources
WTP	wastewater treatment plant

1 INTRODUCTION

This document presents a draft Adaptive Management and Value Engineering (VE) Plan for remediation of polychlorinated biphenyls (PCBs) in Operable Units (OUs) 2 to 5 of the Lower Fox River and Green Bay Site (Site; Figure 1-1). "Adaptive Management" is exactly that—management of a lengthy project that "adapts" itself over time to reflect the lessons learned from actual experience gained during the course of project implementation. The objective is to build on things that work in the early implementation process — and change the things that do not work, or are not fully efficient —with an eye towards achieving remedial objectives in the most efficient and cost-effective manner possible. Adaptive management involves tailoring a technical approach based on experience, and in particular, determining whether field experience has yielded information that differs significantly from assumptions made when a particular course of action was chosen in the first place. Adaptive management requires flexibility so that a technical approach in general, and the specifics of implementation in particular, can be changed—when warranted—without cumbersome procedural hurdles.

"Value Engineering" is different from adaptive management. It reflects a desire to design or engineer activities in the underlying project in a manner that adds "value" to the project, meaning greater efficiency, reduced time to completion, more effective production and/or less cost. The objective is to implement work in the best way possible consistent with overall project objectives. VE can be undertaken up front as a part of remedial design (RD). Several examples are described in the following sections. VE can also be a critical subcomponent of adaptive management — as when, for example, experience shows that past practice is not the best way to do things and VE can be used to optimize the project to find a successful alternative as the project moves forward. The alternative may be a "tweak" to past practices, or it might reflect a more significant change in the way things are done.

Although they are two different concepts, VE and adaptive management work together in many respects, as discussed in the sections below. When the two work together, project experience can reveal the need to adapt the way things are being done, and VE can be used—based on site-specific experience—to show which adaptation is the most likely to succeed. In any event, flexibility is an important component of both adaptive management and VE.

Adaptive management and VE of the OUs 2 to 5 RD and remedial action (RA) will be a collaborative process involving the United States Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR) (collectively the "Response Agencies") and the implementing parties. The Response Agencies and implementing parties will initially seek to refine this draft plan through the use of collaborative RD workgroups, and will continue the process through collaborative evaluation of field data and engineering evaluations as the RA is initiated, regularly assessing the relevance of new information on future actions, and readjusting the course for future implementation as appropriate.

The OUs 2 to 5 RA will be one of the largest and most costly remediation projects ever performed in the U.S. Based on current estimates presented in the 60 Percent Design Volume 2, the RA is expected to cost approximately $600 million, and will include dredging of approximately 3.9 million cubic yards (cy) of sediments exceeding the 1.0 part-per-million (ppm) PCB remedial action level (RAL), placement of engineered caps over approximately 410 acres of the river, and sand covers placed over an additional 300 to 700 acres depending on post-dredge residual characteristics. Other large-scale components of the project include sediment dewatering at the former Shell property and beneficial reuse of relatively clean segregated sand, all of which will are anticipated to continue over a 9-year period beginning in 2009 and continuing through 2017. Long-term and large-scale projects such as the OUS 2 to 5 RA provide an excellent opportunity for adaptive management and VE to accomplish schedule and cost savings while concurrently achieving equivalent or enhanced environmental protection, consistent with the Record of Decision (ROD) Amendment issued 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 2007).

As described in the RD Work Plan, which was approved by the Response Agencies in June 2004, adaptive management is an integral element of this RD. The RD Work Plan defines, with Agency oversight, the framework for modification of annual RA Work Plans in response to new information and experience gained during initial RA in OUs 2 to 5. Because of the large scale and complexity of the OUs 2 to 5 RA, VE will also be integrated into the adaptive management program to achieve schedule and cost savings while at the same time assuring equivalent or enhanced environmental protection. Annual RA Work Plans incorporating adaptive management and VE elements will be reviewed and approved by the Response Agencies

pursuant to the Administrative Order for RA, USEPA Docket No. V-W-08-C-885 (the "Order"). Thus, the goal of achieving sediment cleanup performance objectives in OUs 2 to 5 will be met by applying information obtained during each year of RA in an iterative framework of measurement and VE evaluations.

This Adaptive Management and VE Plan uses elements commonly found in adaptive management programs for water resource management (National Research Council [NRC] 2004), natural biological resource management (Holling 1978), and ecosystem restoration (Thom 1997). According to the NRC (2004), adaptive management is not a one-size-fits-all process. Instead, each project's adaptive management plan contains unique features that are dependent on the type of project, the process for developing the project, and a variety of other factors. At the same time, adaptive management plans typically contain certain common elements, generally summarized by the NRC (2004) as follows:

- Steps to monitor performance and evaluate outcomes
- Assessing and revising project objectives as needed
- Incorporating past experience into future decisions

As discussed in USEPA (2005), the process to optimize management of large sediment ("megasite") cleanup projects, such as OUs 2 to 5, is complex and likely to involve many considerations. Adaptive management is a way to balance these considerations in the first place, and to modify site activities — with Response Agency review and approval — as experience and circumstances dictate later on.

The overall program goals of CERCLA are to implement remedies that are cost-effective and protective of human health and the environment. The best route to meeting these and other requirements, as well as the best route to overall risk reduction, depends on many factors, some of which may be subject to significant uncertainty. Notwithstanding that uncertainty, management decisions must be made. Implementation of an appropriately tailored adaptive management plan can improve the decision-making process while at the same time assuring consistency with CERCLA requirements, the ROD Amendment, and Response Agency review and approval. That is the purpose of this Adaptive Management and VE Plan. This approach is particularly valuable for the OUs 2 to 5 RA, since remedy implementation is envisioned to last nearly a decade.

The remainder of this Adaptive Management and VE Plan consists of the following sections:

- Section 2 presents the background of VE undertaken to date and summarizes ongoing VE activities.
- Section 3 describes the type of monitoring that will be conducted during the adaptive management program.
- Section 4 describes the adaptive management and VE strategies that will be implemented during RA, including general types of adaptive responses that may be used if certain field conditions exist.
- Section 5 describes the general decision making process, documentation and schedule for adaptive management modifications, coupled with annual RA Work Plans.
- Section 6 lists the references used in preparing this Adaptive Management and VE Plan.

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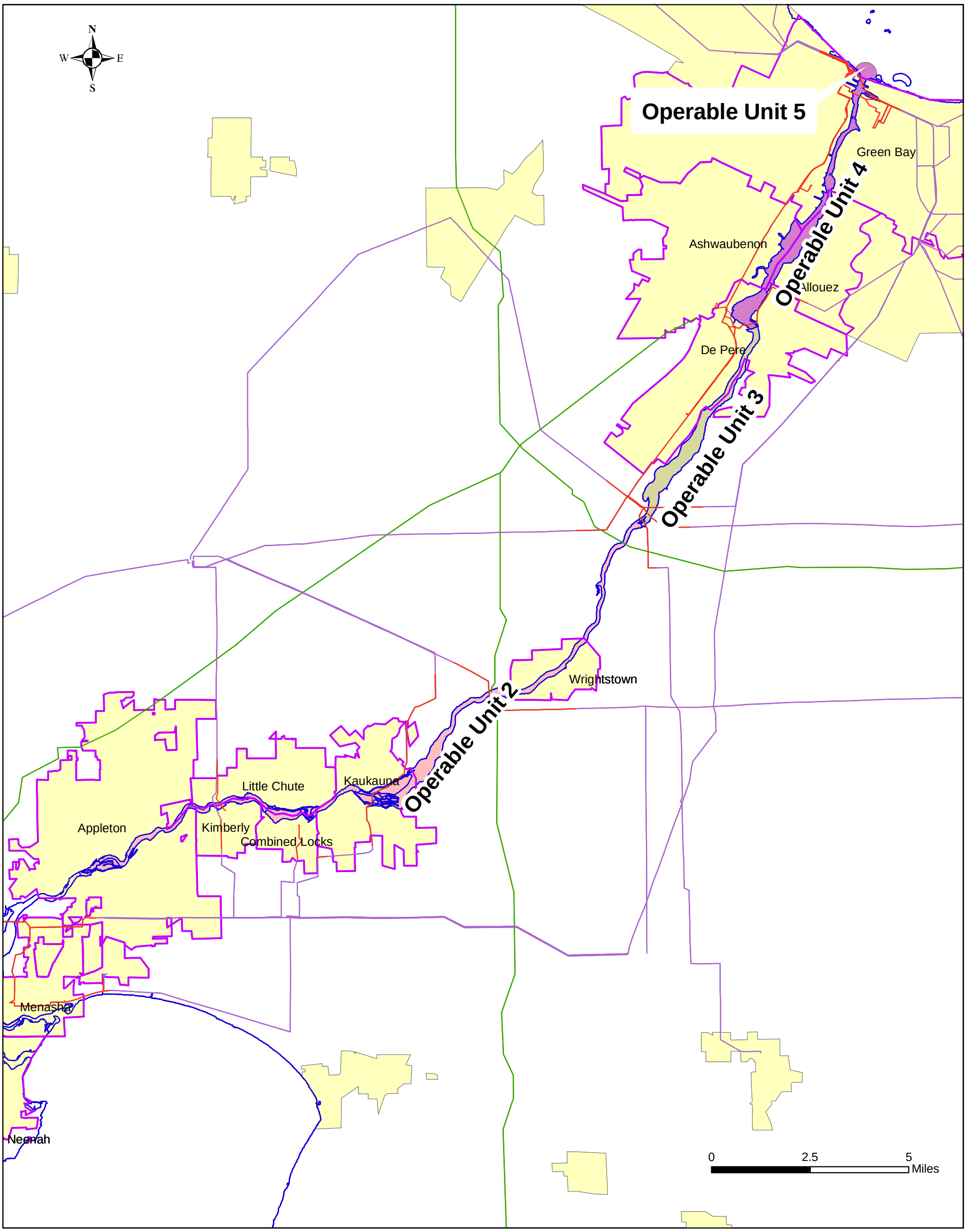

Legend

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

Operable Unit Number

- 2
- 3
- 4

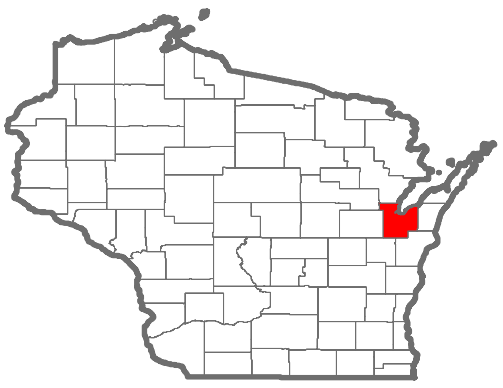

Figure 1-1
Lower Fox River
Area Location Map

Lower Fox River OU 2-OU 5

TETRA TECH EC, INC.

ANCHOR ENVIRONMENTAL, L.L.C.

Shaw

2 VALUE ENGINEERING BACKGROUND

An informal VE process as a part of RD began in March 2008 as a collaborative undertaking between the Response Agencies, the respondents to the Order, and the RD/RA contractor (the Tetra Tech Team). An initial brainstorming session identified a number of design modifications that might provide schedule and/or cost savings with equivalent or enhanced environmental protection. A total of 53 ideas were discussed at the initial session. A preliminary cost screening, based on order-of-magnitude cost estimating, was performed in April 2008 to identify the best candidates for application to the OUs 2 to 5 RA. This was followed by a collaborative workgroup meeting, where the screening of alternatives was presented and discussed. From this discussion, 11 strategies were identified as the most promising, and they were subjected to further screening and evaluation, culminating in a final meeting in May 2008 where it was agreed that six consolidated VE strategies would be carried forward during RD/RA as follows:

1. Streamline RD process through collaboration
2. Optimize RD and RA sampling and analysis
3. Optimize dredging design and implementation
4. Optimize sand segregation and reuse
5. Optimize sediment processing operations and materials/services
6. Optimize capping design and implementation

These six VE strategies were carried forward, either as part of near-term activities (i.e., incorporated into the RD Volumes 1 and 2, and/or in the forthcoming 2009 RA Work Plan), or as follow-on activities that would be developed in more detail and incorporated into later annual RA Work Plans prior to implementation. The initial VE process recognized that additional VE opportunities may be identified during the course of RA. These opportunities will be addressed through adaptive management and included in the annual RA Work Plans, as discussed in subsequent sections.

3 MONITORING AND ENGINEERING EVALUATIONS

As discussed in Section 1, the basic tenets of adaptive management are that: 1) collecting information and learning about the system while the program is underway is a critical part of project management; and 2) based on operational experience and data, timely revisions and modifications to site work can be made to improve performance while assuring compliance with project objectives. Ongoing data collection, engineering evaluation, and documentation are built into the overall RD/RA program for OUs 2 to 5, and are also integrated into this adaptive management and VE program.

The Construction Quality Assurance Project Plan (CQAPP; Appendix D of the 60 Percent Design Report Volume 1) and CQAPP Addendum (Appendix F of the 60 Percent Design Report Volume 2), for example, outline monitoring and associated short-term contingency plans that will be performed during implementation of annual RA activities in 2009 and in 2010 and beyond, respectively. Actual performance in the field and corresponding monitoring data will be evaluated to determine whether changes need to be made in the way things are being done. The success of adaptive management will become apparent if and when the implementation of such changes results in significant improvements in performance (cost, schedule, and/or effectiveness).

Construction monitoring activities to be performed as described in the CQAPP include water quality monitoring and sediment confirmation sampling to verify compliance with RD objectives, consistent with the ROD Amendment and earlier Response Agency RODs. This includes a post-dredge verification sampling program to confirm the attainment of the 1.0 ppm RAL and or/compliance with the surface weighted average concentration (SWAC) goals of the ROD Amendment. If the RAL and SWAC are not met within an RA certification area, a range of response actions may be appropriate. Presently, the RD contemplates re-dredging or sand cover based upon the specific data collected during verification sampling after dredging, along with contingencies for post-dredge engineered cap placement. Post-dredge engineering evaluations to determine appropriate response actions will consider data collected on sediment physical properties (including in-situ density), system geomorphology, high resolution bathymetric output, and post-dredge chemical sampling and analysis. An evaluation of sampling type (core versus surface grab) and frequency for each dredge management unit (DMU) will be developed as part of the adaptive management process. The CQAPP

Addendum also includes plans for verifying that engineered caps and sand covers have been constructed in compliance with the RD. Post construction verification programs can be optimized as part of the adaptive management process, depending on which activities or technologies demonstrated superior results, including faster data processing capabilities and degree of accuracy.

Other elements of the RA will require long-term monitoring and/or maintenance. For example, long-term monitoring will be performed on any caps that are installed in OUs 2 to 5 to ensure their integrity, protectiveness, and effectiveness in perpetuity. Long-term cap monitoring will include bathymetric surveys and focused surface sediment sampling and core sampling (where feasible). If monitoring or other information indicates that the cap in an area no longer meets its original as-built design criteria and that degradation of the cap in the area may result in an actual or threatened release of PCBs at levels exceeding the RAL, additional response activities will be undertaken in the affected cap area. Long-term cap monitoring plans and contingency measures are presented in the Operations, Maintenance, and Monitoring Plan (OMMP; Appendix H of the 60 Percent Design Report Volume 2) and are summarized in Figure 2-3 of the OMMP.

Natural recovery areas in OU 2 (which are downstream of OU 1 and upstream of OU 2 active remediation areas) and in OU 5 (which are offshore of the mouth of the Fox River) will be monitored to verify the anticipated reduction in surface sediment concentrations of PCBs over time, to confirm ROD predictions of natural recovery over the next decade or more. As practicable, co-location of sampling locations with prior Response Agency remedial investigation/feasibility study (RI/FS) stations will be performed to facilitate assessments of natural recovery over time. Natural recovery monitoring will also include a limited number of "no action" stations within OUs 3 and 4. Long-term sediment natural recovery monitoring plans are presented in the OMMP (Appendix H of the 60 Percent Design Report Volume 2).

Although the 1.0 ppm PCBs RAL performance standard or the SWAC goal (0.28 ppm in OU 3 and 0.25 ppm in OU 4) must be met before construction of the RA can be deemed complete in those OUs, the Response Agencies have concluded that it will take additional time for natural recovery before some of the remedial action objectives (RAOs) specified in the ROD and ROD Amendment are achieved. For example, while the ROD Amendment estimated that a SWAC of

approximately 0.28 ppm PCBs will be achieved in OU 3 after the completion of active remediation, an additional 9 years of natural recovery was assumed to be necessary to achieve the surface sediment quality threshold (SQT) for unlimited walleye consumption (i.e., 0.049 ppm PCBs). Natural recovery of both actively remediated and un-remediated areas will be necessary for certain SQTs and other RAOs discussed in the RODs and ROD Amendment to be achieved.

Long-term monitoring of surface water and biota will be performed to assess progress in achieving RAOs and to determine remedial success. Monitoring will continue until acceptable levels of PCBs are reached in surface water and fish. A preliminary draft of the Long-Term Monitoring Plan (LTMP) is presented in Appendix I of the 60 Percent Design Report Volume 2, and is subject to further collaborative workgroup review.

As practical, natural recovery monitoring, cap monitoring, and water/biota sampling will be coordinated to take place during the same year, conducted approximately 1 year prior to the scheduled CERCLA 5-year reviews, so that the most up-to-date information will be available to inform the process and to better scope future monitoring efforts and strategies (see Section 5). The data collection will include monitoring to assess success criteria as defined in the RODs and ROD Amendment, as well as monitoring to collect data to evaluate design and implementation uncertainties.

Data collected from all these activities will form an integral part of the yearly adaptive management and VE evaluations to be performed prior to finalizing the annual RA Work Plans. If significant changes are envisioned from the ongoing implementation protocols, a collaborative discussion will be conducted within the technical workgroups to identify and select methods and techniques that will further optimize the RA.

A summary of relevant CQAPP, OMMP, and LTMP monitoring and associated evaluations that will inform the adaptive management and VE process are presented in Sections 3.1 through 3.3; more detailed discussions are presented in the appendices that accompany the 60 Percent Design Report.

3.1 CQAPP Monitoring

As described in the CQAPP (Appendix D of the 60 Percent Design Report Volume 1) and CQAPP Addendum (Appendix F of the 60 Percent Design Report Volume 2), detailed 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. The verification plans and performance criteria were developed consistent with the ROD Amendment and build on similar plans and criteria that were utilized for the Lower Fox River Phase 1 and OU 1 projects. The CQAPP addresses the following issues relevant to verification sampling and contingency response actions:

- Verification that dredging has been completed to the limits and extents required by RD
- Verification that dredging has achieved the RAL for PCBs in dredge-only areas
- Verification that post-dredge surface concentrations in dredge-and-cap areas are consistent with RD expectations and that post-dredge cap thicknesses have been selected and constructed appropriately
- Verification of post-dredge PCB concentrations for which placement of a minimum 6-inch sand cover would be a suitable management response action, consistent with the provisions of the ROD Amendment
- Description of specific elements of the more detailed post-dredge engineering evaluations that would be performed in 'real time' to inform expedited contingency response decisions (e.g., re-dredging, engineered capping, or sand cover placement) within a given certification area

Building on an initial VE strategy, sediment sampling will be performed in summer 2008 (as part of Phase 2A tasks under the Order) to further refine the neatline delineation of sediments containing PCB concentrations above the 1.0 ppm RAL in dredge-only areas in upper OU 3 targeted for dredging in 2009. As part of the collaborative workgroup RD process, an evaluation was performed of potential further refinements to the geostatistically-based depth of contamination model. The recent geostatistical evaluation, presented as an attachment to the CQAPP, indicated that additional sampling to initially double the current sampling density in certain dredge-only areas to achieve an overall sampling density averaging approximately five samples per 2 acres in upper OU 3 would further optimize the

dredge plans in this area. The objectives of the additional pre-dredge "infill" sampling plans are to: a) reduce remediation of non-target sediment; b) reduce costs of post-dredge verification sampling; and c) reduce (and potentially eliminate) the need for re-dredging cleanup passes.

Upon completion of the 2008 infill sediment sampling and analysis program in upper OU 3, the dredging neatline elevation in dredge-only areas of upper OU 3 that are targeted for RA in 2009 will be updated using ordinary kriging of all available data. The forthcoming geostatistical analyses will be incorporated into the Final Design Volume 1 and 2009 RA Work Plan, and will target a significance level of 0.5 for the dredge template, but will also evaluate whether alternative significance levels may provide improved overall performance, with and without consideration of anticipated overdredge allowances.

The additional infill sampling is expected to improve the performance of the neatline dredging plans based on ordinary kriging. The updated dredging neatline will serve as the basis for final dredge plans to be implemented in 2009, and will be documented in the Final Design Volume 1 and 2009 RA Work Plan. Subject to further VE and adaptive management (see Section 4), a more focused scope (and likely reduced frequency) of infill sampling may occur each year prior to planned dredging actions; the results of additional infill sampling will be incorporated into annual RA Work Plans.

Consistent with the approach utilized for the Phase 1 and OU 1 projects, placement of the minimum specified thicknesses of sand cover and each layer of engineered caps will be verified through a combination of accurate material placement records (to compute the delivered thickness), physical measurements, and bathymetric surveying. The specific method and measurement technique utilized to verify cap and cover placement will be dependent on the thickness and material type of the layer being verified (e.g., ranging from a 6-inch sand layer to an 18-inch quarry spall layer) and on the local site conditions (e.g., water depth, size of area, etc).

Engineered cap and sand cover placement activities, respectively, will be initiated within discrete test areas. The intent of these test areas will be for the Tetra Tech Team and the Agency/Oversight Team (A/OT) to observe methods of material placement for compliance

with the performance criteria, to assess quality control methods (including potential refinements to protocols or tools), and to confirm required thickness and extent of materials. The Tetra Tech Team may need to adjust its production or measurement methods based on the results of the initial tests.

Following completion of sand or cap placement, the thickness of placed sand will be physically measured in samples collected at randomly-selected locations. Selection of the most appropriate measurement technique will be determined prior to or during the initial stages of construction and may be varied as RA proceeds, depending on local site conditions. For example, if physical measurements verify that the mixing zone at the base of the placed cap layer is negligible, the adaptive management process will be employed to reduce the scope of further verification monitoring, and/or reevaluate the need for a 6-inch chemical isolation layer using a sand cover. A thinner chemical isolation layer may suffice when the mixing zone is negligible.

During the initial stages of full-scale sand cover placement, a regression-based statistical approach will be used to develop a relationship between the thickness determined through material placement records and the mean measured thickness of the sand cover placed, consistent with the approach utilized for the Phase 1 and OU 1 projects. Initially, it is anticipated that physical measurements of the placed sand cover thickness will be performed within each placement unit. However, assuming the correlation between the measurement methods is verified, and provided the method of placement has not been significantly modified, the frequency of physical sampling may be reduced as construction proceeds to expedite the process of verifying compliance with the minimum required thicknesses. More intensive sampling would be resumed following extended periods of inactivity or significant modifications to the material placement method, or in special subarea locations where site specific conditions require a deviation in approach.

Contingency plans for addressing poor correlations between thickness measurements will be developed as part of the adaptive management process in order to more fully utilize information gained from early RAs. Again, monitoring adjustments and contingency plans will be documented in annual RA Work Plans.

3.2 OMMP Monitoring

Certain elements of the RA require long-term monitoring and/or maintenance, and such activities are covered under the OMMP (Appendix H of the 60 Percent Design Report Volume 2), including post-construction monitoring and maintenance of capped areas to ensure the cap remains physically stable (i.e., does not erode) and chemically protective. The OMMP also includes long-term monitoring of natural recovery areas. The objectives of the OMMP monitoring programs are to confirm that RA performed in OUs 2 to 5 achieves the performance standards specified in the ROD Amendment, including verification of the effectiveness of engineered caps and sediment natural recovery. The OMMP also identifies points of compliance for the RA and potential cap contingency response actions that could be implemented in the event that the engineered caps do not meet performance standards.

The integrity of the caps will be monitored to ensure the cap thickness does not diminish by erosion. Cap monitoring will also ensure that chemicals of concern in the underlying sediments do not migrate through the cap and into the river. Given that completion of capping is anticipated to span approximately 8 years (beginning in 2010 and continuing through 2017), physical monitoring will occur independently within individual cap certification unit (CCU) groupings constructed in the same year. Focused sediment core sampling and physical inspections (or other techniques suitable for measuring the thickness of placed caps with consideration of armor stone size) will also be performed.

Post-construction bathymetric surveys of all capped area will be completed and focused core sampling (or other suitable measurements) will be collected during Years 2, 4, and 9 following completion of capping throughout the individual work area, such that the results could be incorporated into the 5 and 10-year CERCLA reviews. In addition, bathymetric surveys of all capped areas will be performed as soon as possible following a hydrodynamic (flood and/or seiche) event with a recurrence interval of 20 years or more. Supplemental bathymetric surveys will also be performed following major river construction events (e.g., new bridge construction) or if water levels drop more than 1 foot below the low-water elevations used to develop the cap designs (see Section 6 of the accompanying 60 Percent Design Volume 2). Adaptive management monitoring modifications will be documented in the annual RA Work Plans.

3.3 LTMP Monitoring

Long-term monitoring of surface water and biota will be performed to assess progress in achieving RAOs and to determine remedial success, building on the results of the 2006 to 2007 baseline monitoring program. Strategies used in the baseline monitoring program to assure effective adaptive management are summarized in Table 3-1, and similar evolving strategies are anticipated under the LTMP. Monitoring under the LTMP will continue until acceptable levels of PCBs are reached in surface water and fish. A preliminary draft of the LTMP is presented in Appendix I of the 60 Percent Design Report Volume 2, and is subject to further collaborative workgroup review and adaptive management.

Table 3-1
Strategies Used in Baseline Monitoring Program to Assure Effective Adaptive Management

Monitoring Activity	Challenges	Successes	Adaptive Strategies Implemented	Implications for Long-term Monitoring	A/OT Comments
BASELINE WATER SAMPLING					
Data Completeness during Winter Months	Severe winter conditions present safety risk for winter sampling crews	Minimum completeness goals (2/4 cold months) met in all OUs; optimum completeness goals (4/4 cold months) met in 6 out of 10 OUs	Marine ice recovery contractor was hired to better assess field conditions for safe access	Stratify water data (winter period = Dec through Mar). Reduce or eliminate sampling in winter, especially in Green Bay. Retain marine ice recovery contractor if needed.	The A/OT recommends that the DT use the existing data to develop a technical justification for the frequency of sampling for April through November. It is our understanding that J. Kern and J. Wolfe are working on this justification based on power considerations.
(2) Blank Contamination	Blank contamination is unavoidable in Method 1668A due to ultra-low level detection limits and ubiquitous trace levels of PCBs in global environment	No evidence of blank contamination due to field procedures. Blank contamination in field samples and lab blanks is similar.	Sample sequentially from low-PCB OU's to high-PCB OU's to the extent possible. Instruct lab to analyze samples in order from cleanest to dirtiest to avoid instrument cross contamination.	Continue field and lab sample sequencing as implemented during baseline program.	Perform detailed blank analysis to assess lab methods and to attempt to reduce uncertainty in blank corrected data. D. Dinsmore and E. Weaver are working on the details of this in preparation for a Feb. 20th work group call
Lost or Broken Samples	Potential breakage during transport. One set of samples froze and broke due to thermostat malfunction at analytical lab.	No data were lost in baseline program	Collect redundant set of bottles from each station and hold in refrigerated storage in Green Bay in case primary samples are lost or broken.	Continue to implement redundant sample collection	No Comment

Monitoring Activity	Challenges	Successes	Adaptive Strategies Implemented	Implications for Long-term Monitoring	A/OT Comments
Green Bay Stratification	Thermocline is not uniformly present during transitional periods in Green Bay	Close coordination of field crews with office management ensured samples were collected from appropriate depths in the bay	Hydrographic data was reviewed in the office and follow-up compositing instructions were provided to lab based on this review	No significant differences between shallow and deep water layers in Green Bay. Stratification of water samples can be dropped from long-term program.	Vertical stratification may not be necessary in subsequent sampling events associated with the LTM. Further discussions in LTM working group will result in a recommendation on how samples will be collected to insure vertical integration of the water column. Water temperatures should be recorded at each location.
BASELINE FISH SAMPLING					
Adequacy of Sample Numbers	Adequately characterizing baseline fish tissue PCB concentrations given inherent variability caused by lipid content, spatially varying sediment exposures, and other uncontrolled field conditions	Estimated sample numbers based on coefficients of variation from historical data were good predictors of actual field variability: Observed CV (Predicted CV) Walleye: 0.26-0.87 (0.72) Bass: 0.30-0.74 (0.62) Carp: 0.18-1.07 (0.68) Drum: 0.20-0.57 (N/A) Gizz Shad: 0.11-0.60 (0.40)	Various adaptive strategies were implemented to ensure QAPP-specified target numbers or at least minimum numbers of fish were collected from each OU (i.e. rotating fish schedule, expanded schedule, alternate fishing techniques, etc.)	QAPP-specified optimum and minimum fish sample numbers are appropriate for use in long-term program (except gizzard shad - see item #7); these numbers strike a good balance between achievable field production and statistical resolution.	The AOT anticipates that the adequacy of the number of samples collected in forth coming LTM events will be determined based on a power analysis of the existing BMP and potentially other data. The specifics of this power analysis will be dependent on the particular statistical analysis methods selected for demonstration of success. It would be useful to also provide a map identifying the locations from which fish were collected. This could be based on specific GPS coordinates of each fish sample or more generally a track along which the electro-fishing boats traveled.

Monitoring Activity	Challenges	Successes	Adaptive Strategies Implemented	Implications for Long-term Monitoring	A/OT Comments
Fish Collection Methods	Not all fishing methods used in the Baseline Monitoring Program were productive. Fyke Nets and Set Lines were unproductive and should be discontinued.	Productive fishing methods included electro shocking, hook and line (with guide), seine nets (gizzard shad), and WDNR trawls (LWB and Green Bay)	Seine netting of gizzard shad was added to program. Hook and line fishing for bass in Spring/Summer 2007 was added to program.	Recommend continued use of electro shocking, hook and line (with guide), seine nets (gizzard shad), and WDNR trawls (LWB and Green Bay)	No Comments
Fishing Schedule	Baseline Monitoring Program allocated 3 days to each OU during initial circuit, with follow-up work as needed (1 to 2 more days) after letting the water "rest". Day 3 was usually not very productive.	In some OUs, target fish catches were easily obtained within the assigned fishing schedule. Other OUs were more difficult for certain species.	Fishing season extended into November. Return trip for bass and catfish in Spring/Summer 2007 (see item #5)	Suggest allocating 2 days per water rest and return for up to 2 more days as needed.	No Comments
Fish Species	Bass and catfish were difficult to collect in Green Bay, esp. in Aug/Sept. Minimum catfish were not obtained in OUs 1 and 5B. Minimum bass not obtained in OU 5A. Minimum gizzard shad not obtained in OUs 1 and 2A. No suitable alternate species was found for gizzard shad.	Optimum walleye numbers were collected in all OUs. Minimum carp and drum numbers were collected in all OUs and optimum numbers were collected in 6 out of 9 and 8 out of 9 OUs, respectively.	Fish size ranges were expanded by two inches either side as needed to improve harvest, per QAPP. Fishing season for bass and catfish extended to June/July 2007 (post-spawning) using hook and line techniques.	Carry walleye forward as human health species in long term monitoring. Use mix of carp and drum for ecological species, pending further Work Group discussion. Carry gizzard shad forward as "early indicator" species, and explore techniques to improve harvest.	Secondary fish for human health is bass, not catfish. Analysis needs to be done on an OU by OU basis, not for the entire river. Is there a primary species target for each OU? Baseline data indicates that different species tell different stories regarding relative contamination between sites. This raises questions whether different species will give different trends in long-term monitoring. This concept needs to be examined in development of the long-term monitoring plan.

Monitoring Activity	Challenges	Successes	Adaptive Strategies Implemented	Implications for Long-term Monitoring	A/OT Comments
Fishing Season	A few data gaps existed after the end of the prescribed fish window (Aug 15 through Sept 15). Potential seasonal effects on lipid content and PCB concentrations must be evaluated for fish collected outside this window.	A majority of the required fish were caught during prescribed fishing window	Fishing season was extended into October/November using WDNR staff. Significant seasonal effects were not observed in these months, although few additional fish were obtained. Fishing season was extended into June/July 2007 for catfish and bass. Evaluation of seasonal effects is pending review of new bass data.	Primary fishing season remains from Aug 15 through Sept 15. Extension of season by one month, if necessary, is not likely to introduce significant to introduce significant seasonal effects. Use June/July as backup season for bass collection, if alternate species required.	No Comments
Fish Sizes	Gizzard Shad - difficult to get sufficient numbers of small fish in 2" to 3" size range; Smallmouth Bass - No size range specifications provided in QAPP	Other Species - Use of QAPP specified size ranges and expanded alternate size ranges, where necessary, were successful	Gizzard Shad - Size range expanded in the field to include 3" to 6" fish after consultation with A/OT, greatly improving success of shad harvest; Smallmouth Bass - 10" to 20" bass were successfully collected; Larger 20" to 22" bass were never encountered	Gizzard Shad - Expand size range to include 2" to 6" fish in long-term program; no evidence of significant size related PCB effects after controlling for lipid content; Smallmouth Bass - recommend 10" - 20" window; Other Species - recommendations as specified in QAPP	The gizzard shad size for the respective year should be confirmed with a WDNR fish biologist for the "year of the young" size.
Compositing Numbers (Ecological Species)	Gizzard Shad - Minimum completeness goals were not achieved at two stations (only 2 composites in OU1, and 3 composites in OU2A); optimum completeness goals were only achieved at 3 out of 9 stations, even with expanded size range	Other Ecological Species - For compositing, minimum completeness was achieved at all stations for carp and drum, and optimum completeness was achieved at most stations (6 and 7 out of 9 stations, respectively)	Expanded size range (i.e. 3" to 6" fish), alternate fishing 6" fish), alternate fishing techniques (i.e. seine nets), and extended fishing season (i.e. October/November) were employed; however fish numbers for gizzard shad still below target, requiring smaller composites.	Modify completeness goals for gizzard shad: Optimum = 10 fish /composite Minimum = 3 fish /composite; Lab has demonstrated ability to provide good Aroclor quantitations (19 U) with as few as three small fish.	The A/OT does not agree with this line item and requests that it be deleted from this summary. The discussions at the 11/28/07 meeting should be reviewed for further discussion.

4 ADAPTIVE MANAGEMENT AND VALUE ENGINEERING RESPONSES

General adaptive management alternatives and specific engineering evaluations to be considered during the implementation of the OUs 2 to 5 RD/RA area described in the sections below.

4.1 Management Alternatives

Under the adaptive management approach, there are three general management alternatives if RA performance criteria are not being met:

1. Continue data gathering and evaluate results
2. Initiate adaptive changes to response actions
3. Adapt performance criteria on a location-specific basis

These alternatives may be used individually or in combination and are discussed below. Decisions regarding the need for adaptive responses, and a description of any response(s) taken or recommended (and their associated rationale), will be documented in annual RA Work Plans, including adaptive management summaries (see Section 6).

4.1.1 Continue Data Gathering and Evaluate Results

One possible response is to gather additional information, including continued annual or expanded monitoring under the existing programs, revised protocols, a review of relevant literature, consultation with experts, and focused studies to evaluate specific RA elements that are not currently addressed by monitoring data. Updated data gathering activities will be documented in annual RA Work Plans.

4.1.2 Initiate Adaptive Changes to Response Actions

There are two classes of response actions—"immediate" and "additional"—as further described below.

Immediate Response Actions

Immediate response actions would be conducted to correct obvious deficiencies. These are actions that would be undertaken, as appropriate, at the time the condition is observed or within a period of weeks to months following the observation. These

response actions would be implemented on a near-term basis, after consultation with Response Agency oversight personnel.

Additional or Modified Response Actions

Additional or modified response actions are those that are appropriately performed at some point after the condition is observed, typically during the following year's RA. Such response actions will normally be addressed as part of adaptive management or VE (see Section 4.2), and the adaptations will be documented in annual RA Work Plans.

4.1.3 Location-Specific Adaptations

Site-specific performance goals may turn out to be unrealistic for some locations. For example, during RA implementation it may become apparent that it is consistently difficult to achieve dredging residual performance criteria in areas with considerable area-wide debris, or where there is large submerged debris, as discussed in Patmont and Palermo (2007). Reevaluating the appropriateness of such goals may occur when monitoring has shown that the performance goals have not been met or are not likely to be met, despite efforts to achieve the success criteria. Again, such reevaluations, should they be necessary, will normally be addressed as part of adaptive management or VE (see Section 4.2), and the adaptations will be documented in the annual RA Work Plans.

4.2 Conduct Further Adaptive Management and Value Engineering

As discussed in Section 2, VE was initiated through the collaborative RD workgroup process to identify and evaluate RD/RA approaches that may improve protectiveness and implementation, and reduce the overall project schedule and cost. The VE evaluations are ongoing, with the understanding that some of the VE ideas may be implemented as part of the adaptive management process as field data and results become available with initial and ongoing remedy implementation. Alternative RD/RA approaches will continue to be evaluated through the workgroups in the adaptive management and VE process.

4.2.1 Streamline RD Process through Collaboration

The technical workgroups have developed approaches to streamline the RD process to allow the schedule requirements of the Order to be achieved, and to facilitate initiation

of full-scale dredging in OUs 2 to 5 at the start of the 2009 construction season. These streamlining approaches are currently being implemented by the Tetra Tech Team. For example, the Draft 60 Percent Design Report Volume 1 has been developed to an approximate 90 percent level of completion and was submitted for Response Agency review on June 16, 2008, concurrent with submittal of this Adaptive Management and VE Plan. Pending Response Agency approval, the Final Design Report Volume 1 will be submitted concurrently with the 2009 RA Work Plan. In addition, since the OUs 2 to 5 RD/RA is being performed on a design-build basis, the project specifications have been tailored to serve mainly as technical specifications for key project components to expedite the documentation process and schedule.

Complying with on-site location-specific ARARs and off-site permitting process is also being streamlined to avoid potential project delays. This strategy is being developed and implemented through collaborative workgroups. Required permits are being tracked along with the substantive requirements of ARARs to ensure that project documents and design drawings are developed in compliance with these requirements. A plan for community relations is also being developed to avoid potential delays during project implementation.

4.2.2 Optimize RD and RA Sampling and Analysis

This VE strategy includes the following items:

- Combining surveys, such as the bathymetric and critical structures surveys, to reduce cost
- Developing an efficient pre- and post-dredging verification sampling and analysis plan (SAP) that: a) reduces remediation of non-target sediment; b) reduces costs of post-dredge verification sampling; and c) reduces (and potentially eliminates) the need for re-dredging cleanup passes.
- Developing a rapid turn-around method for PCB analysis to ensure results are reported accurately and timely, to prevent project delays

The pre- and post-dredging verification plan and PCB analysis method are being developed collaboratively in technical workgroups. As discussed in Section 4.1, follow-on data gathering including infill sampling, post-dredge verification, cap and cover

placement verification, long-term cap performance monitoring, and other activities such as LTMP implementation will likely utilize a more focused scope (and likely reduced sampling frequency) over time. Such streamlining of data gathering is anticipated as greater confidence and predictability of data collection outcomes is realized over time. Updated data gathering activities will be documented in annual RA Work Plans.

4.2.3 Optimize Dredging Design and Implementation

As discussed in Section 3.1, the "neatline"-based dredge limit developed using geostatistical analyses at a defined level of significance (LOS) of 0.5 will be further refined following infill sampling to be performed in OUs 2 through 4 beginning in 2008. The additional analytical data is expected to reduce the uncertainty involved with estimating the neatline, and hence reduce the amount of overcut required during dredging to meet the RAL. As the geostatistical analyses and associated geomorphic modeling are completed for each RA area, the neatline dredge design will be refined and the resulting dredge volume estimates will be prepared.

Follow-on dredge plan optimization, which will be documented in annual RA Work Plans, will also consider the following:

- Coordination with U.S. Army Corps of Engineering (USACE) navigation channel maintenance dredging in OU 4B; to the extent practicable, USACE maintenance dredging of relatively clean surficial sediments will be sequenced to occur prior to RA dredging of underlying OUs 2 to 5 sediments; other opportunities for collaboration with the USACE may also emerge as the RA unfolds
- Coordination with other development and maintenance projects, and consideration of physical changes over time (e.g., sedimentation, marina dredging, and new structures)
- Possible declines in water levels over time to below current design baseline elevations, potentially resulting in modifications of dredging and capping plans prior to initiation of RA in shallow-water areas; see Section 4.2.7
- Possible declines in sediment PCB concentrations over time prior to initiating RA in a given area as determined from pre-dredge infill sampling (e.g., remedy changes in shallow surficial PCB deposits and shoreline areas as a result of natural recovery)

- Presumptive engineering evaluations for dredge residual management, potentially resulting in modifications of final cleanup pass dredging, capping, and cover plans (see Section 4.24.4)

4.2.4 Optimize Dredge Residual Management

As detailed in the CQAPP and summarized in Section 3.1, post-dredge data for dredge-only areas will be evaluated to characterize the nature and extent of dredging residuals, and to develop appropriate management alternatives for dealing with both generated and undisturbed residuals, using guidance provided in the ROD Amendment. Consistent with the approach utilized on the Phase 1 Project, dredge areas within OUs 2 to 5 will be subdivided based on location and operational considerations into DMUs. As practicable to verify generated residual predictions, post-dredge sampling locations within each DMU will be co-located with RD and pre-dredge infill sampling stations. Depending on location-specific factors and based on the results of follow-on VE and adaptive management evaluations, a variable number of DMUs will be combined into DCUs for verifying compliance with performance criteria described in the ROD Amendment.

The limitations of modern dredging equipment are discussed in the ROD Amendment. Typically, modern dredging equipment can consistently achieve 91 to 98 percent removal of the targeted "neatline" PCB mass within the last production cut (Patmont and Palermo 2007); greater removal has proven to be difficult and/or technically infeasible. Moreover, performance requirements for multiple passes of the dredge to achieve a low residual concentration have often been inefficient and costly, with little or no discernable benefit in the form of reduced generated residual concentrations, thicknesses or risk. The relatively low density of generated residuals, combined with the observation that dredging is less efficient for such low density materials, suggest that the cleanup pass option has limitations when applied to generated residual management. Accounting for the limitations of modern dredging equipment, and subject to evaluation of CQAPP monitoring data and adaptive management evaluations, the remaining mass per unit area will likely be a key consideration in the engineering evaluation, along with information on residual thickness, concentration, density and 'nearest neighbor' response actions. Where the residual PCB mass per unit area is relatively low within a

DCU (i.e., similar to the mass per unit area identified for cover actions in nearby areas), and/or when at least 90 percent of the original PCB mass has been removed from a given DCU, the engineering evaluation will give additional consideration to adaptive management options other than redredging.

Consistent with the ROD Amendment, if the average surface (0 to 6 inch) composite sediment PCB concentration in a given DCU is greater than 10 ppm, and/or if the average subsurface (layers below 6 inches) composite sediment PCB concentration in a given DCU is greater than 1.0 ppm, a technical workgroup consisting of the respondents to the Order, and the Tetra Tech Team will work collaboratively with the A/OT to determine the appropriate extent of areas requiring additional response. An engineering evaluation will be conducted to determine the most appropriate residual management action(s). The engineering evaluation will consider:

- Calculation of the percent PCB mass removed to date within each DCU, along with updated mass per unit area calculations that provide increased statistical confidence relative to pre-dredge estimates of PCB mass
- Practicability, technical feasibility, cost-effectiveness, and implementability factors (e.g., layer thickness, PCB concentration, and density)
- Consideration of the residual management (if any) in adjacent DCUs

The need for optimizing real-time decisions (i.e., expedited decision-making process), cost-effectiveness, productivity, and statistical rigor will be accommodated by applying principles of adaptive management to the management of dredge residuals. Depending on an assessment of experience in the field to date, options for addressing dredge residuals include the placement of 6 or more inches of sand cover, placement of an engineered cap, additional dredging (followed by resampling), and additional dredging immediately followed by placement of a sand cover or engineered cap. Annual adaptive management updates to the RA Work Plans will incorporate lessons learned from experience in the field and engineering evaluations of both field experience and project needs going forward. Based on the results of engineering evaluations performed in the initial RA year, it may be possible to develop standardized actions for post-dredge management of undisturbed and generated residuals, considering feasibility and cost-effectiveness. Further details will be developed as part of the annual RA Work Plans.

4.2.5 Optimize Sand Segregation and Re-use

The segregation of sand from sediment not subject to Toxic Substances Control Act (TSCA) requirements has the potential to significantly reduce the volume of filter cake requiring landfill disposal. Based on geotechnical data from sediment samples obtained from OUs 2 to 5, sand content is estimated to range from approximately 30 to 40 percent. Sand segregation will be accomplished through the use of hydrocyclone separators added to the sediment processing plant.

A bench-scale study was performed during RD on composite samples obtained from OUs 3 to 5 to evaluate the effectiveness of the hydrocyclone separators. This study indicated that the coarse fraction of sand (greater than 200 mesh) had PCB levels that were typically lower than 1.0 ppm, and could be considered for beneficial reuse without additional treatment. Additional bench-scale testing is being performed as part of Phase 2A RA to further investigate the potential for separation of fine to medium-grained sand and the corresponding PCB concentrations, as well as to refine production estimates for removal of the coarse fraction. Standard operating procedures (SOPs) will also be developed to determine PCB concentration correlations with sediment type. This information will be useful in determining the optimum separation level(s) (i.e., by sieve or gradation size) that will yield the maximum volume of separated sand while minimizing PCB content. It may be possible to segregate the fine to medium fraction and reuse this material as well, but an additional treatment step such as soil washing may be required to reduce the PCB concentration to allowable levels.

Beneficial reuse of the separated sand will require approval by WDNR under a low-hazard exemption, consistent with WDNR's "*Guidance for the Reuse of Sand Separated from Fox River PCB Sediment*" dated April 18, 2008. The ROD Amendment included allowable PCB concentrations in sand considered for beneficial reuse. These requirements are described in detail in Section 5 of the 60 Percent Design Report Volume 2.
Potential uses described in WDNR's guidance that are currently being evaluated include:

- Granular fill for the open cell bulkhead wall to be constructed on the former Shell property staging and material processing facility

- Road bed fill for highway projects
- Mine reclamation fill
- Capping or drainage material use at landfill facilities
- Raw material for production of asphalt or concrete
- Regional restoration projects

Additional beneficial reuse opportunities have been identified and will continue to be evaluated. Some of the regional restoration project opportunities will require coordination with WDNR and USACE, among other parties. This will be conducted under the adaptive management/VE framework as the RD/RA advances. Further details of these opportunities are discussed in Section 5 of the 60 Percent Design Report Volume 2.

4.2.6 Optimize Sediment Processing Operations and Materials/Services

Optimization of sediment processing operations at the former Shell property staging and material processing facility was developed in technical workgroups, and is being implemented as part of Phase 2A RA under the Order. Materials to be procured include sand, gravel, quarry spall, concrete, sheetpile, high-density polyethylene (HDPE) piping, building materials, and chemicals/carbon needed for the wastewater treatment plant (WTP), at a minimum. Services to be procured include landfill disposal services and various subcontract services. In addition, alternative transportation means will be evaluated for shipment of materials to the site, including truck, rail, or barge. All materials and services will be verified as meeting the RD requirements to be considered for use on the project and in the VE analysis.

4.2.7 Address Potential Future Lake Level Declines

As discussed in the OMMP and summarized in Section 3.2, following completion of cap construction in each OU, post-construction monitoring and maintenance of capped areas will be performed to ensure the cap remains physically stable (i.e., does not erode) and remains chemically protective. Cap designs described in detail in the 30 Percent Design report and 60 Percent Design Volume 2 have been developed using conservative engineering approaches to ensure that the armor layer remains protective under reasonable worst-case erosion characteristics (considering propwash, vessel wakes, etc.),

and also to ensure that minimum post-cap water depths will be maintained even under historic low water elevations. Nevertheless, should future water levels decline more than one foot below the low-water design elevations, additional monitoring, maintenance, and contingency response actions will be implemented as necessary to ensure that the caps continue to remain protective. The scope of monitoring, maintenance, and contingency response actions is described in the OMMP.

As discussed in the OMMP, if bathymetric monitoring and/or and verification core sampling (or other suitable measurements) indicate that cap erosion is occurring in the future (under low-water or other conditions), possible response actions will include:

- No action if the chemical analytical results indicate the remaining cap thickness is sufficient to prevent "breakthrough" of contaminants
- Repair area of erosion (e.g., reestablish cap thickness)
- Armor area of erosion
- Enact managerial or institutional controls, such as changes to vessel operations in specific berthing areas, to help control any further cap erosion

If monitoring data indicate that a cap placed in an area no longer meets its original design criteria and that degradation 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. Sediment cores collected for evaluation of chemical breakthrough will be evaluated on a case-by-case basis. If chemical profiles in sediment cores indicate cap breakthrough may have occurred, possible response options can include:

- Increasing the thickness of the cap to ensure cap integrity
- Increasing the frequency and intensity of cap monitoring

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 removal of the cap and underlying contaminated sediment. If such a pattern is observed during

the implementation of RA, the annual RA Work Plans will include an assessment of appropriate VE-based modifications to dredging and capping plans.

4.2.8 Optimize Capping Design and Implementation

Current sediment cap designs are described in the 30 Percent Design Report, supplemented with appendices to the 60 Percent Design Volume 2. The total cap thickness for these caps ranges from 13 inches to 33 inches, including armor. Various materials are currently available for sediment capping that may provide equivalent or better environmental protection to the sand layer currently proposed for the isolation layer of the cap. Some of these materials could also provide the filtration function currently provided by the gravel proposed for Cap C1. Sediment capping materials that will be evaluated include, but may not be limited to, the following:

- Sand with activated carbon, coal, or coke amendment
- AquaBlok®
- Geocomposite clay liner (GCL)
- Organoclay

These materials are generally more expensive than sand but less thickness is generally required to provide chemical isolation. A description of each technology is provided in Section 4.4.6.1 through 4.4.6.4.

Sand with activated carbon, coal, or coke amendment

Commercially available sorbents can be used to amend sand caps to improve their ability to prevent contaminant migration from the sediments into the bioactive zone. Amendments typically include activated carbon, coal, coke, and organic-rich soil. Recent studies have confirmed that cap performance in high seepage areas can be improved with such amendments (e.g., Murphy et al. 2006). An in-situ pilot test in the Grasse River (New York) has also confirmed that relatively low-cost activated carbon additions directly into surface sediments can reduce PCB bioavailability similar to that of caps and covers (July 2007, Technology News and Trends, USEPA CLU-IN Technology Innovative Program; Anchor, unpublished data 2008).

AquaBlok®

AquaBlok® is a proprietary clay polymer composite manufactured by AquaBlok, Ltd. in Toledo, Ohio, and consists of an aggregate core coated by bentonite clay with polymer additives. The material is designed to hydrate and form a continuous, low permeability isolation layer over sub-aqueous contaminated sediments in predominantly non-terrestrial settings (USEPA 2007b). AquaBlok® can be manufactured to include specific amendments, such as activated carbon. Potential advantages of AquaBlok® in specific locations may include: 1) higher degree of cohesiveness and cap uniformity; 2) higher resistance to physical erosion due to cohesiveness; 3) less thickness required for isolation; 4) higher contaminant attenuation capacity; and 5) seals around debris, structures, rocks, and other obstructions that may be present in the capping area. Potential disadvantages include the potential for the cap structure to be displaced in areas of relatively high groundwater seepage. The effectiveness of AquaBlok® is assessed in USEPA (2007b).

GCL

GCL material consists of bentonite clay sandwiched between two nonwoven geotextile filter fabrics inter-stitched together to provide increased shear strength. When hydrated, the clay swells to form a very low-permeability seal. This material must be installed over a relatively smooth surface, free of large obstructions or debris. The geotextile filter fabric provides a filter separation layer that could potentially replace a gravel filter layer in a Cap C1 application. Applications of GCL caps are summarized in Fleischer and Haibaum (2002).

Organoclay

Organoclay is an organically-modified bentonite clay designed to limit the mobility of contaminants in sediments. It can be obtained in mat form (similar to GCL) or in a form similar to AquaBlok®. Performance of organoclay caps is discussed by Reible (2005). Active capping technologies such as organoclay applications can provide an effective, low-cost means of capping in certain circumstances (Reible 2007).

4.2.8.1 Alternative Capping Material Evaluation

A preliminary listing of alternative cap configurations that may be evaluated during future VE is presented on Table 4-1. During the initial evaluation of these materials, thicknesses may be adjusted based on cost and performance, as previously described.

Table 4-1
Preliminary Listing of Alternative Capping Material

OUs 2 to 5 Cap Designs	Alternative Cap Design	Comments
13-inch sand and gravel [3-in sand + 4-in gravel (6-in sand + 7-in gravel with allowance)]	**10-inch sand and gravel** [0.5-in AC amended sand cap + 4-in gravel (3-in AC amended sand cap + 7-in gravel with allowance)]	GCL, RCM are also applicable. Cost savings due to less dredging of 3-inch may not be justifiable. Needs further evaluation.
16-inch sand and gravel [6-in sand + 4-in gravel (9-in sand + 7-in gravel with allowance)]	**10-inch sand and gravel** [0.5-in AC amended sand cap + 4-in gravel (3-in AC amended sand cap + 7-in gravel with allowance)]	GCL, RCM or 3-in AquaBlok® are also applicable. Cost savings due to less dredging of 6-inch needs further evaluation.
33-inch sand and gravel/quarry spall cap [12-in sand + 12-in gravel (15-in sand + 18-in gravel with allowance)]	**21-inch sand and gravel** [1-in AC amended sand cap + 6-in gravel + 6-in quarry spall (3-in AC amended sand cap +18-in gravel/quarry spall with allowance)]. A 6-inch filter (gravel) layer is recommended to keep active cap in-place undisturbed before placing larger size quarry spall.	GCL, RCM or 3-in AquaBlok® are also applicable. RD modeling to be updated to determine equivalency of 12-in sand to the proposed alternative cap. Cost savings due to less dredging of 9-inch needs further evaluation.

Alternative materials that provide both cost savings and at least equivalent environmental protection based on the above analyses may be proposed for isolation and/or filtration layer use in the cap design, as a replacement for the sand and gravel filter layers (where present).

4.2.9 Other Adaptive Management Ideas

As discussed earlier, the adaptive management process is expected to "develop" on its own, in large part due to the data, observations and lessons learned from field implementation of the RA, especially during the initial years. However, the following additional aspects may be evaluated as part of the adaptive management process:

- Effectiveness of dredging equipment and optimization of construction sequencing
- Cap construction methods, including placement of thicker lifts of sand and other cap materials as site conditions may allow

- Effectiveness of various cap types, in particular, the effect of potential future low lake levels on cap stability
- Optimization of post-construction monitoring and maintenance of capped areas

Finally, consistent with CERCLA requirements, the Response Agencies and the Order Respondents will also evaluate the remedy performance and the need for and scope of continued monitoring as part of the regular 5-year review process, and incorporate any relevant lessons learned into future actions, as applicable.

As discussed above, alternative RD/RA approaches will continue to be evaluated through the workgroups in the adaptive management and VE process. The adaptations will be documented in the annual RA Work Plans.

5 ADAPTIVE MANAGEMENT DECISION MAKING AND DOCUMENTATION

As discussed in Section 1 of this Plan, the three basic tenets to the adaptive management process, as defined by the NRC (2004), are:

1) Steps to monitor performance and evaluate outcomes
2) Assessing and revising project objectives as needed
3) Incorporating past experience into future decisions

One of the cornerstones of the adaptive management process is definition of the success criteria – this will vary depending on the adaptive management goal – whether it is performance of the remedy, sampling, or verification of constructed remedy. Regardless, the critical aspects of the adaptive management process are the definition of the "bounds of success" and an associated "time frame" during which it is acceptable to meet the success criteria. The Tetra Tech Team will work with the A/OT in collaborative workgroups to define these criteria for each of the project components that lend themselves to adaptive management as generally discussed in Section 4, with documentation as part of the annual RA Work Plan process. Such components include:

- Sampling needs for RD
- Specifics on individual remedy components (e.g., dredging, capping, and cover)
- Sampling needs for future monitoring (CQAPP, OMMP and LTMP)
- Tools and techniques for RA

In formulating adaptive management decisions, the following questions will be asked in the collaborative workgroups to determine whether an adaptive management process is necessary for the specific component:

- Were the project goals clearly and sufficiently defined?
  - Could they be optimized?
- Did the remedy process and construction techniques deliver results that were satisfactory to meet the goals?
  - Could they be optimized?
- Was the technical implementation of the project components efficient and effective?
  - Could improvements be made to save on schedule and costs (VE)?
  - Under what conditions were the techniques inefficient, or ineffective, if any?
  - Could the process benefit by changes?

- Are the monitoring and measurement protocols reliable and sufficient?
  - Could improvements be made to the techniques?
  - Can the frequency or intensity be optimized?
- Are there any overall lessons learned that could be applied to future remedy actionsin OUs 2 to 5?

The Tetra Tech Team will submit annual RA Work Plans, including a summary of adaptive management and VE elements, to the Response Agencies by January 31 of each year of RA, beginning January 31, 2010, following RA in 2009. Each report will present the monitoring data collected during the prior calendar year, including the database used to develop the report, and the results of the adaptive management and VE evaluations conducted. Each year's RA Work Plan will document evaluations of the adaptive management benchmarks (where relevant), assess progress toward meeting success criteria, and summarize any adaptive responses taken during the previous year. Each such report will also include recommendations, as appropriate, for additional adaptive response or VE actions, continuation or revision of the data collection program, termination of monitoring in certain areas, or revisiting the goals for specific areas. Prior to submittal of these reports, a comprehensive review of the prior years' activities and results will be evaluated and relevant adaptive management and/or VE recommendations brought forth as A/OT discussion items through the collaborative workgroup process. It is anticipated that through a series of collaborative technical exchanges, the workgroup will determine which adaptive management and VE strategies merit inclusion in the respective annual RA Work Plans. During the initial years of RA, such adaptive management and VE workgroup evaluations will occur annually (i.e., beginning in late 2009/early 2010). During later years of RA, adaptive management and VE workgroup evaluations may be reduced to a biennial frequency as needed. Adaptive management is intended to be a continuous learning process, where VE ideas will be regularly discussed and revised, based on real time field data and observations.

As discussed earlier, the VE process is an integral subcomponent of the adaptive management process. With the commencement of full-scale dredging and dewatering activities at the beginning of the 2009 construction season, as required by the Order, it is crucial that VE strategies relating to these activities be completed in 2008 and incorporated in the 2009 RA Work Plan. Many of these VE strategies are currently under evaluation, as described in the

sections above. The approximate schedule for completing the initial VE evaluation for each strategy is presented below. It should be noted that the VE process will continue to be used throughout the duration of the RA project (as part of the adaptive management process) to continue to evaluate and refine these strategies each year, until RA is completed in 2017.

Strategy	Start Date	Completion Date
Optimize dredging design and implementation	March 2008	October 2008
Streamline RD process through collaboration	March 2008	October 2008
Optimize RD and RA sampling and analysis	May 2008	October 2008
Optimize sand segregation and reuse	April 2008	March 2009
Optimize sediment processing operations and materials/services	April 2008	March 2010
Optimize capping design and implementation	June 2008	October 2009
Adaptive management changes in techniques and/or protocols for remedy components, implementations, sampling or verification/measurement	Continuous process (following remedy implementation start)	January 31 of each RA Year (Annual RA Work Plans, following discussion with A/OT Work Groups)

Many of these strategies involve multiple components, some of which must be completed sooner than the completion date shown above.

As practical, long-term natural recovery monitoring, cap monitoring, and water/biota sampling will be coordinated to take place during the same year, conducted approximately 1 year prior to the scheduled CERCLA 5-year reviews, so that the most up-to-date information will be available to inform the process and to better scope future monitoring efforts and strategies. The data collection will include monitoring to assess success criteria as defined in the RODs and ROD Amendment, as well as monitoring to collect data to evaluate design and implementation uncertainties. These long-term programs will be implemented and documented as part of the OMMP and LTMP.

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APPENDIX F

ADDENDUM TO THE VOLUME 1 CONSTRUCTION QUALITY ASSURANCE PLAN

ADDENDUM 1 CAP AND COVER PLACEMENT

TO
CONSTRUCTION QUALITY ASSURANCE PROJECT PLAN

FOR
REMEDIAL ACTION OF OPERABLE UNITS 2, 3, 4, AND 5

LOWER FOX RIVER AND GREEN BAY SITE

Brown, Outagamie, and Winnebago Counties, Wisconsin

Prepared for:
Appleton Papers Inc.
Georgia-Pacific Consumer Products LP
NCR Corporation

For Submittal to:
Wisconsin Department of Natural Resources
U.S. Environmental Protection Agency

Prepared by:

Tetra Tech EC, Inc.
Anchor Environmental LLC
J. F. Brennan
Boskalis Dolman

June 2008

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APPROVALS

By their signature, the undersigned hereby certify that this Addendum to the Construction Quality Assurance Project Plan has been reviewed and approved for use at the Remediation of Lower Fox River, Operable Units 2 through 5.

Ray Mangrum Project Manager	Date
Mike Nicol Corporate Director Quality Programs	Date
Mike Estess Construction Manager	Date
Kevan McCaslin QA / QC Manager	Date

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Table of Contents

1.0 BACKGROUND **1**

2.0 INTRODUCTION **1**

2.1 SCOPE 2

3.0 QUALITY ASSURANCE/QUALITY CONTROL ORGANIZATION **2**

4.0 PROCEDURES FOR SCHEDULING INSPECTIONS **3**

5.0 TRAINING **3**

6.0 DOCUMENTATION **3**

7.0 PROCEDURES FOR SCHEDULING, REVIEWING, AND MANAGING SUBMITTALS **3**

8.0 MATERIAL RECEIPT INSPECTIONS **3**

9.0 CONTROL TESTING PROCEDURES **3**

9.1 POST-DREDGE SAMPLING 3
9.2 SAND COVERS AND ENGINEERED CAPS 4
9.2.1 Verification of Import Material Quality *4*
9.2.2 Achieving Specified Capping Thickness and Extent *5*

10.0 MONITORING AND MAINTENANCE MEASURES **12**

11.0 REPORTING PROCEDURES **12**

12.0 PROCEDURES FOR TRACKING DEFICIENCIES AND CORRECTIVE ACTIONS **12**

13.0 PROCEDURES FOR CONTROLLING DESIGN ACTIVITIES **12**

14.0 SCHEDULE **12**

15.0 REFERENCES **13**

List of Figures

FIGURE 3-1. QUALITY ASSURANCE ORGANIZATION 2

List of Tables

TABLE 9-1. METHODS FOR PHYSICAL SAND AND ARMOR THICKNESS MEASUREMENTS 11

Acronyms and Abbreviations

2007 RA Order Respondents	Appleton Papers Inc., CBC Coating, Inc. (formerly known as Riverside Paper Corporation), Georgia-Pacific Consumer Products, LP (formerly known as Fort Howard Operating Company), Menasha Corporation, NCR Corporation, P.H. Glatfelter Company, U.S. Paper Mills Corp., and WTM 1 Company (formerly known as Wisconsin Tissue Mills, Inc.)
A/OT	Agency/Oversight Team
ASTM	American Society for Test and Materials
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CQAPP	Construction Quality Assurance Project Plan
OU	Operable Unit
PCB	polychlorinated biphenyl
Phase 2A Respondents	Appleton Papers Inc., CBC Coating, Inc., Georgia-Pacific Consumer Products, LP, NCR Corporation, and U.S. Paper Mills Corp.
QA	quality assurance
QC	quality control
RA	remedial action
RD	remedial design
Response Agencies	USEPA and WDNR
ROD	Record of Decision
Tetra Tech Team	Tetra Tech EC Inc, Anchor Environmental, J.F. Brennan Company, Boskalis Dolman
USEPA	U.S. Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources

1.0 BACKGROUND

The Lower Fox River and Green Bay Site (Site) includes approximately 39 miles of the Lower Fox River, as well as the bay of Green Bay. The Fox River portion of the Site extends from the outlet of Lake Winnebago and continues downstream to the mouth of the Fox River at the city of Green Bay. The bay portion of the Site extends from the mouth of the Fox River at the city of Green Bay to the point where the Green Bay enters Lake Michigan. The Site has been divided into five geographically defined Operable Units (OUs) (1, 2, 3, 4, and 5) for the remediation of polychlorinated biphenyls (PCBs) that have been released into the river.

Remedial design (RD) and remedial action (RA) in OU 1 is being addressed under an agreement between the U.S. Environmental Protection Agency (USEPA), Wisconsin Department of Natural Resources (WDNR), and the WTM 1 Company. The PCB cleanup remedy for the Lower Fox River OUs 2 through 5 was originally set forth in Records of Decision (RODs) issued in December 2002 and June 2003 by USEPA and WDNR (collectively known as the "Response Agencies") under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, 42 U.S.C. §§ 9601-9675. RD sampling indicated elevated concentrations of PCBs in sediments along the west bank of the river, just downstream of the De Pere Dam, and Phase 1 RA is being implemented in this area under a Consent Decree (CD) between the Response Agencies, and NCR Corporation and Sunoco–U. S. Mills, Inc. All remaining elements of the RA in OUs 2 through 5 will be implemented in Phase 2.

To adhere to the project schedule, Phase 2 of the OU 2 through 5 RA will be subdivided into stages: Phase 2A and 2B. Certain of the Respondents to the 2007 Administrative Order for RA (collectively, the "Phase 2A Respondents") are required to conduct the Phase 2A work; these are Appleton Papers Inc., CBC Coating, Inc., Georgia-Pacific Consumer Products, LP, NCR Corporation, and U.S. Paper Mills Corp. Phase 2A work elements have been expedited and are being completed in 2008 in order to commence full-scale sediment remediation in OUs 2 through 5 at the start of the 2009 construction season and/or as necessary to allow for continuation of full-scale actions in subsequent years. The Response Agency-approved Phase 2A Construction Quality Assurance Project Plan (CQAPP) was developed to establish quality assurance/quality control (QA/QC) ground rules for the Phase 2A work. Phase 2B comprises all remaining work to implement the OU 2 through 5 RA such as the performance of full scale sediment remediation at the start of the 2009 construction season and subsequent years. The CQAPP for RA of OUs 2 through 5, Lower Fox River was developed to establish QA/QC ground rules for all Phase 2B work.

2.0 INTRODUCTION

This document represents an addendum to the CQAPP for the OUs 2 through 5 included as Appendix D to Volume 1 of the 60 Percent Design Report for OUs 2 through 5. That CQAPP addresses 2009 Phase 2B remediation activities, including mobilization, removal (dredging), dewatering, and disposal of sediments, water treatment and post-dredge verification sampling and residuals management. This CQAPP Addendum incorporates the earlier document by reference and is not intended to act as a stand-alone plan. This Addendum addresses 2010 and follow-on Phase 2B RA. These activities include installation of sand covers and engineered caps in addition to the dredging activities addressed in the CQAPP.

2.1 SCOPE

Remedial work activities described in this CQAPP Addendum include:

- Verification that sand covers (placed either as a primary remedial action or as a secondary post-dredge residuals management response) achieve the design specifications
- Verification that engineered caps have been placed in accordance with the design specifications

3.0 QUALITY ASSURANCE/QUALITY CONTROL ORGANIZATION

The Tetra Tech Team has overall verification planning and implementation responsibility and will coordinate all activities to ensure the acquisition and reporting of data are consistent with the strategies in the CQAPP and this CQAPP Addendum. The CQAPP included with Volume 1 of the 60 Percent Design describes TtEC's QA/QC organization. Figure 3-1 presents TtEC's organizational structure for this CQAPP Addendum, showing the reporting lines for each individual by category.

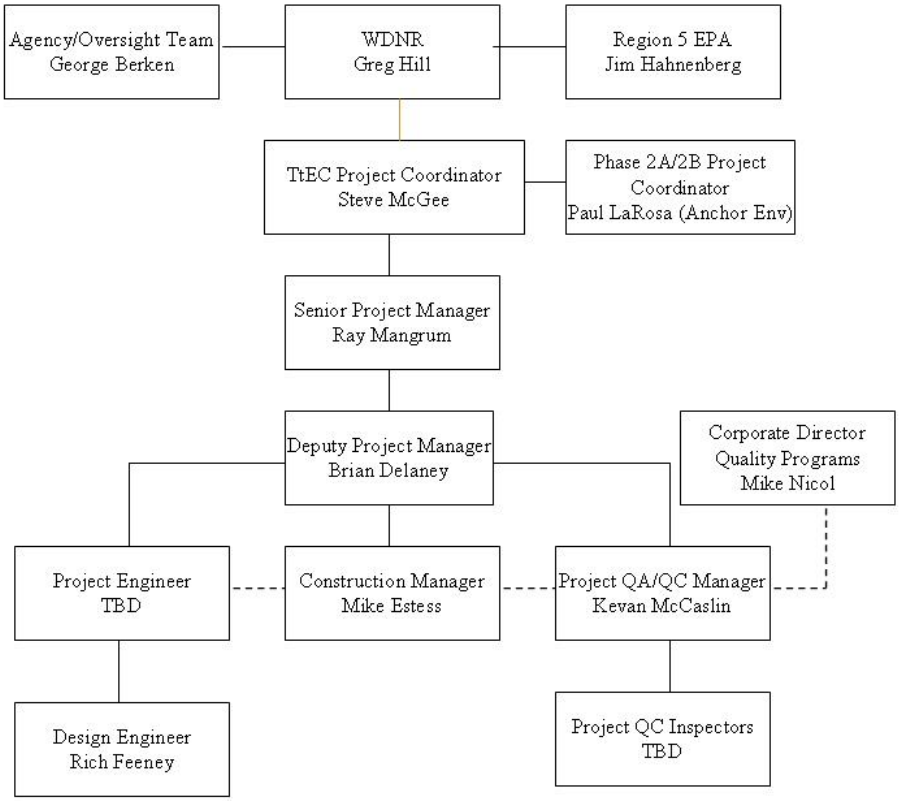

Figure 3-1. Quality Assurance Organization

4.0 PROCEDURES FOR SCHEDULING INSPECTIONS

TtEC's procedures for scheduling inspections related to 2009 RA work are provided in the CQAPP included with Volume 1 of the 60 Percent Design. Procedures for scheduling inspections for RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

5.0 TRAINING

Training related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

6.0 DOCUMENTATION

Documentation related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP. Continued refinement of construction methods and associated verification sampling will be documented in annual RA Work Plans and in further addenda to the CQAPP, as necessary.

7.0 PROCEDURES FOR SCHEDULING, REVIEWING, AND MANAGING SUBMITTALS

Procedures for scheduling, reviewing, and managing submittals related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

8.0 MATERIAL RECEIPT INSPECTIONS

Material receipt inspections related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

9.0 CONTROL TESTING PROCEDURES

In addition to the elements described in the 2009 CQAPP included in Volume 1 of the 60 Percent Design, one of the primary CQAPP elements is the verification the engineered caps and sand covers have been placed to the limits and extents specified by the RD. This section discusses the methodology that will be used to confirm that the constructed alternative remedial approaches meet the minimal design criteria provided in Chapter XI(A)2 of the ROD Amendment.

9.1 POST-DREDGE SAMPLING

The control testing procedures for post-dredge sampling in 2010 and beyond will be identical to that described in the CQAPP, with the following addition for dredge-and-cap areas.

For dredge-and-cap areas, the appropriate cap type (e.g., Cap A, Cap B, etc.) was selected during RD based on predictions of post-dredge generated residuals concentrations using RD sampling data and anticipated residuals characteristics. In order to verify that the appropriate cap type is placed, focused surface sediment sampling will be performed during RA in dredge-and-cap areas following dredging, but prior to cap placement, to confirm RD forecasting of the PCB concentration in the top 6 inches of sediment underlying the cap. Details of the surface sediment

sampling in dredge-and-cap areas will be finalized through the technical workgroup and documented in further addenda to the CQAPP, as appropriate,

9.2 SAND COVERS AND ENGINEERED CAPS

In the course of performing the remediation of OUs 2 through 5 during the 2010 construction season and subsequent years, sand covers and engineered caps will be installed. The designed capping and cover systems (see Volume 2 of 60 Percent Design) will require the use of various materials as well as placement technologies, based on the multi-layer cap system requirements. Sand- and small gravel-sized materials placed for caps and covers will be spread utilizing a broadcast method, while larger cap material (armor stone) will require placement via more conventional, mechanical techniques. The following QA/QC steps will be performed relative to sand covers and engineered caps:

- Verification of Import Material Quality. The chemical and physical characteristics of the capping and sand cover material will be verified as appropriate for their intended use.
- Verification of Specified Capping Thickness and Extent. Capping and sand cover material will be satisfactorily placed over the required areas and to the required thicknesses provided by the design.
- Demonstration of Appropriate Chemical Isolation Layer Placement. Appropriate placement of the chemical isolation layer of engineered caps will be demonstrated through focused chemical testing.

9.2.1 Verification of Import Material Quality

Import material used for engineered cap and sand covers must meet the requirements described in 60 Percent Design. Prior to the use of any imported material, a Borrow Source Characterization Report will be prepared for each import material verifying its specified physical properties, chemical properties, and gradation. Verification of the physical and chemical quality of the import materials will be performed using the following approach:

- One representative sample per 30,000 tons from each distinct source will be submitted for analysis of the following:
  - Grain size distribution (American Society for Testing and Materials [ASTM] method D422-63)
  - In situ moisture content (ASTM method D2216)
  - Weight per unit volume of uncompacted materials (if requested) (ASTM method D5057)
  - Particle specific gravity (ASTM method D5057)
  - pH (USEPA SW 846 9040C/9041A/9045D)
  - Biological oxygen demand (USEPA SW 846 5210B)
  - Nitrate (USEPA SW 846 6500/9056/9210)
  - Nitrite (USEPA SW 846 6500/9056/9216)
  - Phosphorus (USEPA SW 846 6010)
  - Orthophosphate (USEPA SW 846 6500/9056)
  - Sulfate (USEPA SW 846 9035/9036/9038)

- Sulfide (USEPA SW 846 9030B/9031)
- Ammonia (USEPA 40 CFR 135 350.1)
- Priority pollutant metals (USEPA SW 846 6010B/6020/7000 Series)
- Volatile organic compounds (USEPA SW 846 8260B)
- Semi-volatile organic compounds (USEPA SW 846 8270C)
- Acid extractables/base neutrals (USEPA SW 846 8270/625)
- Polycyclic aromatic hydrocarbons (USEPA SW 846 8270/8310/525)
- Total petroleum hydrocarbons (Method 8015B)
- PCBs (Fox River Method 8082)
- Chlorinated pesticides (USEPA SW 846 8081)
- Herbicides (USEPA SW 846 3535/3545/3546/3580/8321/8151A)
- Total organic carbon (USEPA SW 846 9060)

• One representative sample per 5,000 tons from each distinct source will be submitted for analysis of the following:

- Grain size distribution (ASTM method D422-63)
- In situ moisture content (ASTM method D2216)
- Weight per unit volume of uncompacted materials (if requested) (ASTM method D5057)
- Particle specific gravity (ASTM method D5057)
- Priority pollutant metals (USEPA SW 846 6010B/6020/7000 Series)
- PCBs (Fox River Method 8082)
- Total organic carbon (USEPA SW 846 9060)

Additionally, individual delivery loads will be visually inspected for any objectionable content to ensure compliance with the general physical requirements of the design.

9.2.2 Achieving Specified Capping Thickness and Extent

Consistent with the general approach approved by the Response Agencies for the Phase 1 and OU 1 projects, placement of the minimum specified thicknesses of sand cover and each layer of engineered caps will be verified through a combination of accurate material placement records (to compute the delivered thickness), physical measurements, and bathymetric surveying. Note that the specific method and measurement technique utilized to verify cap and cover placement will be dependent on the thickness and material type of the layer being verified (e.g., ranging from a 6-inch sand layer to an 18-inch quarry spall layer) and on the local site conditions (e.g., water depth, size of area, etc).

A combination of the various measurement techniques will provide the accuracy and spatial coverage necessary to confirm adequate placement to the required limits and extents. In the case of verification using the computed delivered thickness in combination with a set of discrete physical measurements, a statistical analysis of the combined data set from both measurement techniques will be performed to ensure with statistical confidence that the minimum thickness has been achieved within a given area.

Positioning equipment will be used to verify proper placement of engineered caps and sand covers to the extents required by the design. The mechanical placement equipment will be outfitted with the same Real Time Kinematic (RTK) Global Positioning System (GPS) positioning equipment, similar to that used during dredging operations. Utilizing this positioning equipment, the operator will be able to view a real-time comparison of the pre- and post-placement cap/sand cover surface elevations. Positioning equipment used during mechanical placement of capping material will validated during operations (see Appendix C, Attachment C-0 of the 60 Percent Design).

Engineered Cap and Sand Cover "Start-up" Areas. Engineered cap and sand cover placement activities, respectively, will be initiated at the start of each construction season (i.e., at least eight start-up tests throughout the project) in discrete "start-up" test areas covering approximately 1 acre. Start-up tests may also be conducted after a significant change in placement methodology or an extended period of inactivity. The intent of these start-up test areas will be for the Tetra Tech Team and/or Agency/Oversight Team (A/OT) to observe the contractor's method(s) of material placement for compliance with the performance criteria, to assess the quality control methods, and confirm required thickness and extent of materials. The contractor may need to adjust its production methods based on the results of the start-up tests.

Engineered Cap and Sand Cover Certification Units. Following completion of placement within the initial start-up areas for engineered caps and sand covers, full-scale production will begin. Similar to the subdivision of dredge areas using a process similar to the development of dredge certification units described in the 2009 CQAPP, sand cover and engineered cap areas will be divided into sand cover certification units (SCCUs) and cap certification units (CCUs), respectively, for assessing compliance. The SCCUs and CCUs will be further subdivided into sand cover management units (SCMUs) and cap management units (CMUs), where several management units will be combined into a certification unit for assessing compliance.

The delineation of management and certification units will be based, in part, on the relative size and position of contiguous cover and cap areas (see accompanying 60 Percent Design plans), as well as, on the typical production rate for sand cover and engineered cap placement. Furthermore, delineation of management and certification units will also consider the various cap design thicknesses so that CCUs will usually consist of areas with consistent cap thicknesses (i.e., separate CCUs for each type of engineered cap: Cap A [min 13-inch], Cap B [min16-inch], Cap C [min 33-inch], and shoreline caps).

Separate from Agency-approved certification decisions, the size range of a given SCMU or CMU will be developed by the contractor based on operational factors in order to facilitate timely and cost-effective completion of activities within individual work units. The specific size of SCMUs and CMUs will be determined prior to construction considering the contractor's operational plans.

The SCMUs, CMUs, SCCUs, and CCUs for the planned work in each season will be presented in the annual RA Work Plans.

Sand Cover and Engineered Cap – Verification of Extents. In order to verify the proper application of caps and covers, various positioning and measurement equipment will be used. The broadcast spreader equipment planned for placing the sand and smaller armor stone (see Volume 2, Section 6 for description of equipment) will utilize a RTK GPS for position and elevation tracking. The RTK GPS system uses satellite links to two spreader barge mounted

receivers, a fixed location receiver with known coordinates, and a geometric method known as trilateration to determine the real time position and elevation of a point on the sand spreader to within 4 centimeters accuracy. This point is configured to be located at the sand discharge location. As the spreader barge travels, turns, and rises and falls on the lake, the system continually updates the northing and easting coordinates, heading, and elevation of the sand discharge position.

The coordinates of the sand spreader will be sent to the DredgePack® survey software system produced by Hypack®. DredgePack® will serve two purposes during cap placement: it will provide a continuous log of coordinates and elevations for the material discharge location, and it will provide tools to help the operator accurately locate the spreader barge at required coordinates.

Sand Cover – Verification of Placed Thickness. The thickness of sand covers placed as a stand-alone remedial action or for post-dredge residuals management will be verified through a combination of accurate material placement records and physical sampling as summarized below:

- The weight of material placed within each SCMU will be accurately tracked, as described below, so that the average thickness of sand placed within that SCMU can be computed. A belt scale on the sand spreader discharge conveyor will continually monitor the tons per hour of sand being discharged from the sand spreader. A Programmable Logic Controller on the sand spreader will be used to monitor the total tonnage of material being spread over a given SCMU. The thickness of placed sand within that SCMU will then be computed based on the tons of material with a known density placed over the measured SCMU area. In addition to the meter belt scale, a comparison of the estimated volume/weight placed will be done by counting the number of level front-end loader buckets (of a known volume) placed onto the material barges that feed the spreading units. Computer-generated outputs will be compared to the metering belt/hopper values to determine if the volume of material placed is balanced. By comparing the slurry plant metering to the conveyor belt scale, volume measurements can be determined over longer periods of time, such as per day.
- Following completion of sand cover placement within a given SCMU, the thickness of placed sand will be physically measured in samples collected at randomly selected locations using a piston core, "catch pan," Russian Peat Borer, vacuum push core, or other appropriate equipment capable of collecting a relatively undisturbed sample of the sand cover (see Table 9-1). Alternatively, where necessary the thickness of sand cover could be measured in-place by divers using survey rods placed prior to sand cover placement. Selection of the most appropriate measurement technique will be determined prior to or during the initial stages of construction (e.g., during the start-up tests) and may be varied as construction proceeds depending on local site conditions. Some random thickness measurement locations will also be placed on the outer limits of (and slightly beyond) the SCMUs to verify adequate thickness across the entire design footprint. Details of the sampling design will be provided in the Final CQAPP and refined as necessary in the annual RA Work Plans.

During the initial stages of full-scale sand cover placement, a regression-based statistical approach will be used to develop a relationship between the thickness determined through

material placement records and the mean measured thickness of the sand cover placed, consistent with the Agency-approved approach for the Phase 1 and OU 1 projects. The details of the statistical procedure will be refined in the technical workgroup and incorporated into the final CQAPP. As each additional SCMU is sampled, the correlation between the placed and measured thicknesses will be refined based on the expanding set of available data; the refined relationship will be used to estimate SCMU-specific mean thicknesses. For each SCCU, the lower tolerance limit of all sand cover thickness measurements will be determined.

Compliance with the minimum sand cover thickness for each SCCU will be based on verification of the minimum specified cover thicknesses (6 inches including any mixing with underlying sediment) over at least 80 percent of the area (of a given SCCU) with 90 percent confidence or greater. To meet these statistical criteria, it is anticipated that the minimum thickness criterion will typically need to be exceeded in approximately 95 percent or more of the physical samples of the sand cover (a similar result is anticipated in capping areas; see below).

The mixed layer will be defined as being comprised of both existing sediment and placed sand where the sand comprises at least half of the matrix, as determined through visual observations and/or physical characterization in the field. It is expected that the A/OT and Tetra Tech Team representatives in the field will work closely to develop a field screening procedure to measure the mixed layer thickness.

Initially, it is anticipated that physical measurements of the placed sand cover thickness will be performed within each SCMU. However, assuming the correlation between the two measurement methods is verified, and provided the method of placement has not been significantly modified, the frequency of physical sampling may be reduced as construction proceeds to expedite the process of verifying compliance with the minimum required thicknesses. More intensive sampling would be resumed following extended periods of inactivity or significant modifications to the material placement method or during placement in areas with significantly different conditions. An adaptive management approach will be used in the field to select which SCMUs will be sampled and the number of physical samples collected for each based on the goal of demonstrating compliance with the specified statistical confidence.

If compliance is not verified for a SCCU, additional sand cover material will be placed in SCMUs having the lowest placed thicknesses (as based on the volume of material delivered, adjusted using the regression equation). Selection of SCMUs for additional sand placement will be based on an evaluation of data relative to the compliance metric. The evaluation will include an assessment of the placement methods and monitoring programs to improve future placement activities. Additional sand volume will be added as necessary to achieve compliance, according to the regression and the compliance criteria. Additional sampling will then be conducted to reassess compliance. Contingency plans for addressing poor correlations between thickness measurements will be developed during subsequent adaptive management phases in order to more fully utilize information gained from early remedial actions and other relevant projects (see Appendix E of the 60 Percent Design, Volume 2).

Engineered Caps A and B. Similar to the discussion above for sand covers, the thickness of engineered Caps A and B (minimum of 13- and 16-inch, respectively) will be verified through a combination of accurate material placement records and physical sampling as summarized below.

- The weight of material placed to construct each layer of the engineered caps (e.g., lower sand chemical isolation layer and overlying gravel armor layer) will be will be accurately tracked such that the placed thickness of each layer within a given CMU will be computed based on the density of the material and the measured area over which it was placed, as described above for sand covers.
- Following completion of placement of each layer (i.e., sand or gravel) within a given CMU, the thickness of placed material will be physically measured at randomly selected locations. Samples of the sand layer may be collected using a piston core, "catch pan," Russian Peat Borer, vacuum push core, or other appropriate equipment capable of collecting a relatively undisturbed sample of the sand (see Table 9-1). Due to the difficulty in collecting a representative core sample of gravel armor layer, physical measurements of the gravel thickness will be limited to catch pans, survey stakes, or comparison of pre- and post-cap placement bathymetric surveys. Selection of the most appropriate measurement technique will be determined prior to or during the initial stages of construction and may be varied as construction proceeds depending on local site conditions.

Consistent with the approach described above for sand covers, a regression-based statistical approach will be developed during initial cap placement activities in the first several CCUs. Using adaptive management, the frequency of physical sampling may be reduced as construction proceeds to expedite the process of verifying compliance with the minimum required thicknesses.

Similar to the sand covers, the metric for verifying compliance of the engineered cap layer thicknesses referenced in the ROD Amendment will be delivery of material to meet the minimum required layer thickness (including mixing with underlying sediment) over at least 80 percent of the area (of a given CCU) with 90 percent confidence or greater. Compliance will be evaluated through accurate material placement records and using a regression-based correlation with in-place measurements. Core samples will also allow direct comparisons with individual layer thickness performance criteria developed using USEPA guidance, as detailed in Volume 2 of the 60 Percent Design.

If compliance is not verified for a CCU, additional sand and/or gravel material will be placed in CMUs having the lowest placed thicknesses (as based on the volume of material delivered, adjusted using the regression equation). Sufficient volume will be added to achieve compliance, according to the regression and the compliance criteria. Additional sampling will then be conducted to reassess compliance. Again, assuming the correlation between the measurement methods is verified, and provided the method of placement has not been significantly modified, the frequency of physical sampling may be reduced as construction proceeds to expedite the process of verifying compliance with the minimum required thicknesses. More intensive sampling would be resumed following extended periods of inactivity or significant modifications to the material placement method. An adaptive management approach will be used in the field to select which CMUs will be sampled and the number of physical samples collected for each based on the goal of demonstrating compliance with the specified statistical confidence.

Engineered Cap C and Armored Shoreline Caps. Consistent with the discussion above for engineered Caps A and B, the thickness of engineered Cap C (minimum 33-inch) and armored

shoreline caps will be verified through a combination of accurate material placement records, physical sampling (where feasible), and bathymetric surveying as summarized below.

- The weight of material placed to construct each layer of the engineered caps (e.g., sand chemical isolation layer and potential armor layer) will be will be accurately tracked such that the delivered thickness of each layer for a given CMU can be computed based on the density of the material and the measured area over which it was placed, as described above for sand covers. Alternate methods of tracking volume or weight of the armor layer may be required due to the anticipated size of the armor stone.
- Following completion of placement of the sand layer within a given CMU, the thickness of placed material will be physically measured at randomly selected locations. Samples of the sand layer may be collected using piston core, "catch pan," Russian Peat Borer, vacuum push core, or other appropriate equipment capable of collecting a relatively undisturbed sample of the sand (see Table 9-1).
- Following verification of compliance of the sand layer thickness and prior to placement of the armor layer, a bathymetric or survey stake survey will be conducted. A second survey will then be conducted following placement of the armor layer and compared to the pre-placement survey to verify compliance with the required armor layer thickness. In shallow water shoreline areas, it may be necessary to perform the bathymetric surveys using manual survey techniques as opposed to acoustical methods appropriate for deeper water areas.

Consistent with the discussion above for engineered Caps A and B, compliance for the sand/filter layer of the Cap C areas will be evaluated through accurate material placement records and using a regression-based correlation with in-place measurements. Compliance with geotechnical "filter criteria" (e.g., to avoid mixing of armor and underlying materials) can be achieved for typical gradations that comply with the armor stone sizes recommended to resist erosion. Although core sampling is generally not feasible for the armor layer due to the size of the material, a similar regression-based statistical evaluation using bathymetric or stake survey points within a CMU, relative to the computed delivered thickness, will be used to assess compliance of the armor layer thickness with the 80 percent coverage with 90 percent confidence metric.

Table 9-1. Methods for Physical Sand and Armor Thickness Measurements

Parameter	Water Depth	Underlying Sediment Characteristic	Sample Method	Frequency
6-inch Sand Cover				
Applied Sand Thickness Verification	> 6 feet	NA	Survey stakes, Catch Pan	TBD
	< 6 feet	Soft	Survey stakes, Vacuum Push Corer, Catch Pans	TBD
		Firm	Survey stakes, Russian Peat Borer, Catch Pans	TBD
Engineered Cap A and B				
Resulting Sand Thickness Verification	NA	Soft	Survey stakes, Vacuum Push Corer	TBD
		Firm	Survey stakes, Russian Peat Borer	TBD
Armor Stone Thickness Verification	NA	NA	Survey stakes, Catch Pan, Bathymetry	TBD
Full Cap Thickness Verification	NA	NA	Bathymetry	TBD
Engineered Cap C and Shoreline Caps				
Resulting Sand Thickness Verification	NA	Soft	Survey stakes, Vacuum Push Corer	TBD
		Firm	Survey stakes, Russian Peat Borer	TBD
Armor Stone Thickness Verification	NA	NA	Bathymetry	TBD
Full Cap Thickness Verification	NA	NA	Bathymetry	TBD

> = greater than
< = less than
NA = not applicable
TBD = To be determined based on ongoing technical workgroup discussions

9.2.3 Demonstration of Appropriate Chemical Isolation Layer Placement

While measurement of the amount of material placed will provide the primary verification metric for engineered caps and sand covers if placement rates track well with physical measures of sand thicknesses (see Section 9.2.2 of this CQAPP Addendum), focused surface sampling and PCB analyses will also be performed during installation of Cap B (minimum 16-inch thickness) and Cap C (minimum 33-inch thickness) caps to demonstrate that clean isolation layers have been placed. While PCB analysis is not a necessary component of verification for the Cap A (minimum 13-inch thickness) because this design is based on a presumed mixing of the sand with the underlying sediment, a limited program of PCB analysis of core segments in the Cap A areas will be conducted to confirm RD assumptions on cap placement behavior. This program for demonstrating the placement of the chemical isolation layer of caps is anticipated to be limited in extent and duration, and will focus on sampling of representative areas. Details of PCB sampling and analysis during cap construction will be further developed through the collaborative workgroups prior to finalizing the Volume 2 RD. Continued refinement of post-dredge and cap verification sampling, will likely utilize a more focused scope and reduced sampling frequency over time as greater confidence and predictability of data collection outcomes are realized over time. Adaptive management of cap/cover placement and verification

plans will be documented in annual RA Work Plans and in further addenda to the CQAPP, as necessary.

10.0 MONITORING AND MAINTENANCE MEASURES

Monitoring and maintenance measures related to RA to be performed in 2010 and beyond, including water quality monitoring during placement of caps and sand covers, will be identical to that described in the CQAPP.

11.0 REPORTING PROCEDURES

Reporting procedures related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP. Continued refinement of construction methods and associated verification plans and contingency responses will be documented in annual RA Work Plans and in further addenda to the CQAPP, as necessary.

12.0 PROCEDURES FOR TRACKING DEFICIENCIES AND CORRECTIVE ACTIONS

Procedures for tracking deficiencies and corrective actions related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

13.0 PROCEDURES FOR CONTROLLING DESIGN ACTIVITIES

Procedures for controlling design activities related to RA to be performed in 2010 and beyond, including placement of caps and sand covers, will be identical to that described in the CQAPP.

14.0 SCHEDULE

Capping and covering of contaminated sediments will be conducted over nine construction seasons: 2010 through 2018. Broadcast spreading operations will be conducted first, followed by mechanical placement of engineered caps. The capping operations will follow the same schedule as dredging operations, April 15 to November 15 of each year, with some fluctuations allowed for river conditions. Capping operations will be limited to 10 hours per day and 5 days per week. This will allow for reduced operations during overnight hours and during peak times for recreational boaters. (i.e., Saturdays and Sundays).

The following schedule shows areas slated for cap and cover placement as part of the Lower Fox River Project:

- 2010—Cap and cover placement in OU 2 and OU 3
- 2011—Cap and cover placement in OU 3
- 2012—Cap and cover placement for residuals management and any additional capping and cover work not completed in OU 2 and OU 3
- 2013—Cap and cover placement in OU 4
- 2014—Cap and cover placement in OU 4

- 2015—Cap and cover placement in OU 4
- 2016—Cap and cover placement in OU 4
- 2017—Cap and cover placement in OU 4, including areas of Green Bay near the river mouth

15.0 REFERENCES

WDNR (Wisconsin Department of Natural Resources) and USEPA (U.S. Environmental Protection Agency). 2002. Record of Decision, Operable Unit 1 and Operable Unit 2. Lower Fox River and Green Bay Wisconsin. December 2002.

WDNR and USEPA. 2003. Record of Decision, Operable Units 3, 4, and 5. Lower Fox River and Green Bay Wisconsin. June 2003.

WDNR and USEPA. 2007. Record of Decision Amendment, Operable Unit 2 (Deposit DD), Operable Unit 3, Operable Unit 4, and Operable Unit 5 (River Mouth). Lower Fox River and Green Bay Superfund Site. June 2007.

USEPA, 2006. Amended Administrative Settlement Agreement and Order on Consent in the matter of Lower Fox River and Green Bay Site. Respondents: Georgia-Pacific Consumer Products LP (formerly known as Fort James Operating Company) and NCR Corporation. CERCLA Docket No. V-W-’04-C-781. U.S. EPA Region 5.

APPENDIX G

INSTITUTIONAL CONTROL IMPLEMENTATION AND ASSURANCE PLAN

DRAFT

APPENDIX G

LOWER FOX RIVER REMEDIAL DESIGN
60 PERCENT DESIGN REPORT

INSTITUTIONAL CONTROL IMPLEMENTATION AND ASSURANCE PLAN

Prepared for

Appleton Papers Inc.

Georgia-Pacific Consumer Products LP

NCR Corporation

For Submittal to

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency

Prepared by

Anchor Environmental, LLC

Tetra Tech EC, Inc.

June 2008

Table of Contents

1 INTRODUCTION AND BACKGROUND 1
1.1 Background on Institutional Controls 1
1.2 The Lower Fox River OUs 2 to 5 Remedial Action 2

2 INSTITUTIONAL CONTROLS DURING CONSTRUCTION 5

3 INSTITUTIONAL CONTROLS TO PROTECT ENGINEERED CAPS 8
3.1 Relationship Between Design of Caps and Required Institutional Controls 8
3.1.1 Limitations on Navigation or Vessel Speed 9
3.1.2 Limitations on Anchoring, Dragging, or Salvage Operations 12
3.1.3 Limitations on Dredging 13
3.1.4 Limitations on Construction Activities 14
3.2 Institutional Controls to Protect Engineered Caps 14
3.2.1 Limitations on Dredging 15
3.2.2 Limitations on Construction Activities 16
3.3 Monitoring and Maintenance 18

4 PUBLIC INFORMATION AND ADVISORIES 21

5 REPORTING 22

6 REFERENCES 23

List of Figures

Figure 1-1 Fox River OUs 2 to 5 Project Area 4
Figure 3-1 Fox River OU 2 and OU 3 Shoreline Cap Areas 10
Figure 3-2 Fox River OU 4 and OU 5 Shoreline Cap Areas 11

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
cy	cubic yards
ICIAP	Institutional Control Implementation and Assurance Plan
LTMP	Long Term Monitoring Plan
MNR	monitored natural recovery
MOA	Memorandum of Agreement
OHWM	ordinary high water mark
OMMP	Operations, Maintenance and Monitoring Plan
OU	Operable Unit
PCB	polychlorinated biphenyl
ppm	part per million
RA	remedial action
RAL	remedial action level
RAO	Remedial Action Objective
RD	remedial design
ROD	Record of Decision
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources

1 INTRODUCTION AND BACKGROUND

This document presents the Institutional Control Implementation and Assurance Plan (ICIAP) for the remediation of polychlorinated biphenyls (PCBs) in Operable Units (OUs) 2 to 5 of the Lower Fox River and Green Bay Site (Site; see Figure 1-1) that will begin in 2009.
As described in the Remedial Design Work Plan approved by the Response Agencies (see definition in Section 1.2) on June 28, 2004, the ICIAP is an integral element of the overall remedial design (RD). The purpose of the ICIAP is to ensure the long-term protectiveness of remedial action (RA) to address contaminated sediments in OUs 2 to 5. The objective of the RA is to protect human health and the environment. Following completion of dredging, capping, and other associated actions at the Site in approximately 2017, those contaminated sediments that are contained beneath engineered caps will continue to be subject to this ICIAP.

Anticipated capping areas in OUs 2 to 5 are shown in Figure 1-5 of the 60 Percent Design Report Volume 2. When remedial work in a given OU is complete, the parties performing the RA will prepare an as-built survey and legal description of each remedial area. As described in Section 3 of this Plan, capping areas will then be recorded on the Wisconsin Department of Natural Resources (WDNR) geographic information system (GIS) Registry and included on appropriate local units of government GIS mapping systems. Additional notification measures will be implemented in shoreline capping areas, including notice to appropriate units of government and, in areas containing shoreline caps, riparian landowners.

This ICIAP does not address the potential need for institutional controls related to upland areas used in implementing the RA, including the former Shell property material processing and staging facility (and including the area planned to become uplands as a result of the build-out of the Shell property). Institutional controls for upland areas are addressed in site development plans for those specific areas, submitted as part of Phase 2A of the RA.

1.1 Background on Institutional Controls

As defined in USEPA (2005) and the ROD Amendment (USEPA and WDNR 2007), institutional controls are non-engineered instruments, such as administrative and legal controls, that may be included as part of the RA to minimize the potential for human health or ecological exposure to sediment contamination and ensure the long-term integrity of the remedy. The term “institutional control” generally refers to measures intended to affect

human activities in such a way as to reduce exposure to hazardous substances, such as by limiting certain uses. USEPA guidance on institutional controls is provided in OSWER Directive 9355.0-74FS-P, *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups* (USEPA 2000).

Institutional controls are typically grouped into the following categories (USEPA 2005):

- Proprietary land use restrictions and maintenance agreements that may involve legal instruments
- Governmental controls including permit conditions for future actions
- Informational devices including signage and fish consumption advisories that may be required until remedial action objectives (RAOs) are met

1.2 The Lower Fox River OUs 2 to 5 Remedial Action

The PCB 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 U.S. Environmental Protection Agency (USEPA) and WDNR (collectively, 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 at the Site from 2004 to 2007. In June 2007, a ROD Amendment was issued by the Response Agencies 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).

The ROD Amendment requires institutional controls in OUs 2 to 5 to maintain the integrity of the remedy, including protection of engineered caps and reducing potential exposure in monitored natural recovery (MNR) areas where residual contamination will remain after completion of RAs. The ROD Amendment discussed the use of governmental and/or property use institutional controls such as regulated navigation areas, and designating areas (including appropriate buffers) where use restrictions will be required. The ROD

Amendment outlined the following types of institutional controls that may be considered during RD:

- Water use restrictions (e.g., limitations on anchoring, spudding, dragging or conducting salvage operations, establishment of "no wake" areas and other operating restrictions for commercial and non-commercial vessels that could potentially disturb the riverbed or the engineered remedy, or restricting public access to remedial construction areas)
- Construction limitations (e.g., restrictions on dredging and other excavation activities such as laying cable in aquatic areas)
- Monitoring and maintenance requirements for certain areas (e.g., dams)
- Providing additional information to the public to assure protectiveness of the remedy (e.g., fish consumption advisories)

The requirement to implement this ICIAP in OUs 2 to 5 is set forth in the Response Agencies' 2007 Administrative Order for Remedial Action ("Order") and the accompanying Phase 2B Scope of Work. The respondents to the Order include Appleton Papers Inc.; CBC Coating, Inc. (formerly known as Riverside Paper Corporation); Georgia-Pacific Consumer Products LP (formerly known as Fort James Operating Company, Inc.); Menasha Corporation; NCR Corporation; P.H. Glatfelter Company; U.S. Paper Mills Corp. (U.S. Paper); and WTM I Company (formerly known as Wisconsin Tissue Mills, Inc.).

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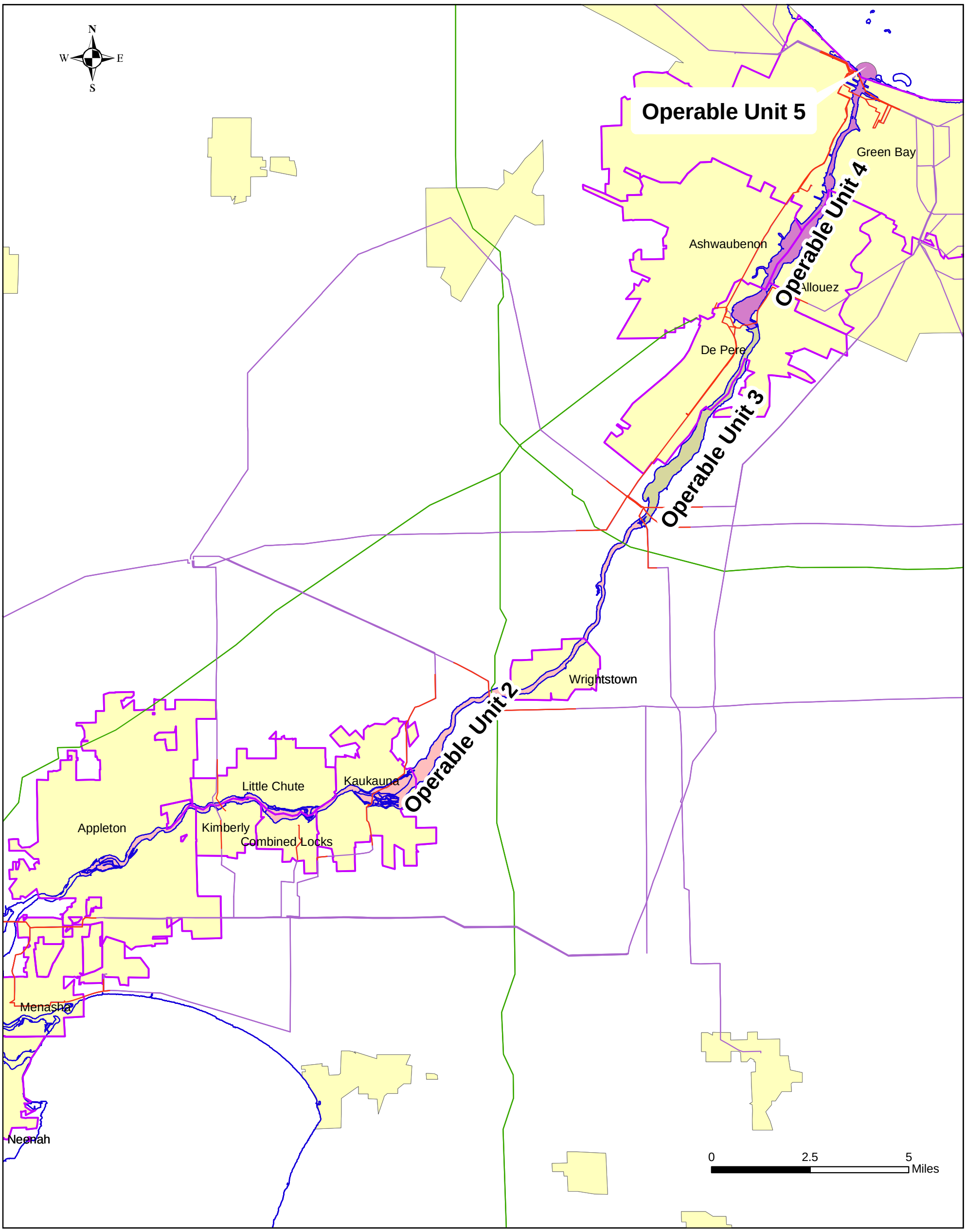

Legend

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

Operable Unit Number

- 2
- 3
- 4

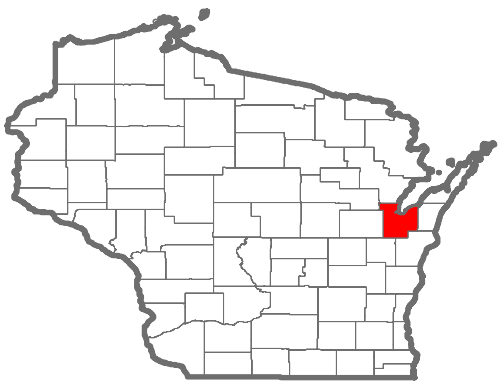

Figure 1-1
Lower Fox River
Area Location Map

Lower Fox River OU 2-OU 5

TETRA TECH EC, INC.

ANCHOR ENVIRONMENTAL, L.L.C.

Shaw

2 INSTITUTIONAL CONTROLS DURING CONSTRUCTION

This section describes the institutional controls that will be used to limit access to areas of the river where active remedial construction is occurring.

Water use restrictions will be used during the active construction phase of the project. During the course of remedial construction, public access to dredging and capping operations will need to be restricted for health and safety reasons. The selected RA contractor (Tetra Tech EC, Inc., J.F. Brennan and Company, Boskalis Dolman, and Anchor Environmental, LLC (collectively "the Tetra Tech Team") will be responsible for setting up and patrolling the construction boundaries to secure the equipment operation areas. The Tetra Tech Team will also be responsible for coordinating temporary waterway closures within portions of OUs 2 to 5 with U.S. Coast Guard (USCG) and Port of Green Bay officials to minimize disruption to commerce and recreation.

Regulated navigation areas are areas of a waterbody that are temporarily or permanently off-limits to navigation. During the active construction phase of the project, regulated navigation areas will be used to keep boat traffic away from in-water work and equipment. Specifically, under their existing authorities, entities authorized by law to control marine vessel traffic will place and maintain waterway navigational markers and signs regarding prohibited activities, vessel size, and speed. Such entities include the USCG or persons authorized by the USCG.

As discussed in Section 5 of the 60 Percent Design Report Volume 1, crossing channel buoys will be placed in OUs 2 to 5 during in-water construction periods. The warning buoys will be staggered at a distance of approximately 500 feet on either side of the dredge pipeline, to allow boaters sufficient time to slow down prior to encountering the pipeline. Spacing will be every 1,000 feet on the same side of the pipeline and every 500 feet when considering buoys on opposing sides. The pipeline delineators will be secured to the pipeline and spaced every 300 feet, providing warning to vessels that may be operating in close proximity to the dredge pipeline. Navigational markers will be placed to designate areas where the dredge pipeline has been securely anchored to the river bottom to provide for safe passage. Both the warning buoys and designated crossing channel buoys will be equipped with mooring lights to better identify the markers during low visibility periods.

As discussed in Section 7 of the 60 Percent Design Volume 1, the RA will comply with USCG guidelines regarding navigational notices when work is being performed in OU 4 channel areas. Notices will be expanded to include work outside the navigational channel. Prior to the start of work, the Tetra Tech Team will meet with USCG officials to review upcoming work so that the USCG may issue accurate notices throughout the work year. Also, periodic update meetings with the USCG will occur so that the accuracy of notices is not compromised. USCG navigational notices are typically effective measures for the dissemination of information to commercial vessel traffic moving through the Port of Green Bay.

Recreational vessels, however, may not monitor marine frequencies where notices are conveyed, and remedial work will also occur outside the federal navigation channel (in OU 2, OU 3, and outside the navigation channel in OU 4). Therefore, additional measures to notify the general public of ongoing safety considerations associated with the remedial activities will be implemented and will include:

- Posting notices at area boat landings and marinas informing the public of the extent and type of work, and the presence of buoys and dredge pipeline
- Distribution of public safety hand-outs, which can be carried by mariners for continued reference
- Meetings with local WDNR Wardens and the County Sheriffs to discuss safety markers, dredging operations, and previously observed public safety concerns that may have compromised boater safety with law enforcement agencies
- Release of project information to local television and print media for public release
- Public safety informational meetings prior to work each season where citizens will be informed of boater safety issues in the vicinity of project operations

Prior to the start of work, owners of property adjacent to the work areas will also be notified by mail of the upcoming work or by door-to-door visits and will be encouraged to attend the public safety informational meetings for local mariners. Finally, prior to each construction season and throughout the season, the Tetra Tech Team will meet with officials from the Port of Green Bay to inform them of ongoing work. Information received will be disseminated by the Port to their commercial tenants and will specifically inform commercial mariners of work at berthing locations.

Safety actions to be implemented, information to be provided, and channels for conveyance of information to the general public are consistent with those employed for work on Little Lake Butte des Morts (OU 1).

3 INSTITUTIONAL CONTROLS TO PROTECT ENGINEERED CAPS

This section describes the institutional controls that will be used to protect the engineered caps once they have been constructed. As discussed above, institutional controls are used to ensure the long-term protectiveness of the remedy. They serve as a supplement to other methods of ensuring the long-term protectiveness of the remedy, including design features and any existing regulatory authorities that control potential risks to the remedy. In cases in which the design of the remedy or existing regulatory authorities already control a potential risk, institutional controls are generally not necessary and, in fact, have the potential to reduce public welfare, such as by impinging on recreational use of the river without providing any environmental benefit. For example, as described below, the engineered caps are designed to allow anchoring by recreational watercraft without endangering the long-term protectiveness of the remedy. As a result, restrictions on anchoring are not proposed.

Section 3.1 contains a discussion of the various potential risks to the engineered caps and eliminates from consideration those risks that are addressed by the design of the caps themselves. Section 3.2 discusses the remaining potential risks, separating them into risks that are addressed by existing regulatory authorities and those that must be addressed by additional institutional controls.

3.1 Relationship Between Design of Caps and Required Institutional Controls

As discussed above, the ROD Amendment outlined certain types of institutional controls that should be considered during RD. In particular, the ROD Amendment discussed the following institutional controls that could be used for protecting the engineered caps:

- Water use restrictions (e.g., limitations on anchoring, spudding, dragging or conducting salvage operations, establishment of "no wake" areas and other operating restrictions for commercial and non-commercial vessels that could potentially disturb the riverbed or the engineered remedy)
- Construction limitations (e.g., restrictions on dredging and other excavation activities such as laying cable in aquatic areas)
- Monitoring and maintenance requirements for certain areas (e.g., dams)

This subsection evaluates whether the design of the engineered caps addresses the potential risks that these institutional controls otherwise would address. As described below, most of

these potential risks are addressed by the design of the engineered caps. The capping designs for OUs 2 to 5 were developed to ensure protection from worst-case hydrodynamic flows including floods, seiches, wind waves, boat wakes, propeller wash, and ice scour forces that could occur within the RA area (e.g., capable of withstanding a 100-year or greater event; see Section 6 of the accompanying 60 Percent Design Report Volume 2). The armor layer designs were developed to resist worst-case shear stresses with an appropriate factor of safety, concurrently providing both an erosion protection and bioturbation layer. While gravel-sized (e.g., 1- to 2-inch) armor provides protection from potential erosion throughout most of OUs 2 to 5, slightly larger armor stone is specified in limited areas with water depths between 3 and 4 feet to ensure long-term protection. No caps will be constructed in turbulent areas downstream of dams or in potential frazil ice areas to ensure their stability. For capping areas within the OU 4B federal navigation channel, where large cargo ships occasionally call on docks up to the Fort Howard Turning Basin, engineering evaluations concluded that an armor layer constructed of larger stones or equivalent are needed to ensure that cap erosion does not occur under anticipated worst-case conditions. Larger stone sizes are also specified for caps to be constructed in limited areas near shoreline facilities and in-water structures, where removal of the sediment would undermine and destabilize those facilities and structures. Shoreline cap areas (less than 3 feet of water under low pool conditions) within OUs 2 to 5 are depicted on Figures 3-1 and 3-2. Section 6 of the accompanying 60 Percent Design Report Volume 2 provides additional details on the development of protective cap designs for specific areas of OUs 2 to 5.

3.1.1 Limitations on Navigation or Vessel Speed

The cap designs developed for OUs 2 to 5 will resist worst-case shear stresses and other potential erosional events with an appropriate factor of safety. As discussed in Appendix A of the 60 Percent Design Volume 2, RD modeling determined that the highest bottom shear stresses from vessel operations occurred during relatively low speed maneuvers. Cap designs were developed using these worst-case combinations of vessel operating parameters. Based on these engineering evaluations, there is no need to establish no-wake or restricted vessel speed zones to ensure protection of engineered caps in the Lower Fox River. (In any case, USCG and the Port of Green Bay currently enforce no-wake and restricted vessel speed zones in parts of OU 4 to provide for general navigation safety.)

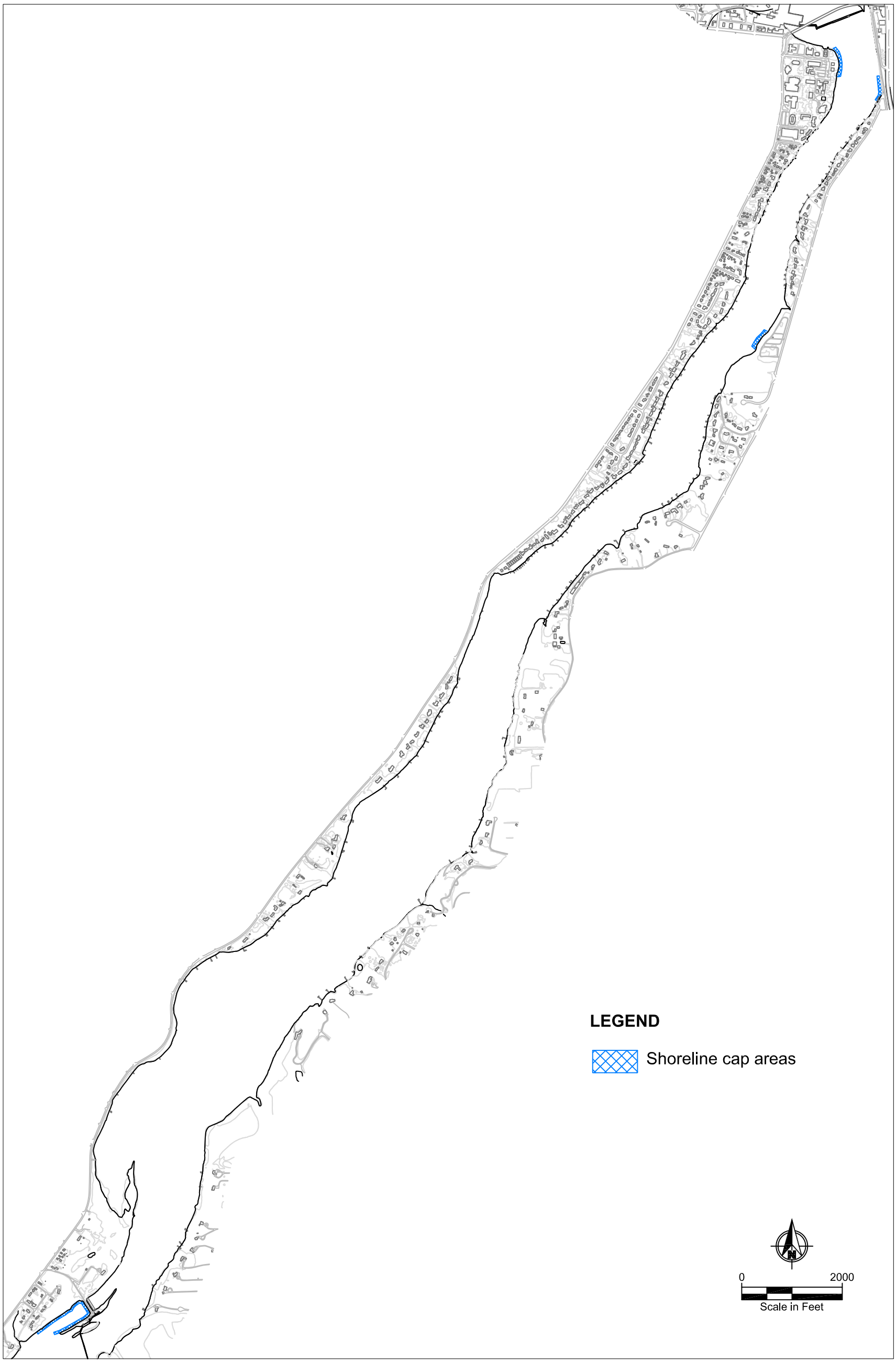

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Figure 3-1
Fox River OUs 2 and 3 Shoreline Cap Areas

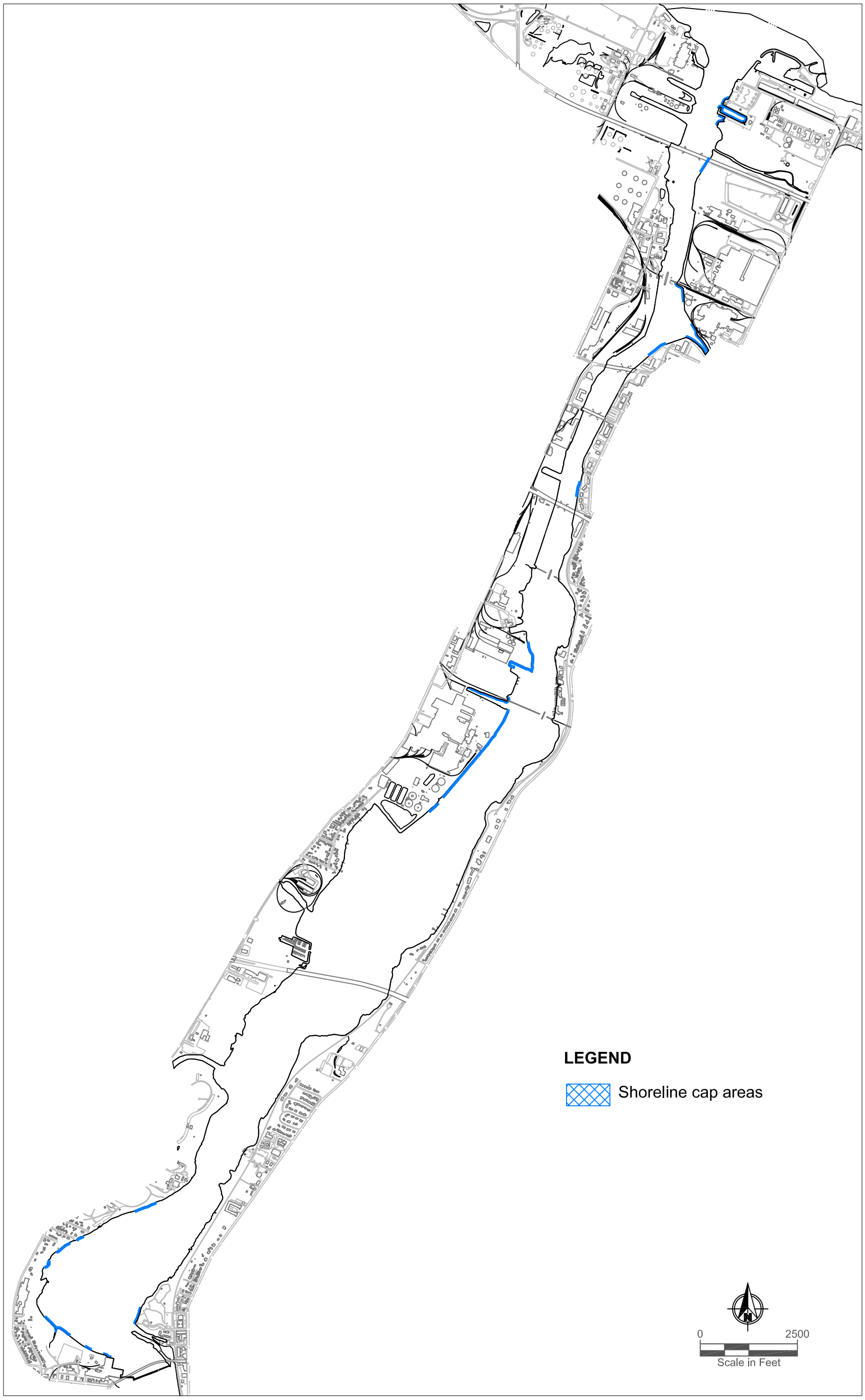

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Figure 3-2
Fox River OUs 4 and 5 Shoreline Cap Areas

3.1.2 Limitations on Anchoring, Dragging, or Salvage Operations

Anchoring, spudding, dragging, and salvage operations are sometimes restricted in sediment capping areas if such restrictions are necessary to provide protection against activities that could potentially compromise the integrity of the armor layer (USEPA 2005). However, the cap designs developed for OUs 2 to 5 include placement of a target thickness of at least 7 inches of an armor layer comprised of gravel or quarry spalls (or equivalent armor layer), as appropriate for the particular location.

Considering the range of anchor types for recreational vessels that operate within the Lower Fox River, and also considering the bearing strength of the designed armor layer, recreational vessel anchors as may be deployed in capping areas will rarely penetrate through the relatively coarse-grained armor layer. This RD issue was addressed in collaborative workgroups, and the cap designs described in the 60 Percent Design Volume 2 were determined to be protective. Long-term cap monitoring will be performed to verify the continued protectiveness of the caps (see Appendix H - Operation, Maintenance, and Monitoring Plan [OMMP]).

The collaborative workgroup discussions and the ROD Amendment (see, e.g., page 59 of the Responsiveness Summary) anticipated localized impacts to engineered caps such as those potentially associated with anchoring, dragging, and/or spudding activities, and noted that such disturbances are not expected to compromise the overall effectiveness of the remedy. Moreover, should an anchor or other disturbance penetrate through the armor layer, the "self-healing" behavior of the cap upon withdrawal of the structure maintains the integrity of the cap (e.g., see Palermo et al. 1998 and Boudreau et al. 2003). In addition, the OUs 2 to 5 caps will be constructed in net depositional environments within the river, such that new sediment will begin accumulating on the cap surface immediately following construction. The clean sediment layer accumulating on the cap will further reduce any anchor-related impacts and will continue to enhance the overall effectiveness of the cap over the long term. To provide appropriate protection from anchoring and related activities in localized high use areas, the accompanying 60 Percent Design Report Volume 2 submittal includes localized modifications of cap designs, such as near boat launches. Long-term post-construction cap monitoring will target higher

use areas of the river, to ensure that the caps continue to be protective (see Section 1.3.4 below).

Thus, further prohibitions on the anchoring of vessels within capping areas of OUs 2 to 5 are not necessary to ensure the effectiveness of the remedy, and would unduly burden local recreational use of the river without a concomitant environmental benefit. (It is noted that USCG already regulates anchoring and other activities that would obstruct navigation within the navigation channel, and these restrictions are expected to continue in perpetuity as part of ongoing channel operations [e.g., see Section 15 of the 1899 Rivers and Harbors Act], but such restrictions are not necessary to protect the navigation channel caps as designed.)

3.1.3 Limitations on Dredging

In order to protect the engineered caps, it is necessary to ensure that dredging operations do not remove the capping material. Two types of dredging operations were evaluated: maintenance of the federal navigation channel in OU 4; and privately-sponsored dredging of marinas and other locations outside of the navigation channel.

The engineered caps have been designed to avoid damage from maintenance of the federal navigation channel. As discussed in Section 6 of the accompanying 60 Percent Design Report Volume 2, engineered caps located within federal navigation channels have been designed to maintain their integrity under worst-case conditions, and the design provides that the top of the cap will be at least 2 feet below the authorized depth of the navigation channel. Consistent with the requirements of the ROD Amendment, all caps placed below the federally authorized navigation channel depth will be at least 33 inches in thickness, including a surface armor layer comprised of quarry spall or equivalent materials. The cap design minimizes the chance that future navigational dredging activities will disturb the engineered caps. Advance maintenance allowances used by the US Army Corps of Engineers (USACE) extend no further than 2 feet below the authorized channel depth.

Section 3.2.3 describes the regulatory authorities and institutional controls that will be used to protect the engineered caps from privately-sponsored dredging operations outside the federal navigation channel.

3.1.4 Limitations on Construction Activities

The cap designs developed for OUs 2 to 5 have been developed to address a range of construction-related disturbances. Boudreau et al. (2003) present engineering analyses and case studies of pile driving through engineered caps, and conclude that pile driving or other similar disturbances do not compromise the integrity or effectiveness of engineered caps that are designed following USEPA and USACE guidelines. The cap designs described in the 60 Percent Design Volume 2 conform to these guidelines, and are protective of a range of physical disturbances including pile driving. The "self-healing" behavior of caps upon entry or withdrawal of a range of structures maintains the integrity of the cap (e.g., see Palermo et al. 1998).

While the cap designs developed for OUs 2 to 5 can address a range of physical disturbances, certain construction activities can nevertheless pose potential risks to engineered caps. For example, removal of a relatively large wing and fender wall structure within a sediment cap resulted in documented recontamination of the nearby area (King County 1996). To ensure the long-term integrity of caps, permanent restrictions on certain in-water development activities will be necessary, including restrictions on setting utility or cable corridors, removal of relatively large (greater than 6-inch diameter) piling, or other significant construction activities that would disturb the integrity of the cap (Palermo et al. 1998).

3.2 Institutional Controls to Protect Engineered Caps

As described above, the design of the engineered caps reduces the scope of potential risks that must be addressed through regulatory authorities or other institutional controls. The risks evaluated in this subsection include disturbance of the caps by dredging or construction activities (in particular, removal of relatively large pilings).

An institutional control may be deemed to be in place already if another agency has responsibility for enforcing a prohibition on the activity that otherwise would need to be the

subject of an institutional control (USEPA 2005). As a result, this subsection examines the extent to which existing regulatory authorities address the potential risks to the engineered caps. To the extent existing regulatory authorities do not fully address these potential risks, this subsection includes the additional institutional controls that will be used to address the potential risks.

3.2.1 Limitations on Dredging

As discussed above, the caps' design and location protect the engineered caps from maintenance of the federal navigation channel. In addition to those design features, however, following approval of the 60 Percent Remedial Design Volume 2 submittal, a memorandum of agreement (MOA) will be developed between USACE, USEPA, and the respondents to the Order or their representatives to further ensure that future dredging activities within the federal navigation channel do not compromise the integrity of the engineered caps. The MOA is anticipated to follow the general form of USACE agreements implemented at other similar CERCLA sediment cap sites located in federally-authorized channels.

Privately-sponsored dredging activities are subject to permitting under WDNR's Chapter 30 program. WDNR's Chapter 30 permitting program creates a comprehensive regulatory and permitting framework that governs both dredging and placement/removal of structures in navigable waters. Wisconsin law has long recognized the existence of certain common law rights that are incidents of riparian ownership of property adjacent to a body of water. Likewise, Wisconsin law has long recognized that these riparian rights are qualified, subordinate, and subject to the paramount interest of the State of Wisconsin (the "State") and paramount rights of the public in navigable waters; the so-called public trust. The State administers the public trust through various statutes and rules which regulate activities in navigable waters. Through these statutes and rules, the State has created the regulatory framework to provide the long-term institutional control to protect the integrity of the caps against potential risks posed by dredging.

There are also a range of federal laws that place restrictions on and require permits to be obtained for dredging, filling, or other construction activities in the aquatic

environment. These include Section 404 of the Clean Water Act, Title 33 United States Code (U.S.C.) Section 1344, and Sections 9 and 10 of the Rivers and Harbors Act of 1899, 33 U.S.C. 401 and 403, which require federal permitting for any construction that would impact the course, capacity, or condition of navigable waters of the U.S. The 401/404 regulations are typically implemented by the USACE, but may also be implemented by USEPA. Under the Section 404(b)(1) guidelines, 40 CFR 230.10(b), no discharge (i.e., excavation of caps) shall be allowed if it:

- Causes or contributes to violations of water quality standards, pursuant to Section 401 of the Clean Water Act (CWA), after consideration of local dilution and dispersion; or
- Violates any applicable toxic effluent standard or discharge prohibition under Section 307 of the CWA.

Thus, existing federal programs will further ensure that dredging activities will not disturb the integrity of the caps to be constructed in OUs 2 to 5. Through the existing state and federal permit programs, WDNR, USACE, and USEPA can place appropriate limitations or construction mitigation requirements on dredging (e.g., for marina expansion or maintenance) to ensure the long-term protectiveness of caps constructed as part of the OUs 2 to 5 remedy.

3.2.2 Limitations on Construction Activities

As discussed in Section 3.1.4, it will be necessary to ensure permanent restrictions on certain in-water development activities to ensure the long-term integrity of caps. For example, construction of boat ramps, retaining walls, or marina development within engineered cap areas could potentially expose subsurface contamination and compromise the long-term effectiveness of the OUs 2 to 5 remedy. As with the potential risks from dredging, restrictions to ensure cap integrity against construction activities can be implemented through agencies such as WDNR and the USACE that have permitting authority over construction activities in the aquatic environment, including programs that require permits to be obtained for dredging and filling, or through other measures to establish limitations on these activities. Existing regulatory authorities are summarized below.

The same federal laws that place restrictions on and require permits to be obtained for dredging activities also address filling and other construction activities in the aquatic environment. These include Section 404 of the Clean Water Act, Title 33 United States Code (U.S.C.) Section 1344, and Sections 9 and 10 of the Rivers and Harbors Act of 1899, 33 U.S.C. 401 and 403, which require federal permitting for any construction that would impact the course, capacity, or condition of navigable waters of the U.S. The 401/404 regulations are typically implemented by the USACE, but may also be implemented by USEPA. Under the Section 404(b)(1) guidelines, 40 CFR 230.10(b), no discharge (i.e., excavation of caps) shall be allowed if it:

- Causes or contributes to violations of water quality standards, pursuant to Section 401 of the Clean Water Act (CWA), after consideration of local dilution and dispersion; or
- Violates any applicable toxic effluent standard or discharge prohibition under Section 307 of the CWA.

These federal programs help ensure that proposed future construction activities will not disturb the integrity of the caps to be constructed in OUs 2 to 5.

In addition, as discussed above, WDNR's Chapter 30 permitting program creates a comprehensive regulatory and permitting framework that governs the types of activities, including placement/removal of structures in navigable waters, that could affect the integrity of the engineered caps. Riparian rights include the right to reasonable use of the shoreline and reasonable access to water by construction of a pier or other structure to aid in navigation. But, as with dredging, these rights are subject to regulation and permitting under the Chapter 30 program. The Chapter 30 regulatory framework, however, exempts certain activities from the permitting requirements, the most notable being a riparian owner's ability to place and remove a pier in less than 3 feet of water. While engineered caps will generally not be placed in less than three feet of water and therefore will not be impacted by such exempt activity, additional measures beyond reliance on the Chapter 30 program will be taken in the shoreline capping areas.

Specifically, the Chapter 30 program will be supplemented by an additional institutional control in areas of shoreline caps. Traditionally, parties conducting environmental cleanups in Wisconsin ensured that property owners would refrain from certain actions by recording deed restrictions that applied to the property. WDNR, however, has moved away from using deed restrictions as a means of a proprietary control to regulate activities where residual contamination remains after a cleanup. Instead, WDNR requires that the affected area be registered on WDNR's GIS Registry, which is WDNR's public notification system for environmental cleanups that contain in-place, residual contamination. WDNR also requires written notification to affected landowners. This revised approach is a result of Wis. Stat. Section 292.12, which the legislature enacted in 2006. Pursuant to this regulatory framework, the location of the shoreline caps will be registered on the GIS Registry and affected riparian landowners will be notified in writing. Additionally, the location of the caps will be indicated on all appropriate local governmental units' mapping systems.

In addition, although the Chapter 30 program already prohibits riparian owners from conducting construction activities in deeper water (i.e., deeper than 3 feet) without a permit, for additional clarity, the location of all engineered caps (even those that are not shoreline caps) will be registered on the GIS Registry and the location of the caps will be indicated on all appropriate local governmental units' mapping systems. (In areas of greater than 3 feet of depth, there is no need to provide separate notification to riparian owners because the Chapter 30 program already requires a permit for construction activity in these areas.)

3.3 Monitoring and Maintenance

As discussed in the ROD Amendment, long-term monitoring and maintenance will be performed to ensure the physical integrity of the cap and the permanent containment of the underlying sediment contaminants. Monitoring events will occur at a pre-determined schedule, with a combination of bathymetric surveys and focused surface sediment sampling and core sampling (where feasible) in sentinel areas (i.e., areas exposed to relatively higher shear stresses). In addition, bathymetric surveys of capped areas will be performed as soon as possible following flood events with a recurrence interval of 20 years or more. If cap integrity and performance are verified under a 20-year event, follow-on

event-based cap monitoring will occur following a 50-year event. Supplemental bathymetric surveys will also be performed following major river construction events (e.g., new bridge construction) or if water levels drop more than 1 foot below the low-water elevations used to develop the cap designs (see Section 6 of the accompanying 60 Percent Design Volume 2). Detailed long-term sediment monitoring plans are presented in the accompanying Operations, Maintenance, and Monitoring Plan (OMMP; Appendix H). Long-term monitoring modifications will be documented in the annual RA Work Plans.

Institutional controls with respect to the De Pere Dam are not necessary to ensure the protectiveness of the remedy in OU 3 and OU 4. Given the ownership and regular inspection and maintenance of the De Pere Dam by USACE, no basis currently exists to anticipate that this dam will fail or be removed. There are already a number of compelling reasons for the USACE and others to continue to maintain the De Pere Dam, such as providing hydropower capability, water supplies, and recreational use.

Even if the De Pere Dam were to be removed in the future and soft sediment deposits in OU 3 upstream of the dam were subject to erosion and transport, the degree to which OU 3 sediment would be transported downstream would depend on the manner in which the dam might be removed. The most likely scenario is that the dam would be removed in a controlled manner; if so, little or no sediment would be transported downstream. However, even if dam removal caused a wholesale movement of sediment, the average PCB concentration of that sediment would likely be low. Under the remedy described in the ROD Amendment and presented in detail in the accompanying 60 Percent Design Report, approximately 2.0 million cubic yards (cy) of recent (post-dam) soft sediments would be retained in OU 3 after remedy construction, along with a relatively small amount (0.2 million cy) of sediment cap material. These sediments would contain an average PCB concentration of about 0.4 parts per million (ppm), well below the remedial action level (RAL) of 1.0 ppm.

In addition, an institutional control may be deemed to be in place already if another agency has responsibility for conducting an activity or enforcing a prohibition and existing laws or regulations require an environmental review before that program is changed (USEPA 2005). USACE and WDNR currently have responsibilities related to operation and maintenance of

dams that are part of the Fox River Navigational System. White Paper 4, issued along with the 2003 ROD, describes Wisconsin regulatory and environmental review requirements associated with proposals for dam removal. White Paper 4 also notes that the USACE has continued to operate, inspect, and maintain the De Pere Dam. Moreover, a considerable amount of infrastructure and recent residential development along OU 3 depends on continued operation of the dam. For all of the foregoing reasons, further institutional controls to prevent the removal of the De Pere Dam are not necessary to ensure the long-term protectiveness of the remedy in OUs 3 and 4.

4 PUBLIC INFORMATION AND ADVISORIES

Fish consumption advisories are informational devices, and an existing WDNR fish consumption advisory is already in place in the Lower Fox River and has been incorporated into the ROD Amendment. Due to the elevated concentrations of PCBs and mercury detected in fish tissue from the Lower Fox River and Green Bay, the WDNR issued consumption advisories in 1977 and 1987 for fish and waterfowl, respectively. General fish consumption advisories are currently in effect for seven species of fish located in the Lower Fox River from Little Lake Butte des Morts to the De Pere Dam, for 13 species of fish located from the De Pere Dam to the mouth of Green Bay, and 11 species of fish located in Green Bay.

In 1984, WDNR initiated its wildlife contaminant monitoring program. Results of the monitoring program indicated that elevated PCB concentrations were present in waterfowl species harvested by sportsmen from Green Bay. WDNR then developed procedures for issuing consumption advisories for waterfowl, and issued a waterfowl consumption advisory for mallard ducks in 1987. The advisory for mallards was issued for mallards taken in the "Lower Fox River from Lake Winnebago at Neenah and Menasha downstream, including Little Lake Butte des Morts, to the northeast city to the northeast city limits of Kaukauna", and the "Lower Fox River from the De Pere Dam to the River's mouth at Green Bay, and lower Green Bay south of a line from Point au Sable west to the west shore of Green Bay". The advisory has remained in place since its issuance. The advisories are issued each year in the annual hunting guide distributed by the WDNR. The federal Food and Drug Administration threshold level for poultry of 3 ppm wet-weight PCBs on a fat basis has been adopted by WDNR for the Lower Fox River.

WDNR's fish and waterfowl advisory programs are expected to continue in the future, so there is no reason to require an independent advisory program as part of the OU 2 to 5 RA. In addition, an independent advisory program could create a risk of contradictory advice to the public. The accompanying Long-Term Monitoring Plan (LTMP; Appendix I) describes the water and biological tissue monitoring program to be implemented by the respondents to the Order in the years following the RA, to verify that the RA will be effective at reducing risk to humans, mammals, birds, fish, and invertebrates. Data collected during implementation of the LTMP will be forwarded to WDNR staff responsible for the fish and waterfowl advisory programs.

5 REPORTING

When the Response Agencies determine that remedial work in a given OU is complete, the parties performing the RA (i.e., the Tetra Tech Team or Order Respondents) will provide an as-built survey and legal description of each remedial area. The legal description shall be tied to upland markers and meet WDNR's survey requirements. As discussed above, the location of engineered caps will be registered on WDNR's GIS Registry and affected landowners will be notified in writing. Additionally, the location of the caps will be indicated on all appropriate local governmental units mapping systems.

As part of the CERCLA 5-year review, USEPA will require periodic certifications of the status and effectiveness of the institutional controls implemented in OUs 2 to 5. As practical, long-term cap monitoring and maintenance reporting under the OMMP and water/biota sampling and reporting under the LTMP will be coordinated to take place during the same year, conducted approximately one year prior to the scheduled CERCLA 5-year reviews, so that the most up-to-date information will be available to inform the review.

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APPENDIX H

OPERATION, MAINTENANCE, AND MONITORING PLAN

DRAFT

APPENDIX H

LOWER FOX RIVER REMEDIAL DESIGN
60 PERCENT DESIGN REPORT

OPERATIONS, MAINTENANCE, AND MONITORING PLAN

Prepared for

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For Submittal to

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency

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June 2008

1 INTRODUCTION 1
1.1 Purpose and Scope 4
1.2 OMMP Organization 6

2 MONITORING AND MAINTENANCE OF CAPPING AREAS 7
2.1 Cap Design Summary 9
2.2 Physical Integrity of Sediment Caps 11
2.3 Chemical Integrity of Sediment Caps 14
2.4 Cap Monitoring Decision Framework Summary 20

3 NATURAL RECOVERY MONITORING 22
3.1 Surficial Sediment Sampling 22
3.2 Trend Analysis 27

4 REFERENCES 28

List of Tables

Table 2-1 Summary of Lower Fox River Flow Rates 12
Table 2-2 Summary Baseline Low-Water Elevations 12

List of Figures

Figure 1-1 Fox River OUs 2 to 5 Project Area 2
Figure 2-1 Sentinel Cap Monitoring Locations: OUs 2 and 3 15
Figure 2-2 Sentinel Cap Monitoring Locations: OUs 4 and 5 16
Figure 2-3 Decision Framework for Sediment Cap Monitoring 18
Figure 3-1 MNR Sampling Locations: OU 2 23
Figure 3-2 MNR Sampling Locations: OU 3 24
Figure 3-3 MNR Sampling Locations: OU 4 25
Figure 3-4 MNR Sampling Locations: OU 5 26

1 INTRODUCTION

This document presents the Operations, Maintenance, and Monitoring Plan (OMMP) for sediment remedial actions including capping and monitored natural recovery (MNR) 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.

This draft OMMP 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. (Fort James) and NCR Corporation (NCR) (collectively the "Respondents"), and amended by the October 2007 revised Administrative AOC and Order on Consent . This draft OMMP will be reviewed and approved by the United States Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR) (collectively the "Response Agencies"). Implementation of the OMMP and other remedial action (RA) elements will be performed pursuant to the Administrative Order for RA, USEPA Docket Number V-W-08-C-885 (the "Order"). The respondents to the Order include Appleton Papers Inc., CBC Coating, Inc. (formerly known as Riverside Paper Corporation), Georgia-Pacific Consumer Products LP (formerly known as Fort James Operating Company, Inc.), Menasha Corporation, NCR Corporation, P.H. Glatfelter Company, U.S. Paper Mills Corp., and WTM I Company (formerly known as Wisconsin Tissue Mills, Inc.). The RD/RA in OU 1 is being addressed under a separate agreement between the Response Agencies and the WTM I Company.

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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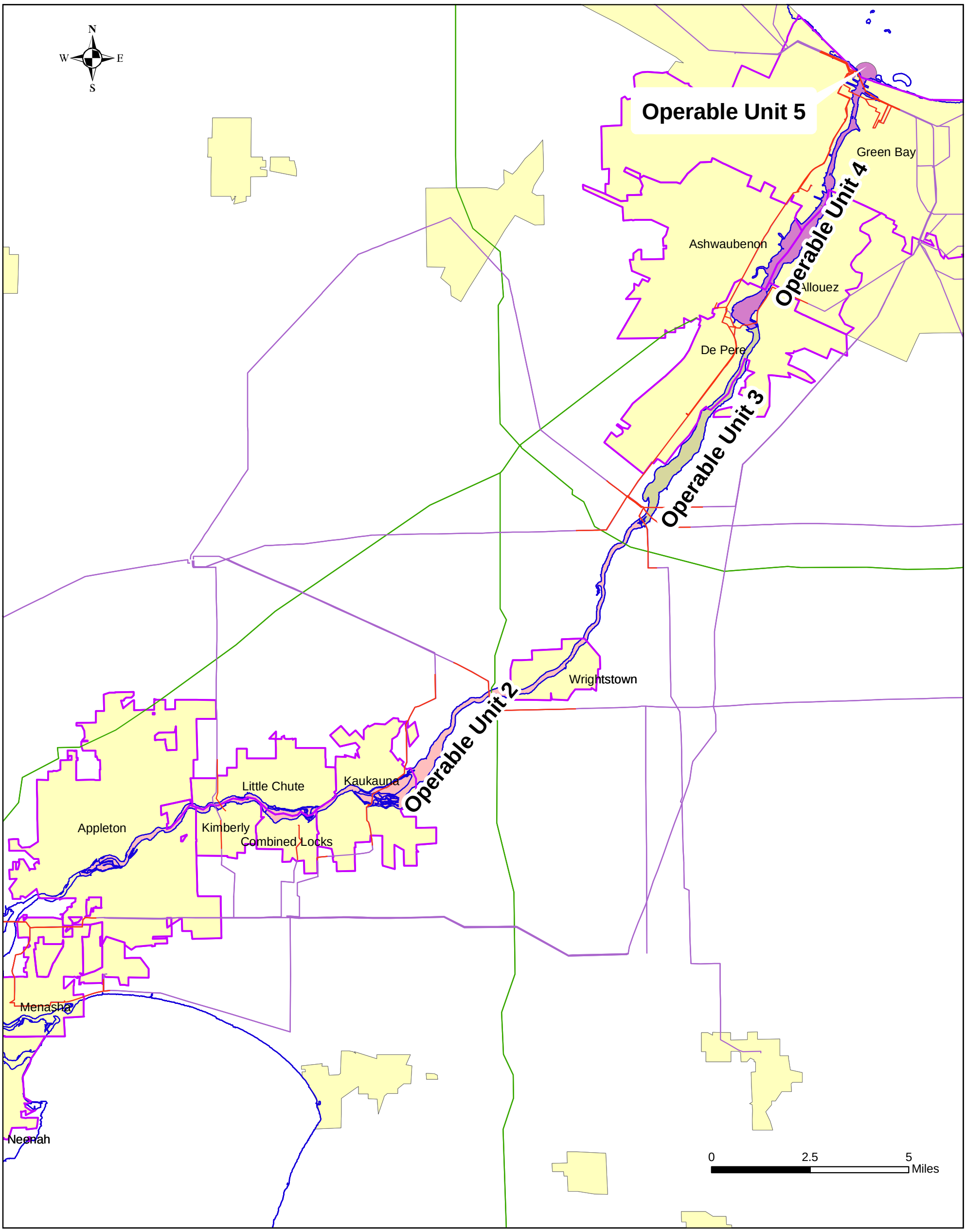

Legend

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

Operable Unit Number

- 2
- 3
- 4

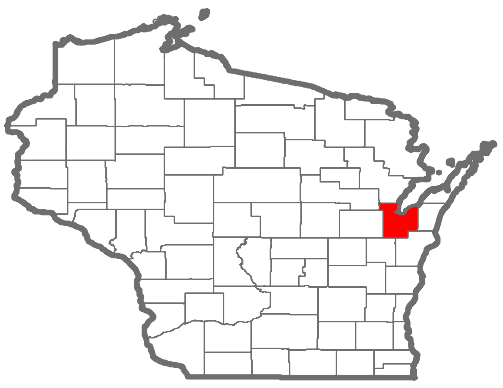

Figure 1-1
Lower Fox River
Area Location Map

Lower Fox River OU 2-OU 5

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Shaw

The 60 Percent Design Volume 1 describes RA activities to be performed in 2009, and the 60 Percent Design Volume 2 describes RA planned for 2010 and beyond. Between 2009 and 2015, approximately 3.9 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 material dewatered and transported to permitted disposal facilities. Relatively clean sand will be segregated from the sediments as practicable, and beneficially reused as approved by WDNR.

Engineered caps will be placed over approximately 410 acres of the river that exceed the 1.0 ppm RAL (including shoreline areas), and sand covers will be placed over an additional approximately 210 acres to address thin deposits of relatively low concentration sediment. In addition, sand covers are anticipated to be used as a residuals management technique over 100 to 500 acres depending on post-dredge sediment characteristics. Capping and covering of contaminated sediment is anticipated to be conducted over eight seasons, beginning in 2010 and continuing through 2017. The proposed sequence of capping and covering operations will generally proceed upstream to downstream following the completion of dredging in those areas. Anticipated capping areas in OUs 2 to 5 are shown in Figure 1-5 of the 60 Percent Design Report Volume 2.

As described in the ROD Amendment, long-term monitoring of engineered caps installed in OUs 2 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. As described in more detail in Section 2, the long-term monitoring of engineered caps will include bathymetric surveys, surface sediment sampling, and core sampling where feasible, beginning in Year 2 following construction, and continuing at least through Year 9. Given that completion of capping is anticipated to span approximately eight years (beginning in 2010 and continuing through 2017), the initial (i.e., Year 2) physical monitoring will occur independently within groups of cap certification units (CCUs) completed within the same year of construction. However, subject to adaptive management and Response Agency approval, follow-on physical and chemical 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 design 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 will be undertaken in the affected area.

The RODs selected MNR for most of OUs 2 and 5 and portions of OUs 3 and 4. Active remediation (dredging, capping and cover) in much of OUs 1, 3 and 4, and also in certain portions of OUs 2 and 5 will reduce PCB loading to the rest of the river and will contribute to the recovery of these areas. The MNR remedy for OUs 2 and 5 also includes a program for monitoring PCB trends in surface sediments in these areas relative to ROD predictions. The MNR sediment monitoring program is included in Section 3 of this OMMP.

Although the 1.0 ppm RAL performance standard or surface weighted average (SWAC) goals (0.28 ppm in OU 3 and 0.25 ppm in OU 4) described in the ROD Amendment will be met before construction of the RA can be deemed complete in an OU, the Response Agencies have concluded that it will take additional time for natural recovery to achieve some of the remedial action objectives (RAOs) specified in the RODs and ROD Amendment. For example, while the ROD Amendment estimated that a SWAC of approximately 0.28 ppm PCBs will be achieved in OU 3 after the completion of RA, an additional 9 years of natural recovery was estimated to be necessary to achieve the sediment quality threshold (SQT) for unlimited walleye consumption (i.e., 0.049 ppm PCBs). Natural recovery of both actively remediated and un-remediated areas will be necessary for certain SQTs and other RAOs discussed in the RODs and ROD Amendment to be achieved. Again, OMMP monitoring of PCB trends in surface sediments will be performed in these areas to compare with ROD predictions.

Long-term monitoring of surface water and biota will be performed as a separate, coordinated Site-wide activity to assess progress in achieving RAOs specified in the RODs and ROD Amendment and to determine remedial success. The preliminary draft Long-Term Monitoring Plan (LTMP) is provided in Appendix I of the 60 Percent Design Report Volume 2, and is subject to further collaborative workgroup review.

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 and MNR areas, along with cap maintenance and contingency measures, are presented in this OMMP.

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. This OMMP also includes long-term monitoring of natural recovery areas to verify ROD and ROD Amendment predictions. The overall objective of the OMMP monitoring programs is to confirm that the OUs 2 to 5 RA activities achieve the performance standards specified in the ROD Amendment, including verification of the effectiveness of engineered caps and sediment natural recovery. This OMMP 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 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 is detailed in the 2009 Construction Quality Assurance Project Plan (CQAPP) included as Appendix D of the 60 Percent Design, Volume 1 and the CQAPP Addendum included as Appendix F of the 60 Percent Design, Volume 2. The CQAPP plans and performance criteria were developed consistent with the ROD Amendment and build on similar plans and criteria that have been utilized for the Phase 1 and OU 1 projects.

This OMMP only addresses confirmation monitoring elements and addresses the following:

- Data quality objectives for post-construction sediment monitoring in cap and natural recovery areas, including rationale for the type, number, location, and frequency of samples to be collected
- Analyses to be performed
- Sampling equipment and methods to be used
- Reporting requirements

1.2 OMMP Organization

Section 2 of this OMMP presents plans for long-term monitoring and contingency responses within sediment capping areas. Section 3 presents plans for long-term monitoring and confirmation of sediment natural recovery. As outlined above, long-term monitoring of surface water and biota will be performed as a separate, coordinated Site-wide activity as described in the LTMP (Appendix I of the 60 Percent Design Report Volume 2).

2 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:

- Bathymetric surveys
- Monitoring for physical integrity
- Monitoring for chemical containment
- Cap maintenance, enhancement or other contingency actions

The integrity of the caps will be monitored to ensure the cap thickness does not diminish by erosion. Cap monitoring will also ensure that chemicals of concern in the underlying sediments do not migrate through the cap and into the river. Given that completion of capping is anticipated to span approximately eight years (beginning in 2010 and continuing through 2017), monitoring will be initiated independently within groupings of CCUs where construction is completed within the same year. The schedule for initiating physical and chemical OMMP cap monitoring activities is outlined in the sections below, and will be detailed in Annual RA Work Plans.

As described in the CQAPP Addendum, sediment cores, "catch pans", or other techniques suitable for measuring the thickness of placed caps with consideration of armor stone size will be collected through the cap during and immediately following construction to correlate with material placement records and pre- and post-cap bathymetric surveys. Measurements of the amount of material placed, verified with post-construction surveys and core thickness measurements, will be performed as necessary to verify that cap 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, 4, and 9 for groups of CCUs completed within the same year of construction. However, subject to adaptive management and Response Agency approval, follow-on post-construction bathymetric monitoring of CCUs completed in different years may potentially be combined to monitor more efficiently. In addition, bathymetric surveys of capped areas will be performed as soon as possible following a flood event with a recurrence interval of 20 years or more.

Supplemental bathymetric surveys will also be performed following major river construction events (e.g., new bridge construction) or if water levels drop more than 1 foot below the low-water elevations used to develop the cap designs (see Section 6 of the accompanying 60 Percent Design Volume 2; also see Section 2.2 below). If cap integrity and performance are verified under a 20-year event, follow-on event-based cap monitoring will occur following a 50-year event. Long-term monitoring modifications will be documented in the annual RA Work Plans.

As discussed in more detail below, if cap erosion is identified by bathymetric surveys, sediment cores (or other suitable measurements) will be collected in areas of potential erosion for physical measurements of cap thickness to verify the results of the bathymetric survey. If cap erosion is confirmed by verification core sampling 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 2.2), then possible response actions can include:

- No action if follow-on chemical sampling and analysis results (see Section 2.3) indicate the remaining cap layer thicknesses are sufficient to prevent "breakthrough" of contaminants and protection from erosion
- Repair area of erosion (e.g., reestablish cap thickness)
- Armor area of erosion
- 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

Sediment cores collected for evaluation of chemical breakthrough will be evaluated on a case-by-case basis, as discussed in Section 2.3. If chemical profiles in sediment cores indicate cap breakthrough may have occurred, possible response options can include:

- Increasing the thickness of the cap to ensure cap integrity
- Increasing the frequency and intensity of cap monitoring
- 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 removal of the cap and underlying contaminated sediment

Consistent with CERCLA requirements, the Response Agencies, Order Respondents, and the Tetra Tech Team will evaluate cap performance and the need for and scope of continued cap monitoring and contingency response actions as part of the five-year review process.

The following sections present a summary of the cap designs to be constructed in OUs 2 to 5, along with detailed plans to monitor the physical and chemical integrity of the engineered caps. Section 2.4 presents the cap monitoring and contingency response decision framework.

2.1 Cap Design Summary

As discussed in detail in Volume 2 of the 30 Percent Design Report for OUs 2 to 5 (Shaw and Anchor 2007), four different cap designs have been developed to address different capping requirements within the Lower Fox River, consistent with the ROD Amendment. Each cap design has specified target and minimum thickness criteria 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 placed thickness of 6 inches of clean sand overlain with 7 inches of placed gravel, taking into consideration operational constraints and overplacement allowances. The placed thickness will be verified as described in the CQAPP Addendum, and consistent with ROD Amendment requirements. The OMMP will assess long-term cap protectiveness relative to USEPA/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.
- **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 placed thickness of 9 inches of clean sand overlain with 7 inches of gravel, to be verified as described in the CQAPP Addendum, and consistent with ROD Amendment requirements. The OMMP 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.
- **Cap C – Sand and quarry spall cap for PCBs > 50 ppm in any underlying sediment interval and for any caps placed in federal navigation channels.** Cap C consists of a placed 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 placed thickness of 18 inches of suitably sized armor material. Within the OU 4A and 4B navigation channel, 4- to 9-inch quarry spall material will be used for the armor layer. Placed thickness will be verified as described in the CQAPP Addendum, and consistent with ROD Amendment requirements. The OMMP 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 material.

- **Shoreline Caps.** A range of shoreline cap designs are currently being developed in the collaborative RD workgroup, including establishing "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 RA Work Plans, also factoring in landowner considerations. Two general shoreline cap conditions occur in OUs 2 to 5:
  1. Transitioning from an offshore dredge area where the depth of contamination (DOC) extends to a depth greater than 2 feet below the mudline and the adjacent RA delineation is dredging
  2. Transitioning from an offshore dredge and cap (or offshore cap) area into the shoreline where the adjacent RA delineation is capping

  Shoreline caps may utilize Cap A, B, or C designs, depending on the chemical concentrations and erosional conditions, as well as alternate designs approved by the Response Agencies (e.g., potentially incorporating geotextiles).

As described in the CQAPP Addendum, engineered cap areas will be divided into CCUs for the purpose of verifying that cap placement specifications have been met. Pre-cap and post-cap (Year 0) elevations to be used for the subsequent OMMP assessment of long-term changes in cap surface elevations and thickness will also 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 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 will be presented in the Annual RA Work Plans.

2.2 Physical Integrity of Sediment Caps

Following the initial post-construction bathymetric survey of the capped areas as described in the CQAPP Addendum, long-term OMMP monitoring of the capping areas will be performed, including bathymetric monitoring in all cap areas and focused chemical verification sampling in "sentinel" capping areas located in areas with relatively high peak bottom shear stresses from floods, seiches, wakes, propeller wash, and/or other forces (see Section 2.3 below).

Post-construction bathymetric surveys of the CCUs within all capped areas will be completed during Years 2, 4, and 9 within groups of CCUs completed within the same year of construction. Since capping in OU 2 and upper OU 3 is scheduled to be completed in 2010, the first "Year 2" cap monitoring event will occur in 2012, with follow-on monitoring to occur in 2014 and 2019. Year 2 bathymetric monitoring within downstream groups of CCUs will be initiated each subsequent year from 2013 to 2019. Capping in lower OU 4 and the OU 5 river delta is scheduled to be completed in 2017, and the last series of cap monitoring in theses areas will be scheduled for 2019, 2021, and 2026. Bathymetric monitoring after 2017 will be coordinated to combine monitoring events as practicable to take place during the same year, potentially rescheduling the Year 4 and 9 surveys ahead or behind by one year to improve monitoring efficiencies, subject to Response Agency approval.

In addition, supplemental bathymetric surveys will be performed as soon as possible following a flood event with a recurrence interval of 20 years or more. Table 2-1 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 (US Geological Survey [USGS] Station No. 04084500) was based on linear interpolation using data from Krug et al. (1991). Corresponding flows at the USGS Oil Tank Depot (Station 040851385) were computed using the drainage area ratio method, consistent with observed flow increases between the Rapide Croche and Oil Tank Depot gages over the 18-year period of record (see Shaw and Anchor

2006). Supplemental bathymetric surveys will also be performed following major river construction events (e.g., new bridge construction) or if water levels drop more than 1 foot below the low-water elevations used to develop the cap designs, as summarized in Table 2-2. Long-term monitoring modifications will be documented in the annual RA Work Plans.

Table 2-1
Summary of Lower Fox River Flow Rates

Recurrence Interval	Flows at Rapide Croche (cfs)	Flows at Oil Tank Depot (cfs)
2	12,700	13,400
5	17,000	17,900
10	19,200	20,200
20	21,000	22,100
25	21,600	22,800
50	23,000	24,200
100	24,200	25,500

1. The computed recurrence interval flow for the Fox River at Rapide Croche is from Krug, et al. 1991. The 20-year recurrence interval was interpolated from the computed recurrence intervals.
2. cfs = cubic feet per second
3. The recurrence interval flows at the Oil Tank Depot were estimated by multiplying the recurrence interval flow at Rapide Croche by the ratio of drainage areas between the Oil Tank Depot gaging station (6,330 square miles; Station No. 040851385) and the Rapide Croche USGS gaging station (6,010 square miles; Station No. 04084500). For example, the 20-year return interval flow at Oil Tank Depot was estimated to be 21,000 cfs x (6,330/6,010) = 22,118 cfs (rounded to 22,100 cfs).

Table 2-2
Summary Baseline Low-Water Elevations

Operable Unit	Baseline Water Elevation Dynamic Height		Basis for Selection
	(IGLD85)	(NAVD88)	
OU 2	593.5 feet	593.6 feet	NOAA Low Water Datum above Little Kaukauna Dam
OU 3	587.3 feet	587.4 feet	Crest of De Pere Dam (and NOAA Low Water Datum)
OU 4	576.5 feet	576.6 feet	Lower 1% occurrence frequency of hourly summer data from NOAA gage at Green Bay (adjusted for long-term data record through 1953)

Daily average flows and water levels measured at the Oil Tank Depot gaging station (Station No. 040851385 http://waterdata.usgs.gov/nwis/) will be used to trigger the supplemental bathymetric monitoring. Updated 20-year return-interval flow rates developed by USGS will also be monitored to refine the appropriate trigger for event-based cap monitoring activities.

The long-term monitoring bathymetric 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 - Bathymetric Surveying dated January, 2002). Details of the survey position and control equipment are presented in the CQAPP and in Section 4 of the 60 Percent Design Report Volume 1. 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.

Changes in bathymetry over time will be evaluated to identify areas of potentially significant erosion, deposition, or consolidation. Initially, erosion will be estimated based on elevation comparisons along each transect, using the Year 0 bathymetric surveys as the baseline. If erosion is identified along a given transect, an additional survey comparison will be performed relative to other pre- and post-cap surveys to determine approximate in-place cap thicknesses. The final number and locations of bathymetric survey transects for each CCU will be presented in the Annual RA Work Plans.

In addition to bathymetric surveys, 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 (i.e., 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 surveys will be conducted in the adjacent areas of the river to determine whether the erosion extends into deeper water.

A three-dimensional surface of the CCU will be developed from the survey transect data. Contour maps of elevation changes relative to post-cap conditions in each CCU will be prepared. These bathymetric survey comparisons 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 2.4. Chemical sampling (see Section

2.3) performed in sentinel monitoring areas will also be informed based on the results of the bathymetric comparisons, along with other site-specific observations.

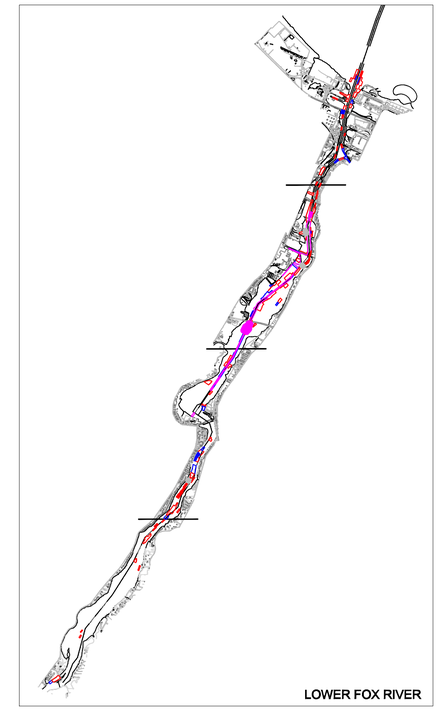
Initially, potential erosional areas will be identified based on elevation comparisons using the Year 0 bathymetric surveys as the baseline. If potential erosion is identified within a significant area, confirmatory physical observations (potentially including core sampling) of the cap profile will be performed in targeted CCU areas in the following circumstances:

- More than 5 percent of the CCU exhibits greater than 6 inches of apparent erosion relative to Year 0 baseline conditions; or
- More than 5 percent of the CCU has less than the minimum in-place Cap A, B, or C thicknesses summarized in Section 2.1, relative to pre-cap surveys.

No further response actions will be performed if follow-on physical observations reveal that elevation changes are attributable to subgrade settlement or consolidation, and if such observations confirm that minimum in-place cap thicknesses are still present.

2.3 Chemical Integrity of Sediment Caps

While bathymetric monitoring will be performed in all cap areas, chemical verification sampling will focus on "sentinel" capping areas located in areas with relatively high peak bottom shear stresses from floods, seiches, wakes, propeller wash, and/or other forces. Such sentinel cap monitoring locations will be located in areas potentially subjected to the upper 10 percent of predicted peak bottom shear stresses within capping areas, and will be generally distributed across OUs 2 to 5, including areas of relatively high recreational vessel use (e.g., near boat launches). Verification of cap integrity and stability in these sentinel areas can be used to infer stability in other capping areas of OUs 2 to 5. Figures 2-1 and 2-2 depict preliminary locations of sentinel cap monitoring areas in OU 2/3 and OU 4/5, respectively, which cover approximately 55 acres, with approximately equal distribution across Cap A, B, and C areas. Specific sentinel monitoring locations will be refined to correspond with final CCUs, which will be documented in Annual RA Work Plans and as-built drawings prepared by the Tetra Tech Team.



- TYPE A CAP BOUNDARIES
- TYPE B CAP BOUNDARIES
- TYPE C CAP BOUNDARIES
- PROPOSED TYPE A SENTINEL CAP AREA
- PROPOSED TYPE B SENTINEL CAP AREA
- PROPOSED TYPE C SENTINEL CAP AREA

SOURCE:

1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE - CENTRAL ZONE NAD83, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88), U.S. SURVEY FEET.

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CHECKED BY: R. MOHAN
APPROVED BY: XX
FILE: AS SHOWN
DATE: JUNE 2008

LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

SENTINEL CAP MONITORING LOCATIONS:
OUS 2 AND 3

FIG. 2-1

C:\0 Projects\Fox River\Sentinel Cap\ANC-2009 SENTINEL CAP AREAS 060608.dwg FIG 2-1a
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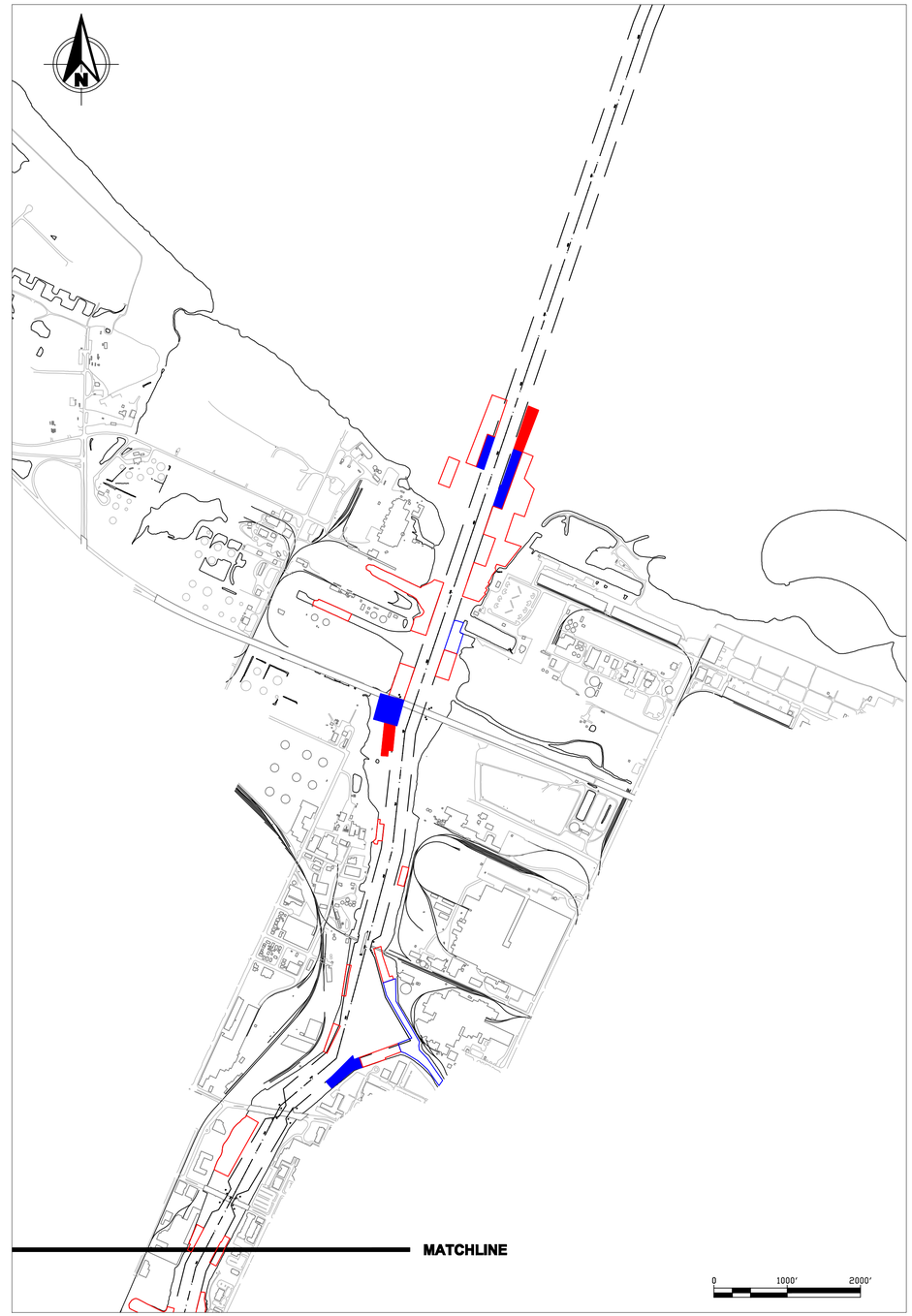

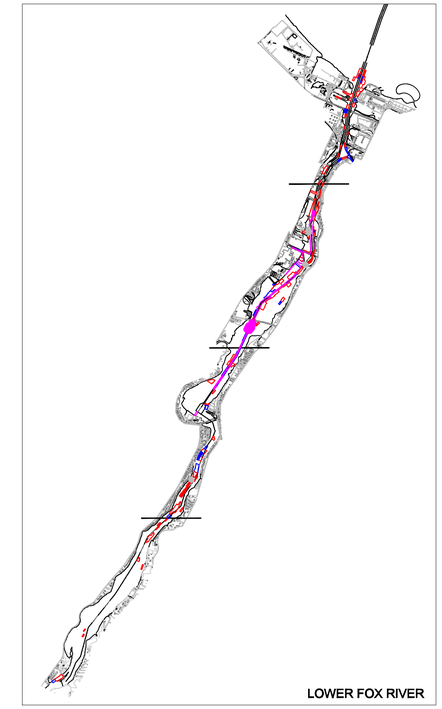

- TYPE A CAP BOUNDARIES
- TYPE B CAP BOUNDARIES
- TYPE C CAP BOUNDARIES
- PROPOSED TYPE A SENTINEL CAP AREA
- PROPOSED TYPE B SENTINEL CAP AREA
- PROPOSED TYPE C SENTINEL CAP AREA

SOURCE:

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3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88), U.S. SURVEY FEET.

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CHECKED BY: R. MOHAN
APPROVED BY: XX
FILE: AS SHOWN
DATE: JUNE 2008

LOWER FOX RIVER REMEDIAL DESIGN
PRELIMINARY 60 PERCENT DESIGN - VOLUME 1

SENTINEL CAP MONITORING LOCATIONS: OUS 4 AND 5

FIG. 2-2

C:\0 Projects\Fox River\Sentinel Cap\ANC-2009 SENTINEL CAP AREAS 0606008.dwg FIG 2b
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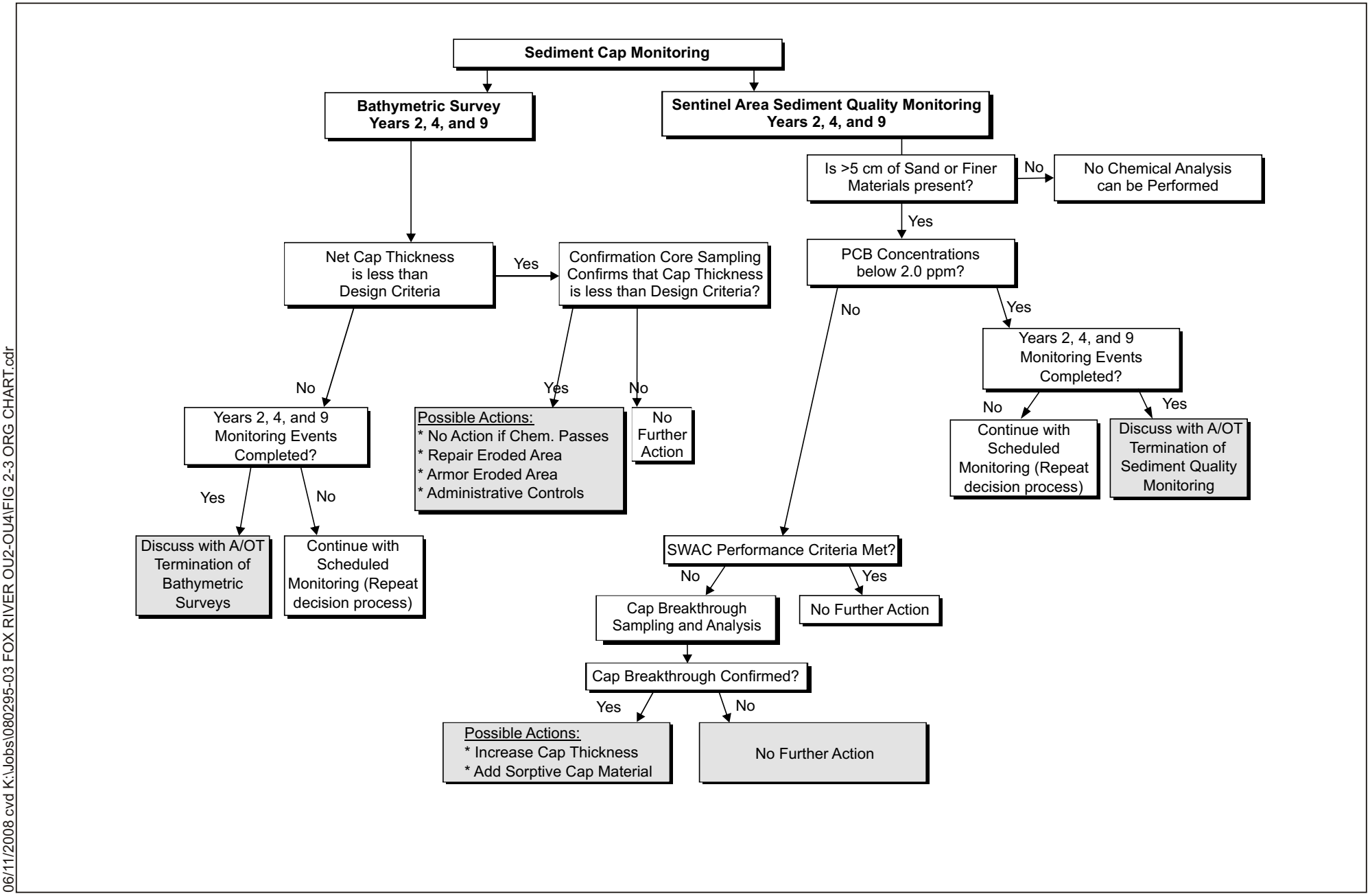
The Lower Fox River is a net depositional environment and newly deposited sediments are expected to begin accumulating on the surface of the engineered caps in many areas immediately after construction. Samples of surface (0 to 6 inches below mudline) sediments on the cap will be the primary measure used to determine whether PCBs are being effectively contained and isolated from surface water and biota, and to verify the chemical integrity of the caps. However, representative chemical analysis can not be performed if less than 2 inches (5 cm) of sand or finer materials are present on the surface of the cap. As practicable (e.g., potentially requiring diver assistance to remove 3-inch or larger armor stone placed in Caps A1, B1, and C areas), sediment cores will be collected and analyzed for evaluation of chemical breakthrough on a focused basis. The cap monitoring decision tree to be used in OUs 2 to 5 is summarized in Figure 2-3.

Surface sediment sampling locations within each CCU will be targeted based on the results of initial bathymetric survey comparisons performed prior to the scheduled chemical integrity monitoring. The bathymetric survey results will be summarized in interim technical memoranda to be submitted to the Response Agencies. Follow-on surface sediment (and potential core) sampling locations within each sentinel CCU monitoring area will be performed following Agency approval of the sampling recommendations.

Surface sediment samples will be collected in locations where surface sampling of the deposited sediments is feasible (e.g., it is not feasible to collect samples of large armor stones). As discussed above, greater than 2 inches of sand or finer materials on the cap surface will need to be present to facilitate sampling. Consistent with procedures used to sample post-dredge areas (as described in the 2009 CQAPP), composite grab samples will be collected and analyzed from within each targeted CCU area. Composite confirmation samples will typically be comprised of five individual grab samples, with an overall sampling density of approximately 1 composite sample per acre throughout the CCU (i.e., approximately 55 composite locations across the total 55-acre sentinel cap monitoring area). An aliquot of each individual grab sample will be separately archived for possible future analysis in case it is determined that finer spatial resolution is needed. Surface sediment sampling in the sentinel cap monitoring areas will be performed during Years 2, 4, and 9 following completion of cap construction within the four general work areas: OU 2, OU 3, OU 4A, and OU 4B (e.g., assuming cap construction in OU 3 is completed in 2011, the Year 2



06/11/2008 cvd K:\Jobs\080295-03 FOX RIVER OU2-OU4\FIG 2-3 ORG CHART.cdr

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

surface sediment sampling in OU 3 will be initiated in 2013). To optimize the chemical monitoring program and concurrently inform evaluations of the OU-wide SWAC (see Figure 2-3), surface sediment sampling in some of the upstream sentinel CCUs within a work area may lag one or two years behind the bathymetric monitoring schedule.

During the 2006/2007 baseline monitoring program (see discussion in Appendix I of the 60 Percent Design Volume 2), PCB concentrations in water column particulate materials in OU 4 averaged 1.1 ± 0.6 ppm. While particulate PCB concentrations are anticipated to be reduced over time as a result of RA and follow-on natural recovery, the RODs and ROD Amendment estimated that such reductions will occur over periods of a decade or more. Recognizing that residual PCB concentrations exceeding the 1.0 ppm RAL are likely to begin accumulating on the cap surface shortly after construction even with a well-functioning cap, surface sediment PCB concentrations of up to 2.0 ppm will not trigger further cap response actions (Figure 2-3).

If any composite sample results contain PCB concentrations greater than 2.0 ppm, the individual grab samples which comprise those composite samples will be analyzed. If the individual sample results do not confirm the composite sample result (i.e., the arithmetic average of a 5 samples is less than 2.0 ppm), then no further response will be required at that location. However, if the individual sample results confirm the composite sample, a sediment core will be collected at the sub-sample location(s) with the highest surface sediment PCB concentration, with sampling and analysis performed as described below.

Consistent with Agency-approved sampling recommendations based on the bathymetric survey results for that year, or as otherwise dictated by a confirmed surface sediment PCB concentration greater than 2.0 ppm as outlined above, sediment cores will be collected to a depth of approximately 4 feet below mudline, potentially requiring diver assistance where sampling through armor stone is feasible. The cores will be sub-sectioned into 6-inch intervals (up to 8 total sections per core) and analyzed for total PCBs, grain size distributions, and total organic carbon (TOC). The core profiles will be visually analyzed to characterize in-place cap thicknesses, and the chemical data assessed to evaluate potential chemical migration through the cap or recent surface deposits. If PCB concentrations at the core location are determined to be a surface phenomenon (i.e., unrelated to "breakthrough"

from lower cap or sediment sections), and if the minimum in-place Cap A, B, or C thicknesses summarized in Section 2.1 are confirmed, then no further response will be required at that location. However, if breakthrough is evident or if the minimum cap thicknesses are not confirmed, additional response actions will be evaluated as described in Section 2.4.

The surface sediment grab and core sampling will be performed in accordance with the Agency-approved Lower Fox River OUs 2 to 5 Pre-design Sampling Plan (Shaw and Anchor, 2004), or consistent with Agency-approved addenda. As part of the Adaptive Management process, alternative methods to monitor the chemical integrity of the cap may be identified. Monitoring alternatives approved by the Response Agencies will be integrated into the OMMP as appropriate.

2.4 Cap Monitoring Decision Framework Summary

As discussed in the sections above, monitoring of the cap areas will primarily involve evaluation of the cap's physical integrity over time, along with monitoring of surface sediment quality in sentinel cap areas where there is sufficient fine or sandy material present to permit sampling and chemical analysis. Where gravel and quarry spalls are present on the cap surface with less than 2 inches of finer-grained surface material, it will not be possible to collect meaningful samples for chemical evaluation (Figure 2-3).

If greater than 95 percent of a CCU is at or above the Year 0 grade (see Section 2.2), and if surface sediment PCB concentrations are maintained below 2.0 ppm, 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 area will continue to be maintained at or above post-construction (Year 0) grade. If the required minimum in-place thickness of cap material is verified by core sampling, it will be determined that substrate settlement has occurred rather than erosion of cap thickness. In this event, there will be no need for further cap maintenance.

If cap erosion is confirmed by bathymetric surveys and verified by sediment core sampling (or other suitable measurements), possible response actions can include:

- No action if the chemical analytical results indicate the remaining cap thickness is sufficient to prevent breakthrough of contaminants
- Repair or augmentation of the thickness of the cap to ensure cap integrity
- Increasing the frequency and intensity of cap monitoring
- Armor area of erosion
- 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

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 2 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 as defined in Section 2.3 above (and summarized in Figure 2-3), 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, Order Respondents, and the Tetra Tech Team will evaluate cap performance and the need for and scope of continued cap monitoring as part of the five-year review process.

3 NATURAL RECOVERY MONITORING

As discussed in Section 1, the Response Agency RODs selected MNR for most of OUs 2 and 5 and portions of OUs 3 and 4. Active remediation (dredging, capping, and sand cover) in much of OUs 1, 3, and 4, and also in certain portions of OUs 2 and 5, will reduce PCB loading to the rest of the river and will contribute to the recovery of these areas. Natural recovery of both actively remediated and passively remediated areas will be necessary for certain SQTs and other RAOs discussed in the RODs and ROD Amendment to be achieved. The MNR remedy for OUs 2 and 5 includes a program for monitoring PCB trends in surface sediments in these areas relative to ROD predictions. This section describes the long-term monitoring program for measuring PCB concentrations in surface sediments. Monitoring of surface water and fish is described in the LTMP (Appendix I of the 60 Percent Design Report Volume 2).

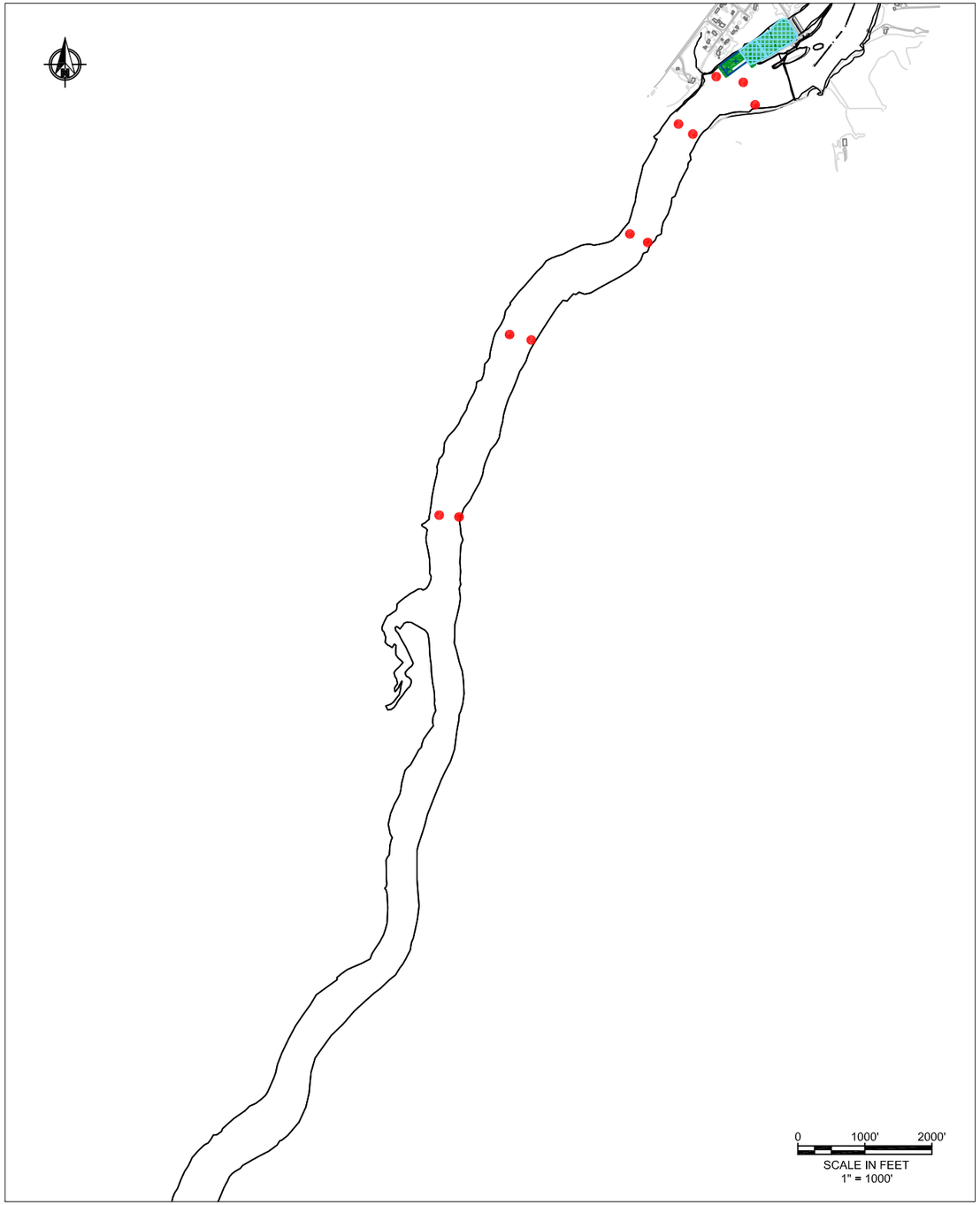
Co-location of sampling locations with prior Response Agency remedial investigation (RI) stations will be performed to support assessments of natural recovery over time. As practical, natural recovery monitoring, cap monitoring, and LTMP water/fish sampling will be coordinated to take place during the same year, conducted approximately one year prior to the scheduled CERCLA five-year reviews, so that the most up-to-date information will be available to inform the process and to better scope future monitoring efforts and strategies.

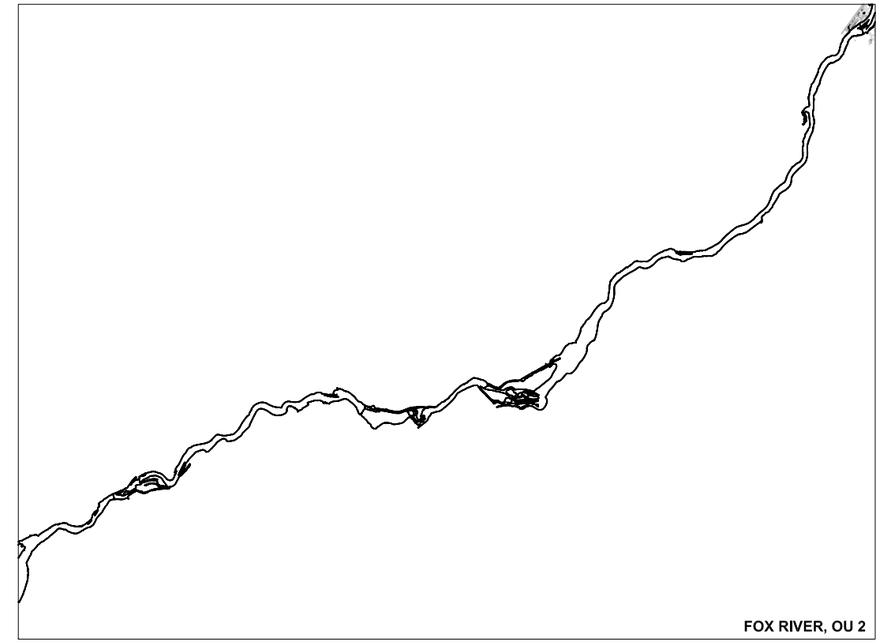
3.1 Surficial Sediment Sampling

To document long-term MNR in OUs 2 to 5, surface sediment samples (0 to 6 inches) will be collected from those RI sampling locations in OU 2 and 5 that are:

- Located in no action areas as described in the RODs and ROD Amendment
- Contained surficial PCB concentrations measured during the RI (or more recent RD) sampling of greater than 0.25 ppm

Figures 3-1 to 3-4 present the proposed MNR sampling stations for OUs 2, 3, 4, and 5, respectively. Approximately 50 sampling stations will be monitored over time to document natural recovery of sediments during and following implementation of RA. Surface sediment samples will be analyzed for total PCBs and TOC. The surface sediment grab and core sampling will be performed in accordance with the Agency-approved Lower Fox River OUs 2 to 5 Pre-design Sampling Plan (Shaw and Anchor, 2004), or consistent with Agency-approved addenda.





LEGEND

- TOTAL PCB SURFACE SAMPLE <0.25 PPM
- TOTAL PCB SURFACE SAMPLE 0.26 - 1 PPM
- TOTAL PCB SURFACE SAMPLE 1.1 - 390 PPM
- PROPOSED MNR SAMPLING LOCATION
- COVER
- CAP A
- CAP B
- CAP C
- DREDGE
- CHANNEL ALIGNMENT

SOURCE:

1. SURVEY AND MAPPING WORK PERFORMED FOR THE WDNR BY THE RETEC GROUP CIRCA 2004.
2. HORIZONTAL DATUM: WISCONSIN STATE PLANE CENTRAL ZONE - NAD83, U.S. SURVEY FEET.
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

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APPROVED BY: XX
FILE: AS SHOWN
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LOWER FOX RIVER REMEDIAL DESIGN
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MNR MONITORING LOCATIONS
FOX RIVER OU 2

FIG. 3-1

SHEET NO. 1 OF 4

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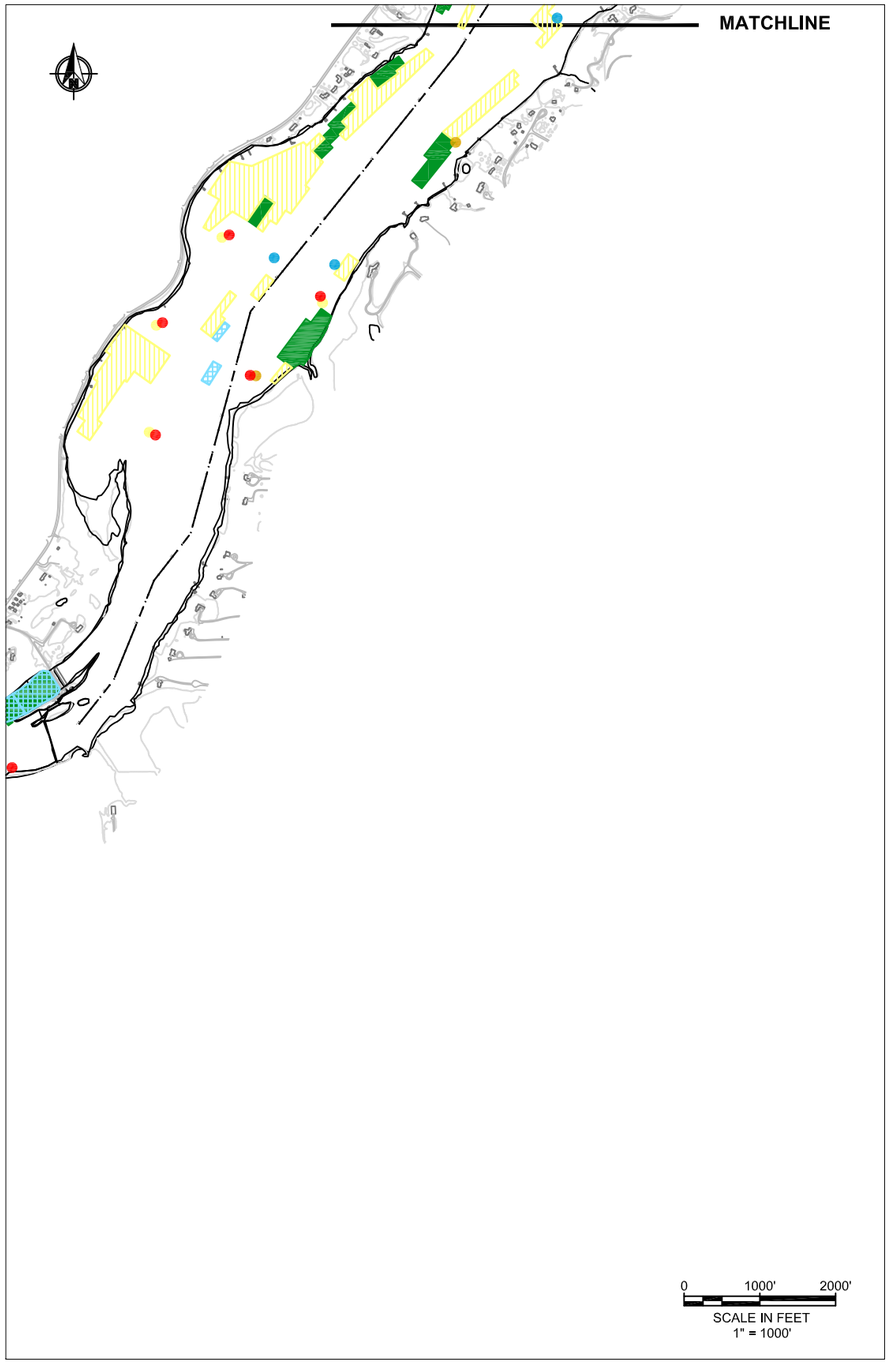

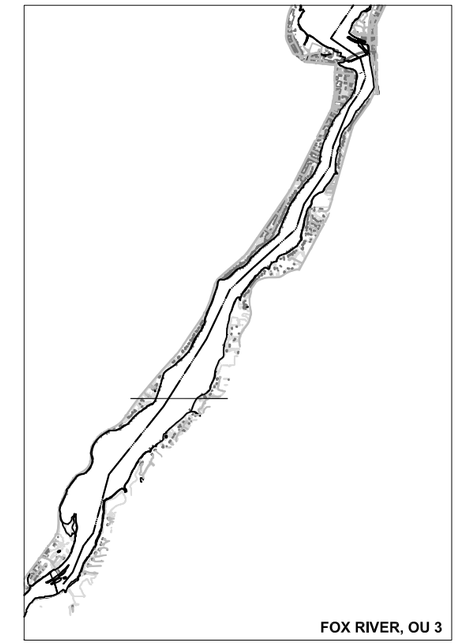

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MNR MONITORING LOCATIONS
FOX RIVER OU 3

FIG. 3-2

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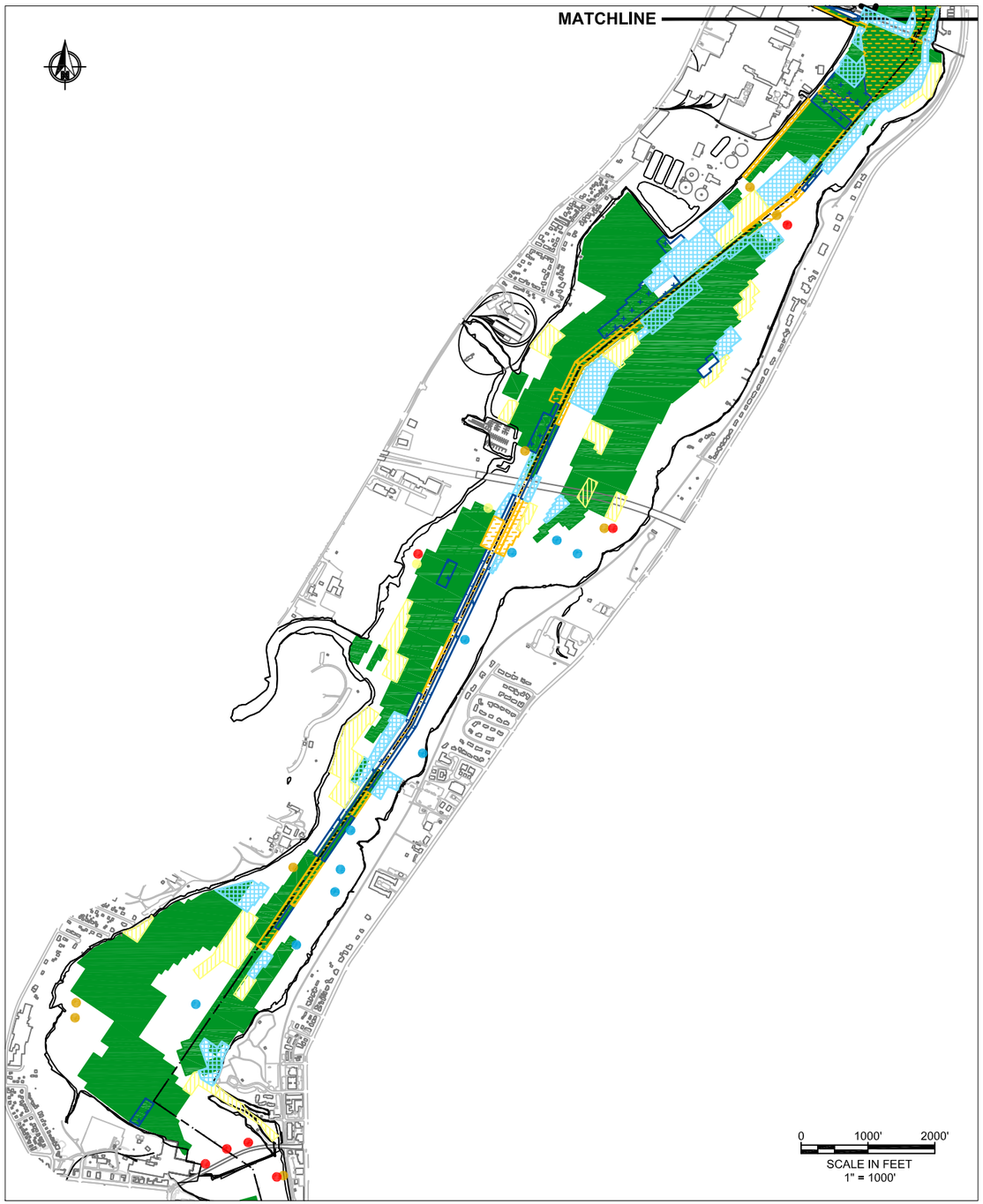

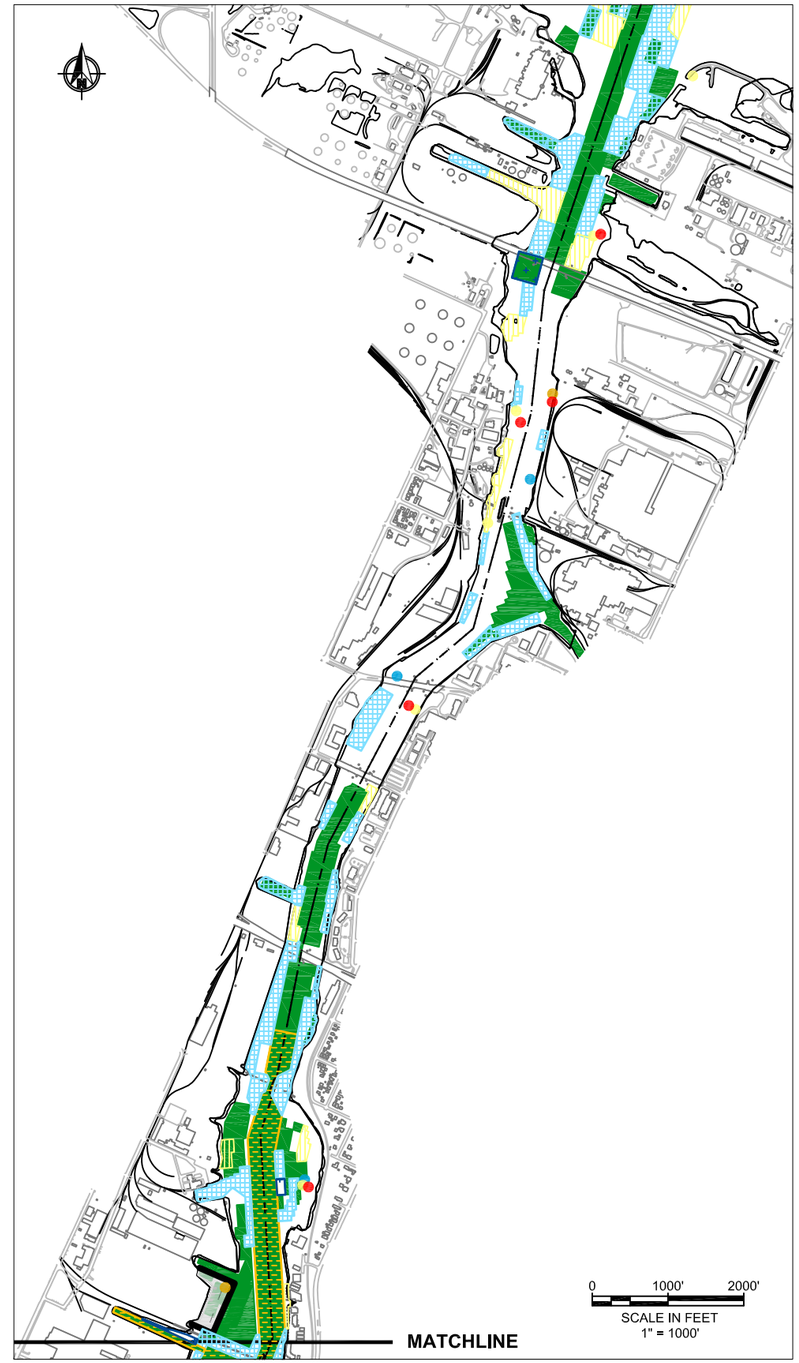

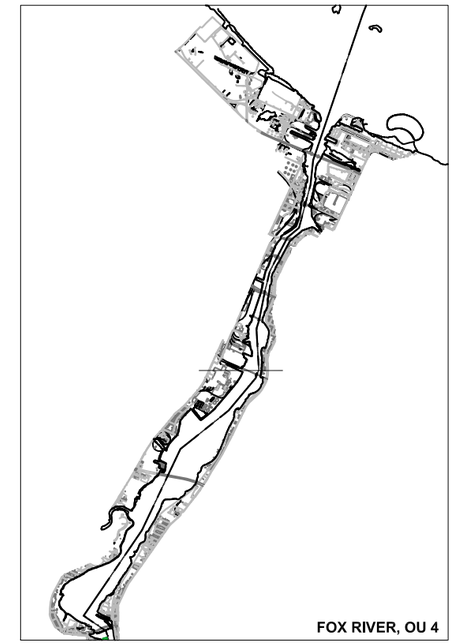

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MNR MONITORING LOCATIONS
FOX RIVER OU 4

FIG. 3-3

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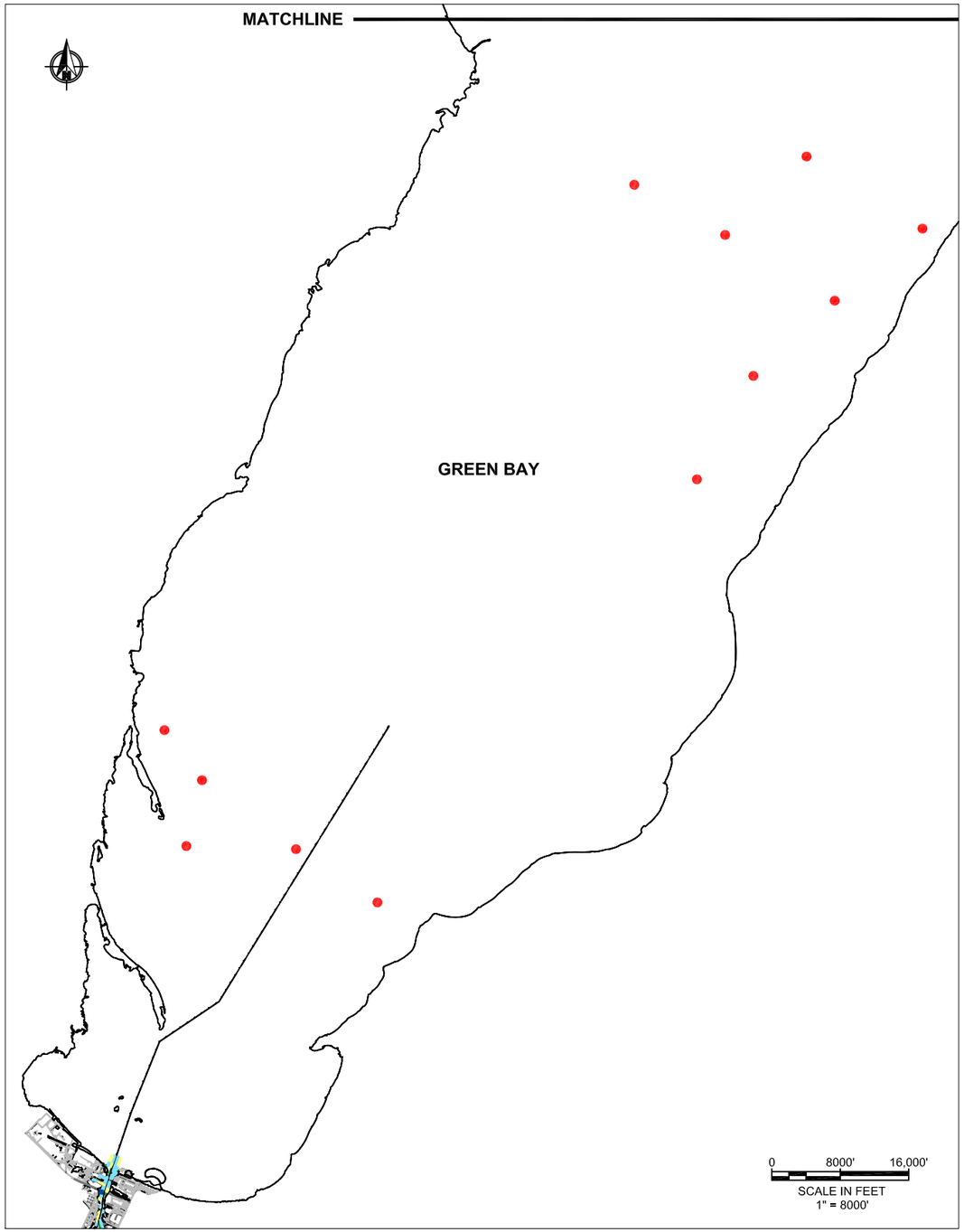

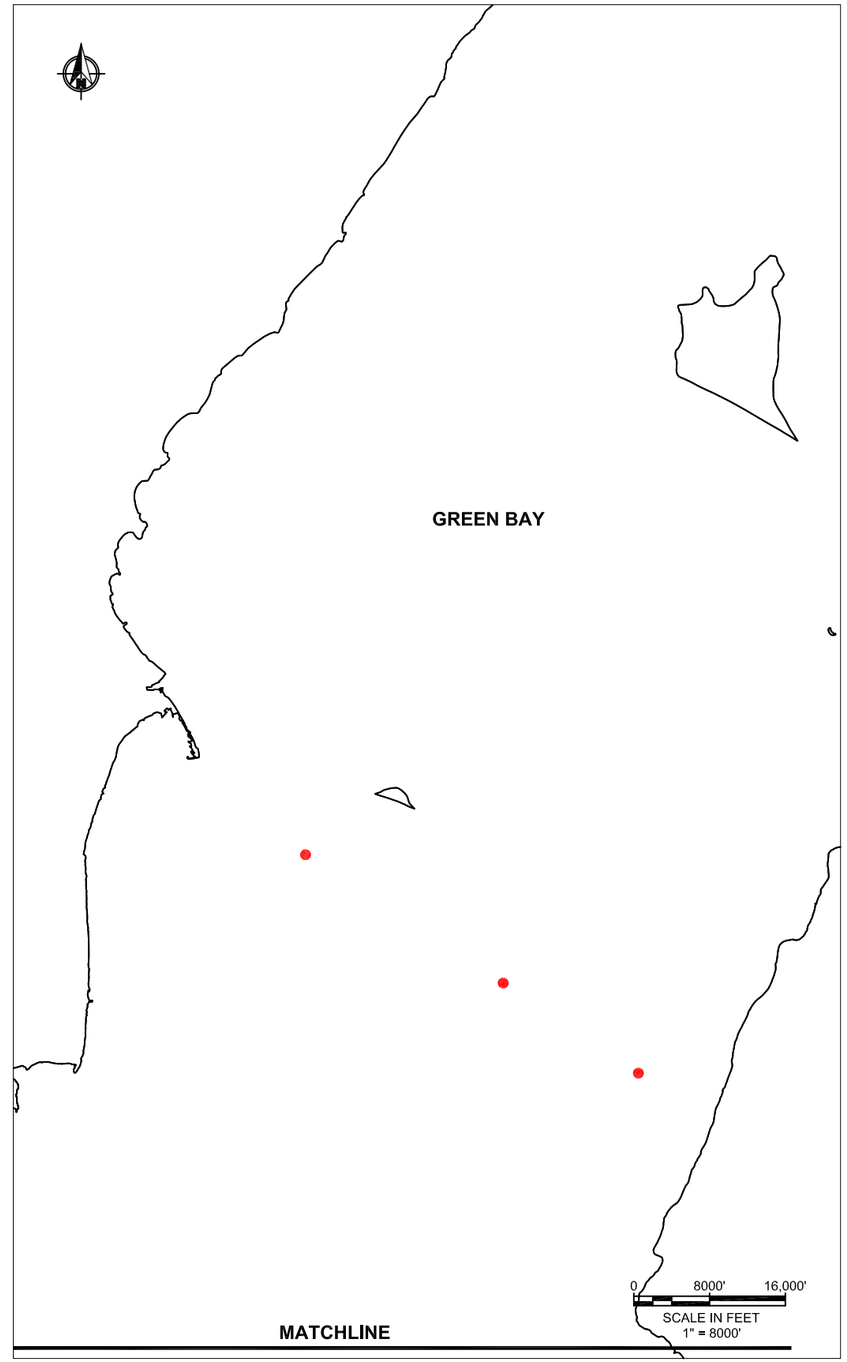

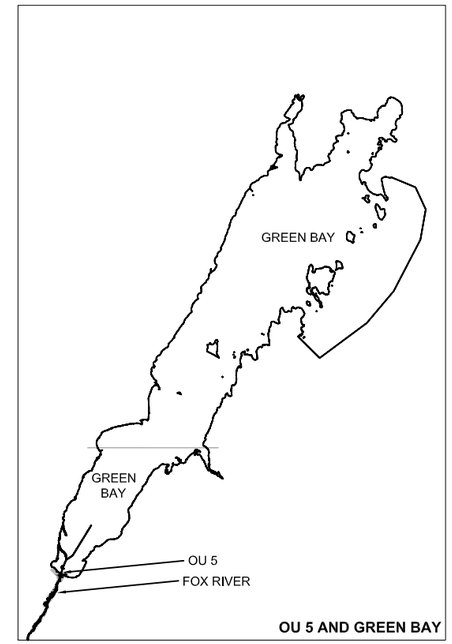

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MNR MONITORING LOCATIONS
FOX RIVER OU 5

FIG. 3-4

SHEET NO. 4 OF 4

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Sediment MNR sampling stations in OU 5 have also been generally aligned with LTMP water and fish stations, as depicted in Figure 3-1. Sampling stations in OU 5 have been focused towards those areas in the south-central shore of Green Bay that during the RI contained surface sediment PCB concentrations between 1.0 and 1.6 ppm.

Surface sediment natural recovery monitoring will be coordinated with LTMP sampling, which is scheduled to occur at 5-year intervals beginning in 2012. Those stations that contain surface sediment PCB concentrations below 0.25 ppm during the 2012 sampling event will not be sampled further as a part of the OMMP. Those stations exceeding 0.25 ppm in 2012 will be resampled in 2017, and potentially also during subsequent 5-year events.

3.2 Trend Analysis

For each sampling station, a trend analysis will be performed. Beginning with the surficial PCB concentration measured during the RI sampling, plots of PCB concentrations versus time will be prepared to evaluate the recovery rates at each location. The recovery rates computed from the trend analysis will be summarized by OU. Consistent with CERCLA requirements, the Response Agencies and Order Respondents will evaluate MNR and the need for and scope of continued MNR monitoring as part of the five-year review process.

As discussed above, long-term monitoring of surface water and biota will be performed as a separate, coordinated Site-wide activity to assess progress in achieving RAOs specified in the RODs and ROD Amendment and to determine remedial success. The preliminary draft Long-Term Monitoring Plan (LTMP) is provided in Appendix I of the 60 Percent Design Report Volume 2, and is subject to further collaborative workgroup review.

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APPENDIX I

LONG-TERM MONITORING PLAN

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APPENDIX I

LOWER FOX RIVER REMEDIAL DESIGN
60 PERCENT DESIGN REPORT

LONG-TERM MONITORING PLAN

Prepared for

Appleton Papers Inc.

Georgia-Pacific Consumer Products LP

NCR Corporation

For Submittal to

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency

Prepared by

Anchor Environmental, L.L.C.

Shaw Environmental & Infrastructure, Inc.

LimnoTech, Inc.

June 2008

LOWER FOX RIVER LONG-TERM MONITORING PLAN

Prepared by:

Anchor Environmental, L.L.C., Shaw Environmental & Infrastructure, Inc., and LimnoTech, Inc.

Approved by:

USEPA Project Coordinator	Date
WDNR Project Coordinator	Date
USEPA QA Reviewer	Date
Respondent Project Coordinator	Date
Respondent Project Manager	Date
Laboratory No. 1	Date
Laboratory No. 2	Date

1 PROJECT MANAGEMENT AND OBJECTIVES 1
1.1 Introduction 1
1.2 Project Organization 2
1.2.1 Respondent Technical Team 2
1.2.2 Subconsultants/Subcontractors 4
1.2.3 Wisconsin Department of Natural Resources (WDNR) 5
1.2.4 U.S. Environmental Protection Agency (USEPA) 6
1.3 Communication Plan 7
1.3.1 Monthly Progress Reports 7
1.3.2 Monthly Meetings 7
1.3.3 Long-Term Monitoring Work Group 7
1.3.4 Electronic Data Transmittal 8
1.3.5 Hard Copy Data Transmittal 8
1.3.6 Notification Procedures 8
1.3.7 Modifications to the Long-Term Monitoring Plan 8
1.4 Problem Definition 9
1.4.1 Problem Statement 9
1.4.2 Long-term Monitoring Objectives 10
1.4.3 Relationship to Other Monitoring Activities 11
1.5 Background Information 12
1.5.1 Site Description 13
1.5.2 Site Water Quality 13
1.5.3 Fish Tissue Quality 15
1.5.4 Conceptual Site Model 16
1.6 Project Description 18
1.6.1 Standards and Criteria 19
1.6.2 Overview of Baseline Monitoring Activities 20
1.6.3 Equipment and Personnel Requirements 21
1.6.4 Preliminary Long-Term Monitoring Schedule 21
1.7 Data Quality Objectives 22
1.7.1 Step 1: State the Problem 23
1.7.2 Step 2: Identify the Decisions 23
1.7.3 Step 3: Identify Inputs to the Decision 27
1.7.4 Step 4: Define the Boundaries of the Study 32
1.7.5 Step 5: Develop Decision Rules 32
1.7.6 Step 6: Specify Limits on Decision Errors 34
1.7.7 Step 7: Optimize the Design 35
1.8 Documentation and Records 40
1.8.1 Data Tracking 40
1.8.2 Electronic Data Management 41
1.8.3 Evidence File 41

2 DATA GENERATION AND ACQUISITION 43

2.1 Water Quality Monitoring Plan 43
2.1.1 Number of Water Samples 43
2.1.2 Water Quality Monitoring Stations 43
2.1.3 Water Quality Monitoring Schedule 44
2.1.4 Water Quality Sample Identification 44
2.1.5 Water Quality Sampling Procedures 45
2.2 Fish Tissue Monitoring Plan 47
2.2.1 Number of Fish Samples 47
2.2.2 Fish Monitoring Stations 48
2.2.3 Fish Collection Schedule 49
2.2.4 Target Fish Species and Size Ranges 49
2.2.5 Fish Tissue Sample Identification 50
2.2.6 Fish Sampling and Preparation Methods 51
2.3 Sample Handling and Custody Requirements 54
2.3.1 Sample Handling, Preservation, Transportation, and Storage 54
2.3.2 Chain of Custody 55
2.4 Laboratory Analytical Methods 56
2.4.1 Water Analysis 56
2.4.2 Fish Tissue Analysis 57
2.5 Quality Control Requirements 58
2.5.1 Precision 59
2.5.2 Accuracy 60
2.5.3 Representativeness 61
2.5.4 Comparability 63
2.5.5 Completeness 64
2.6 Instrument Testing, Inspection and Maintenance 66
2.6.1 Field Instruments Calibration 66
2.6.2 Laboratory Instruments Calibration 66
2.7 Data Management 66
2.7.1 Field Documentation 66
2.7.2 Laboratory Documentation 67
2.7.3 Data Reporting 69

3 ASSESSMENT AND OVERSIGHT 73
3.1 Field Audits 73
3.2 Laboratory Audits 74
3.3 Corrective Actions 76
3.3.1 Field Corrective Action 76
3.3.2 Stop Work Order 76
3.3.3 Laboratory Corrective Action 77
3.4 Field Contingency Plans 78
3.4.1 Water Sampling Contingency Plan 78
3.4.2 Fish Sampling Contingency Plan 78

4 DATA VALIDATION AND DATA ANALYSIS 81
4.1 Data Review and Validation 81
4.1.1 Field Screening Data 81
4.1.2 Data Validation and Verification 82
4.1.3 Reconciliation with Data Quality Objectives 84
4.2 Data Analysis 84
4.2.1 PCB Summation 84
4.2.2 Blank Correction for PCB Congeners 86
4.2.3 Statistical Analysis of Monitoring Data 88

5 REFERENCES 94

List of Tables

Table 1-1 Water Column Summary Statistics (Total PCBS in ng/L)
Table 1-2 Descriptive Summary Statistics for Fish Tissue Data
Table 1-3 Fish Consumption Advisories
Table 1-4 Statistical Distribution Test Results – Water
Table 1-5 Statistical Distribution Testing of Fish Tissue Concentrations
Table 1-6 Sample Location Rationale
Table 1-7 Estimated Sample Sizes for Water and Fish Tissue Monitoring
Table 1-8 Estimated Statistical Confidence for Detecting 50 Percent Reduction in PCB Concentration
Table 2-1 Water Sampling and Analysis Plan
Table 2-2 Water Sampling Locations
Table 2-3 Target Fish Species, Size Classes, and Compositing Plan
Table 2-4 Fish Tissue Sampling and Analysis Matrix
Table 2-5 Fish Habitat and Collection Methods
Table 2-6 Sample Containers, Holding Times, and Preservation Requirements
Table 2-7 Analytical Methods, Detection Limits, and Control Limits
Table 2-8 PCB Congener Reporting Limits
Table 2-9 Quality Control Criteria – Standard Analyses
Table 2-10 Quality Control Criteria – PCB Congeners

List of Figures

Figure 1-1 Site Location Map
Figure 1-2 Seasonal Variation in Water Column PCB Concentrations
Figure 1-3 Long-Term Monitoring Schedule
Figure 2-1 Index to Sampling Maps
Figure 2-2 Lake Winnebago Sampling Stations
Figure 2-3 Operable Unit 1 Sampling Stations
Figure 2-4 Operable Unit 2A Sampling Stations

Figure 2-5 Operable Unit 2B Sampling Stations
Figure 2-6 Operable Unit 2C Sampling Stations
Figure 2-7 Operable Unit 3 Sampling Stations
Figure 2-8 Operable Unit 4 Sampling Stations
Figure 2-9 Lower Green Bay Sampling Stations
Figure 3-1 Field Decision Flow Chart for Fish Sampling

List of Appendices (Reserved)

Appendix A Laboratory QA Plans and Certificates
Appendix B Data Validation Qualifiers
Appendix C Field Standard Operating Procedures
Appendix D Laboratory Standard Operating Procedures
Appendix E Electronic Data Deliverable Format
Appendix F Health and Safety Plan
Appendix G Field Sampling Details

Anchor	Anchor Environmental, L.L.C.
AOC	Administrative Order on Consent
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BOD_5	biochemical oxygen demand
CERLA	Comprehensive Environmental Response, Compensation, Liability Act
CFR	Code of Federal Regulations
CLP	contract laboratory program
cm	centimeter
COC	chain-of-custody
CPT	cone penetration testing
CQAP	Construction Quality Assurance Plan
CST	column settling test
CU	consolidated-undrained
CV	coefficient of variation
DOC	dissolved organic carbon
DGPS	differential global positioning system
DQO	data quality objective
DRET	dredging elutriate test
EDD	electronic data deliverables
EIMS	environmental information management system
FRG	Fox River Group
FCR	field change request
Fort James	Fort James Operating Company, Inc.
FTL	field team leader
GIS	geographic information system
HSP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
high-res	high-resolution
I-DW	investigation-derived waste
LCS	laboratory control sample
LIMS	laboratory information management system
LOD	level of detection

LOQ	level of quantitation
LTMP	Long Term Monitoring Plan
MDL	method detection limit
MET	modified elutriate test
mg/L	milligrams per liter
MDRD	Minimum Detectable Relative Difference
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NAVD	North American Vertical Datum
NCP	National Contingency Plan
NCR	NCR Corporation
OMMP	Operations, Maintenance, and Monitoring Plan
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PARCC	precision, accuracy, representativeness, comparability, completeness
PCB	polychlorinated biphenyl
PCLT	pancake column leach test
PM	project manager
PPE	personal protective equipment
ppm	part per million
QA	quality assurance
QAM	quality assurance manager
QAP	quality assurance plan
QAPP	quality assurance project plan
QC	quality control
QL A	Quality Level A
QL B	Quality Level B
QL C	Quality Level C
QL D	Quality Level D
RAL	remedial action level
RAO	Remedial Action Objective
RD	Remedial Design

RG	Remedial Goals
ROD	Record of Decision
RPD	relative percent difference
SAP	sampling and analysis plan
RM	river mile
SDG	sample delivery group
Shaw	Shaw Environmental and Infrastructure, Inc.
SIC	seepage-induced consolidation
SOP	standard operating procedure
SOW	statement of work
SPT	standard penetration testing
STL	Severn Trent Laboratories, Inc.
SUE	subsurface utility engineering
SWAC	surface-weighted average concentration
TBA	to be determined
TOC	total organic carbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WSLH	Wisconsin State Lab of Hygiene

1 PROJECT MANAGEMENT AND OBJECTIVES

1.1 Introduction

The Lower Fox River 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 (Figure 1-1). The Lower Fox River 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 (PCBs) were discovered in the Lower Fox River in the 1970s. Due to their persistence in the environment, PCBs remain the focus of current remedial design and remediation efforts in the river.

This draft Long-Term Monitoring Plan (LTMP) presents a program for monitoring the post-remediation recovery of surface water and biota in Operable Units (OUs) 1 through 5 of the Lower Fox River and Green Bay. Long-term monitoring will be performed to assess progress toward achieving the remedial action objectives (RAOs) specified in two Records of Decision (RODs) and a ROD Amendment issued in December 2002, June 2003, and June 2007, respectively, by the United States Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR) (collectively, the "Response Agencies") under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. This draft LTMP is subject to further collaborative review in the Long-Term Monitoring Work Group.

This draft LTMP was prepared pursuant to the remedial design (RD) Administrative Order on Consent (AOC) for OUs 2 to 5, originally executed in March 2004 and amended by the October 2007 revised Administrative AOC and Order on Consent . The requirement to implement the LTMP in OUs 2 through 5 is set forth in the Response Agencies' 2007 Administrative Order for Remedial Action (RA) ("Order") and the accompanying Phase 2B Scope of Work. The respondents to the order include Appleton Papers Inc.; CBC Coating, Inc. (formerly known as Riverside Paper Corporation); Georgia-Pacific Consumer Products, LP (formerly known as Fort James Operating Company, Inc.); Menasha Corporation; NCR Corporation; P.H. Glatfelter Company; U.S. Paper Mills Corp; and WTM I Company (formerly known as Wisconsin Tissue Mills, Inc.) (collectively the "Respondents"). Implementation of RD/RA and long-term monitoring activities in OU 1 is being addressed under a separate agreement between the Response Agencies and the WTM I Company.

Active remediation (dredging and capping) of Lower Fox River sediments began in OU 1 in 2004 and is scheduled for completion in 2009. A Phase 1 removal action in OU 4 was performed in 2007. The remaining dredging and capping actions in OUs 2 through 4 are expected to occur between 2009 and 2017. This LTMP, in conjunction with the Baseline Monitoring Program, conducted in 2006-2007, is designed to monitor improvements in water and fish tissue quality in the Lower Fox River and Green Bay as a result of these sediment remedial actions. Long-term monitoring of sediment quality in capped areas and natural recover areas is described separately in the accompanying Operations, Maintenance, and Monitoring Plan (OMMP).

1.2 Project Organization

This section describes the project organization, responsibilities, authorities, and lines of communication. The roles and responsibilities of key project personnel are described below.

1.2.1 Respondent Technical Team

1.2.1.1 Respondent Team Project Coordinator

The duties of the Respondent Team Project Coordinator include:

- Administration and management of long-term monitoring activities, including schedule and budget control
- Authorization and coordination of subcontractors
- Authority to stop work based on quality control issues, health and safety issues, or other deficiencies that may compromise the safety of the field crew or the integrity of the Long-Term Monitoring Program
- Ongoing communication with USEPA and WDNR regarding project status, problems encountered and recommended solutions, deviations from scope of work, and other related issues
- Coordination and resolution of key technical issues with Respondent and Response Agency Teams
- Coordinate document production
- Prepare and submit progress reports

1.2.1.2 Respondent Team Project Manager

The duties of the Respondent Team Project Manager include:

- Co-Chair, Long-Term Monitoring Work Group
- Management of preparation of Long-Term Monitoring Plans and Data Reports
- Coordination and trouble-shooting of field activities, including recommendations for scope modifications as needed based on field conditions
- Review and assessment of corrective action procedures in consultation with Project Coordinator
- Oversight of water and fish tissue data analysis and interpretation

1.2.1.3 Field Quality Assurance Manager (Field QAM)

The duties of the Field Quality Assurance Manager include:

- Auditing of field activities to ensure compliance with LTMP requirements
- Review of all field documentation for consistency, accuracy, and completeness, and to ensure any procedural modifications are appropriately documented and communicated
- Reporting of deficiencies in field procedures or documentation to the Project Manager to initiate corrective action procedures

1.2.1.4 Data Quality Assurance Manager (Data QAM)

The duties of the Analytical Quality Assurance Manager include:

- Direct the review of quality assurance plans and procedures
- Schedule and coordinate the analytical laboratories and data validators
- Oversee the tracking of samples and data from the time of field collection through laboratory reporting and database entry
- Review laboratory data for compliance with LTMP requirements

1.2.1.5 Baseline Monitoring Field Supervisors

The duties of the Field Supervisors include:

- On-site coordination and direction of field activities and personnel
- Coordination of field and laboratory schedules

- Oversight of field activities to ensure they are conducted in accordance with this LTMP and the HSP
- Communicate field conditions and progress, problems encountered and recommended scope modifications, if needed, to the project team
- Oversee sampling subcontractors

1.2.1.6 Corporate Health and Safety Manager

The duties of the Corporate Health and Safety Manager include:

- Remote supervision of field activities to ensure adherence to the HSP
- Final authority on HSP issues and approval of significant modifications to the HSP, if needed, based on changed field conditions

1.2.2 Subconsultants/Subcontractors

1.2.2.1 Analytical Laboratory Project Managers

The duties of the Analytical Laboratory Project Managers include:

- Oversee laboratory QA/QC requirements for the project
- Convey project requirements and objectives to laboratory staff and analysts
- Provide technical guidance to the Consultant Team
- Review laboratory data for compliance with LTMP requirements

1.2.2.2 Laboratory Quality Assurance Managers (Laboratory QAM)

The duties of the Laboratory Quality Assurance Managers include:

- Evaluate compliance with laboratory standards of practice and ensure that systems are in place to provide QA/QC as defined in this LTMP
- Initiate and oversee audits of corrective action procedures
- Perform laboratory data quality reviews
- Maintain laboratory documentation

1.2.2.3 Data Quality Validator

- The duties of the Data Quality Validator include:
- Provide independent third-party validation of at least 10 percent of analytical data

- Evaluate compliance with laboratory QA/QC criteria and other project requirements as defined in this LTMP
- Qualification of analytical data as needed to identify noncompliance with QA/QC criteria, and assessment of acceptability of data to fulfill project objectives

1.2.3 Wisconsin Department of Natural Resources (WDNR)

As one of the lead Response Agencies, WDNR and its consultants will observe, review, and provide regulatory and technical comments to ensure the Long-Term Monitoring Program fulfills the requirements of the ROD and provides data necessary to evaluate attainment of Remedial Action Objectives in the Lower Fox River and Green Bay. WDNR and EPA have sole approval authority over any modifications to this Plan.

1.2.3.1 WDNR Project Coordinator

The duties of the WDNR Project Coordinator include:

- Review all project plans and data reports, and provide input to development of overall project strategies and technical approaches
- Ensure LTMP meets the requirements of the ROD, and assist Consultant Team and WDNR staff in interpreting the intent of the ROD
- Final review and approval of Long-Term Monitoring Plans and Data Reports
- Ongoing communication with Consultant Team Project Coordinator and Project Manager

1.2.3.2 WDNR Project Manager

The duties of the WDNR Project Manager include:

- Co-Chair, Long-Term Monitoring Work Group
- Scheduling and coordination of WDNR reviews and approvals of Long-Term Monitoring Plans and Data Reports
- Coordination of technical resources for WDNR and its consultants, and application of these resources to help support the design and implementation of the Long-Term Monitoring Plan
- Assist WDNR Project Coordinator with project administrative duties
- Review progress reports detailing work accomplished

1.2.3.3 WDNR Quality Assurance Manager

The duties of the WDNR Quality Assurance Manager include:

- Review Long-Term Monitoring Plan for technical accuracy and completeness
- Provide technical assistance to the WDNR Project Manager and Project Coordinator regarding analytical methods and quality control procedures
- Review of data validation results, data quality, and the need for and scope of corrective actions, if any

1.2.4 U.S. Environmental Protection Agency (USEPA)

As one of the lead Response Agencies, USEPA and its consultants will observe, review, and provide regulatory and technical comments to ensure the Long-Term Monitoring Program fulfills the requirements of the ROD and provides data necessary to evaluate attainment of Remedial Action Objectives in the Lower Fox River and Green Bay. USEPA and WDNR have sole approval authority over any modifications to this Plan.

1.2.4.1 USEPA Remedial Project Manager

The duties of the EPA Remedial Project Manager include:

- Review all project plans and data reports, and provide input to development of overall project strategies and technical approaches
- Ensure LTMP meets the requirements of the ROD
- Final review and approval of Long-Term Monitoring Plans and Data Reports
- Ongoing communication with Consultant Team Project Coordinator and Project Manager

1.2.4.2 USEPA Quality Assurance Manager

The duties of the EPA Quality Assurance Manager include:

- Review Long-Term Monitoring Plans for technical accuracy and completeness
- Provide technical assistance to the EPA Remedial Project Manager

1.3 Communication Plan

1.3.1 Monthly Progress Reports

During periods of long-term monitoring activity (i.e. data collection, evaluation, and reporting), the Respondent Team Project Coordinator will provide written monthly progress reports to the Response Agencies by the tenth day of every month. These progress reports will describe the status of long-term monitoring activities.

1.3.2 Monthly Meetings

During periods of long-term monitoring activity, the Project Coordinators will hold monthly progress report meetings or telephone conferences unless it is deemed unnecessary by the Response Agencies. Briefings on the status of long-term monitoring activities and preliminary results, as available, will be provided during the meetings.

1.3.3 Long-Term Monitoring Work Group

In an effort to develop a coordinated and cost-effective Long-Term Monitoring Program that is consistent with the intent of the ROD, representatives and consultants from the Respondent Team and the Response Agencies have formed the Long-Term Monitoring Work Group. Since October 2004, the Long-Term Monitoring Work Group has held periodic meetings and conference calls to discuss monitoring objectives, field and analytical methods, data evaluation tools and techniques, and the design and implementation of the Baseline Monitoring Program. Draft notes from these meetings are maintained in the Response Agency project files. The Long-Term Monitoring Work Group will continue to meet on a mutually agreeable schedule as needed to design and implement the Long-Term Monitoring Program. It is expected that meetings will be held to discuss the following:

- Lessons learned from the Baseline Monitoring Program, and implications for long-term monitoring activities
- Adaptive management of field sampling, laboratory analysis, and data validation procedures
- Review and evaluation of long-term water and fish tissue analytical results as they become available
- Ongoing assessment of the effects of sediment remediation, and progress toward achieving RAOs in the Lower Fox River and Green Bay

1.3.4 Electronic Data Transmittal

Technical documents, reports, data, comments, schedules, meeting notices and general project communications related to long-term monitoring activities will be distributed electronically to designated members and consultants of the Response Agencies. Documents that are too large to send via email will be posted on a shared access website. In such cases, an e-mail notification will be sent to the same persons with information on how to access those documents. Electronic copies (CD-ROM) of laboratory analytical data packages (in pdf format) will be provided to the Response Agencies upon receipt from the laboratory.

1.3.5 Hard Copy Data Transmittal

For documents requiring hard copy distribution, one copy will be sent to each of the following Response Agency personnel:

- USEPA Remedial Project Manager
- WDNR Project Coordinator
- WDNR Project Manager
- WDNR Quality Assurance Manager
- WDNR Oversight Consultant Project Manager
- Other Personnel, as appropriate

1.3.6 Notification Procedures

Requirements for periodic progress reports and meetings between the Respondent Team, WDNR and USEPA are described in Sections 1.3.1 and 1.3.2. At least 15 days of notice shall be given to the WDNR Project Coordinator and the USEPA Remedial Project Manager prior to beginning sampling.

1.3.7 Modifications to the Long-Term Monitoring Plan

Significant modifications to the LTMP will be provided to USEPA and WDNR for review and approval via revisions to the LTMP or Addenda to the LTMP. Modifications that will require USEPA and WDNR approval include the following:

- Major changes/revisions to the monitoring design
- Major changes/revisions to the sampling or analytical methods

- Major changes to project team personnel

Modifications may be required as a result of unexpected or changed field conditions, extreme weather or hydrologic events, or the results of ongoing discussions of monitoring strategies, techniques, and procedures in the Long-Term Monitoring Work Group.

1.4 Problem Definition

1.4.1 Problem Statement

Data collected during the remedial investigation/feasibility study and related investigations were used to define Remedial Action Objectives (RAOs), Remediation Goals (RGs), and Cleanup Levels (CULs) for the Site (see EPA 2005). The RAOs, RGs, and CULs for the Lower Fox River are set forth in the Records of Decision (ROD) for OUs 1-2 and OUs 2-5 signed by the Response Agencies in December 2002 and June 2003, respectively.

As with other CERCLA sites, the ROD described the overall goals and objectives, and selected a specific remedy that the Response Agencies believe will achieve the goals and objectives. Specifically, the RODs require that the remedies for the Site be designed to achieve CULs (i.e., addressing sediments above 1 ppm or, if that is not achieved, a surface weighted average concentration of 0.26 and 0.25 ppm in OU 3 and OU 4, respectively). The RODs have concluded that achieving the CULs will result in achieving the RGs (target fish tissue concentrations) and RAOs (human and ecological risk reduction and surface water PCB load reductions to Green Bay). This translates into two types of remedy success measures: (1) remedy effectiveness success (whether the CULs are met); and (2) risk reduction success (whether achievement of the CULs leads to the desired risk reduction). A monitoring program to evaluate remedy effectiveness success (primarily sediment verification sampling) will be developed as part of the Construction Quality Assurance Project Plan (CQAPP; see Section 1.4.4.2).

The overall objective of this Long-Term Monitoring Plan (LTMP) is to develop a monitoring program to evaluate risk reduction success. The LTMP is informed by the results of the baseline monitoring program (Anchor and Shaw 2008), ongoing

discussions in the Long-Term Monitoring Work Group, and ongoing remedial design activities. The results of the LTMP program, in turn, will be used to inform the five-year, post-remediation review process for the Lower Fox River.

1.4.2 Long-term Monitoring Objectives

Long-term monitoring data will be collected to evaluate progress toward achieving the RAOs of reduced risk to humans and the environment, as presented in the RODs (WDNR/EPA 2002, 2003). The data collection effort is focused on water and fish tissue, these being critical components of all major bioaccumulation risk pathways. Water is the primary medium of transport which relates PCB concentrations in sediments to exposures in pelagic fish (whereas benthic fish may receive some of their exposure directly from the sediments). Water is also the primary medium through which contaminants in the Lower Fox River 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.

The long-term monitoring objectives include:

- **Monitor Reductions in Water and Fish Tissue Concentrations.** Verify that sediment remedial actions in the Lower Fox River result in substantive reductions in water column and fish tissue PCB concentrations. The RODs identified water and fish tissue as key exposure media through which bioaccumulation may occur.
- **Monitor Progress toward Achieving Human Health Risk Goals.** Verify progress toward achieving human health risk goals through analysis of recovery trends in water and fish tissue monitoring data. As described in the RODs, one of the goals of the remedial action is removal of fish consumption advisories for recreational and high-intake fish consumers. The results of the long-term monitoring program will be submitted to WDNR's Fish Consumption Advisory Program for their consideration in determining if and when modification or removal of advisories is warranted.
- **Monitor Progress toward Achieving Ecological Risk Goals.** Verify progress toward achieving ecological risk goals through analysis of recovery trends in water and fish tissue monitoring data. In addition to reducing human health

risks, another goal of remedial action is achievement of safe ecological thresholds for fish-eating birds and mammals. The results of the long-term monitoring program will be considered using the risk assessment framework described in the RODs, and in consultation with WDNR and EPA risk assessors, to determine if and when ecological thresholds are achieved.

- **Monitor Reductions in PCB Loadings to Green Bay.** Verify that sediment remedial actions in the Lower Fox River result in substantive reductions of PCB loadings to Green Bay. Decreased loadings from the Lower Fox River will help facilitate natural recovery processes in Green Bay.

1.4.3 Relationship to Other Monitoring Activities

Other related short-term and long-term monitoring activities in the Lower Fox River and Green Bay are described in the documents listed below.

1.4.3.1 Baseline Monitoring Data Report

Baseline fish tissue and water quality monitoring data in the Lower Fox River and Green Bay were collected to characterize existing (pre-remediation) conditions, and to provide an initial point of comparison for determining the magnitude and extent of decreasing PCB concentrations over the long term (Anchor and Shaw 2008). The combined baseline and long-term monitoring data sets will allow the Response Agencies to determine whether or to what degree the implemented remedy meets risk reduction success criteria. The baseline monitoring program has characterized the statistical variability of fish and water data to help evaluate the statistical power of long-term monitoring decisions and to help define appropriate sample sizes. To the extent possible, field and analytical techniques and procedures used in the long-term monitoring program will be consistent with those used in the baseline monitoring program to control statistical variability.

1.4.3.2 Construction Quality Assurance Project Plan (CQAPP)

Water column monitoring during construction activities, including dredging, capping, and dredged material disposal activities will be described in the CQAPP. These monitoring activities will be designed to ensure construction best management practices are being properly implemented to prevent construction

activities from impacting the river or bay. One of the objectives of the CQAPP is to achieve RAO 5, as specified in both RODs: "Minimize the downstream movement of PCBs during implementation of the remedy." A sediment verification sampling program will be specified in the CQAPP as needed to confirm the attainment of remedial action levels in sediments. If remedial action levels are not met at the completion of construction, a range of contingency response actions will be developed.

1.4.3.3 Operations, Maintenance, and Monitoring Plan (OMMP)

Elements of the remedial action requiring long-term maintenance and monitoring will be covered under the OMMP. The OMMP will include, for example, maintenance and monitoring of capped areas to ensure the caps remains physically stable (i.e., do not erode) and chemically protective. Similar to the CQAP, the OMMP will include a discussion of potential contingency response actions in the event that post-construction monitoring data reveal that containment actions (e.g., engineered caps) have not met remedial action criteria. The range of possible post-construction response actions and the decision criteria used to guide their selection will be presented in the OMMP.

1.5 Background Information

The design of the Long-Term Monitoring Plan has benefited from the data collected during the Baseline Monitoring Program, as well as from ongoing review and discussion of the baseline data in the Long-Term Monitoring Work Group. The Baseline Monitoring Program was conducted between August 2006 and July 2007. The results are compiled in *Baseline Monitoring Data Report, 2006-2007, Lower Fox River, Wisconsin* (Anchor and Shaw 2008), and summarized briefly in this section.

To the extent possible, field and analytical methods used in the Baseline Monitoring Program will be carried forward in the Long-Term Monitoring Program to ensure comparability of data and to minimize statistical errors caused by sampling and analytical methods.

1.5.1 Site Description

The Lower Fox River is divided into five operable units (Figure 1-3):

- OU 1 is also known as Little Lake Butte des Morts. The Neenah and Menasha Dams control the pool elevation of Lake Winnebago and the discharge to the upstream end of OU 1 at river mile (RM) 39. The remediation of OU 1 is being addressed under a separate SOW and Consent Order from that of OUs 2-5.
- OU 2 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 Lower Fox River system and the greatest elevation drop and gradient. Sediments have a very patchy distribution in this reach with extensive intervening bedrock exposures. Monitored natural recovery (MNR) is the selected remedy for OU 2, except for Deposit DD just upstream of Little Rapids Dam which is planned for active remediation.
- OU 3 extends from the Little Rapids Dam to the De Pere Dam at RM 7.1. Soft sediment covers most of this unit.
- OU 4 extends from the De Pere Dam to the river mouth at Green Bay. This unit contains a federal navigation channel. The federal channel is currently maintained by the USACE downstream of the Fort James Turning Basin, but the section above here is unmaintained. The area around OU 4 is highly urbanized, including the City of Green Bay metropolitan area.
- OU 5 begins at the river mouth, and includes the entirety of Green Bay. Except for a relatively small PCB deposit on the river-mouth delta, MNR is the selected remedy for OU 5.

1.5.2 Site Water Quality

Chapter 4 of the Baseline Monitoring Data Report provides a summary and evaluation of water quality in the Lower Fox River, Green Bay, and Lake Winnebago (Anchor and Shaw 2008). Water samples were collected on a monthly basis from ten operable units or sub-units (weather permitting) over a period of one year. A description of the baseline water quality investigation is summarized briefly below.

1.5.2.1 Water Quality Summary Statistics

Summary statistics of blank-corrected Total PCB concentrations (congener analysis by EPA Method 1668A), sorted by operable unit, are presented in Table 1-1. This table includes nonparametric statistics (minimum, maximum, median and other percentiles) and parametric statistics (arithmetic mean, standard deviation, coefficient of variation).

1.5.2.2 Spatial Distribution of Water Column PCB Concentrations

Average annual total PCB concentrations generally increase downstream in the Lower Fox River, from 4 ng/L (or parts per trillion, ppt) in OU1 to 28 ng/L in OU 4. Total PCB concentrations decrease beyond the mouth of the river in Green Bay, dropping from an average PCB concentration of 2 ng/L in OU5A to 0.4 ng/L in OU5C. The lowest concentrations were observed in Lake Winnebago, with a mean concentration of 0.2 ng/L, representing upstream "background" concentrations unaffected by site activities and inputs.

1.5.2.3 Seasonal Trends in PCB Concentrations

Baseline water samples were collected on a monthly basis for a period of one year. These data show a pronounced seasonality in total PCB concentrations in the Lower Fox River (see Anchor and Shaw 2008, Figure 4-3). Based on the observed seasonality, the data are stratified into winter months (December through March) and warm-weather months (April through November). Peak concentrations in the summer months of July and August are typically an order of magnitude or more higher than concentrations in the winter months throughout the Lower Fox River. However, seasonality is less pronounced in Lake Winnebago and Green Bay. Seasonal changes in ambient water temperature appear to be the primary cause the observed of seasonality in total PCB concentrations.

1.5.2.4 Seasonal Trends in PCB Loads

Estimated PCB loads (concentration times flow in mass/day) at the mouth of the Lower Fox River exhibit a seasonality that mimics the annual distribution of water concentrations (Anchor and Shaw 2008; Appendix J). In particular, it is estimated that the PCB load during the four winter months between November and March,

when total PCB concentrations are lowest, amounts to only approximately 10 percent of the total annual PCB load to Green Bay.

1.5.3 Fish Tissue Quality

Chapter 3 of the Baseline Monitoring Data Report provides a summary and evaluation of fish tissue quality in the Lower Fox River, Green Bay, and Lake Winnebago (Anchor and Shaw 2008). At least five different fish species were collected from nine operable units or sub-units in late summer/fall 2006, with limited follow-up sampling in late spring/summer 2007 to fill some data gaps in the program. The five fish species included a primary and secondary species for monitoring human health risk (walleye and bass, respectively), and a primary, secondary, and young-of-year species for monitoring ecological risk (carp, drum, and gizzard shad, respectively).

1.5.3.1 Fish Tissue Summary Statistics

Summary statistics of Total PCB concentrations (Aroclor analysis by EPA method 8082), sorted by operable unit and species, are presented in Table 1-2. This table includes nonparametric statistics (percent detection, minimum, maximum, median and other percentiles) and parametric statistics (arithmetic mean, standard deviation, coefficient of variation).

1.5.3.2 Fish Consumption Advisories

In the Lower Fox River and southern Green Bay, fish consumption advisories are in effect for nineteen species. All species are listed for PCBs. The species restricted by consumption advisories are summarized in Table 1-3.

1.5.3.3 PCB Concentration by Species

The highest total PCB concentrations are generally associated with ecological index species – carp, drum, and gizzard shad. In OU4, the average fish tissue PCB concentrations for these species are 4,600 μg/kg, 1,347 μg/kg, and 938 μg/kg, respectively. In contrast, somewhat lower PCB concentrations are associated with human health index species – walleye and bass – with average fish tissue PCB concentrations of 671 μg/kg and 442 μg/kg in OU4, respectively. Higher concentrations are observed in ecological index species because: (1) ecological

species were analyzed as whole fish, whereas human health index species were analyzed as skin-on fillets with fatty organs removed during cleaning, and (2) ecological species may have habitat preferences that result in increased exposure to PCB-contaminated sediments (carp, for example, tend to be associated with fine-grained, mud bottom habitats), whereas walleye and bass spend more time in open water.

1.5.3.4 Spatial Distribution of PCBs in Fish Tissue

Similar to the spatial patterns observed in water quality data, mean PCB concentrations in fish tissue generally increase downstream to peak concentrations in OU 4. For example, mean PCB concentrations in walleye increase from 135 μg/kg in OU1 to 671 μg/kg in OU 4. Fish tissue PCB concentrations decrease beyond the mouth of the river into Green Bay. For example, walleye concentrations decrease to 494 μg/kg in OU5A and further decrease to 296 μg/kg in OU5B. Similar trends were observed in other species, although the absolute magnitude of the tissue concentrations may differ. The lowest fish tissue concentrations are observed in Lake Winnebago, which represents upstream "background" concentrations unaffected by site activities and inputs, and with mean tissue concentrations typically one to two orders of magnitude lower than those in the river.

The spatial pattern of tissue concentrations in Green Bay is evidently affected by the migration behavior of the species. Carp show the most pronounced decrease in PCB concentrations between the river and the bay (dropping from 4,600 μg/kg in OU4 to 337 μg/kg in OU5B) suggesting carp have a strong fidelity for the riverine habitat with limited migration into the bay. Drum, on the other hand, show virtually no discernible gradient between the river and the bay (with mean PCB concentrations of 1,347 μg/kg, 1,392 μg/kg, and 1,490 μg/kg in OU4, OU5A, and OU5B) suggesting they probably migrate more freely between the two environments.

1.5.4 Conceptual Site Model

It was recognized in the RODs that bioaccumulation of PCBs in fish tissue and subsequent ingestion by higher-level organisms (humans, mammals, birds, and the fish themselves) is the primary risk pathway of concern in the Lower Fox River and Green

Bay. A conceptual site model has been developed to better understand the relationship between sediments, water, fish, and fish-eating animals, including humans. The conceptual site model will be used to help interpret long-term monitoring data for water and tissue.

1.5.4.1 Predicted Reduction in SWAC due to Cleanup Action

The RODs estimated that sediment remedial action in the Lower Fox River will result in an approximate 90 percent reduction of the SWAC for PCBs (WDNR and USEPA, 2002, 2003). Remediating the in-water sources of PCBs in sediments is expected to result in substantive reductions in PCB water column concentrations, PCB loadings to Green Bay, PCB concentrations in young-of-year fish, and eventually, PCB concentrations in adult fish. There will likely be a lag period of at least several years before improvements in the tissue quality of adult organisms (i.e., fish of harvestable size) will be evident.

1.5.4.2 Predicted Reduction in Water Concentrations

As reported in the RODs and RI/FS, model projections for the Lower Fox River indicate order-of-magnitude improvements in both water column PCB concentrations and PCB loads resulting from the remedial action. Model predictions referenced in the RODs suggest that over the long term (i.e., roughly 30 years), post-remedial action PCB concentrations in the Lower Fox River will decline by about 50 percent every 5 years, on average, compared to pre-remedial baseline values. These changes are predicted based on the combined effects of the remedy and subsequent long-term natural recovery processes.

1.5.4.3 PCB Concentrations vs. PCB Loads

The PCB load to Green Bay (mass/time) is the product of PCB water column concentration (mass/volume) times river flow (volume/time). Because the PCB load may be confounded by annual variations in flow (i.e., year-to-year changes in weather and river hydraulics), PCB concentration is expected to provide a more accurate indicator of trends in water quality. However, differences in PCB concentration may also be confounded by the effects of flow conditions and

temperature, so these variables will be controlled using appropriate statistical methods, including multiple regression techniques, during long-term data analysis.

1.5.4.4 Seasonal Effects on Water Quality

Water temperature exerts a seasonal influence on PCB concentrations in the Lower Fox River, with the highest PCB concentrations and loads occurring in the warm weather months from April through November. In contrast, less than 10 percent of the annual PCB load is discharged during the cold weather months from December through March, as estimated from baseline monitoring data (Anchor and Shaw 2008). This is consistent with previous studies that estimated 4 to 12 percent of the annual PCB load, 8 percent on average, is discharged during this time period (Velleux and Endicott 1994, USEPA 2002a and 2004b, and LTI 2002). Total suspended solids (TSS) concentrations are also correlated with PCB concentrations. The correlation between PCB concentration and flow appears to be weak but this relationship will be explored further during analysis of long-term monitoring data (Anchor and Shaw 2008; Appendix J).

1.5.4.5 Bioaccumulation Exposure Pathways

As determined in the Baseline Risk Assessment (Retec 2002), the primary exposure pathway for humans and wildlife to become exposed to PCBs in the Lower Fox River is through consumption of PCB-contaminated fish. Therefore, the focus of Long-Term Monitoring Program is to monitor risk reduction to humans and wildlife (including fishermen as well as fish-eating mammals and birds) by monitoring PCB concentrations in an appropriate selection of fish species, sizes, ages, and preparation methods which are relevant to these receptors.

1.6 Project Description

The Long-Term Monitoring Program is designed to assess long-term (i.e. decadal) conditions and trends in water and fish contamination in the Lower Fox River and Green Bay following the sediment remedial action.

1.6.1 Standards and Criteria

1.6.1.1 Remedial Action Levels

The remedial action level (RAL) for the Lower Fox River is:

- Remediation of sediments with PCB concentrations above 1 ppm

If post-dredge residual PCB concentrations remain above 1 ppm following the remedial action, the contingent cleanup level becomes:

- Attainment of a surface-weighted average concentrations (SWAC) in sediments of 0.26 and 0.25 ppm in OU 3 and OU 4, respectively

Through achievement of the RAL or SWAC, the remedial action is expected to result in improved sediment quality conditions in the Lower Fox River. In response, it is expected that first water and then fish tissue PCB concentrations will decline. Measuring the rate and magnitude of this decline in water and fish tissue, over a representative set of stations, seasons, and species, is a key objective of the Long-Term Monitoring Plan.

1.6.1.2 Human Health Target Tissue Goals

As stated in the Lower Fox River RODs, the human health remedial action objective is removal of fish consumption advisories for recreational and high-intake fish consumers. Beyond this narrative standard, the RODs did not provide numerical target tissue concentrations for protection of human health. It is anticipated that the Wisconsin Fish Consumption Advisory Program will ultimately determine if and when modification or removal of fish advisories is warranted.

1.6.1.3 Ecological Target Tissue Goals

As stated in the Lower Fox River RODs, the ecological remedial action objective is achievement of safe ecological thresholds for fish-eating birds and mammals, which are among the most sensitive of ecological receptors to PCB contamination. Beyond this narrative standard, the Lower Fox River RODs did not provide numerical target tissue concentrations for protection of ecological resources. It is anticipated that safe ecological thresholds will be determined based on a review of the Ecological Risk Assessment for the Lower Fox River, and appropriate updates.

1.6.2 Overview of Baseline Monitoring Activities

Water and fish tissue will be periodically monitored at a number of stations from upstream Lake Winnebago, through the Lower Fox River, and out into Green Bay.

1.6.2.1 Water Quality Plan

The water monitoring plan includes systematic monthly sampling of 10 stations during the 8-month non-winter season between April and November (10 x 8 = 80 water samples, plus QC samples, during a given monitoring year). Water monitoring stations are sited near the downstream boundaries of Lake Winnebago (upstream background) and each of the OUs such that the net PCB contribution from each OU, and the effectiveness of the remedy in each OU, can be evaluated. Multiple water quality monitoring stations are sited in OU 2 (including OU2A, OU2B, and OU2C) and OU 5 (including OU5A, OU5B, and OU5C) to provide increased coverage in these large MNR areas with more diverse environments. The water quality monitoring locations are the same as those used in the Baseline Monitoring Program, and will be maintained throughout the Long-Term Monitoring Program.

1.6.2.2 Fish Tissue Plan

The fish tissue monitoring plan includes sampling of four different types of species – walleye (human health index species), carp and drum (ecological index species), and gizzard shad (young forage fish species). The fish will be sampled at 9 different stations in Lake Winnebago, Lower Fox River, and Green Bay; they will be collocated with all water stations except OU5C. Each walleye station will be comprised of 15 individual fish; each carp or drum station will be comprised of 5 composite samples of 5 fish in each composite; and each gizzard shad station will be comprised of 7 composite samples of 25 fish in each composite. It is expected that different fish species will be collected from different parts of the OUs because of varying habitat preferences, feeding and migration patterns. Recommended fish sampling locations are presented in Section 2.2.2 based on lessons learned during the Baseline Monitoring Program; however, exact locations may be adjusted in response to the local field conditions at the time of sampling.

1.6.3 Equipment and Personnel Requirements

1.6.3.1 Equipment Requirements

Equipment required for water quality monitoring activities includes:

- Sampling boat with echo sounder
- Water quality monitoring probe (temperature and turbidity)
- Sampling pump (peristaltic), tubing, and accessories (Lower Fox River and Lake Winnebago)
- Water column sampler (Niskin bottle or equivalent) (Green Bay)
- Differential Global Positioning System (DGPS)
- Safety and personal protective equipment (per HSP)

Equipment required for fish sampling activities includes:

- Sampling boat with echo sounder
- Support boat
- Electrofishing equipment
- Other fish collection equipment as needed (e.g., rod/reel, nets, trawls)
- Global Positioning System (GPS)
- Safety and personal protective equipment (per HSP)

1.6.3.2 Personnel Requirements

Field Supervisors will be experienced in conducting water and/or fish sampling activities at hazardous waste sites as necessary to implement the tasks required in this Plan in accordance with the field and laboratory quality assurance requirements of this Plan. Field personnel will be trained in the safe and proper use of the above-listed equipment. All field personnel will have completed 40-hour HAZWOPER training with up-to-date, annual 8-hour refresher training, as specified in the Health and Safety Plan (HSP).

1.6.4 Preliminary Long-Term Monitoring Schedule

An overview of the projected schedule of long-term monitoring activities is presented on Figure 1-2. This schedule is of a conceptual nature only, given the current uncertainties

in the schedule for completion of sediment remedial actions in the different OUs which trigger the initiation of long-term monitoring activities.

The key concepts of the long-term monitoring schedule include the following:

- Remediation of OU 1 began in 2004 and is expected to be completed in 2009. An initial Phase 1 removal action in OU 4 was performed in 2007. The main phase of sediment remediation in OUs 2-4 is projected to occur from 2009 through 2017. Remediation will be completed in OUs 2 and 3 first, then the majority of the construction period will be spent working in OU 4.
- Post-construction monitoring will begin at or near the completion of remediation, in 2012 for Lake Winnebago through OU 3, and in 2017 for OU 4 and OU 5. Once the remediation of OU 3 has been completed or nearly completed, post-construction monitoring will begin in OU 3 and all upriver areas. The monitoring in OU 4 and Green Bay will lag by five years waiting for the remediation of OU 4 to be completed or nearly completed.
- Initially, the monitoring will be scheduled on five-year intervals. The monitoring should occur one year prior to the scheduled CERCLA five-year reviews. This provides for periodic reassessment of the scope of the monitoring program in light of progress achieved toward environmental recovery. Based on the results of the five-year review, the path forward could include: (1) continued monitoring at five-year intervals; (2) continued monitoring at less frequent intervals, e.g. ten-year intervals; (3) continued monitoring of fish and phasing out of water monitoring because RAOs are on track; and (4) termination of monitoring because RAOs have been achieved.
- During each designated monitoring year, water sampling will be conducted on a monthly basis from April through November. Fish sampling will occur between August 15 and September 15.

1.7 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that define the objectives of the project, identify the most appropriate types of data and data collection procedures, and specify acceptable error limits for decision making. The DQOs for this project were developed in accordance with *USEPA Guidance for Data Quality Objectives*

Process, EPA QA/G-4 (USEPA, 2000b) and *USEPA Region 5 Instructions on the Preparation of the Superfund Division Quality Assurance Project Plan, Revision 0* (USEPA, 2000a). Once approved, any proposed additions or changes to methods and procedures of this Long-Term Monitoring Plan will be documented in an addendum to the Plan subject to the review and approval by WDNR and USEPA.

The DQO Process for Baseline Monitoring is presented below.

1.7.1 Step 1: State the Problem

The overall objective of the Long-Term Monitoring Plan is to characterize long-term, post-remediation, water quality and fish tissue quality in the Lower Fox River and Green Bay. The combined baseline and long-term monitoring data will provide the Response Agencies with information to determine whether the implemented remedy meets remedial action objectives (RAOs) and risk reduction success criteria.

As stated in the ROD (WDNR/EPA 2002, 2003; see also Section 1.4.3), the RAOs for this project which are relevant to the Long-Term Monitoring Program include:

- Reduction of water column PCB concentrations
- Removal of human health fish consumption advisories
- Achievement of safe ecological thresholds for fish-eating birds and mammals, and other ecological receptors
- Reduction of Lower Fox River PCB loadings to Green Bay

These objectives are expected to be met through completion of the sediment remedial action (design of which is currently underway) and achievement of sediment remedial action levels as specified in the RODs.

1.7.2 Step 2: Identify the Decisions

1.7.2.1 Narrative Management Decisions

The long-term monitoring program is being designed to answer the following questions:

- Are water and fish tissue PCB concentrations declining in response to sediment remedial actions and natural recovery processes?

- Are Lower Fox River PCB loadings to Green Bay declining in response to sediment remedial actions and natural recovery processes?
- To what extent are PCB concentrations being controlled by ancillary variables (e.g. temperature and turbidity for water; size and lipid content for fish)?
- At some point in the future following the remedial action, is it possible that water and fish tissue concentrations in the Lower Fox River will have declined to the point that they are no different than those in Lake Winnebago, the upstream reference area?
- Can fish consumption advisories be lifted within ROD-specified time periods?
- Will safe ecological thresholds be achieved within ROD-specified time periods?

These questions will be evaluated and reevaluated as long-term monitoring data becomes available using statistical methods and hypothesis testing. The data will be analyzed on an OU-by-OU basis, allowing management and monitoring decisions to be made on an OU-by-OU basis. In OU 2 and OU 5, both of which include multiple monitoring stations due to their substantially greater extent and environmental complexity, management decisions will be further subdivided into portions of the OUs.

Ultimately, the achievement of human health and ecological remediation goals will be based on fish tissue concentrations. However, water represents the principal medium through which pelagic fish are exposed to PCBs, and will therefore be used as an indicator of bioaccumulation, an indicator that potentially responds more quickly to the effects of the remedial action. Water is also the principal medium through which PCBs are transported from the Lower Fox River to Green Bay.

1.7.2.2 Statistical Hypotheses

The following hypotheses will be tested in the Long-Term Monitoring Program to evaluate the degree to which RAOs are being achieved.

(1) Comparison of Mean Concentrations.

- *Null Hypothesis 1.* Water and fish tissue contaminant concentrations measured in the post-remediation period are not significantly different than baseline concentrations.
- *Alternative Hypothesis 1.* Water and fish tissue contaminant concentrations measured in the post-remediation period are lower than baseline concentrations.

(2) Time Trend Analysis.

- *Null Hypothesis 2.* Water and fish tissue contaminant concentrations in the post-remediation period are static and unchanging over time.
- *Alternative Hypothesis 2.* Water and fish tissue contaminant concentrations are decreasing over time as a result of the sediment remedial action.

(3) Time Trend Slope Projections.

- *Null Hypothesis 3.* Fish tissue contaminant concentrations in the post-remediation period are decreasing at a rate that will result in the achievement of RAOs (i.e. lifting of fish consumption advisories and achieving safe ecological thresholds) within ROD-specified time frames.
- *Alternative Hypothesis 3.* Fish tissue contaminant concentrations are not likely to achieve RAOs within ROD-specified time frames.

(4) Future Comparisons to Target Tissue Levels.

- *Null Hypothesis 4.* Fish tissue contaminant concentrations in the Lower Fox River and Green Bay are above target tissue levels for protection of human health and wildlife (levels to be determined).
- *Alternative Hypothesis 4.* At some point in the post-remediation monitoring period, fish tissue concentrations are at or below target tissue levels for protection of human health and wildlife (levels to be determined).

(5) Future Comparisons to Background.

- *Null Hypothesis 5.* At some point in the post-remediation monitoring period, Lower Fox River water and fish tissue contaminant concentrations are no different than upstream background concentrations (in Lake Winnebago).

- *Alternative Hypothesis 5.* Water and fish tissue contaminant concentrations in the Lower Fox River and Green Bay are significantly higher than background concentrations.

The following hypotheses will be tested in the Long-Term Monitoring Program to evaluate the statistical characteristics of the monitoring data, and to improve where possible the statistical power applied to long-term management decisions.

(6) Identification of Controlling Variables.

- *Null Hypothesis 6.* Water and fish tissue data are in conformance with standard normal and/or lognormal statistical distributions.
- *Alternative Hypothesis 6.* Water and fish tissue data do not conform to standard normal or lognormal distributions.

(7) Identification of Controlling Variables.

- *Null Hypothesis 7.* The number of water and fish tissue samples being collected in the long-term monitoring program are providing sufficient statistical power to support long-term decision making, considering the statistical variability of the data (i.e. the coefficient of variation).
- *Alternative Hypothesis 7.* The data are not providing an appropriate level of statistical power for long-term decision making.

(8) Identification of Controlling Variables.

- *Null Hypothesis 8.* Water and fish tissue contaminant concentrations are independent of ancillary variables (fish length and lipid content; water temperature and suspended sediment concentration).
- *Alternative Hypothesis 8.* Water and fish tissue contaminant concentrations are significantly correlated with ancillary variables. As a result, controlling for these variables may increase statistical power for decision making.

1.7.3 Step 3: Identify Inputs to the Decision

1.7.3.1 Baseline Monitoring Data

A comprehensive baseline monitoring data set was collected between August 2005 and July 2006 to characterize current environmental conditions at the Site. These data were analyzed to develop a statistically based long-term monitoring program, to confirm estimated sample sizes for long-term monitoring, and to define a baseline level of contamination for evaluating the recovery of water and fish tissue concentrations in the years following the completion of the sediment remedial action.

Water Quality Summary. Summary statistics of blank-corrected Total PCB concentrations in water (congener analysis by EPA Method 1668A), sorted by operable units, are presented in Table 1-1. Water quality data are tested for conformance with standard normal and lognormal distributions in Table 1-4.

Water column data have a bi-modal distribution, with higher concentrations during the warm weather months of April through November, and much lower concentrations during the winter, often ice-covered months of December through March. Stratification of the data therefore improves the statistical characteristics of the data. Water quality data during the warm weather months are well described by standard normal distributions (i.e., data are normally distributed at 7 out of 10 monitoring stations) whereas the year-round data set shows more significant deviations from normality (normally distributed at only 3 out of 10 monitoring stations). The CVs in the Lower Fox River during the warm weather months (0.56 to 0.70) are also much lower than the CVs for the year-round data set (0.79 to 1.04), indicating stratification of the warm-weather data helps to control statistical variability.

Fish Tissue Summary. Summary statistics of Total PCB concentrations in fish tissue (Aroclor analysis by EPA method 8082), sorted by operable units and species, are presented in Table 1-2. Fish tissue data are tested for conformance with standard normal and lognormal distributions in Table 1-5. Distribution test results show that fish tissue concentrations are well described by standard normal distributions in a

majority of cases. The data are also well described by lognormal distributions; however, in general lognormal distributions do not improve the goodness-of-fit over normal distributions.

1.7.3.2 Existing Monitoring Guidance

Federal and State guidance documents were consulted in preparing the Long-Term Monitoring Plan, including the following:

- EPA, 2000 Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis
- Great Lakes Sport Fish Advisory Task Force 1993, Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory
- EPA 2005, Contaminated Sediment Remediation Guidance for Hazardous Waste Sites

1.7.3.3 Key Inputs to Monitoring Plan Design

A number of important considerations and monitoring strategies have been discussed in the LTMP Work Group and have helped to guide the design of this Long-Term Monitoring Plan. General programmatic monitoring strategies include the following:

- Expanded Baseline Monitoring Activities. The Baseline Monitoring Program was designed to be more broad-based than the long-term monitoring program; this strategy will provide flexibility to accommodate changing environmental conditions in the decades ahead, such as changes in fish species availability. For example, an expanded list of fish species was sampled during the Baseline Monitoring Program, including primary as well as secondary contingency species. During long-term monitoring, only primary species will be analyzed; secondary species will only be analyzed if the primary species are not available.
- State-of-the-Art Detection Limits. Because PCBs are difficult to detect in water at concentrations of environmental concern, a highly sensitive analytical method with ultra-low detection limits has been selected to carry the program forward into the future, in anticipation of declining concentrations in the future. Specifically, PCBs in water will be analyzed

using high-resolution gas chromatography/mass spectrometry (HRGC/MS) by EPA Method 1668A which provides the lowest commercially achievable detection limits at the present time.

- Control of Confounding Variables. The assessment of river recovery, as measured by decreasing water and fish contaminant concentrations, may be confounded by random or systematic changes in other controlling variables. For example, PCB concentrations in water are affected by river temperature and turbidity, and possibly flow, and PCB concentrations in fish are affected by fish type, age, length, and fat content. As a result, field sampling and data analysis techniques will be utilized to control for the effects of confounding variables to the extent possible, thus providing a more accurate assessment of river recovery rates and magnitudes.
- General Strategy for Sampling Locations. Post-remediation management decisions will be made on the basis of operable units. Therefore, fish and water sampling stations are allocated to each of the operable units on the Lower Fox River. More detailed monitoring will be conducted in areas of monitored natural recovery, specifically OU 2 and OU 5; these OUs are characterized by multiple fish and water stations due to their greater spatial extent and habitat complexity. The rationale for selection of water and fish monitoring locations is summarized in Table 1-6.
- Timing of Fish Sampling. Fish sampling will occur in late summer (August 15 – September 15) for the following reasons: (1) fish lipid content, which tends to concentrate PCBs, is typically highest in late summer and early fall after heavy spring and summer feeding, and therefore fish are expected to carry some of their highest PCB burdens during that time of year; (2) recreational fishing is popular at that time of year; (3) fish spawning periods are avoided; and (4) the state conducts many of its fish sampling programs and fish population surveys during that time, allowing for coordinated data collection activities. If a secondary human health species is required, bass may be collected from certain OUs the following June (Lake Winnebago, OU 4, and Green Bay), mimicking the collection schedule used in the Baseline Monitoring Program.

- Timing of Water Sampling. Water samples will be collected monthly during the eight non-winter months from April through November. The four winter months are excluded from the monitoring program for the following reasons: (1) winter sampling from December through March presents a safety concern for the field crew due to severe weather conditions; (2) PCBs in the Lower Fox River are at their annual lowest concentrations in winter, such that the four winter months combined contribute less than ten percent of the annual PCB mass load; (3) the lower PCB concentrations during the winter months are more difficult to quantify in the analytical lab, and therefore have greater uncertainty; (4) PCB concentrations in winter are so low, relative to the rest of the year, that they generate data with a higher variance and non-normal statistical distributions, such that sampling the four additional months does not increase the statistical power for decision making. Samples will be collected systematically each month, at regular sampling intervals, to provide an unbiased and representative sample of the water year. Although "storm chasing" will not be practiced, in part because high flows on the Lower Fox River are largely controlled by dam releases, the systematic sampling design is expected to capture a representative range of flow conditions during a particular monitoring year.
- Human Health Fish Species. Walleye were selected as the primary human health fish species because: (1) they are a regionally important and popular recreational fishery; (2) they were reliably present and relatively easily harvested in most of the OUs and in most of the target size ranges during the Baseline Monitoring Program; and (3) walleye are widely distributed throughout the Lower Fox River and Green Bay. Consistent with the State Fish Advisory Program, walleye will be analyzed as skin-on fillets over a range of legal, harvestable sizes.
- Ecological Fish Species. 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 monitored in OU 4. Carp was selected as the primary ecological species in the Lower Fox River because: (1) carp exhibit some of the highest PCB concentrations of the fish species sampled; (2) carp are a prey species for higher-order predators, such

as eagles; (3) carp have an affinity for mud bottoms and may have more intimate contact with PCB-contaminated sediments; (4) carp are easily and reliably harvested from most of the OUs in the range of target fish sizes. Drum was selected as the primary ecological species in Green Bay because: (1) PCB concentrations in drum are typically higher than carp in Green Bay, whereas the reverse is generally true in the Lower Fox River; and (2) drum are easily and reliably harvested in all OUs and in the range of target fish sizes.

- Young-of-Year Fish Species. Gizzard shad were selected as the young-of-year fish species based on: (1) monitoring a juvenile life stage that does not carry a legacy PCB burden, and which may therefore respond more quickly to improving water quality conditions in the Lower Fox River; (2) representativeness as a prey species for higher-order predators (i.e., fish-eating birds and mammals, as well as predatory fish); (3) ease and reliability of harvesting.
- Fish Compositing Design. Ecological fish species will be composited for analysis because bioaccumulation is caused by the cumulative effects of long-term average dietary exposures. Compositing will be performed using strict fish-length windows (typically 2-inch windows) to control for the effects of size and age on PCB concentration. To preserve site fidelity, grouping of fish into composite samples will be kept within individual operable units, or sub-units in the case of OU 2 and OU 5, and will not cross operable unit or sub-unit boundaries.
- Comparability of Background Stations. Procedures used for sampling background water and fish in Lake Winnebago will be the same as those used throughout the Lower Fox River and Green Bay to ensure comparability of data and accurate statistical comparisons.
- Location Control Requirements. Accurate sample location control is essential for ensuring quality data and reproducibility between field sampling events. More accurate and precise control is needed in the water monitoring program to be able to reoccupy monitoring stations and depths along the designated cross-section of flow every month. A reduced level of accuracy is appropriate for the fish monitoring program because fish are transient and

migratory. Water stations will be located to within a target accuracy of two meters; fish stations will be located to within a target accuracy of ten meters.

Additional details of the water and fish monitoring plans are provided in Sections 2.1 and 2.2, respectively.

1.7.4 Step 4: Define the Boundaries of the Study

The study area for the Long-Term Monitoring Program is bounded spatially and temporally by the terms of the ROD.

1.7.4.1 Geographic Boundaries

The study area encompasses the following (see Figure 1-1):

- Upstream Reference Site – Lake Winnebago
- Remedial Action Areas – OU 1 through OU 4
- Downstream Receiving Water Body – OU 5

1.7.4.2 Temporal Boundaries

According to the ROD, long-term monitoring will be conducted after remediation is completed. Long-term monitoring will be performed for a period of 30 years or until the RAOs are achieved, as determined by the Response Agencies, whichever comes first. The time frames estimated by the Response Agencies for achievement of the RAOs is:

- Recreational Anglers: 10 years
- High-Intake Anglers: 30 years
- Fish-eating Birds and Mammals: 30 years

Monitoring may be terminated early if RAOs are achieved sooner than expected.

1.7.5 Step 5: Develop Decision Rules

Long-term monitoring will be conducted in accordance with the following decision rules:

1. If it can be shown with statistical confidence that PCB concentrations in water or fish tissue are not static, but are in fact *decreasing*, then progress toward achieving

the RAOs will have been demonstrated. It is assumed that any observed reduction in water or fish tissue concentrations, when controlled for changes in other potentially confounding variables (e.g., river temperature or turbidity, fish age or fat content), and absent any long-term trends in these variables, is primarily the result of the sediment remedial action.

2. If water and fish tissue concentrations are declining at a rate that indicates RAOs will be achieved within the ROD-predicted time frames, then monitoring will continue until such time as the RAOs have been achieved. If concentrations are declining at a rate that equals or exceeds expectations, revisions to the monitoring program (i.e., decreased sampling intensity) may be considered. Such revisions would be discussed in the Long-Term Monitoring Work Group.
3. If RAOs are achieved (i.e., PCB loads have decreased and fish tissue concentrations have recovered to the extent that fish consumption advisories may be lifted and ecological resources are safely protected), then the effectiveness of the remedy will be confirmed and the monitoring program will be terminated. Showing that monitored site concentrations are statistically comparable to background concentrations, as established in Lake Winnebago upstream of the Lower Fox River remediation areas, will be an alternate means of demonstrating remedy effectiveness. Exit criteria will be developed in the LTMP Work Group to more clearly define how and when monitoring may be terminated.
4. If water or fish tissue concentrations are not declining, or are declining at a rate that indicates RAOs will not be achieved within the ROD-predicted time frames, then project assumptions will be reassessed (i.e., are the ROD-predicted recovery rates realistic and achievable in light of the knowledge gained during the monitoring program?). If project goals and assumptions remain valid, the data will be evaluated to determine the likely cause(s) of the delayed recovery, and whether revisions to the monitoring program (i.e., increased sampling intensity, improved characterization of ambient background conditions, etc.) should be considered. Such revisions would be discussed in the Long-Term Monitoring Work Group.

Information collected during the Long-Term Monitoring Program will be used to assess the effectiveness of natural recovery in OU 2 and OU 5, and to determine if additional actions may be needed in areas where natural recovery is the selected remedy. Such evaluations would be performed during the CERCLA five-year reviews.

Long-term monitoring decisions will be made at the scale of individual operable units. OU 2 and OU 5 contain multiple (two to three) fish and water stations and will therefore generate data at a sub-unit level, allowing for smaller-scale decision units in the monitored natural recovery areas. The scale of the decision units will influence the data evaluation process (i.e., determining which OUs exhibit significant reducing trends in water and/or fish tissue concentrations) and the fulfillment of long-term monitoring goals through the achievement of exit criteria and eventual termination of monitoring (i.e., some OUs may fulfill exit criteria and be removed from the monitoring program sooner than others).

1.7.6 Step 6: Specify Limits on Decision Errors

The Long-Term Monitoring Program is designed to meet the following statistical criteria:

1.7.6.1 Minimum Detectable Relative Difference (MDRD)

The specified MDRD between two consecutive monitoring rounds is 50 percent. The monitoring program should be able to detect with statistical significance a 50 percent reduction in water or fish tissue concentrations.

In response to the anticipated 90 percent reduction in average surface sediment PCB concentrations following completion of the remedial action, combined with ongoing natural recovery processes in the river and bay, order-of-magnitude reductions in water and fish tissue concentrations are expected to occur. One order-of-magnitude reduction is approximately equal to three 50-percent reductions. Therefore, an MDRD of 50 percent provides an appropriate level of sensitivity for monitoring the concentration reductions that are expected to result from the remedial action.

1.7.6.2 Statistical Confidence and Power

The collection of water and fish tissue data is targeted to achieve the following levels of statistical significance:

- Alpha = 0.1 (90% confidence)
- Beta = 0.2 (80% power)

1.7.7 Step 7: Optimize the Design

To achieve the data quality objectives specified for this project, a sufficient number of water and fish tissue samples will be collected and analyzed using field and laboratory methods which provide adequate sensitivity for detection and quantitation of PCBs.

1.7.7.1 Number of Samples

The number of water and fish samples collected in the Baseline Monitoring Plan were estimated based on the desired MDRD, the desired level of statistical confidence and power (see Section 1.7.6.2), and an estimate of the variability of the data (described by the coefficient of variation, or CV) based on historical monitoring data.

The relationship between sample size and statistical power follows EPA (1998, section 9.3.3):

$$N = (Z_{\alpha} + Z_{2\beta})^2 \, (CV/MDRD)^2$$

where [N] = number of samples, [Z_{α} and $Z_{2\beta}$] are Z statistics at the specified alpha and beta levels, [CV] is the coefficient of variation of water or fish tissue data, and [MDRD] is the minimum detectable relative difference (see Section 1.7.6.1).

The estimated sample size as a function of CV for either water or fish tissue data is provided in Table 1-7. For comparison purposes, a range of confidence levels (alpha = 0.2, 0.1, and 0.05) is provided. The estimated sample sizes are based on an assumed normal distribution; both fish tissue data and seasonally stratified water data are reasonably described by normal distributions, as shown in Tables 1-4 and 1-5.

The statistical characteristics of the data collected in the Baseline Monitoring Program (see Tables 1-1 and 1-2) can be used to validate the sample sizes for the Long-Term Monitoring Program. The estimated level of statistical confidence provided by the Baseline Monitoring data, based on the observed CV of these data, is summarized in Table 1-8. In a majority of cases, sample sizes met or exceeded expectations for statistical power, as described below.

Water Sample Sizes. When monthly water samples are evaluated as a year-round data set, statistical power expectations are generally not met. Water column data in only 3 out of 10 OUs showed statistical confidence levels of 90 percent or higher.

Without considering the effects of controlling variables, statistical power was improved by removing the winter months (December through March) from the data set. Statistical confidence levels of 90 percent or higher were observed in 7 out of 10 OUs, in spite of having fewer samples in the data set. Two of the remaining OUs showed confidence levels greater than 80 percent. Lake Winnebago showed the lowest confidence levels (>75 percent) compared to all other OUs, likely due to the extremely low PCB concentrations and higher analytical uncertainty associated with this upstream background location.

In summary, the 8-month warm-weather data set exhibited better statistical power for detecting long-term reductions in PCB concentrations compared to the year-round data set. Expected levels of statistical confidence were met in a majority of cases in the 8-month data set. It is therefore recommended that long-term monitoring of the water column continue on a monthly basis from April through November. Additional sampling in the winter months is not likely to improve and may actually degrade statistical performance.

Fish Sample Sizes. The statistical confidence levels associated with human health fish species – walleye and bass – were uniformly excellent and typically exceeded 95 percent (Table 1-8). Statistical confidence levels associated with ecological fish species – carp and drum – were also excellent, with a few localized exceptions. Sub-optimal confidence levels were associated with carp data in OU 1 (>80 percent), OU

2A and OU 5B (>70 percent). OU 2A and OU 5B are each affected by an outlier, and are probably better described by lognormal distributions (see Table 1-5). Drum performance was only slightly below expectations in OU 2C (>80 percent), but exceeded expectations (>95 percent) in a majority of the other OUs. Overall, these comparisons validate the continued use of the sample sizes specified in the Baseline Monitoring Program for the Long-Term Monitoring Program.

Statistical confidence goals were only sometimes met in the gizzard shad data, the young-of-year species intended to serve as an early indicator of ecosystem recovery. Five of the OUs showed excellent power of discrimination, with over 95 percent confidence, whereas the other four OUs showed only modest power, with 80 to 90 percent confidence. Therefore, the gizzard shad sample size will be increased from five to seven composite samples during the Long-Term Monitoring Program to improve statistical power, especially in the Lower Fox River (see Table 1-7).

Effect of Increasing Monitoring Period. The preceding evaluation of statistical power is based on a simple t-test comparison of means between two successive monitoring rounds. Statistical confidence levels are expected to increase with each successive monitoring round due to increasing sample sizes, a longer time period of record, and progressively larger declines in water and fish tissue concentrations in the future, as the effects of the remedial action propagate through the ecosystem. However, the variance of the pooled data may also increase as the time period of record grows. As a result, two-sample comparisons will likely be supplemented with regression-based approaches after the first few rounds of post-construction data are collected (see Section 4.2.3.4).

Other Controlling Variables. Statistical power may be further improved using multiple regression techniques which help to reduce the effects of other controlling variables (LTI 2005). Controlling variables include the effects of temperature, flow, or suspended solids concentrations on water column PCB concentrations, or the effects of lipid content or fish size/length on fish tissue PCB concentrations. These effects are captured in the "random" variability of the existing data; however, they may be

predictable to some degree using multivariate statistical techniques such as multiple regression.

Multiple regression methods will be used to evaluate the strength of the association between PCB concentrations and other controlling variables to determine if simple PCB time trend analysis may be confounded by trends in other variables. If so, then PCB trends will be estimated after controlling for covariation with controlling variables. It is expected that trend analysis of tissue concentrations will control for variation in lipid content and fish length, and trend analysis of surface water concentrations will control for variation in flow and temperature. If associations with other controlling variables are identified, these will also be incorporated into multiple variable models to adjust spatial and temporal comparisons. These procedures are described further in LTI (2005).

1.7.7.2 Analytical Sensitivity

To achieve the data quality objectives for this project, analytical methods must be sensitive enough to:

- Quantify upstream "background" concentrations in Lake Winnebago
- Quantify future PCB concentrations based on anticipated order-of-magnitude reductions

Water is the more difficult medium and requires greater analytical sensitivity because PCBs are extremely hydrophobic, i.e., they tend to concentrate in the fatty tissue of fish but are poorly soluble in water. The method specified for water analysis in the Long-Term Monitoring Program is PCB congener analysis by high-resolution gas chromatography/mass spectrometry (high-res GC/MS) using EPA Method 1668A. The laboratory used in the Baseline Monitoring Program (TestAmerica Knoxville) achieved method detection limits (MDLs) for individual congeners ranging from 0.0005 to 0.003 ng/L, and reporting limits (RLs) ranging from 0.02 to 0.03 ng/L. The PCB congener reporting limits were enhanced by extraction of double sample volumes (two liters per sample) as well as by installation of upgraded electronics for the mass spectrometer, resulting in state-of-the-art sensitivity for a commercial laboratory.

Minimum Number of Detected Congeners. Water column PCB data is expressed as total PCBs, which is the sum of all detected congeners using zero for undetected congeners below the MDL, and using estimated values between the MDL and the RL. The congener compositions of the most highly contaminated samples in the Baseline Monitoring Program (i.e. those samples with the fewest number of undetected congeners and the least amount of "censoring") were evaluated to determine how many of the 209 possible congeners make up the bulk of the PCB mass. Water samples from August and September in OU 3 and OU 4 were analyzed for this purpose. It was determined that the top 20 to 25 congeners contributed 80 percent of the total PCB mass.

Based on this evaluation, the goal for the Long-Term Monitoring Program is to detect and quantify 25 congeners in each sample. With this level of detection, a majority of the PCB mass will be positively quantified. Detections of fewer numbers of congeners may tend to bias results low because a larger fraction of the PCB mass would be undetected or "censored".

Analytical Sensitivity in Water. A review of the water data from the Baseline Monitoring Program shows EPA Method 1668A is sufficiently sensitive to meet the objectives of Long-Term Monitoring Program, at least during the initial monitoring rounds. During the warm-weather months from April to November, between 49 and 132 congeners were detected in water samples from the Lower Fox River; 33 to 99 congeners were detected in water samples from Green Bay; and 31 to 61 congeners were detected in Lake Winnebago (all statistics based on blank-corrected data). Good detection frequencies were achieved for total PCB concentrations as low as 0.1 ng/L. This level of quantitation exceeds the expectations of the Baseline Monitoring Plan, which predicted good quantitations at about 1 ng/L.

In winter months, fewer numbers of congeners were detected overall. In Lake Winnebago, the number of detected congeners dropped below the minimum recommended detection frequency (<25 congeners) for two months.

Given the order of magnitude reductions in PCB concentrations which are predicted to occur in the decades following the remedial action, the sensitivity of the PCB analytical methods may need to be evaluated at some point in the future of the Long-Term Monitoring Program. However, data collected during the Baseline Monitoring Program indicates high-quality data should be obtained during the initial monitoring rounds using EPA Method 1668A, with the modifications as recommended in this plan.

Analytical Sensitivity in Fish Tissue. PCB concentrations in fish tissue from the Lower Fox River and Green Bay range from about 0.1 to 10 mg/kg (Aroclor basis), depending on the particular species and river reach. The detection limit achieved in the Baseline Monitoring Program for PCBs in fish tissue was 0.019 mg/kg. All fish species were at or near 100 percent detection in all parts of the Lower Fox River and Green Bay. In Lake Winnebago, more frequent non-detects were observed, especially in the human health species (50% nondetect for walleye, 40% nondetect for bass). Because PCB concentrations in the Lower Fox River and Green Bay are typically about an order of magnitude higher than those in Lake Winnebago, additional analytical sensitivity in Lake Winnebago does not appear to be warranted at this time.

1.8 Documentation and Records

Complete and accurate records of sample collection, sample analysis, quality assurance, data corrections, and data analysis will be maintained. Integrity of this information must be maintained throughout all data transfers and manipulations. Procedures used to generate, transform, and validate data are critical for effective data management. A summary of the data management procedures is provided below.

1.8.1 Data Tracking

When samples are processed and the appropriate sample identification is given, the sample tracking process will be initiated. Every sample will be tracked individually from its collection through receipt of the analytical results and final validation. The date collected, laboratory receipt, data receipt, status of data validation, and status of

database entry for each sample will be tracked and recorded in a sample tracking database.

1.8.2 Electronic Data Management

Technical data, including field observations, laboratory analytical results, and data validation results, will be stored in a relational database. The Database Administrator will be responsible for uploading sample collection data into the database under the supervision of the Data QAM. Data received from analytical labs in EDD format will be checked for completeness by comparing them to the sample collection forms before appending them into the database. At this point, the analytical data will be marked as "unvalidated" but will be available for preliminary queries. Data checks will be completed, including a comparison of the electronic data against the hard copy reports received from the laboratory. Finally, the Database Administrator will upload validation qualifiers as they are received from the Data Validator, validation qualifiers will be checked, and the data will be marked as "validated".

In addition to analytical data, the database will be used to organize field observation data, and field parameter measurements. These data will be transcribed by field personnel into electronic files (spreadsheets), where they will be uploaded into the database.

1.8.3 Evidence File

The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities. The Respondent Team Project Coordinator or his/her designee will be the custodian of the evidence files and will maintain the contents of the evidence files for the Long-Term Monitoring Program, including all relevant records, reports, field logbooks, field forms, pictures, contractor reports, and data reviews in a secured, limited access area.

All records will be kept by the Respondent Team until the monitoring program is completed. As necessary, records may be transferred to an offsite records storage facility which provides secure, access-controlled storage. Raw analytical laboratory data, including COC forms, analytical bench sheets, instrument printouts and

chromatograms, certificates of analyses, and QA/QC report summaries will be stored in electronic format (pdf files). The subcontract laboratory will retain its raw analytical data and QA data for a minimum of 10 years after completion of a given monitoring event.

2 DATA GENERATION AND ACQUISITION

2.1 Water Quality Monitoring Plan

2.1.1 Number of Water Samples

Monthly water samples will be collected at all monitoring stations during the eight warm-weather months (April through November) during each monitoring year (8 samples at each of 10 stations). Sampling may not always be possible at all stations due to unforeseen field conditions; therefore, the "completeness" objective for the water quality sampling program will be a minimum of 7 out of 8 possible sampling events at each station.

2.1.2 Water Quality Monitoring Stations

In general, water monitoring stations are sited near the downstream boundaries of the OUs such that the net PCB contribution from each OU, and the effectiveness of the remedy in each OU, can be evaluated. In addition, multiple water quality monitoring stations are sited in OU 2 and OU 5 to provide more detailed coverage in monitored natural recovery areas.

Water column samples will be collected and analyzed at 1 upstream reference location in Lake Winnebago, 6 stations along the Lower Fox River (OUs 1-4), and 3 stations in Green Bay (OU 5), for a total of 10 stations. The stations recommended for the Long-Term Monitoring Program are identical to those occupied during the Baseline Monitoring Program.

The water monitoring stations are located on Figures 2-2 through 2-9, and listed below (see also Figure 2-1 for an index map):

- *Lake Winnebago (upstream reference station).* Just above Neenah and Menasha Channels (Figure 2-2)
- *OU-1.* Downstream of LLBDM and above the first Appleton Dam (Figure 2-3)
- *OU-2.* Three sampling stations:
  - *OU-2A.* Reach between Lock 4 and Cedars Lock (Figure 2-4)
  - *OU-2B.* Reach between Lock 5 and Rapide Croche Lock (Figure 2-5)
  - *OU-2C.* Above Little Rapids Dam (Figure 2-6)
- *OU-3.* Above DePere Dam (Figure 2-7)

- *OU-4.* Near the USGS stream gage (Oil Depot gage); approximately 1,300 meters upstream from the mouth, and largely beyond the influence of bay water under seiche conditions (Figure 2-8).
- *OU-5 (Green Bay).* Three sampling stations (Figure 2-9):
  - *OU-5A.* Zone II/Zone III Boundary
  - *OU-5B.* Zone III South
  - *OU-5C.* Zone III North

Three stations have been specified for both OU 2 and OU 5 (Green Bay). Monitored natural recovery (MNR) is the selected remedy for these areas. The decision criteria for the selection of water sampling stations in OU-2 are as follows:

- *OU-2A.* To provide information in a reach of OU 2 having a steeper gradient and faster water velocities, as well as to provide information on natural recovery processes due to Deposit N removal
- *OU-2B.* To provide information in a reach of OU 2 with gentler gradients and slower water velocities (i.e., more likely to be depositional)
- *OU-2C.* To provide information on natural recovery processes due to removal of Deposit DD, and data regarding the PCB mass loading from OU 2 to OU 3

The water sampling stations in OU 5 were sited to characterize the concentration gradient in Green Bay between the mouth of the Lower Fox River and Lake Michigan.

2.1.3 Water Quality Monitoring Schedule

Sampling will be performed on a monthly basis from April through November in a given monitoring year (8 sampling events total). 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 and if possible, the entire monitoring circuit will be completed within a seven day period, weather and field conditions permitting.

2.1.4 Water Quality Sample Identification

Water quality samples will be coded as follows (see also Table 2-1):

AAAA-YY-MMDD

where "AAAA" is a 3 to 4 letter code that identifies the operable unit (OU1) or subunit (OU2B); "YY" is the two-digit year (e.g., -05 for 2005, -10 for 2010, etc.); and "MMDD" is the month and day of the sample collection. For example, "OU4-05-0912" is a water sample from the OU 4 station collected on September 12, 2005. This sample identification scheme is designed to sort alphabetically in time and space.

Duplicates and other quality control samples will be coded in the initial letter string (e.g. OU1D or OU2BD) in order to preserve the time stamp at the end of the name.

Each of the water quality samples will be composited from six separate aliquots from different distances and depths along the channel transect, as described below (Section 2.1.5.1). Each aliquot will be 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**

The six aliquots will be submitted separately to the analytical laboratory for compositing.

2.1.5 Water Quality Sampling Procedures

Water quality sampling procedures are described below.

2.1.5.1 Location Control

Water quality monitoring stations will be located to within a target accuracy of 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 SOP *Location Control*.

2.1.5.2 "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 of the Lower Fox River, Lake Winnebago, and Green Bay will be sampled in general accordance with USGS "quarter point" sampling procedures. The channel cross-sections are divided into 3 equal areas based on bathymetric data. Water sampling stations are positioned at the midpoint of each of the three flow areas; the coordinates of these stations are listed in Table 2-2. In the Lower Fox River and Lake Winnebago, discrete water samples will be collected at 0.2 and 0.8 times the depth of the water column.

In Green Bay, the sampling depths will be adjusted based on the observed temperature profiles and specifically the depth of the thermocline at the time of sampling (see Section 2.1.5.3). The surface sampling depths will be positioned midway between the water surface and the thermocline, and the bottom sampling depths will be positioned midway between the thermocline and the bottom of the water column. The thermocline is defined as the depth at which there is a sharply decreasing temperature gradient. In the absence of stratification, a surface-water sample will be collected from one meter below the surface, and a deep water sample will be collected from the mid-point of the water column. It should be noted that during the Baseline Monitoring Program, Green Bay transects were stratified into two layers – shallow and deep layers, above and below the thermocline; however, it was determined that PCB concentrations in the shallow and deep layers were not statistically different and as a result, sample stratification will not be required in the Long-Term Monitoring Program.

2.1.5.3 Sample Compositing

Discrete water subsamples 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), then shipped to the analytical laboratory where the compositing will be performed under clean laboratory conditions. A one-liter bottle will be collected at each of the 6 subsampling locations/depths (6 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.

2.1.5.4 Field Equipment

Samples in the Lower Fox River will be collected using a peristaltic pump with expendable tubing (i.e., used only once for each transect). Samples in Green Bay will be collected with a pre-cleaned, dedicated Niskin bottle (or equivalent). Each Niskin bottle will be dedicated to a specific Green Bay monitoring station.

2.1.5.5 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 in continuous casts from water surface to river bed to assess water column stratification and spatial heterogeneity in each cross section of the river or bay at the time of sampling.

2.2 Fish Tissue Monitoring Plan

2.2.1 Number of Fish Samples

Optimum Completeness Goal. The following number of fish samples will be targeted at each sampling station (i.e., in each OU, or part of an OU):

- *Walleye (human health index species).* 15 individual fish.
- *Carp (Lake Winnebago through OU 4) and Drum (OU 4 and OU 5) (ecological index species).* 25 individual fish, to be composited into 5 groups of 5 fish each.

- *Gizzard Shad (young 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, according to the field decision criteria outlined in Section 3.5.2. However, if sufficient numbers of fish cannot be collected at certain sampling stations, the following minimum numbers of fish will be collected to satisfy project completeness goals, while still providing a reasonable level of statistical power:

- *Walleye (human health index species).* Minimum 8 individual fish.
- *Carp (Lake Winnebago through OU 4) and Drum (OU 4 and OU 5) (ecological index species).* Minimum 5 individual fish, to be analyzed separately (no compositing).
- *Gizzard Shad (young forage fish).* Minimum 21 individual fish, to be composited into 7 groups of 3 fish each.

2.2.2 Fish Monitoring Stations

There are nine fish monitoring stations, including an upstream reference site (Lake Winnebago), six stations in the Lower Fox River (OU 1 through OU 4), and two stations in Green Bay (OU 5). One sampling station is assigned to each OU, except OU 2 which has three sampling stations and OU 5 which has two stations. The fish monitoring stations are shown on Figures 2-2 through 2-9, and listed below:

- *Lake Winnebago.* Upstream reference station. (Figure 2-2).
- *OU-1.* Little Lake Butte de Morts (Figure 2-3).
- *OU-2.* Three sampling reaches:
  - *OU-2A.* Reach between Lock 4 and Cedars Lock (Figure 2-4).
  - *OU-2B.* Reach between Lock 5 and Rapide Croche Lock (Figure 2-5).
  - *OU-2C.* Reach above Little Rapids Dam (Figure 2-6).
- *OU-3.* Reach above DePere Dam (Figure 2-7).
- *OU-4*. Reach from DePere Dam to the mouth of the Lower Fox River (Figure 2-8).
- *OU-5.* Two sampling reaches (Figure 2-9):
  - *OU-2A.* Shallow, inner portion of Green Bay
  - *OU-2B.* Deeper, central portion of Green Bay, and the eastern shore from around Dyckesville to Little Sturgeon Bay

Recommended fish collection sites, based on the catches obtained during the Baseline Monitoring Program, are provided on these figures. However, fishing locations may be adjusted as needed in the field based on species availability, habitat, river or bay 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 sub-OU which they represent; therefore, they should be representative of the general environmental conditions in the OU.

2.2.3 Fish Collection 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. Sample collection activities may be extended an additional month (through October 15) if necessary to fill data gaps.

If the walleye catch is found to be deficient and bass are substituted for the human health index species, bass fishing in certain OUs (Lake Winnebago, OU 4 and OU 5) should be conducted in the following month of June to be consistent with the bass collection schedule used in the Baseline Monitoring Program.

2.2.4 Target Fish Species and Size Ranges

Target fish species were selected based on the following criteria:

- Presence of fish consumption advisories (human health index species)
- Popular recreational fishery (human health index species)
- Key species evaluated in Human Health or Ecological Risk Assessments (Retec 2002c)
- Common food source for upper-level animals, e.g., fish-eating mammals and birds (ecological index species)
- Availability in the Lower Fox River and Green Bay based on recommendations from State fish biologists

Target fish species are summarized in Table 2-3. A total of five fish species were analyzed during the Baseline Monitoring Program to provide greater flexibility during

long-term monitoring. Four fish species will be analyzed during the Long-Term Monitoring Program, including a human health index species, two ecological index species, and a young forage fish species. The young forage fish species is intended to provide an early indication of recovery in the river and bay because these fish best represent current conditions unburdened by legacy contaminants. The four primary species that will be targeted during the Long-Term Monitoring Program are:

- Walleye (human health index)
- Carp (ecological index for Lower Fox River)
- Drum (ecological index for Green Bay)
- Gizzard Shad (young 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 Lower Fox River)
- Carp (ecological index for Green Bay)

It is recommended that all secondary species 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.

2.2.5 Fish Tissue Sample Identification

With the exception of gizzard shad, each individual fish will be given a unique sample ID, as follows (see also Table 2-4):

LLLL-YY-SP-NN

where [LLLL] is the location code describing the operable unit or subunit (OU1, OU2A, OU2B, etc.), [YY] is the two-digit year (i.e., 08 is 2008), [SP] is the species identification code (WA = walleye, SB = smallmouth bass, CA = carp, DR = drum, and GS = gizzard shad), and [NN] is a sequential number assigned to each individual fish in a given operable unit. For example, OU4-08-WA-23 is the twenty-third walleye collected in OU 4 during a monitoring event in 2008. 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.

Composite sample ID's will follow a similar convention as the ID's 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 C1, C2, C3, etc. These ID's will be assigned in the laboratory where the compositing will be performed.

Duplicate samples will be coded in the initial letter string (e.g. OU1D or OU2BD).

2.2.6 Fish Sampling and Preparation Methods

Fish sampling procedures are described below.

2.2.6.1 Location Control

The beginning, end, and turning points of fishing transects will be located to within a target accuracy of 10 meters using a global positioning system (GPS) as well as references to shoreline landmarks. Project-specific location control requirements for fish sampling activities are described in the SOP *Location Control*.

2.2.6.2 Fish Sampling Methods

The following fish collection methods are recommended based on the experience gained during the Baseline Monitoring Program (see Table 2-5):

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

Rod and reel techniques were found to be productive for bass fishing in June but may also be productive for other species during the fall. Fyke nets and set lines were

not generally productive. Methods may be modified as needed based on field conditions at the time of sampling.

The coordinates, time, and water depth of the starting point, ending point, and turning points of each fishing run will be recording in field logs. Start and end times will also be marked on the hard copy print out from the echosounder. 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, gizzard shad will not be logged individually. All gizzard shad fingerlings from a particular fishing location will be combined in a plastic bag and forwarded to the analytical lab for compositing.

2.2.6.3 Compositing

Carp and drum (ecological index species), and gizzard shad (young forage fish species) will be analyzed as composite samples; carp and drum composites will consist of 5 composites with 5 individuals in each composite (i.e., 25 fish total). 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 which are representative of the size classes listed in Table 2-3. Ideally, composites would be prepared for each of the five two-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. Then the fish will be assigned to compositing groups. Similarly sized individuals (within two-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 stations, i.e., across operable units, or across sub-units in OU 2 or OU 5.

2.2.6.4 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 (see Biological Tissue Preparation SOP).

2.2.6.5 Tissue Archiving

Aliquots of all homogenized fish tissue samples (including both individual and composited samples) will be set aside and archived (frozen) for possible future analysis.

For human health species (i.e., walleye or bass), one fillet will be analyzed and the other side 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. The remainder of the individual samples will be archived for possible future analysis in case it is later determined that analysis of individual fish would be useful. For gizzard shad, an aliquot of each composited and homogenized sample will be set aside and archived.

2.3 Sample Handling and Custody Requirements

The following sections describe the procedures for sample handling, preservation, transportation, and storage (see *Shipping and Packaging of Non-hazardous Samples* SOP). Sample chain-of-custody procedures are also described (see *COC Documentation* SOP).

2.3.1 Sample Handling, Preservation, Transportation, and Storage

Table 2-6 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 to the CLP Program* (USEPA, 2001b). Sample containers will be purchased 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. For PCB congener analysis by EPA 1668A, ultra-low level detection limits are required, and there is increased risk of cross-contamination; therefore, additional precautions are necessary. Procedures for tracking, lot checking, and ensuring clean sample containers are delivered to the field crew are specified in the *Lot Checking Sample Containers SOP*.

2.3.1.1 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 CFR 171-177.

2.3.1.2 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.

2.3.2 Chain of Custody

Proper sample and data custody procedures will be followed during the Long-Term Monitoring Plan. 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, and copies will be forwarded to the project files.

2.3.2.1 Field Custody Procedures

COC forms will be required for all samples. The sample processing team will initiate COC forms. COC forms will contain 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 (See *COC Documentation* SOP).

2.3.2.2 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. 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 with a sample acknowledgement letter. If the sample temperatures are outside the required range, the laboratory will contact the Laboratory Quality Assurance Manager 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 degrees Celsius (°C) or frozen, as appropriate. Access to refrigerators and freezers will be limited to authorized laboratory personnel.

2.4 Laboratory Analytical Methods

The analytical parameters and methods specified for water and fish tissue analysis are the same as those used in the Baseline Monitoring Program, as described in Sections 2.4.1 and 2.4.2, below. In water, PCB congeners will be analyzed using EPA Method 1668A to achieve ultra-low level detection limits. In fish, PCB Aroclors will be extracted and analyzed using WSLH methods to ensure consistency with historical fish monitoring data and the state fish consumption advisory program.

2.4.1 Water Analysis

Eight rounds of water column samples (once a month from April through November) will be collected at ten stations, for a total of 80 samples, plus quality control samples.

2.4.1.1 Analytical Parameters

All water column samples will be analyzed for the following:

- PCB Congeners (209 total) by EPA Method 1668A (high-res GC/MS)
- Total Suspended Solids (TSS) by EPA Method 160.2
- Total Organic Carbon (TOC) by EPA Method 415.1

2.4.1.2 Methods and Reporting Limits

Analytical methods and reporting limits for water analysis are summarized in Table 2-7. Estimated detection limits (EDL) and reporting limits for PCB congeners by Method 1668A are listed in Table 2-8.

2.4.1.3 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:

- Lake Winnebago (analyze first)
- OU 5B
- OU 5A
- OU 1
- OU 2A
- OU 2B
- OU 2C
- OU 3
- OU 4 (analyze last)

2.4.2 Fish Tissue Analysis

For the human health indicator species (walleye or bass), fifteen individual fish will be analyzed from nine stations (135 analyses total) if all completeness goals are met. For carp, five composite samples from seven stations will be analyzed (35 analyses total). For drum, five composite samples from four stations will be analyzed (20 analyses total). For gizzard shad, seven composite samples from nine stations will be analyzed (63 analyses total). In all, as many as 253 fish tissue samples will be analyzed, considering the various species and the numbers of individual or composite analyses for each species, plus quality control samples.

2.4.2.1 Analytical Parameters

Fish tissue samples will be analyzed using the following methods:

- Tissue Extraction (WSLH Method)
- PCB Aroclors (EPA Method 8082)

- Lipid Content (Randall et al., 1991)

2.4.2.2 Methods and Reporting Limits

Analytical methods and reporting limits for tissue analysis are summarized in Table 2-7.

Detected values above the method detection limit but below the reporting limit (also known as the limit of quantitation) will be reported by the laboratory as estimated values with a "J" 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 method detection limits 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.

2.5 Quality Control Requirements

The overall QA objective for this project is to collect data of a known and high level of quality through the specification and implementation of quality control procedures during field sampling, sample handling, laboratory analysis, and data management.

Location Control. Field sampling locations must be determined to within known accuracy specifications. Water quality monitoring stations will be located to a target accuracy of within 2 meters using a differential global positioning system (DGPS) calibrated to known shoreline benchmarks before and after each sampling transect. The beginning, end, and turning points of fishing transects will be located to a target accuracy of within 10 meters using a global positioning system (GPS) as well as references to shoreline landmarks (see SOP *Location Control*).

Analytical Control. Analytical specifications, reporting limits, quality control procedures, assessment criteria, and corrective actions are summarized in the following tables:

- *Table 2-7*. Laboratory Analytical Methods and Reporting Limits
- *Table 2-8*. PCB Congener Reporting Limits

- *Table 2-9*. Quality Control Procedures, Criteria, and Corrective Actions—PCB Aroclors and Conventionals
- *Table 2-10*. Quality Control Procedures, Criteria, and Corrective Actions—PCB Congeners

The quality assurance program is designed to generate data of known and acceptable *precision, accuracy, representativeness, comparability,* and *completeness*, as described below.

2.5.1 Precision

Precision is a measure of reproducibility of sample results. All work will adhere to the established protocols presented in this Plan. Checks for field and analytical precision will include the analysis of field replicates for water and fish, as well as MS/MSDs.

Field Replicates for Water. To provide an overall assessment of the field and analytical precision associated with PCB congener analysis, field duplicate samples will be collected from two different OUs during each of the eight monitoring months (16 duplicates total). Four duplicates will be collected from Lake Winnebago and four will be collected from OU 4, systematically distributed throughout the 8-month monitoring period. One duplicate sample will be collected from each of the other eight monitoring stations during the 8-month monitoring period. No more than one duplicate will be collected from Green Bay (OU 5A, 5B, and 5C) in any given month.

In the lake and the river, all six sampling points on the transect (A through F) will be sampled, then a second circuit of the sampling points will be made to collect the six aliquots for the field replicate sample. In Green Bay, the field replicate sample will be collected from a second, separate deployment of the Niskin bottle.

Field Replicates for Fish. Field replicate samples will be collected and prepared for both individual and composite samples of fish, as indicated in Table 2-4. For those species analyzed on an individual basis (i.e., walleye or bass), a pair of fish specimens from the same haul, and nearly identical in size (i.e., within one inch in length, if possible), will be designated as a primary specimen and a replicate specimen. For those species analyzed on a composited basis (i.e., carp, drum, and gizzard shad), a replicate

composite grouping will be prepared from a second group of fish in the same size class. For carp and drum, replicate composite groups may be prepared from multiple hauls. For gizzard shad, replicate composite groups should be prepared from the same haul as the original sample, to the extent possible.

One replicate sample of each species in each OU should be targeted for the Long-Term Monitoring Program. The minimum completeness goal is to obtain a replicate sample in at least half of the OUs for each species.

Evaluation and Response. Field replicate data will be evaluated in the LTMP Work Group. If significant discrepancies are evident in field replicate results, the field documentation will be reviewed to determine whether the discrepancies are potentially caused by field sampling error or alternatively, natural heterogeneities in environmental media which are beyond the control of the sampling crew. Note that it may not always be possible to differentiate these two potential sources of sampling variability. Appropriate modifications to the Long-Term Monitoring Program, if warranted, will be discussed in the LTMP Work Group.

2.5.2 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field accuracy (i.e., temperature and turbidity measurements) and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MSs, blank samples, LCS, and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery, as follows:

$$\%\text{Recovery} = \frac{(A-X)}{B} \times 100$$

where:

A = Value measured in spiked sample or standard

X = Value measured in original sample

B = True value of amount added to sample or true value of standard

This formula uses an assumption of constant accuracy between the original and spiked measurements.

2.5.3 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions. Representativeness is dependent on sampling and analytical variability and the variability of environmental media at the site.

2.5.3.1 Representativeness in Space

Accurate and precise location control is a fundamental requirement for obtaining representative samples (see Location Control SOP).

Water Representativeness. Representativeness of water samples will be achieved through the use of modified USGS "quarter-point" sampling procedures which provide systematic characterization of water quality over the depth and across the width of the river, lake, and bay. Representativeness will be further assessed by analyzing the spatial variability of field parameter measurements (i.e. temperature and turbidity) at the time of sample collection. Whereas Green Bay samples were stratified into shallow and deep water layers during the Baseline Monitoring Program, it was determined that the PCB concentrations in these two layers, which are seasonally separated by a thermocline, were not statistically different. Therefore, Green Bay transects will be composited into a single sample at each monitoring station.

Fish Representativeness. Representativeness of fish samples will be achieved by collecting specimens from a range of sizes and a cross-section of habitats which are frequented by the target fish species in the various operable units of the Lower Fox River. Because fish are migratory, they provide spatial integration of contaminant exposures over the extent of their home range. A goal of the monitoring program is to characterize each fish station with fish specimens collected from at least three separate fishing sites within the OU or sub-OU. Collecting specimens from multiple fishing sites will help to provide representative geographic coverage of particular

river reaches or bay areas. If possible, depending on species availability, some specimens should be collected using a second, complementary fishing method (e.g., electrofishing and rod-and-reel) to evaluate the potential for field sampling bias (i.e., potential for one type of fishing gear to preferentially sample a particular habitat or size class).

Subdivision of OU 2 and OU 5. To provide better representation of the range of environmental conditions in a long and fragmented reach of the Lower Fox River, three sampling stations were assigned to OU 2 (OU 2A, 2B, and 2C). Similarly, to provide better representation of the physical and environmental transition from the mouth of the Fox River into Green Bay, two sampling stations were assigned to OU 5 (OU 5A and 5B).

2.5.3.2 Representativeness in Time

Representativeness of water samples will be achieved through the use of systematic monthly sampling over the eight-month monitoring period (April through November) when greater than 90 percent of the annual PCB load is discharged. Representativeness of fish samples will be achieved by targeting a late summer (August 15 – September 15) sampling window, as recommended by EPA (2000), and maintaining this same sampling window throughout all baseline and long-term monitoring events to minimize seasonal variability in fish lipid content and contaminant levels.

If walleye are relinquished in favor of bass, bass samples should be collected during the same late summer window, to the extent they are available. Bass samples should also be collected in Lake Winnebago, OU 4, OU 5A, and OU 5B during the following June, to be consistent with the Baseline Monitoring Program. If possible, complimentary data sets should be collected from these four stations in both the late summer window and the June window to better characterize seasonal differences in PCB and lipid concentrations. If seasonal differences are not significant or are controllable using appropriate statistics, and if bass can be successfully obtained in the fall, the spring sampling event may be phased out at the discretion of the LTMP Work Group.

2.5.4 Comparability

Comparability is the degree of confidence with which one data set can be compared to another, as discussed below.

Comparability between Baseline and Long-Term Monitoring Programs. Internal consistency will be achieved by occupying the same sampling stations and performing the same field and analytical methods in the Baseline Monitoring Program and the Long-Term Monitoring Program. Specifically, comparability between baseline and long-term monitoring events will be ensured by:

- Occupying the same water monitoring stations and the same general fishing areas during all baseline and long-term monitoring events
- Utilizing the same field sampling and analytical techniques during all monitoring events
- Collecting water data according to the same systematic monthly sampling schedule during all monitoring events (i.e., monthly sampling from April through November)
- Adhering to a fish sampling window between August 15 and September 15 during all monitoring events to minimize seasonal variations in tissue concentrations and fish lipid content

Tissue Performance Evaluation Sample. Comparability of PCB Aroclor analysis between Baseline and Long-Term Monitoring Programs will be further evaluated by preparing a tissue performance evaluation (PE) sample from a representative composite of fish collected during the Baseline Monitoring Program with a typical site-specific Aroclor composition. One PE sample will be prepared for the Lower Fox River and another PE sample will be prepared for Green Bay. The PE samples will be analyzed five times by the contract laboratory used in the Baseline Monitoring Program, then archived in the freezer for future use in the Long-Term Monitoring Program. When long-term monitoring activities are initiated, the selected contract laboratory (whether the same or a different laboratory) will also be required to analyze each of the tissue PE samples five times, and a statistical comparison of Aroclor results will be performed to assess comparability of labs and analytical methods. The details of the PE sample

preparation and statistical comparison tests are being developed in the LTMP Work Group.

Comparability with Historical Data. Historical data will be used in a more qualitative than quantitative manner because monitoring stations, field and analytical methods specified in this Plan are not always comparable to those used in historical studies of the Lower Fox River and Green Bay. Comparability with historical data will need to be determined on a case-by-case basis. Comparability issues may arise due to station positioning methods, sampling and processing methods, analytical methods, and the level of data quality review.

Comparability with past and ongoing studies will be improved by:

- Utilizing sample preparation and analytical methods which are comparable to past and ongoing studies, to the extent possible (e.g., use of WSLH fish tissue extraction and tissue analysis methods)
- Occupying sampling stations which are coincident with stations occupied during past and ongoing studies to the extent possible (e.g., collocation with the USGS Oil Depot station at the mouth of the Lower Fox River)
- Collecting fish species (e.g., walleye, carp, gizzard shad) that have been routinely collected in past monitoring studies, to the extent possible

2.5.5 Completeness

2.5.5.1 Field Completeness

Field completeness is the percentage of stations or monitoring events successfully completed during the field program. For example, some samples may be lost, certain fish species may be sparse or unavailable in particular river reaches, and water sampling may be precluded at one or more stations because of severe weather or safety issues (e.g. wind, unstable ice, etc.).

The completeness of the field data is calculated using the following equation:

$$\% \text{ Completeness} = [(\# \text{ Samples Collected}) / (\# \text{ Samples Planned})] \times 100$$

Field Completeness Goals. The overall completeness goal for the water column sampling program is collection of valid water samples in at least 7 out of 8 warm-weather months (i.e., 88 percent). The overall completeness goal for the human health fish species (walleye) is collection of 8 out of 15 specimens at a given sampling station (i.e., 53 percent). The overall completeness goal for ecological fish species (carp and drum) is collection of 5 individual fish as opposed to 5 composites of 5 fish each (i.e., 20 percent of the fish and 100 percent of the laboratory analyses). The overall completeness goal for gizzard shad is collection of 5 composites of 5 fish each as opposed to 7 composites of 25 fish each (i.e., 14 percent of the specimens and 71 percent of the laboratory analyses).

These reduced numbers of samples should still provide sufficient statistical power to assess progress toward meeting RAOs, as discussed in Section 1.7.7. If completeness goals are not met for water, additional sampling may be required; if completeness goals are not met for fish, alternate species may need to be collected and analyzed. In the event completeness goals are not met for water or fish, appropriate contingency actions are described in Sections 3.5.1 and 3.5.2, respectively.

Completeness Goal for Water Transects. The minimum completeness goal for any individual water sampling transect is collection of four out of six aliquots along the transect. For example, it is possible that the sampling crew could be driven off the water partway through a sampling transect due to foul weather. If at least four aliquots were obtained from the transect, these existing aliquots should be submitted to the analytical lab for compositing. If fewer than four aliquots were obtained on a particular sampling day, the aliquots should be discarded and the transect should be completely resampled on a later day when the field crew can remobilize.

2.5.5.2 Laboratory Completeness

Laboratory completeness is a measure of the percentage of data that were successfully collected and analyzed as planned and not rejected during the validation process. Data qualified as estimated values using qualifiers such as "J" are still deemed acceptable and can still be used to make project decisions.

The completeness of the analytical data is calculated using the following equation:

% Completeness = [(# Valid Sample Results) / (# Samples Collected)] × 100

The overall completeness goal for the laboratory is 90 percent. All valid and usable data must have accompanying location control and field documentation.

2.6 Instrument Testing, Inspection and Maintenance

2.6.1 Field Instruments Calibration

Field instruments will be calibrated daily in accordance with manufacturers' specifications before the beginning of daily sampling activities (see Water Quality Meter SOP). Standards used to calibrate the field instruments will be traceable to the standards of the National Institute of Standards and Technology whenever possible. The DGPS system will be checked against known benchmarks before and after each water sampling transect. Location control requirements, calibration protocols, and quality indicators are described in the Location Control SOP.

2.6.2 Laboratory Instruments Calibration

Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. The frequency and QC limits for the analytical instrument calibrations are provided in the relevant Laboratory SOPs.

2.7 Data Management

2.7.1 Field Documentation

2.7.1.1 Field Logbooks

Field logbook entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory. Modifications to field sampling protocols must be documented in the field logbook. The Field Supervisor is responsible for ensuring that modifications to sampling protocols are documented in the field logbook (see Field Logbook SOP).

2.7.1.2 Field Forms

Additional detailed sampling information may be recorded on separate field forms and referenced in the field logbook. The field team members will manage the raw data during field activities as overseen by the Field Supervisor. Periodically, The QAM will collect and compile the field data to maintain a current summary of field activities and measurements. All field sampling forms MUST include the project name, OU, date and time, sample location and sample number(s), and name and signature of the person completing the form.

2.7.1.3 Photographs

Photographs will be taken as needed to document field activities. Digital photograph files will be downloaded from the field camera to the project directory. The information listed below will be linked to each photograph.

- Name of person who took the picture
- Date and time photograph was taken
- Location and direction toward which the photograph was taken
- Description of the photograph

2.7.2 Laboratory Documentation

2.7.2.1 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document important aspects of the analytical work, including quality control metrics. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without obliterating or overprinting the erroneous entry, and initialed and dated by the individual making the correction. Lining out unused portions and initialing by the person lining out the page will complete pages of logbooks that are not used.

The analyst will record information about the sample, analytical procedures, and results on laboratory forms or notebook pages and enter this information in LIMS. These notes will be dated and will also identify the analyst; instruments used, and instrument conditions.

Sufficient raw data records must be retained to permit reconstruction of initial instrument calibrations (e.g., calibration date, test method, instrument, analysis date, each analyte name, concentrations and responses, calibration curves, response factors, or unique equations or coefficients used to reduce instrument responses into concentrations).

Laboratory notebooks will be reviewed periodically by the laboratory group leaders for accuracy, completeness, and compliance with the requirements of this Plan. The laboratory group leader will verify all entries and calculations. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs the notebook.

2.7.2.2 Laboratory Project File

In accordance with analytical laboratory's records information management, documentation will be placed in secured project files which will be maintained by the laboratory records manager. These files will include the following:

- Agreements
- Correspondence
- Memos
- Notes and data

Filed materials may only be removed by authorized personnel on a temporary basis, at which time the name of the person removing the file will be recorded. Laboratories will retain project files and data packages for a minimum of 10 years unless otherwise specified.

2.7.2.3 Electronic Data Storage

The analytical laboratories will provide the full data package, including chromatograms and raw data, in pdf format on a CD-ROM. These electronic data will be archived in project files for the duration of the Long-Term Monitoring Program. Laboratory instrument files and instrument software will be archived at the analytical laboratories for a minimum of ten years, which surpasses the NELAC standard for data storage. The laboratory will provide notice to the QAM or Project Coordinator before purging any instrument files or instrument software at the end of the archiving period.

2.7.3 Data Reporting

2.7.3.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, or field instrumentation will be recorded in field logbooks, data sheets, and/or field forms, then entered into an electronic database or spreadsheet. Data will be reviewed by the Field Supervisor for adherence to the requirements of this Plan. Any concerns identified as a result of this review will be discussed with the QAM, corrected if possible, and incorporated into the data evaluation process.

The Field QAM will review the accuracy and completeness of the field documentation, logbook entries, and field forms. The field documents will be checked for the following:

- Completeness and readability
- Use of Plan-specified procedures, with any modifications appropriately documented and communicated
- Instrument calibration and maintenance records
- Correctness of sample locations
- Correctness of reporting units, calculations, and interpretations

Where appropriate, field data forms and calculations will be processed and included in appendices to the appropriate data report. Original field logbooks and supporting documents will be kept in the project file.

2.7.3.2 Laboratory Data Reporting

Full "contract laboratory program (CLP)-equivalent" reporting is required for all water and fish tissue analyses. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Electronic data storage will be utilized. All electronic data will be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration. Per the requirements of the AOC, electronic data will be accessible and retrievable for a period of 10 years after project completion and the Response Agencies will be notified prior to destruction of any data files (USEPA, 2004).

Raw data will be examined to assess compliance with QC guidelines. Surrogate and matrix spike sample recoveries will be checked. Samples and laboratory blanks will be checked for possible contamination or interferences. Chromatograms and concentrations will be checked to ensure that sample results are within the calibration range; if necessary, dilutions will be performed when the sample concentration of a constituent exceeds the initial calibration range of instrument.

Deviations from guidelines will call for corrective action. Deviations determined to be caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. Calculations will be checked, as specified in the referenced analytical methods, and the report reviewed for discrepancies, errors or omissions.

The laboratory data report will be submitted to the Laboratory PM for review and approval. The Laboratory PM will review the package, conduct a forms review on 100 percent of definitive data, and ensure that any necessary corrections are made and that the package is complete. A copy of the data package will be maintained in the project file. Data packages will be made available, upon request, to the Response Agencies.

Laboratory data reports will include, at a minimum:

Case Narrative. Summary of activities that took place during the course of sample analysis, including the following information:

- Laboratory name and address
- Date of sample receipt
- Laboratory ID number cross-referenced to contractor ID number.
- Analytical methods
- Deviations from specified protocol, if any
- Corrective actions taken
- Sample handling documents including; field and internal COC forms, air bills, or bills of lading from couriers

Chemical Analytical Results. The following information, as applicable, will be reported with the analytical results:

- Sample results with laboratory sample and client sample identification
- Detection and reporting limits
- Extraction and analysis times
- Sample volume
- Percent moisture
- Dilution factor
- Surrogate recovery
- LCS/LCD accuracy and precision summary
- MS/MSD accuracy and precision summary
- Method blank summary
- Initial calibration summary–including concentration levels, retention times, response factors, and linearity demonstration
- Calibration blank summary
- Continuing calibration summary–including unique instrument/column identification, retention times, retention time windows, calibration factors, percent difference, or drift as appropriate to method
- Internal standard recoveries
- Degradation summary
- Analytical sequence
- Compound identification summary

2.7.3.3 Electronic Data Deliverable (EDD) Format

An EDD file will be generated by the laboratory for every sample delivery group (SDG). These files will be incorporated into the Long-Term Monitoring Database. Each file will be named "*.txt," where "*" represents the batch SDG number. The USEPA Region 5 valid value list will be used for field and parameter names (see http://www.epa.gov/region5superfund/edman/download/EDD%20V1_05.pdf).

3 ASSESSMENT AND OVERSIGHT

Assessment and oversight activities are performed to determine whether the quality control measures identified in this LTMP are implemented and documented as required. The Respondent Team Project Coordinator, Project Manager, and Field Supervisors will perform assessment and oversight to check conformance to this LTMP. For example, during a review, the Field Supervisor may check that a sample has been processed and labeled correctly or that the field QC samples were collected at the appropriate frequency. The need for a check can be determined independently by the Project Coordinator or Project Manager, or assigned by these persons to another team member.

Response Agency oversight activities may be performed by USEPA and WDNR. At all reasonable times, USEPA and WDNR personnel and their authorized representatives shall have the authority to enter and freely move about all on-site and off-site areas where work, if any, is being performed, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, field notes, and data related to these monitoring activities, provided project health and safety requirements are followed.

Aspects of the LTMP will be adaptively managed through the Long-Term Monitoring Work Group, whose members include the Respondents, Response Agencies, their respective technical consultants, and other participating agencies. Using an adaptive management approach, information collected during the early stages of the monitoring program may be used to guide or improve the performance of later field tasks. Long-Term Monitoring Work Group meetings will provide a forum for the Respondents and Response Agencies to discuss monitoring progress, preliminary results, problems encountered, if any, and recommended modifications to field or analytical procedures.

3.1 Field Audits

Planning, scheduling, and conducting QA audits and surveillance are required to verify that site activities are being performed in conformance with approved plans, standards, federal and state regulatory requirements, sound scientific practices, and contractual requirements. Planned and scheduled audits may be performed to verify compliance with aspects of the QA program and to evaluate the effectiveness of the QA program. Audits include an

objective examination of work areas, activities, processes, review of documents and records, interviews with project personnel, and review of plans and standards.

Internal review of the sampling program will be conducted on a regular basis during the field activities. Reviewers will pay particular attention to the sampling program with respect to representativeness, comparability, and completeness of the specified measurements.

Field documentation (e.g., COC forms, field sampling forms, and logbooks) will be reviewed as it is generated, by the Field Supervisor or designee, for accuracy, completeness, and compliance with the requirements of this LTMP. The Field QAM, Project Manager, or Project Coordinator will audit field sampling procedures periodically for compliance with LTMP procedures. The auditor will check that the following procedures are being properly implemented:

- Sampling protocols are being followed.
- Samples are placed in appropriate containers.
- Samples are stored and transported properly.
- Field documentation is complete, accurate, and legible.

Internal field audits will be conducted by one of the individuals listed above at the beginning of each new field activity (i.e., fish sampling; water sampling) and during a significant crew change (i.e., replacement of Field Supervisor). Additional field audits may be conducted on an as-needed basis if potential data quality issues are identified by field staff or during senior review of field reports and field documentation.

In addition to internal field audits, the USEPA and WDNR oversight team may also conduct field audits. At least 15 days of notice shall be given to the WDNR and USEPA Project Coordinators prior to beginning sampling. If necessary, corrective action shall be performed as provided in Section 3.4 of this Plan.

3.2 Laboratory Audits

The Laboratory QAM may conduct internal system audits. An internal audit is a qualitative evaluation of all components of the laboratory QC measurement system. The audit serves to

determine whether measurement systems are being used appropriately. The system audits are conducted to evaluate the following:

1. Sample handling procedures
2. Calibration procedures
3. Analytical procedures
4. QC results
5. Safety procedures
6. Recordkeeping procedures
7. Timeliness of analysis and reporting

The Laboratory QAM will evaluate laboratory precision and accuracy by comparing results of duplicate samples, QC samples, spikes, and blanks. When a beyond-control limit situation is encountered, analytical results will be checked by the Laboratory Project Manager prior to distribution.

In addition, laboratories are subject to external audits. The focus of these audits is to assess general laboratory practices and conformance to the requirements of this LTMP. Laboratory audits may be performed by the Data QAM prior to the start of analyses for this project and at any time during the course of the project as deemed necessary.

External reviews of laboratory performance may also be conducted based on an evaluation of QC check samples analyzed as part of the USEPA and/or Wisconsin state certification requirements. In addition, performance audits may be conducted by sending double-blind performance evaluation samples (samples that are not discernable from routine field samples) to the analytical laboratory.

The USEPA and WDNR may also perform laboratory audits in addition to routine certification audits or performance evaluation sample results. Any discrepancies will be remedied as described in this Plan.

3.3 Corrective Actions

3.3.1 Field Corrective Action

Any project team member may initiate a field corrective action process. The corrective action process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the corrective action, verifying that the problem has been eliminated, and documenting the corrective action.

Corrective actions include correcting COC forms; correcting problems associated with sample collection, packaging, shipping, or field record keeping; or additional training in sampling and analysis. Additional approaches may include re-sampling or evaluating and amending sampling procedures. The Field Supervisor will summarize the problem, establish possible causes, and designate the person responsible for a corrective action. The Field Supervisor will verify that the initial action has been taken, that it appears to be effective, and then follow up at a later date to verify that the problem has been resolved.

Technical staff and field personnel will be responsible for reporting suspected technical or QA nonconformances or suspected deficiencies to the Field Supervisor. The Field Supervisor will assess suspected problems in consultation with the Project Coordinator, Project Manager, and/or Field QAM, as appropriate, and reach a coordinated decision based on the potential for the situation to impact data quality. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the Field Supervisor.

3.3.2 Stop Work Order

The Project Coordinator has the authority to stop work based on quality control, health and safety, or other serious deficiencies that may compromise the integrity of the Long-Term Monitoring Program or the safety of the field crew. The decision to stop work will be determined on a case-by-case basis in consultation with the Project Manager, Field QAM, Field Supervisor, and as appropriate, the WDNR Project Coordinator and USEPA Remedial Project Manager. Stop work decisions may also be made on the basis of hazardous field conditions by the Field Supervisor, Corporate H&S Manager, or the boat captain.

3.3.3 Laboratory Corrective Action

Corrective actions are required whenever an out-of-control event or potential out-of-control event is identified at the analytical laboratory during sample handling and preparation, instrument analysis, or data generation, or during the Respondent Team's oversight of these activities (see Tables 2-9 and 2-10). The investigative and corrective actions taken are somewhat dependent on the severity of the problem and its potential to adversely impact data quality. Corrective actions may be necessary if the following situations occur:

- QC data are outside control limits for precision and accuracy
- Blanks contain target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or RPDs between duplicates
- Unusual changes in detection limits occur
- Deficiencies are detected by the Laboratory QAM during internal or external audits or from results of performance evaluation samples

Corrective action procedures are often handled at the bench level by the analyst who reviews preparation or extraction procedures for possible errors, and checks instrument calibrations, spike and calibration mixes, and instrument sensitivity. If problems persist or cannot be identified, matters are referred to the Laboratory QAM or Laboratory Project Manager for further investigation. Full documentation of the corrective action procedures is filed with the Laboratory QAM after discussion with and approval by the Data QAM. If corrective actions are insufficient, the Project Coordinator or the Data QAM may issue a stop-work order. Corrective action may include the following:

- Re-analyzing the samples, if sample or extract volume is adequate and holding times have not lapsed
- Performance of additional cleanup steps
- Re-sampling and analyzing
- Evaluating and amending sampling or analytical procedures
- Accepting data and acknowledging a higher level of uncertainty

If re-sampling is deemed necessary due to laboratory problems, the Respondent Team's Project Coordinator and Project Manager will coordinate collection of additional sample

material, and if appropriate, pursue cost recovery from the laboratory for the additional sampling effort. If a proposed corrective action results in a significant change or modification to the procedures defined in this LTMP, review and approval by the WDNR and USEPA may be required prior to implementing the recommended procedural modifications.

3.4 Field Contingency Plans

3.4.1 Water Sampling Contingency Plan

It is possible severe weather conditions (e.g., ice, high winds, etc.) or other safety concerns will preclude water sampling at one or more locations during the monitoring year (April through November). Water sampling will be targeted for the first two weeks of each month. If severe weather or other difficult field conditions delay sampling, sampling will be performed as soon as possible during the month. If sampling cannot be completed at all during the month, the monthly sampling event will be lost.

The overall completeness goal for the water column sampling program is collection of valid water samples in at least 7 out of 8 monitoring months (see also Section 2.1.3). If this completeness goal is not met, the deficiency will be presented to the Long-Term Monitoring Work Group, and an appropriate corrective action will be determined. Corrective action may include:

- Acceptance of fewer than the required number of sampling events at certain stations for the monitoring year
- Assignment of two sampling events in one month to make up for the deficiency
- Extension of the monitoring program into the winter or the following spring

3.4.2 Fish Sampling Contingency Plan

It is possible that a sufficient number of appropriately sized fish may not be obtainable for all species and all OUs during the August 15 though September 15 sampling window. Figure 3-1 summarizes the steps that will be taken to optimize fish collection efforts, and a decision framework that will be followed to ensure that the most complete and representative fish data are obtained during each monitoring event.

At the outset of the sampling effort, two days will be allocated for fish collection at each station. Electrofishing will be the primary fishing method, as it was consistently productive for nearly all of the target species during the Baseline Monitoring Program. Trawling, seine netting, and rod-and-reel may also be used at the discretion of the Field Supervisor or Field Biologist. Recommended fishing areas, based on experience gained during the Baseline Monitoring Program, are shown on Figures 2-2 through 2-9. Fishing methods and locations may be modified as necessary to target the species and sizes needed at each station, and to adapt to field conditions and fish occurrence. All primary (walleye, carp, drum, gizzard shad) and secondary (bass) species within the Plan-specified size ranges (Table 2-3), as well as two inches shorter and two inches longer than the specified size ranges, will be collected and archived in the event that all target species and sizes are not obtainable.

The sampling crew will move to the next station as soon as the requisite species and sizes have been collected or after two days are spent at any station. During the Baseline Monitoring Program, a third fishing day was not generally productive. The sampling crew will complete the circuit of nine stations in this manner, with a maximum of two days at each station. If some stations still lack the full complement of target species and sizes, then a field contingency strategy will be implemented, as described below, to optimize follow-up sampling efforts.

1. *Resample Incomplete Stations.* Once the circuit of nine fishing stations has been completed, the sampling crew will circle back and resample any stations where additional species or sizes are needed, on the premise that it may be helpful to let the water "rest" for a few weeks, especially during the transition from summer to fall. An additional one to two days will be allocated to any incomplete stations. Different fishing techniques may need to be tried. If necessary, the fishing season may be extended as late as October 15.
2. *Expand Target Size Ranges.* If all sizes and species have not been collected after the second attempt, the target size ranges will be expanded plus or minus two inches to achieve the *requisite* numbers of fish to prepare the individual and composite samples.
3. *Reduce Sample Sizes.* If the requisite numbers of fish cannot be achieved even after expanding the target size ranges, then fewer fish will be analyzed for human

health species, and fewer fish will be used to prepare the composite samples for ecological species. Sampling will be considered complete if each fishing station contains at least eight walleye (or bass), at least five carp or drum, and at least 5 composites of 3 gizzard shad each (i.e., at least 15 gizzard shad).

4. *Use Alternate Species.* If there are still insufficient numbers of target fish species, consideration will be given to the use of alternate species, especially if alternate species were collected and archived during sampling. Bass is the alternate species for walleye; drum is the alternate species for carp in the Lower Fox River, and carp is the alternate species for drum in Green Bay. If an alternate species is needed to replace gizzard shad, it would be an opportunistic decision at the time of sampling based on the availability of another small, young-of-year species (e.g., emerald shiner, walleye fingerlings, etc.).

4 DATA VALIDATION AND DATA ANALYSIS

Data validation is the process by which data generated in support of this project are evaluated according to the QA/QC requirements of this LTMP. The data are evaluated for precision and accuracy against analytical protocol requirements. Nonconformance or deficiencies that could affect the precision or accuracy of the reported result are identified and noted. The effect on the result is then considered when assessing whether the result is sufficient to achieve project DQOs.

4.1 Data Review and Validation

The data validation process is conducted to assess the effect of the overall sampling and analysis process on the usability of the data. There are two areas of review: laboratory performance evaluation, and the effect of matrix and sampling interference. Evaluation of laboratory performance is a check for compliance with the method requirements and is a straightforward examination: the laboratory either did or did not analyze the samples within the QC limits of the analytical method and according to protocol requirements. For this project, holding time exceedances for PCBs will be qualified, rather than invalidated. The assessment of potential matrix and sampling effects consists of a QC evaluation of the sample analytical results as well as the results of blank, duplicate, and matrix spike samples; and assessing whether, or how much, the usability of the data could be affected.

All analytical data will be provided in a data package with supporting QC information (see Section 2.7.3 for laboratory deliverable requirements). Before the laboratory releases each data package, the Laboratory QAM will carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

4.1.1 Field Screening Data

Field screening data include measurements of water temperature and turbidity, fish length and weight. These data will be validated by checking the completeness and accuracy of field measurements, field documentation, and location control. The calibration records for the water probe will be reviewed for accuracy, completeness, and adherence to the calibration schedule.

4.1.2 Data Validation and Verification

One hundred percent of the PCB laboratory data will undergo a forms review by the laboratory consistent with the procedures specified in this LTMP. A minimum of ten percent of the PCB data will undergo third-party data validation using USEPA's Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999) and USEPA's Contract Laboratory Program National Functional Guidelines for Inorganic Review (USEPA, 2002b) (the "National Functional Guidelines"). This is consistent with USEPA Region 5 QAPP guidance (USEPA, 2000a) which cites the National Functional Guidelines as appropriate for use in data validation at Superfund sites in this region. Third-party data validation will start at ten percent unless problems are encountered that warrant increasing data validation requirements. One-hundred percent of the data from the first week of sampling will undergo validation early in the project to ensure adherence to protocols. This initial validation effort will allow for the early implementation of any corrective actions, if needed. This initial effort will be counted towards the overall 10 percent data validation requirement.

Forms Review. One hundred percent of the laboratory data collected during the Long-Term Monitoring Program will undergo a forms review by the laboratory prior to submitting the results to the Data QAM and subsequently to the Data Validator. The data package supplied by the laboratory will be validated through the forms review process for compliance with the following:

- Holding times and sample temperature
- Surrogate recovery
- MS/MSD precision and accuracy
- LCS precision and accuracy
- Initial calibration and continuing calibration precision and accuracy
- Instrument tuning criteria (where applicable)
- Blank contamination
- Field duplicate precision and accuracy

The QA criteria to be implemented during the forms review process are presented in Table 2-9 and Table 2-10.

Data Validation. The laboratory data packages will be sent directly to the Data QAM by the subcontract laboratories. The Data QAM will select 10 percent of the data to be validated by an independent, third-party Validation Subcontractor. The Data QAM will provide the Validation Subcontractor with copies of the selected data packages. Once validated, the Validation Subcontractor will make copies of the data validation report as well as the summary forms and submit them to the Data QAM, then they will be forwarded to the USEPA Project Manager, and the WDNR Project Coordinator. The acceptance criteria for data validation are those listed in Table 2-9 and Table 2-10 of this Plan. The QC requirements specified in this Plan shall take precedence over the requirements of the National Functional Guidelines.

Data validation is at times based upon professional judgment. In order to achieve consistent data validation, data worksheets will be completed for each data validation effort. A data review worksheet is a summary form on which the data validator records data validation notes and conclusions specific to each analytical method. The worksheets will help the validator track and summarize the overall quality of the data. Sample results will then be assigned a degree of usability based upon the overall data quality. The Consultant Team will review the data validation results and assess how the data, as qualified by the data validation process, can be used to fulfill project objectives, i.e. to evaluate progress toward achieving RAOs in the Lower Fox River and Green Bay.

Data Verification. After validation, the data will be compiled in an electronic database and the data will be verified to confirm:

- The correct samples were analyzed and the correct parameters were reported
- EDDs and hard copy data deliverables are consistent
- Results are consistent with expectations based on Baseline Monitoring results or the results of previous Long-Term Monitoring events.

In the first two instances, the laboratory will be directed to correct any omissions or inconsistencies in reporting. If the data obtained from the laboratories are not consistent with expectations, based on prior sampling data, a more in-depth evaluation of the results will be performed to determine if the deviation is a real environmental phenomenon or an artifact of the sampling and analysis process.

Project-Specific Qualifiers. While maintaining consistency with the National Functional Guidelines, the Region 5 QAPP guidance also allows for the definition of additional project-specific data qualifiers. For this program, a project-specific data qualifier may be developed for water monitoring results analyzed by EPA Method 1668A with too-few congener detections. The specific procedures for data qualification in these circumstances will be developed in the LTMP Work Group, as discussed in Section 4.2.1.2.

4.1.3 Reconciliation with Data Quality Objectives

The goal of the data collection effort is to acquire enough information and data to verify that sediment remedial actions in the Lower Fox River result in substantive reductions in water column and fish tissue PCB concentrations and loads. Field and laboratory data will be evaluated in accordance with the DQOs established in Section 1.7. Progress toward achieving RAOs will be evaluated using the data analysis methods and statistical procedures described in Section 4.2 below. Determining whether the data are sufficient to achieve project objectives will be the collective responsibility of the Respondents and the Consultant Team, the Response Agencies and the Oversight Team, and members of the Long-Term Monitoring Work Group.

4.2 Data Analysis

4.2.1 PCB Summation

In water samples, total PCBs will be summed using zero for congeners undetected at the estimated detection limit (EDL). In tissue samples, total PCBs will be summed using zero for Aroclors undetected at the method detection limit (MDL). Estimate (J-flagged) values between the EDL/MDL and the reporting limit will be included in the summation.

4.2.1.1 Aroclors versus Congeners

It should be noted that total PCBs which are summed using congener data are not generally comparable to total PCBs which are summed using Aroclors. These different analytical techniques and quantitation methods respond differently to matrix interference, PCB weathering, and instrument sensitivity. Therefore,

comparing water quality data which is reported as PCB congeners, as specified in this Plan, with historical data reported as PCB Aroclors is problematic, unless the bias between the two different analytical methods is adequately understood. As a result, historical data prior to the Baseline Monitoring event will generally not be used to assess time trends in water quality.

4.2.1.2 Minimum Detected Congeners

Based on an evaluation of the PCB congener compositions in the OUs and monitoring months with the highest PCB concentrations, it was determined that the top 20 to 25 congeners contributed 80 percent of the total PCB mass (see Section 1.7.7.2). Based on this evaluation, the goal for the Long-Term Monitoring Program is to detect and quantify 25 congeners in each sample. With this level of detection, a majority of the PCB mass will be positively quantified. Detections of fewer numbers of congeners may tend to bias results low because a larger fraction of the PCB mass would be undetected or "censored". In addition, highly contaminated samples should be diluted such that 25 individual congeners continue to be detected in the diluted sample.

A review of the water data from the Baseline Monitoring Program shows EPA Method 1668A is sufficiently sensitive to meet the objectives of Long-Term Monitoring Program, at least during the initial monitoring rounds. During the warm-weather months from April to November, between 49 and 132 congeners were detected in water samples from the Lower Fox River; 33 to 99 congeners were detected in water samples from Green Bay; and 31 to 61 congeners were detected in Lake Winnebago (all statistics based on blank-corrected data). Good detection frequencies were achieved for total PCB concentrations as low as 0.1 ng/L. This level of quantitation exceeds the expectations of the Baseline Monitoring Plan, which predicted good quantitations down to about 1 ng/L.

In summary, data collected during the Baseline Monitoring Program indicates high-quality data should be obtained during the initial long-term monitoring rounds using EPA Method 1668A. However, given the order of magnitude reductions in PCB concentrations which are predicted to occur in the decades following the

remedial action, the sensitivity of the PCB analytical methods may need to be evaluated at some point in the future of the Program. If fewer than 25 congeners are detected in some samples (after blank correction), the Long-Term Monitoring Work Group will convene to determine whether some type of corrective action is warranted to improve the estimate of Total PCBs. Possible corrective actions may include:

- Qualify the PCB summation as "estimated" and report the number of detected congeners that contribute to the total value
- Develop a correction factor to account for undetected PCB mass in the "censored" part of the data
- Modify the field and/or analytical procedures in an attempt to achieve lower detection limits

4.2.2 Blank Correction for PCB Congeners

The lowest PCB congener concentrations in water samples from the Baseline Monitoring Program were found in the upstream reference area (Lake Winnebago) and in the middle of Green Bay. At times, the concentrations in these areas approach the sensitivity of the high-resolution GC/MS 1668A method, as well as ambient background levels of PCB contamination in the global atmosphere, and following the sediment remedial action, concentrations are expected to decline further. As a result, blank correction of the PCB congener data must be carefully performed, especially in OUs with background or near-background concentrations.

During the Baseline Monitoring Program, blank correction was evaluated using three different correction procedures: (1) standard method following National Functional Guidelines (in which congener concentrations less than five times the method blank concentrations are corrected to nondetect), and (2) blank subtraction method of Ferrario et al. 1997, also referenced in Section 17.6.1.4.4 of EPA Method 1668A (in which blank correction is based on the mean plus two standard deviations of the method blank data set during the period of analysis) (3) a nonparametric modification of Ferrario et al. 1997 subtraction method (in which blank correction is based on the 95th percentile of the method blank data). In discussions of the Long-Term Monitoring Work Group, the Ferrario method was determined to be superior to the standard method because the

standard method resulted in too few congener detections and fragmented and unrealistic congener fingerprints after blank correction.

The Ferrario method is described in Section 17.6.1.4.4 of EPA Method 1668A:

> "Blank corrected results may be reported in addition to reporting of separate results for samples and blanks. The recommended procedure for blank correction is that a result is significantly above the blank level, and the level in the blank may be subtracted, if the result is greater than the mean plus 2 standard deviations of results of analyses of 10 or more blanks for a sample medium."

The Long-Term Monitoring Work Group further decided that a nonparametric modification of the Ferrario method was appropriate due to concerns regarding treatment of censored values (i.e., non-detects) in the method blank data set, and the determination of means and standard deviations from censored data. As a result, the Long-Term Monitoring Work Group decided to blank correct using the 95th percentile of the method blank data, rather than the mean plus two standard deviations. The percentile approach provides an equivalent level of statistical certainty but is unaffected by high percentages of undetected values in the method blank data set. The Ferrario method and the nonparametric modification of the Ferrario method showed very little difference in terms of blank-corrected Total PCB concentrations in the baseline data set (typically less than a few percent RPD between the two calculations).

The blank correction procedures to be used in the Long-Term Monitoring Program will be the nonparametric modification of the Ferrario subtraction method. The procedure for nonparametric blank subtraction is described below:

1. Compile laboratory method blank data for EPA 1668A during the period of laboratory analysis corresponding to the eight month monitoring period (April through November), plus three months before and three months after the monitoring period
2. Prepare a time-series graph of the method blank data to determine whether there are any significant trends in blank concentrations, especially abrupt changes in blank concentrations that may be traceable to a change in laboratory procedure or equipment

3. Determine whether there were any changes in chromatographic columns during the period of analysis, and ascertain the exact date of column replacement
4. The method blank data set, and the associated statistical calculations and blank subtraction terms, must be calculated separately for any analysis periods in which different chromatographic columns were used, and for periods in which procedural modifications had a significant effect on method blank results, as per items (2) and (3) above
5. It is preferable to have at least ten to twenty method blank results in every analysis period for which blank subtraction terms are being calculated. If there are fewer than twenty results, two options are available: (a) use the maximum blank concentration in the data set as the blank subtraction term, or (b) consider pooling together some of the analysis periods, if appropriate, to provide more blank results in each period.
6. For each analysis period, calculate the 95th percentile concentration of the method blank data: [k=0.95(n+1)] where k is the rank of the sample corresponding to the 95th percentile concentration, and n is the number of method blank samples in the analysis period. Fractional, non-integer ranks will be interpolated between the two closest data points. The 95th percentile method blank concentrations become the blank subtraction terms.
7. Subtract the 95th percentile method blank concentrations from the raw PCB concentrations for all samples analyzed during the corresponding period. The resultant values are the blank-corrected PCB concentrations. If the sample congener concentration is less than the corresponding 95th percentile blank values, the congener will be corrected to an undetected value. Undetected congeners will not contribute to the summation of Total PCB concentrations.
8. Blank-corrected Total PCB concentrations will be used in the statistical analyses described in the following section, unless otherwise specified.

4.2.3 Statistical Analysis of Monitoring Data

Water and fish tissue data will be statistically analyzed to assess the performance of the monitoring program and the more fundamental objective of monitoring progress toward achieving the RAOs. Descriptive statistics, distribution tests, and correlation tests will be performed using long-term monitoring data, as described in this section.

Post-remediation monitoring data will be used in time trend analysis of water and fish tissue (see Section 4.2.3.4). In general, time trend analysis during the post-construction period will be performed by comparing mean values between successive monitoring events (i.e., two-sample comparisons) and by using simple or multiple regression techniques.

4.2.3.1 Descriptive Statistics

For each round of long-term monitoring, descriptive statistics will be calculated for each OU and each fish species. Descriptive statistics will include mean, median, minimum and maximum, 10th, 25th, 50th, 75th, and 90th percentiles, percent nondetects, standard deviation and coefficient of variation (CV). These statistics will be used to verify the assumptions underlying the sampling design and to confirm that the expected level of statistical power is being achieved.

4.2.3.2 Statistical Distribution Tests

Water and fish data will be subjected to statistical distribution tests to assess conformance with standard normal or lognormal distributions. Conformance with these distributions will allow the data to be analyzed using more powerful parametric testing procedures. Distribution testing will utilize either numerical procedures (i.e., Shapiro-Wilk or D'Agostino Tests) or graphical procedures (i.e., normal probability plots).

4.2.3.3 Correlations and Controlling Variables

The data will be tested for statistical correlations between PCB concentrations and potential controlling variables. In particular, aqueous PCB concentrations will be tested for correlations with flow, temperature, and TSS concentrations. Fish tissue PCB concentrations will be tested for correlations with fish length (a surrogate for fish age and the primary basis for fish consumption advisories) and lipid content.

4.2.3.4 Trend Analysis

A primary objective of the baseline and long-term monitoring programs is to evaluate risk reduction success as measured by declining PCB concentrations in

water and fish tissue. The essence of this analysis is determining the significance and magnitude of trends in the monitoring data. Statistical testing of the difference between monitored site concentrations and background concentrations will be an alternate means of demonstrating risk reduction success (i.e., concentrations not significantly different from background).

Comparison of Means. A simple test of significance is a comparison of mean PCB values between two monitoring events to determine if the mean value of the later event is significantly lower than the earlier event. If a decreasing trend is present, the power of this type of test will tend to increase as the time between monitoring events increases (i.e., the length of the monitoring record increases). Using this type of analysis, the estimated percent reduction and statistical significance of PCB concentration reductions between the baseline and each successive monitoring event can be calculated. The results will be used to infer the magnitude and statistical significance of the combined effects of active remediation and natural recovery on reducing PCB concentrations.

The same test can also be used to compare site concentrations in the Lower Fox River and Green Bay with background concentrations unaffected by site-related contamination. Because of its upstream location, Lake Winnebago is a suitable background reference area for characterizing regional water quality and fish quality. Also, samples collected in central Green Bay (OU 5B for fish and OU 5C for water) are increasingly influenced by background contributions from Lake Michigan, with diminishing effects from the Lower Fox River. It is possible that future PCB concentrations in the river and bay will approach background levels, after the effects of the remedial action and natural recovery are more fully realized, and this test will indicate when the difference between site contamination and ambient regional background contamination is no longer statistically significant.

Simple Linear Regression. The data will be analyzed to determine an appropriate trend model. The default assumption is that PCB reductions will follow an exponential decay model. This model can be tested by fitting a linear regression through a plot of log PCB concentrations (in water or tissue) versus time. Multiple rounds of post-

construction monitoring will be needed to estimate the time rate of recovery in this way. Once the data are sufficient to estimate a model of PCB concentrations over time, the model can be used to predict future concentrations and compare predictions to remedial action targets. Time regressions will be performed separately for each OU and each fish species. For fish data, it may be appropriate to either stratify the data by size classes, or normalize the data using lipid content or fish length, to reduce the effects of confounding variables. Nonparametric trend analysis may be considered if the data are poorly described by standard statistical distributions.

Multiple Regression. If warranted, more complex, multivariate statistical analysis procedures may be considered. In particular, multiple regression techniques may be useful if significant correlations are established with multiple controlling variables (LTI, 2002; 2005).

Multiple linear regression provides a way to estimate the effects of an independent variable on water column PCB concentrations, such as the effect of sediment remediation, while controlling for the effects of other variables known to affect PCBs, such as flow, suspended solids, and seasonal temperature changes. At a minimum, baseline data and data from at least one post-remediation sampling round are necessary to estimate the effects of the remedial action. These data would be pooled to estimate the coefficients of an equation predicting PCB concentrations as a function of the independent variables mentioned above. Another independent variable would be a digital indicator to denote post-remediation conditions, equal to 0 for the baseline data and 1 for post-remediation data. The regression coefficient for this indicator would provide an estimate of the effect of remediation, after controlling for the effects of the other variables. A test of the hypothesis of "no effect of remediation" could be structured as a t-test of the null hypothesis that this coefficient is equal to zero.

A finding of a "significant effect" requires rejection of the null hypothesis at a given level of statistical confidence (i.e. probability of Type I error, which is the rejection of the hypothesis if it is true). The smaller the prediction error of the regression

equation and the larger the number of data points in the monitoring program, the more accurately the effect of remediation can be estimated, thereby expanding the range of scenarios that can be judged "significantly different from zero". Similarly, smaller prediction errors and larger sample sizes also reduce the likelihood of accepting a null hypothesis of "no effect" if it is false, increasing the statistical power of the test.

Variations in the specification of the regression equation can be made, depending on what variables are known to affect PCB concentration and whether their effects are linear, nonlinear, or interactive. One important variation which is a commonly observed relationship in environmental data assumes the natural logarithm of PCB concentration is a linear function of its determinants. The inclusion of variables and their functional forms should be dictated by scientific understanding of cause and effect relationships, supplemented by comparisons of goodness-of-fit of alternative forms of the equation. Variables should be retained in the regression equation if the hypothesis of "no effect" for each independent variable can be rejected at a high level of significance.

4.2.3.5 PCB Loading Calculations

One of the RAOs for the remedial action is to achieve a reduction of PCB loadings to Green Bay to accelerate natural recovery of bay sediments. To address this objective, PCB loads will be calculated at the mouth of the Lower Fox River at the USGS Oil Depot gage. PCB loads will also be calculated at several upstream reference locations to monitor the natural recovery of the river system as a whole in response to sediment remedial actions in various parts of the river. Specifically, PCB loads will be calculated at the downstream ends of the following reaches:

- Lake Winnebago (background loading to Lower Fox River)
- OU 1
- OU 2
- OU 4 (discharge to Green Bay)

Loadings will be estimated using Beale's ratio estimator method. The Beale's method uses daily flow measurements and less frequent concentration measurements to estimate the average daily load. This estimate is computed as the average of loads for all days that both flow and concentration are measured, with a bias correction that accounts for higher- or lower-than average flows on the days when concentration was sampled. Richards (1999) provides formulas for the estimate of the average daily load and its root mean squared error (RMSE). Daily gaged flows are available at Rapide Croche, and can be scaled according to watershed area ratios to estimate daily flows at the four stations for which loads are to be estimated.

Analysis of baseline monitoring data (LimnoTech 2008) indicates the aggregate PCB load discharged in the winter months from December through March contributes less than 10% of total annual load in the river, although these months represent one-third of the year. This study also showed that stratifying the data into the non-winter months from April through November provided more accurate loading estimates and lower RMSEs compared to loading estimates calculated over the entire year. Because only a small fraction of the PCB load is missed in the winter months, because the error on the loading estimate increases when winter months are included, and because field crews often face severe weather safety hazards during these months, winter sampling from December through March will be suspended for the Long Term Monitoring Program. Therefore, long-term assessments of PCB loads, time trends, baseline comparisons, and background comparisons, will be based on the eight-month monitoring period from April through November. Baseline monitoring data will be truncated accordingly to conform to this monitoring period. If necessary, total annual PCB loads can also be estimated based on the proportion of the annual load that is discharged from December through March, as observed during the Baseline Monitoring Program.

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TABLES

Table 1-1
Water Quality Summary Statistics (Total PCBs in ng/L)

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B	OU5C	ALL
Whole Year (12 months)											
Count (No. Samples)	11	12	12	10	12	12	12	24	20	20	145
No. Nondetects	1	0	0	0	0	0	0	0	0	0	0
Percent Nondetects	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mean	0.19	3.98	3.83	4.77	4.48	5.34	27.97	1.97	1.03	0.37	4.64
Median	0.13	2.50	2.76	4.24	2.69	4.17	15.07	1.59	0.67	0.31	1.38
Minimum	0.00	0.16	0.13	0.23	0.24	0.32	1.72	0.85	0.41	0.15	0.00
Maximum	0.80	10.77	11.59	12.54	14.51	14.88	81.74	3.72	3.26	1.02	81.74
10th Percentile	0.03	0.17	0.19	0.92	0.61	0.67	2.05	1.12	0.43	0.16	0.17
25th Percentile	0.09	0.51	0.50	1.94	0.94	1.28	6.63	1.35	0.52	0.19	0.44
50th Percentile	0.13	2.50	2.76	4.24	2.69	4.17	15.07	1.59	0.67	0.31	1.38
75th Percentile	0.19	6.27	6.03	7.10	6.59	8.08	46.98	2.70	0.99	0.43	3.68
90th Percentile	0.28	9.97	10.20	7.98	10.29	11.09	60.54	3.05	2.01	0.68	10.60
Standard Deviation	0.22	4.03	4.00	3.78	4.53	4.77	27.15	0.87	0.87	0.23	10.76
Coefficient of Variation	1.18	1.01	1.04	0.79	1.01	0.89	0.97	0.44	0.84	0.64	2.32
Warm Weather (April through November)											
Count (No. Samples)	8	8	8	8	8	8	8	16	16	16	104
No. Nondetects	0	0	0	0	0	0	0	0	0	0	0
Percent Nondetects	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mean	0.24	5.82	5.61	5.81	6.38	7.59	40.12	2.36	1.13	0.42	6.11
Median	0.15	5.16	4.72	5.73	5.28	7.72	41.03	2.48	0.77	0.33	2.14
Minimum	0.08	1.38	1.53	1.89	1.93	2.24	10.99	1.35	0.41	0.15	0.08
Maximum	0.80	10.77	11.59	12.54	14.51	14.88	81.74	3.72	3.26	1.02	81.74
10th Percentile	0.10	1.80	1.99	2.03	1.93	2.28	11.50	1.45	0.43	0.19	0.28
25th Percentile	0.10	2.76	3.04	3.36	3.07	5.11	16.74	1.59	0.52	0.27	0.63
50th Percentile	0.15	5.16	4.72	5.73	5.28	7.72	41.03	2.48	0.77	0.33	2.14
75th Percentile	0.23	9.30	7.31	7.28	8.75	9.18	56.44	2.92	1.28	0.56	6.10
90th Percentile	0.43	10.29	10.93	8.99	11.72	12.43	67.34	3.37	2.56	0.69	11.53
Standard Deviation	0.24	3.71	3.78	3.49	4.45	4.27	25.47	0.81	0.94	0.24	12.39
Coefficient of Variation	1.01	0.64	0.67	0.60	0.70	0.56	0.63	0.34	0.83	0.57	2.03

Table 1-2
Descriptive Summary Statistics for Fish Tissue Data

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B	ALL
Walleye (Total PCBs in µg/kg)										
Count (No. Samples)	17	16	18	16	16	15	16	15	16	145
No. Nondetects	8	0	0	1	0	0	0	0	0	9
Percent Nondetects	47%	0%	0%	6%	0%	0%	0%	0%	0%	6%
Mean	24	135	317	144	579	677	671	494	296	365
Median	20	140	300	130	380	450	575	400	290	280
Minimum	19	21	97	21	130	250	240	180	160	19
Maximum	36	340	800	480	1,800	2,000	1,400	1,300	450	2,000
10th Percentile	19	45	128	84	195	284	330	274	180	27
25th Percentile	19	68	175	106	238	325	453	355	225	130
50th Percentile	20	140	300	130	380	450	575	400	290	280
75th Percentile	24	165	388	150	703	860	800	525	363	460
90th Percentile	34	225	482	170	1,350	1,360	1,135	772	415	784
Standard Deviation	6	84	175	97	503	524	336	277	93	363
Coefficient of Variation	0.26	0.62	0.55	0.68	0.87	0.77	0.50	0.56	0.31	1.00
Bass (Total PCBs in µg/kg)										
Count (No. Samples)	15	15	16	15	16	15	19	8	19	138
No. Nondetects	6	0	0	0	0	0	0	0	0	0
Percent Nondetects	40%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mean	29.6	212	255	208	187	197	442	319	360	250
Median	20	160	200	210	140	190	400	320	320	210
Minimum	19	20	96	110	71	66	140	150	19	19
Maximum	70	540	530	320	470	370	950	460	1,200	1,200
10th Percentile	19	53	120	124	76	107	194	199	53	27
25th Percentile	19	89	140	160	79	150	325	235	180	110
50th Percentile	20	160	200	210	140	190	400	320	320	210
75th Percentile	27	335	310	260	285	225	460	405	515	360
90th Percentile	59	394	480	272	345	304	754	453	592	470
Standard Deviation	17	156	143	63	128	81	221	117	281	196
Coefficient of Variation	0.58	0.74	0.56	0.30	0.68	0.41	0.50	0.37	0.78	0.78
Carp (Total PCBs in µg/kg)										
Count (No. Samples)	6	6	5	5	6	6	6	6	5	51
No. Nondetects	0	0	0	0	0	0	0	0	0	0
Percent Nondetects	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mean	36	1,917	4,120	1,200	988	972	4,600	780	337	1,648
Median	36	1,750	2,400	1,200	930	970	4,600	805	240	1,000
Minimum	28	300	2,100	800	670	590	2,800	480	72	28
Maximum	46	3,600	11,000	1,500	1,500	1,600	6,400	980	950	11,000
10th Percentile	29	900	2,140	920	685	595	3,100	600	73	46
25th Percentile	31	1,525	2,200	1,100	740	685	3,575	723	74	595
50th Percentile	36	1,750	2,400	1,200	930	970	4,600	805	240	1,000
75th Percentile	38	2,425	2,900	1,400	1,150	1,075	5,625	888	350	2,000
90th Percentile	42	3,100	7,760	1,460	1,350	1,350	6,100	935	710	3,600
Standard Deviation	7	1,113	3,858	274	319	373	1,404	178	362	1,981
Coefficient of Variation	0.18	0.58	0.94	0.23	0.32	0.38	0.31	0.23	1.07	1.20

Table 1-2
Descriptive Summary Statistics for Fish Tissue Data

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B	ALL
Drum (Total PCBs in µg/kg)										
Count (No. Samples)	6	6	5	5	5	5	6	6	5	49
No. Nondetects	0	0	0	0	0	0	0	0	0	0
Percent Nondetects	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mean	175	450	1,268	728	1,082	1,292	1,347	1,392	1,490	1,010
Median	170	445	1,100	580	1,100	1,400	1,250	1,450	1,300	940
Minimum	110	160	770	310	590	460	740	950	750	110
Maximum	250	650	2,300	1,300	1,700	2,000	2,300	1,700	2,100	2,300
10th Percentile	130	265	810	406	602	516	840	1,075	930	196
25th Percentile	153	383	870	550	620	600	955	1,250	1,200	550
50th Percentile	170	445	1,100	580	1,100	1,400	1,250	1,450	1,300	940
75th Percentile	195	590	1,300	900	1,400	2,000	1,575	1,575	2,100	1,400
90th Percentile	225	640	1,900	1,140	1,580	2,000	1,950	1,650	2,100	2,000
Standard Deviation	47.6	181.2	612.5	382.5	484.5	739.1	574.5	276.4	594.1	625.1
Coefficient of Variation	0.27	0.40	0.48	0.53	0.45	0.57	0.43	0.20	0.40	0.62
Gizzard Shad (Total PCBs in µg/kg)										
Count (No. Samples)	6	2	3	7	5	6	6	6	6	47
No. Nondetects	1	0	0	0	1	0	0	0	0	2
Percent Nondetects	17%	0%	0%	0%	20%	0%	0%	0%	0%	4%
Mean	25	895	343	102	114	427	938	325	283	342
Median	26	895	300	98	100	400	845	335	285	250
Minimum	19	790	180	89	19	190	250	260	230	19
Maximum	33	1,000	550	130	190	870	1,800	360	350	1,800
10th Percentile	20	811	204	90	47	195	420	285	235	28
25th Percentile	21	843	240	92	90	243	630	313	250	99
50th Percentile	26	895	300	98	100	400	845	335	285	250
75th Percentile	28	948	425	105	170	483	1,210	350	305	365
90th Percentile	31	979	500	118	182	685	1,550	355	330	822
Standard Deviation	5.4	148.5	188.8	14.4	68.4	250.0	548.4	37.3	44.6	361.9
Coefficient of Variation	0.21	0.17	0.55	0.14	0.60	0.59	0.58	0.11	0.16	1.06

Table 1-3
Fish Consumption Advisories

Species	OU1 to OU3	OU4	Southern Green Bay
Brown trout	---	---	12 meals/year to DNE; size dependent
Black Crappie	---	12 meals/year	---
Bluegill	---	12 meals/year	---
Carp	DNE	DNE	DNE
Channel Catfish	---	DNE	6 meals/year; size dependant
Chinook Salmon	---	---	6 to 12 meals/year; size dependent
Northern Pike	12 meals/year	6 to 12 meals/year; size dependant	12 meals/year; size dependent
Rainbow Trout	---	---	12 meals/year
Rock Bass	---	12 meals/year	---
Sheepshead	---	6 to 12 meals/year to DNE; size dependent	12 meals/year
Smallmouth Bass	12 meals/year	12 meals/year	12 meals/year
Splake	---	---	6 to 12 meals/year to DNE; size dependent
Sturgeon	---	---	DNE
Walleye	12 meals/year	6 to 12 meals/year to DNE; size dependent	6 to 12 meals/year to DNE; size dependent
White Bass	12 meals/year	DNE	DNE
White Perch	12 meals/year	6 meals/year	6 meals/year
White Sucker	---	6 meals/year	12 meals/year
Whitefish	---	---	6 meals/year
Yellow Perch	12 meals/year	12 meals/year	52 meals/year

Notes:
DNE = Do Not Eat

Table 1-4
Statistical Distribution Test Results – Water

Normal Goodness-of-Fit Test (Probability Plot Regression)

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B	OU5C
Year-round (12 months)	NON-PARA 0.658	(NORMAL) 0.871	(NORMAL) 0.864	NORMAL 0.929	(NORMAL) 0.863	NORMAL 0.904	(NORMAL) 0.886	NORMAL 0.902	NON-PARA 0.691	(NORMAL) 0.835
Warm Weather (Apr - Nov)	NON-PARA 0.640	NORMAL 0.929	NORMAL 0.904	NORMAL 0.918	NORMAL 0.924	NORMAL 0.950	NORMAL 0.952	NORMAL 0.926	NON-PARA 0.746	(NORMAL) 0.876

Normal Test Results (12 Months)	
3	NORMAL
5	NEAR NORMAL
2	NONPARAMETRIC

Normal Test Results (8 months)	
7	NORMAL
1	NEAR NORMAL
2	NONPARAMETRIC

Lognormal Goodness-of-Fit Test (Probability Plot Regression)

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B	OU5C
Year-round (12 months)	NON-PARA 0.768	LOGNORM 0.905	LOGNORM 0.920	LOGNORM 0.901	LOGNORM 0.976	LOGNORM 0.941	LOGNORM 0.940	LOGNORM 0.951	(LOGNORM) 0.877	LOGNORM 0.943
Warm Weather (Apr - Nov)	(LOGNORM) 0.887	LOGNORM 0.938	LOGNORM 0.966	LOGNORM 0.947	LOGNORM 0.965	(LOGNORM) 0.889	(LOGNORM) 0.920	LOGNORM 0.925	LOGNORM 0.900	LOGNORM 0.970

Lognormal Test Results (12 Months)	
8	LOGNORMAL
1	NEAR LOGNORMAL
1	NONPARAMETRIC

Lognormal Test Results (8 months)	
8	LOGNORMAL
2	NEAR LOGNORMAL
0	NONPARAMETRIC

Notes:

R^2 value provided below each distribution determination

NORMAL or LOGNORMAL = R^2 value greater than 0.9

(NORMAL) or (LOGNORMAL) = R^2 value greater than 0.8 and less than 0.9

NON-PARA = R^2 value less than 0.8 = nonparametric

Table 1-5.
Statistical Distribution Testing of Fish Tissue Concentrations

Normal Goodness-of-Fit Test (Probability Plot Regression)

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B
Walleye	NORMAL 0.93	NORMAL 0.92	NORMAL 0.91	*NORMAL 0.91*	(NORMAL) 0.80	NON-PARA 0.78	NORMAL 0.92	*NORMAL 0.93*	NORMAL 0.97
Bass	NON-PARA 0.66	NORMAL 0.94	(NORMAL) 0.88	NORMAL 0.97	(NORMAL) 0.86	NORMAL 0.96	(NORMAL) 0.87	NORMAL 0.92	(NORMAL) 0.88
Carp	NORMAL 0.92	NORMAL 0.96	*Small Sample*	NORMAL 0.97	NORMAL 0.94	NORMAL 0.91	NORMAL 0.98	NORMAL 0.92	(NORMAL) 0.80
Drum	NORMAL 0.98	NORMAL 0.94	(NORMAL) 0.83	NORMAL 0.94	NORMAL 0.94	(NORMAL) 0.88	NORMAL 0.92	NORMAL 0.96	NORMAL 0.90
Gizzard Shad	NORMAL 0.95	*Small Sample*	*Small Sample*	(NORMAL) 0.84	NORMAL 0.95	(NORMAL) 0.88	NORMAL 0.98	(NORMAL) 0.88	NORMAL 0.97

Normal Test Results
29 NORMAL
11 NEAR NORMAL
1 NONPARAMETRIC

Lognormal Goodness-of-Fit Test (Probability Plot Regression)

	LWB	OU1	OU2A	OU2B	OU2C	OU3	OU4	OU5A	OU5B
Walleye	NORMAL 0.93	LOGNORM 0.94	LOGNORM 0.97	NON-PARA 0.78	LOGNORM 0.96	LOGNORM 0.91	LOGNORM 0.99	LOGNORM 0.96	LOGNORM 0.95
Bass	NON-PARA 0.73	LOGNORM 0.96	LOGNORM 0.96	LOGNORM 0.94	LOGNORM 0.90	LOGNORM 0.95	LOGNORM 0.95	LOGNORM 0.92	(LOGNORM) 0.87
Carp	LOGNORM 0.93	(LOGNORM) 0.82	*Small Sample*	LOGNORM 0.93	LOGNORM 0.97	LOGNORM 0.93	LOGNORM 0.97	(LOGNORM) 0.87	LOGNORM 0.93
Drum	LOGNORM 0.98	(LOGNORM) 0.85	LOGNORM 0.92	LOGNORM 0.97	LOGNORM 0.92	(LOGNORM) 0.87	LOGNORM 0.96	LOGNORM 0.92	LOGNORM 0.91
Gizzard Shad	LOGNORM 0.95	*Small Sample*	*Small Sample*	(LOGNORM) 0.87	(LOGNORM) 0.83	LOGNORM 0.94	LOGNORM 0.96	(LOGNORM) 0.85	LOGNORM 0.97

Notes:
R^2 value provided below each distribution determination
NORMAL or LOGNORMAL = R^2 value greater than 0.9
NORMAL or LOGNORMAL = R^2 value greater than 0.9 w/ one outlier removed
(NORMAL) or (LOGNORMAL) = R^2 value greater than 0.8 and less than 0.9
NON-PARA = R^2 value less than 0.8 = nonparametric

Lognormal Test Results
34 LOGNORMAL
8 NEAR LOGNORMAL
1 NONPARAMETRIC

Table 1-6
Sample Location Rationale

Station	General	Water	Fish
All Stations	Characterize effectiveness of LFR remedial actions and natural recovery processes. Collocate fish and water sampling stations to characterize bioaccumulation pathways. OU 2 and OU 5 are subsampled on a finer scale to provide more detailed characterization of monitored natural recovery areas.	Preference for locations in relatively straight reaches with simple U-shaped cross-sections and relatively uniform flow. Preference for locations near downstream OU boundaries, to monitor cumulative impacts from the entire OU, and net contributions (contaminant loadings) to the next OU.	Preference for known productive fishing sites based on Baseline Monitoring results. Preference for tailwater locations below dams where upstream-migrating species (i.e., walleye) may congregate. Preference for matching habitat of target species. It is assumed fish migrate freely between dams, and provide spatial representativeness of an entire OU. OU 2 is further subdivided because of length, dam interruptions, and variable riffle and pool habitats. OU 5 is further subdivided because of areal extent.
Lake Winnebago	Characterize ambient background conditions upstream of LFR remediation areas.	Characterize ambient background PCB concentrations upstream of LFR remediation areas. Estimate background PCB loading to OU 1.	Characterize ambient background PCB concentrations upstream of LFR remediation areas.
OU-1	Characterize effectiveness of OU 1 remedial action.	Characterize water column PCB concentrations at the downstream end (exit point) of OU 1 remedial action area. Estimate downstream PCB loading to OU 2.	Characterize fish tissue PCB concentrations in OU 1 remedial action area. Assume fish migrate freely within OU 1 below Neenah and Menasha dams.
OU-2A	Characterize natural recovery processes in OU 2, along with the effectiveness of prior remedial action in Deposit N. Characterize environmental conditions in a reach with steep gradients and swift water velocities.	Characterize water column PCB concentrations in upstream reach of OU 2 natural recovery areas. Characterize environmental conditions in a reach with steep gradients and swift water velocities. Available boat access.	Characterize fish tissue PCB concentrations in the upstream reach of OU 2 natural recovery areas. Characterize environmental conditions in a reach with steep gradients and swift water velocities. Available boat access.
OU-2B	Characterize natural recovery processes in OU 2, along with the effectiveness of prior remedial action in Deposit N. Characterize environmental conditions in a reach with gentler gradients and slower water velocities (i.e., more likely depositional).	Characterize water column PCB concentrations in central reach of OU 2 natural recovery areas. Characterize environmental conditions in a reach with gentler gradients and slower water velocities (i.e., more likely depositional). Available boat access.	Characterize fish tissue PCB concentrations in the central reach of OU 2 natural recovery areas. Characterize environmental conditions in a reach with gentler gradients and slower water velocities (i.e., more likely depositional). Available boat access.
OU-2C	Characterize natural recovery processes in OU 2, along with the effectiveness of prior remedial action in Deposit N, and pending remedial action in Deposit DD.	Characterize water column PCB concentrations at the downstream end (exit point) of OU 2 natural recovery areas. Estimate downstream loading to OU 3. Available boat access.	Characterize fish tissue PCB concentrations at the downstream end of OU 2 natural recovery areas. Available boat access.
OU-3	Characterize effectiveness of OU 3 remedial action.	Characterize water column PCB concentrations at the downstream end (exit point) of OU 3 remedial action areas.	Characterize fish tissue PCB concentrations in OU 3 remedial action areas. Assume fish migrate freely within OU 3 below Little Rapids dam.
OU-4	Characterize effectiveness of OU 4 remedial action.	Characterize water column PCB concentrations at the downstream end (exit point) of OU 4 remedial action areas. Estimate downstream loading to Green Bay. Collocate with historical and ongoing USGS monitoring near Oil Depot gage. Beyond the influence of upstream migration of bay water under seiche conditions.	Characterize fish tissue PCB concentrations in OU 4 remedial action areas. Assume fish migrate freely within OU 4 downstream of DePere dam. Anticipate congregation of walleye in DePere dam tailwaters; popular fishing area.
OU-5A	Characterize natural recovery processes in Green Bay, downstream of Lower Fox River remedial actions.	Characterize longitudinal PCB gradient in Green Bay water column near the mouth of the Lower Fox River (Zone II)	Characterize fish tissue concentrations in shallow, inner reaches of Green Bay subject to discharges from the mouth of the Lower Fox River.
OU-5B	Characterize natural recovery processes in Green Bay, downstream of Lower Fox River remedial actions.	Characterize longitudinal PCB gradient in Green Bay water column (Zone III-South)	Characterize fish tissue concentrations in depositional areas along eastern shoreline of Green Bay where highest sediment PCB concentrations have occurred
OU-5C	Characterize natural recovery processes in Green Bay, downstream of Lower Fox River remedial actions.	Characterize longitudinal PCB gradient in Green Bay water column (Zone III-South) with increasing water depth and influence from Lake Michigan and other external sources	No fish samples in this zone. This area is too far removed from Fox River inputs and thus subject to contaminant contributions from other confounding external sources

Table 1-7
Estimated Sample Sizes for Water and Fish Tissue Monitoring

Minimum Detectable Difference: 50%

Confidence (alpha)	Power (beta)	Coefficient of Variation							
		0.3	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**
0.2	0.2	1	2	2	3	5	6	8	10
0.1	0.2	2	3	5	7	9	12	15	19
0.05	0.2	3	5	7	10	14	18	23	29

Table 1-8
Estimated Statistical Confidence for Detecting 50 Percent Reduction in PCB Concentration

	n	LWB	OU 1	OU 2A	OU 2B	OU 2C	OU 3	OU 4	OU 5A	OU 5B	OU 5C
Water											
Year-Round	12	>75%	>80%	>80%	>90%	>80%	>80%	>80%	>95%	>80%	>95%
Apr-Nov	8	>75%	>90%	~90%	>90%	>80%	>90%	>90%	>95%	>80%	>90%
Fish											
Walleye	15	>95%	>95%	>95%	>95%	>90%	>90%	>95%	>95%	>95%	---
Bass	15	>95%	>90%	>95%	>95%	>95%	>95%	>95%	>95%	>90%	---
Carp	5	>95%	>80%	>70%	>95%	>95%	>95%	>95%	>95%	>70%	---
Drum	5	>95%	~95%	>90%	~90%	>90%	>80%	~95%	>95%	~95%	---
Gizzard Shad	5	>95%	>95%	>80%	>95%	>80%	>80%	>80%	>95%	>95%	---

Table 2-1
Water Sampling and Analysis Plan

	Number of Monthly Samples	Total Number of Analyses	Field Parameters [Temp, Turbidity]	Total Suspended Solids [EPA 160.2]	Total Organic Carbon [EPA 415.1]	PCB Congeners [EPA 1668A]
LWB-yy-mmdd	8	8	X	X	X	X
OU1-yy-mmdd	8	8	X	X	X	X
OU2A-yy-mmdd	8	8	X	X	X	X
OU2B-yy-mmdd	8	8	X	X	X	X
OU2C-yy-mmdd	8	8	X	X	X	X
OU3-yy-mmdd	8	8	X	X	X	X
OU4-yy-mmdd	8	8	X	X	X	X
OU5A-yy-mmdd	8	8	X	X	X	X
OU5B-yy-mmdd	8	8	X	X	X	X
OU5C-yy-mmdd	8	8	X	X	X	X
TOTAL	80	80				

Table 2-2
Water Sampling Locations

Transect	Position	X_WTM27	Y_WTM27	Latitude	Longitude	X_WTM8391	Y_WTM_8391
LW	W	625,571	392,512	44.1770	-88.4293	645,559	412,726
	M	626,486	393,942	44.1897	-88.4175	646,474	414,157
	E	627,390	395,354	44.2022	-88.4058	647,378	415,569
OU1	W	624,544	399,939	44.2440	-88.4403	644,531	420,154
	M	624,583	399,885	44.2435	-88.4399	644,571	420,100
	E	624,618	399,838	44.2431	-88.4394	644,606	420,053
OU2A	W	632,719	404,099	44.2800	-88.3369	652,707	424,314
	M	632,733	404,036	44.2794	-88.3368	652,721	424,251
	E	632,749	403,969	44.2788	-88.3366	652,736	424,184
OU2B	W	642,374	408,027	44.3135	-88.2149	662,362	428,242
	M	642,413	407,981	44.3131	-88.2145	662,400	428,197
	E	642,452	407,936	44.3127	-88.2140	662,440	428,151
OU2C	W	649,030	415,114	44.3759	-88.1295	669,017	435,329
	M	649,070	415,075	44.3756	-88.1290	669,057	435,290
	E	649,103	415,044	44.3753	-88.1286	669,090	435,259
OU3	W	653,989	422,665	44.4428	-88.0650	673,977	442,881
	M	654,035	422,628	44.4425	-88.0645	674,022	442,844
	E	654,090	422,584	44.4421	-88.0638	674,077	442,799
OU4	W	658,157	432,421	44.5297	-88.0097	678,144	452,637
	M	658,219	432,409	44.5296	-88.0089	678,206	452,625
	E	658,268	432,400	44.5295	-88.0083	678,255	452,615
OU5A	W	661,674	447,915	44.6683	-87.9606	681,661	468,130
	M	665,240	445,525	44.6460	-87.9164	685,227	465,741
	E	668,193	443,546	44.6275	-87.8798	688,180	463,762
OU5B	W	677,043	470,189	44.8651	-87.7591	697,029	490,405
	M	680,385	468,332	44.8475	-87.7175	700,371	488,548
	E	684,551	466,018	44.8257	-87.6657	704,538	486,234
OU5C	W	694,097	493,040	45.0661	-87.5347	714,083	513,255
	M	700,719	488,883	45.0269	-87.4523	720,705	509,099
	E	705,334	485,986	44.9995	-87.3950	725,319	506,202

Notes:

Quarter-point sampling location code: W = west, M = middle, E = east location in water sampling transect

All Wisconsin Transverse Mercator (WTM) coordinates are in meters

Table 2-3
Target Fish Species, Size Classes, and Compositing Plan

Primary Species	Objective	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. Individuals (Target)	No. Individuals (Minimum)	No. Composites	No. Fish/Composite (Target)	No. Fish/Composite (Minimum)
Walleye	Human Health												X		15	8	0	n/a	n/a
Carp (OU 1-4)	Ecological													X	25	5	5	5	1
Drum (OU 4-5)	Ecological													X	25	5	5	5	1
Gizzard Shad	Young Forage													X	175	15	7	25	3
Alternate Species	**Objective**																		
Smallmouth Bass	Human Health												X		15	15	0	n/a	n/a
Drum (OU 1-3)	Ecological													X	25	5	5	5	1
Carp (OU 5)	Ecological													X	25	5	5	5	1

Notes:

Target Size Class

Alternate Size Class

n/a - Walleye and Bass will not be composited

Table 2-4
Fish Tissue Sampling and Analysis Matrix

	Number of Composites	No. Fish / Composite	No. Individual Fish	Total Number Analyses	No. Field Replicates	Minimum Size (inches)	Maximum Size (inches)	Preparation Method	PCB Aroclors [8082/SLOH]	Lipid Content [EPA 2000]	Archive [Freeze]
LWB-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU1-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU2A-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU2B-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU2C-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU3-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU4-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU5A-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
OU5B-YY-WA-000	n/a	n/a	15	15	1	12	22	SOF	X	X	X
WALLEYE SUBTOTAL			135	135	9						
LWB-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU1-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU2A-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU2B-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU2C-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU3-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
OU4-YY-CA-000	5	5	25	5	1	12	22	WF	X	X	X
CARP SUBTOTAL			175	35	7						
LWB-YY-DR-000	5	5	25	5	1	12	22	WF	X	X	X
OU4-YY-DR-000	5	5	25	5	1	12	22	WF	X	X	X
OU5A-YY-DR-000	5	5	25	5	1	12	22	WF	X	X	X
OU5B-YY-DR-000	5	5	25	5	1	12	22	WF	X	X	X
DRUM SUBTOTAL			100	20	4						
LWB-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU1-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU2A-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU2B-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU2C-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU3-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU4-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU5A-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
OU5B-YY-GS-000	7	25	175	7	1	2	3	WF	X	X	X
GIZZARD SHAD SUBTOTAL			1,575	63	9						

SUBTOTAL FISH ANALYSES:	253
SUBTOTAL REPLICATE ANALYSES:	29
GRAND TOTAL:	282

Notes:

SOF = Skin-On Fillet; WF = Whole Fish

WA = walleye; CA = carp; DR = drum; GS = gizzard shad

See Section 2.2.5 for key to sample identification system

Table 2-5
Fish Habitat and Collection Methods

	SPECIES	GENERAL HABITAT DESCRIPTION	Electrofish	Trawl	Rod and Reel	Seine Net	Other
Lower Fox River (LWB, OU 1 - OU 4)	Walleye	Below dams, near discharges, submerged weed beds, hard rocky substrates, bridge pillars and abutments	X	X	X		
	Carp	Muddy flats and bays, aquatic vegetation and weed beds, below dams, near discharges, bridge pillars, creek mouths	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		
	Gizzard Shad	Nearshore areas, aquatic vegetation and weed beds, along reefs, below dams, near discharges, bridge abutments, creek mouths	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		
Green Bay (OU 5)	Walleye	Aquatic vegetation and weed beds, rocky shorelines, near boat launches	X	X	X		
	Carp	Weedy, muddy, flats and bays along shorelines	X	X			
	Drum	Near shore to 30' of water, all substrates, near boat launches	X	X			
	Gizzard Shad	Near shore, near boat launches	X	X		X	
	Smallmouth Bass	Aquatic vegetation and weed beds, rocky shorelines; deep holes with structure	X	X	X		

Table 2-6
Sample Containers, Holding Times, and Preservation Requirements

Parameter	Analytical Method	Matrix	Container	Preservation	Minimum Sample	Maximum Holding
TOC - water	EPA 415.1	Water	Polyethylene / Glass	4˚C, H2SO4 OR H3PO4 TO pH <2	100 mls	28 days
TSS	EPA 160.2	Water	1 Liter Polypropylene. Certified Clean	None	1,000 mls	7 days
PCB Congeners	EPA 1668	Water	2 Liter Amber Glass with Teflon lined cap. Certified clean	4˚C. Residual chlorine will be tested at the lab upon receipt. If residual chlorine present, add 80 mg. Sodium Thiosulfate	1,000 mls	1 year
PCB Aroclors	SW 8082	Fish	Clean glass container or polyethylene bags	Stored frozen	20 grams	Stored frozen until extraction and analyzed within 40 days of extraction

Table 2-7
Analytical Methods, Detection Limits, and Control Limits

Analytical Parameter	Matrix	Proposed Laboratory	Analysis Methods	Laboratory SOP Number	Reporting Limit	Units
Aroclor 1016	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1221	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1232	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1242	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1248	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1254	Tissue	TBD	Method 8082	TBD	50	ug/kg
Aroclor 1260	Tissue	TBD	Method 8082	TBD	50	ug/kg
Lipids	Tissue	TBD	EPA 2000	TBD	0.1	%
TOC	Water	TBD	EPA 415.1	TBD	2	mg/L
TSS	Water	TBD	EPA 160.2	TBD	1	mg/L
PCB Congeners	Water	TBD	EPA 1668A	TBD	0.020 – 0.031 [See Table 2-8]	ng/L

Table 2-8
PCB Congener Reporting Limits

CAS Registry Number	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
2051-60-7	1	0.00128	0.02	NA	50-150
2051-61-8	2	0.00114	0.02	NA	
2051-62-9	3	0.00105	0.02	NA	50-150
13029-08-8	4	0.01263	0.0314	NA	50-150
16605-91-7	5	0.0079	0.02	NA	
25569-80-6	6	0.00726	0.02	NA	
33284-50-3	7	0.00759	0.02	NA	
34883-43-7	8	0.0073	0.0269	NA	
34883-39-1	9	0.00763	0.02	NA	
33146-45-1	10	0.00783	0.02	NA	
2050-67-1	11	0.00755	0.0239	NA	
2974-92-7	12	0.0073	0.0259	NA	
2974-90-5	13	0.00729	0.0259	NA	
34883-41-5	14	0.00719	0.02	NA	
2050-68-2	15	0.00637	0.02	NA	50-150
38444-78-9	16	0.00731	0.02	NA	
37680-66-3	17	0.00589	0.02	NA	
37680-65-2	18	0.00487	0.0224	NA	
38444-73-4	19	0.00636	0.02	NA	50-150
38444-84-7	20	0.00216	0.02	NA	
55702-46-0	21	0.00223	0.02	NA	
38444-85-8	22	0.00234	0.02	NA	
55720-44-0	23	0.0024	0.02	NA	
55702-45-9	24	0.00427	0.02	NA	
55712-37-3	25	0.00203	0.02	NA	
38444-81-4	26	0.00224	0.02	NA	
38444-76-7	27	0.00416	0.02	NA	
7012-37-5	28	0.00216	0.02	NA	
15862-07-4	29	0.00224	0.02	NA	
35693-92-6	30	0.00487	0.0224	NA	
16606-02-3	31	0.0022	0.02	NA	
38444-77-8	32	0.00382	0.02	NA	
38444-86-9	33	0.00223	0.02	NA	
37680-68-5	34	0.00233	0.02	NA	
37680-69-6	35	0.00231	0.02	NA	
38444-87-0	36	0.00216	0.02	NA	
38444-90-5	37	0.00193	0.02	NA	50-150
53555-66-1	38	0.00221	0.02	NA	
38444-88-1	39	0.00205	0.02	NA	
38444-93-8	40	0.00226	0.02	NA	
52663-59-9	41	0.00226	0.02	NA	
36559-22-5	42	0.0025	0.02	NA	
70362-46-8	43	0.00207	0.02	NA	
41464-39-5	44	0.00203	0.02	NA	
70362-45-7	45	0.00236	0.02	NA	
41464-47-5	46	0.00275	0.02	NA	
2437-79-8	47	0.00203	0.02	NA	
70362-47-9	48	0.00226	0.02	NA	
41464-40-8	49	0.00193	0.02	NA	
62796-65-0	50	0.00227	0.02	NA	
68194-04-7	51	0.00236	0.02	NA	
35693-99-3	52	0.00217	0.02	NA	
41464-41-9	53	0.00227	0.02	NA	

Table 2-8
PCB Congener Reporting Limits

CAS Registry Number	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
15968-05-5	54	0.00342	0.02	NA	50-150
74338-24-2	55	0.0017	0.02	NA	
41464-43-1	56	0.00168	0.02	NA	
70424-67-8	57	0.00167	0.02	NA	
41464-49-7	58	0.00163	0.02	NA	
74472-33-6	59	0.00164	0.02	NA	
33025-41-1	60	0.00165	0.02	NA	
33284-53-6	61	0.00158	0.02	NA	
54230-22-7	62	0.00164	0.02	NA	
74472-34-7	63	0.00156	0.02	NA	
52663-58-8	64	0.00164	0.02	NA	
33284-54-7	65	0.00203	0.02	NA	
32598-10-0	66	0.00155	0.02	NA	
73575-53-8	67	0.00146	0.02	NA	
73575-52-7	68	0.00151	0.02	NA	
60233-24-1	69	0.00193	0.02	NA	
32598-11-1	70	0.00158	0.02	NA	
41464-46-4	71	0.00226	0.02	NA	
41464-42-0	72	0.00161	0.02	NA	
74338-23-1	73	0.00207	0.02	NA	
32690-93-0	74	0.00158	0.02	NA	
32598-12-2	75	0.00164	0.02	NA	
70362-48-0	76	0.00158	0.02	NA	
32598-13-3	77	0.00145	0.02	NA	50-150
70362-49-1	78	0.00161	0.02	NA	
41464-48-6	79	0.00136	0.02	NA	
33284-52-5	80	0.00145	0.02	NA	
70362-50-4	81	0.0016	0.02	NA	50-150
52663-62-4	82	0.00358	0.02	NA	
60145-20-2	83	0.00371	0.02	NA	
52663-60-2	84	0.00362	0.02	NA	
65510-45-4	85	0.00256	0.02	NA	
55312-69-1	86	0.00257	0.02	NA	
38380-02-8	87	0.00257	0.02	NA	
55215-17-3	88	0.00319	0.02	NA	
73575-57-2	89	0.00346	0.02	NA	
68194-07-0	90	0.00268	0.02	NA	
68194-05-8	91	0.00319	0.02	NA	
52663-61-3	92	0.00324	0.02	NA	
73575-56-1	93	0.00313	0.02	NA	
73575-55-0	94	0.00342	0.02	NA	
38379-99-6	95	0.00313	0.02	NA	
73575-54-9	96	0.00238	0.02	NA	
41464-51-1	97	0.00257	0.02	NA	
60233-25-2	98	0.00318	0.02	NA	
38380-01-7	99	0.00255	0.02	NA	
39485-83-1	100	0.00313	0.02	NA	
37680-73-2	101	0.00268	0.02	NA	
68194-06-9	102	0.00318	0.02	NA	
60145-21-3	103	0.00293	0.02	NA	
56558-16-8	104	0.00231	0.02	NA	50-150
32598-14-4	105	0.00141	0.02	NA	50-150
70424-69-0	106	0.00157	0.02	NA	

Table 2-8
PCB Congener Reporting Limits

CAS Registry Number	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
70424-68-9	107	0.00139	0.02	NA	
70362-41-3	108	0.00154	0.02	NA	
74472-35-8	109	0.00257	0.02	NA	
38380-03-9	110	0.00227	0.02	NA	
39635-32-0	111	0.00218	0.02	NA	
74472-36-9	112	0.00255	0.02	NA	
68194-10-5	113	0.00268	0.02	NA	
74472-37-0	114	0.00125	0.02	NA	50-150
74472-38-1	115	0.00227	0.02	NA	
18259-05-7	116	0.00256	0.02	NA	
68194-11-6	117	0.00256	0.02	NA	
31508-00-6	118	0.00131	0.02	NA	50-150
56558-17-9	119	0.00257	0.02	NA	
68194-12-7	120	0.0021	0.02	NA	
56558-18-0	121	0.00229	0.02	NA	
76842-07-4	122	0.00162	0.02	NA	
65510-44-3	123	0.0013	0.02	NA	50-150
70424-70-3	124	0.00154	0.02	NA	
74472-39-2	125	0.00257	0.02	NA	
57465-28-8	126	0.00159	0.02	NA	50-150
39635-33-1	127	0.00143	0.02	NA	
38380-07-3	128	0.0022	0.02	NA	
55215-18-4	129	0.00225	0.02	NA	
52663-66-8	130	0.00286	0.02	NA	
61798-70-7	131	0.00288	0.02	NA	
38380-05-1	132	0.00281	0.02	NA	
35694-04-3	133	0.00264	0.02	NA	
52704-70-8	134	0.00288	0.02	NA	
52744-13-5	135	0.00405	0.02	NA	
38411-22-2	136	0.003	0.02	NA	
35694-06-5	137	0.00215	0.02	NA	
35065-28-2	138	0.00225	0.02	NA	
56030-56-9	139	0.00242	0.02	NA	
59291-64-4	140	0.00242	0.02	NA	
52712-04-6	141	0.00256	0.02	NA	
41411-61-4	142	0.00283	0.02	NA	
68194-15-0	143	0.00288	0.02	NA	
68194-14-9	144	0.00396	0.02	NA	
74472-40-5	145	0.00307	0.02	NA	
51908-16-8	146	0.00232	0.02	NA	
68194-13-8	147	0.00233	0.02	NA	
74472-41-6	148	0.00404	0.02	NA	
38380-04-0	149	0.00233	0.02	NA	
68194-08-1	150	0.00294	0.02	NA	
52663-63-5	151	0.00405	0.02	NA	
68194-09-2	152	0.0029	0.02	NA	
35065-27-1	153	0.00198	0.02	NA	
60145-22-4	154	0.00347	0.02	NA	
33979-03-2	155	0.00281	0.02	NA	50-150
38380-08-4	156	0.00175	0.02	NA	50-150
69782-90-7	157	0.00175	0.02	NA	50-150
74472-42-7	158	0.00172	0.02	NA	
39635-35-3	159	0.00181	0.02	NA	

Table 2-8
PCB Congener Reporting Limits

CAS Registry Number	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)
41411-62-5	160	0.00201	0.02	NA	
74472-43-8	161	0.00188	0.02	NA	
39635-34-2	162	0.00181	0.02	NA	
74472-44-9	163	0.00225	0.02	NA	
74472-45-0	164	0.00215	0.02	NA	
74472-46-1	165	0.00205	0.02	NA	
41411-63-6	166	0.0022	0.02	NA	
52663-72-6	167	0.00154	0.02	NA	50-150
59291-65-5	168	0.00198	0.02	NA	
32774-16-6	169	0.00174	0.02	NA	50-150
35065-30-6	170	0.00198	0.02	NA	
52663-71-5	171	0.00255	0.02	NA	
52663-74-8	172	0.00258	0.02	NA	
68194-16-1	173	0.00255	0.02	NA	
38411-25-5	174	0.00239	0.02	NA	
40186-70-7	175	0.00229	0.02	NA	
52663-65-7	176	0.00182	0.02	NA	
52663-70-4	177	0.00256	0.02	NA	
52663-67-9	178	0.00246	0.02	NA	
52663-64-6	179	0.0018	0.02	NA	
35065-29-3	180	0.00167	0.02	NA	
74472-47-2	181	0.00239	0.02	NA	
60145-23-5	182	0.00232	0.02	NA	
52663-69-1	183	0.00229	0.02	NA	
74472-48-3	184	0.00169	0.02	NA	
52712-05-7	185	0.00229	0.02	NA	
74472-49-4	186	0.00184	0.02	NA	
52663-68-0	187	0.00217	0.02	NA	
74487-85-7	188	0.00176	0.02	NA	50-150
39635-31-9	189	0.0016	0.02	NA	50-150
41411-64-7	190	0.00185	0.02	NA	
74472-50-7	191	0.0018	0.02	NA	
74472-51-8	192	0.00195	0.02	NA	
69782-91-8	193	0.00195	0.02	NA	
35694-08-7	194	0.00209	0.02	NA	
52663-78-2	195	0.00229	0.02	NA	
42740-50-1	196	0.00313	0.02	NA	
33091-17-7	197	0.00229	0.02	NA	
68194-17-2	198	0.00311	0.02	NA	
52663-75-9	199	0.00311	0.02	NA	
52663-73-7	200	0.00229	0.02	NA	
40186-71-8	201	0.00228	0.02	NA	
2136-99-4	202	0.00241	0.02	NA	50-150
52663-76-0	203	0.00287	0.02	NA	
74472-52-9	204	0.00235	0.02	NA	
74472-53-0	205	0.00146	0.02	NA	50-150
40186-72-9	206	0.00146	0.02	NA	50-150
52663-79-3	207	0.00132	0.02	NA	
52663-77-1	208	0.00127	0.02	NA	50-150
2051-24-3	209	0.00096	0.02	NA	50-150

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

Table 2-8
PCB Congener Reporting Limits

CAS Registry Number	Congener Number	Average EDL (ng/L)	Reporting Limit (ng/L)	Precision (%RPD) [1]	Accuracy (%R)

NA - Not applicable.

RPD - Relative percent difference.

Table 2-9
Quality Control Criteria – Standard Analyses

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
EPA Method 8082 w/ WSLOH Modification	Aroclors 1016/1260	Five-point initial calibration (ICAL)	Initial calibration prior to sample analysis	Calibration factor of each peak < 20 % RSD	Correct problem, then repeat initial calibration
	Aroclors, 1221, 1232, 1242, 1248, 1254	One point midrange calibration standard	With each Aroclor 1016/1260 initial calibration	Calibration is acceptable if Aroclor 1016 and 1260 meet acceptance criteria.	None, use response factor from mid-range standard to quantify Aroclor if present
	All Aroclors	Qualitative match for Aroclor Identification	Every sample	Minimum 5 peak match for all Aroclors except Aroclor 1221 (3 peak match)	None, do not report as detected Aroclor
	All Aroclors	Retention time window	Each calibration verification	ICAL mean RT + 0.03 minutes	Correct problem, then reanalyze all samples analyzed since the last retention time check
	Aroclors 1016/1260	Calibration verification	After every 10 samples	Average RF of > 5 peaks < 15 % difference from ICAL mean RF	Correct problem, then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
	Aroclors 1016/1260	Ending calibration verification	After all samples analyzed	Average RF of > 5 peaks < 15 % difference from ICAL mean RF	If sensitivity increased > 15 %, no reanalysis of undetected samples needed. If sensitivity decreased > 15 %, reanalyze samples.
	All Aroclors	Method blank (MB)	One per analytical batch of 20 samples or less	No analytes detected > RL	Correct problem, then repeat prep and analysis of method blank and all samples with detects < 20 X MB processed with the contaminated blank
	Aroclors 1254	LCS	One LCS per analytical batch of 20 samples or less	40-128%	Assess all other batch QC for same bias, if consistent bias present, repeat prep and analysis of LCS and all samples in the affected analytical batch
	All Aroclors	Surrogate spikes (TMX, DCB)	Every sample, spiked sample, standard, and method blank	TMX 40-136% DCB 47-145%	If both TCX and DCB out of limit, re-extract and re-analyze sample

Table 2-9
Quality Control Criteria – Standard Analyses

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
	Aroclor 1254	MS/MSD	One MS/MSD per every 20 project samples	43-130% recovery 56% RPD	If recovery is out of limit, qualify data and note in case narrative suspected matrix problem
	All Aroclors	Field Duplicates	Submitted blind to lab	< 35 % RPD	May request analysis of additional aliquot(s), data qualified as estimated during validation
EPA Method 415.1	TOC (water)	Method Blank	1 with each batch of samples processed not to exceed 20 samples	Absolute value < RL of 2 mg/L, if sample level > 20 x MB, no action	Rerun all samples associated with unacceptable blank. If MB > MDL < RL, qualify sample levels < 20 x MB with "A"
	TOC (water)	Laboratory Control Sample	1 with each batch of samples processed not to exceed 20 samples	Percent recovery must be within laboratory control limits 80-120%	If not within laboratory control limits, rerun all associated samples
	TOC (water)	MS/MSD	1 per 10 samples, minimum of one per batch of samples processed	Percent recovery must be within laboratory control limits 80 -120% RPD < 20%	Flag data outside of limit
	TOC (water)	Update calibration factor with 3 standard plus blank.	Initially and as needed when calibration failures occur	See instrument manual	Correct problem, then repeat initial calibration
	TOC (water)	ICV	1 mid-level at beginning of every analytical run	± 10% of true value	Correct problem, then repeat calibration verification and reanalyze all samples not bracketed by an acceptable ICV
	TOC (water)	ICB	Immediately after ICV	Absolute value < RL of 2 mg/L	Correct problem, then repeat calibration verification and reanalyze all samples not bracket by acceptable ICB
	TOC (water)	CCV	1 mid-level every 10 samples	± 10% of true value	Correct problem, then reanalyze all samples not bracketed by an acceptable CCV
	TOC (water)	CCB	Immediately after CCV	Absolute value < RL of 2 mg/L. If sample level >10 x CCB, no action	Correct problem, then reanalyze all samples not bracketed by an acceptable CCB

Table 2-9
Quality Control Criteria – Standard Analyses

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
	TOC (water)	Field Duplicate	Submitted blind to lab	<30% RPD	May request analysis of additional aliquot(s), data qualified as estimated during validation
EPA Method 160.2	Total suspended solids	Method Blank	1 with each batch of samples processed not to exceed 20 samples	< + RL	Reanalyze all samples associated with unacceptable MB
	Total suspended solids	Laboratory Control Sample	1 with each batch of samples processed not to exceed 20 samples	80-120%	Reanalyze all samples associated with unacceptable LCS
	Total suspended solids	Duplicate	1 with each batch of samples processed not to exceed 10 samples	< 10% RPD when results >5xs RL	Flag Parent result with appropriate qualifier

Table 2-10
Quality Control Criteria – PCB Congeners

Analytical Method	Calibration/ QC Check	Frequency	Acceptance Criteria	Corrective Action
EPA Method 1668, Revision A	Check of mass resolution mass accuracy (PFK) and gc performance,	Every 12 hours	1) > 10,000 resolving power; 2) < 5 ppm deviation from reference mass. 3) < 40 % valley between PCBs 34 and 23. 4) < 40 % valley between PCBs 187 and 182.	1) Retune or service GC/MS system. 2) Repeat check
	Initial 6-point calibration	Initially and as needed	1) %RSD for CCCs calculated by isotope dilution - < 20%; 2) %RSD for CCCs calculated by internal standard - < 35%; 3) %RSD for Labeled congeners calculated by internal standard - < 35%;	1) Identify the root cause. 2) Perform corrective action 3) Repeat the initial calibration
	Continuing calibration verification (CCV):	Every 12 hours	1) > 10,000 resolving power; 2) < 5 ppm deviation from reference mass % D <20% for CCCs 3) Ion abundance ratios within limit in 1668A Table 8. 4) S/N > 10 for all targets and internal standards. 5) %D for all target PCBs < 30%. 6) % D for labeled internal standards < 50%.	1) If %D > 30% for non-toxic/locs, but is < 60%, use shift response factor. 2) Evaluate system, service as required. 3) Repeat calibration check 4) Perform new initial calibration 5) Reanalyze affected samples.
	level 3 calibration standard	Twenty-eight 13C-labeled congeners added to every sample, QA sample, standard	1) %Recovery 30-140% on LCSs. 2) %Recovery > 25% on samples, blanks.	1) Check all calculations for error. 2) Ensure that instrument performance is acceptable. 3) Recalculate the data and/or reanalyze if either of the above checks reveal a problem 4) If any recovery is < 25%, evaluate labeled congener S/N and EDLs. If S/N > 10 and EDL< EML, report with qualifiers and discuss in narrative
	Labeled congeners/internal standards	One per batch of not more than 20 samples on each instrument to be used for analysis/per 12 hr period.	No target compounds >RL -or at or above 10% of the measured concentration of that analyte in the associated sample, whichever is higher (except for common laboratory contaminants). -or target is not present in sample. -or total PCB concentration is < 300 pg/L. [Note: If any target is detected in the method blank, regardless of level, all detections will be “B” qualified	1) Service system/glassware to eliminate contamination 2) Notify Shaw POC. 3) Reanalyze blank and all associated samples.
	Method blank	One per batch of not more than 20 samples	All criteria in Table 6. Method 1668A.	1) Corrective action required may include: Re-extraction and Re-analysis of LCS and associated samples If batch is not re-extracted reasons for acceptance must be clearly presented in the project records and report. If re-extraction and reanalysis of the batch is not possible due to limited sample volume or other constraints the OPR is reported and the failure is documented in the project narrative.

FIGURES

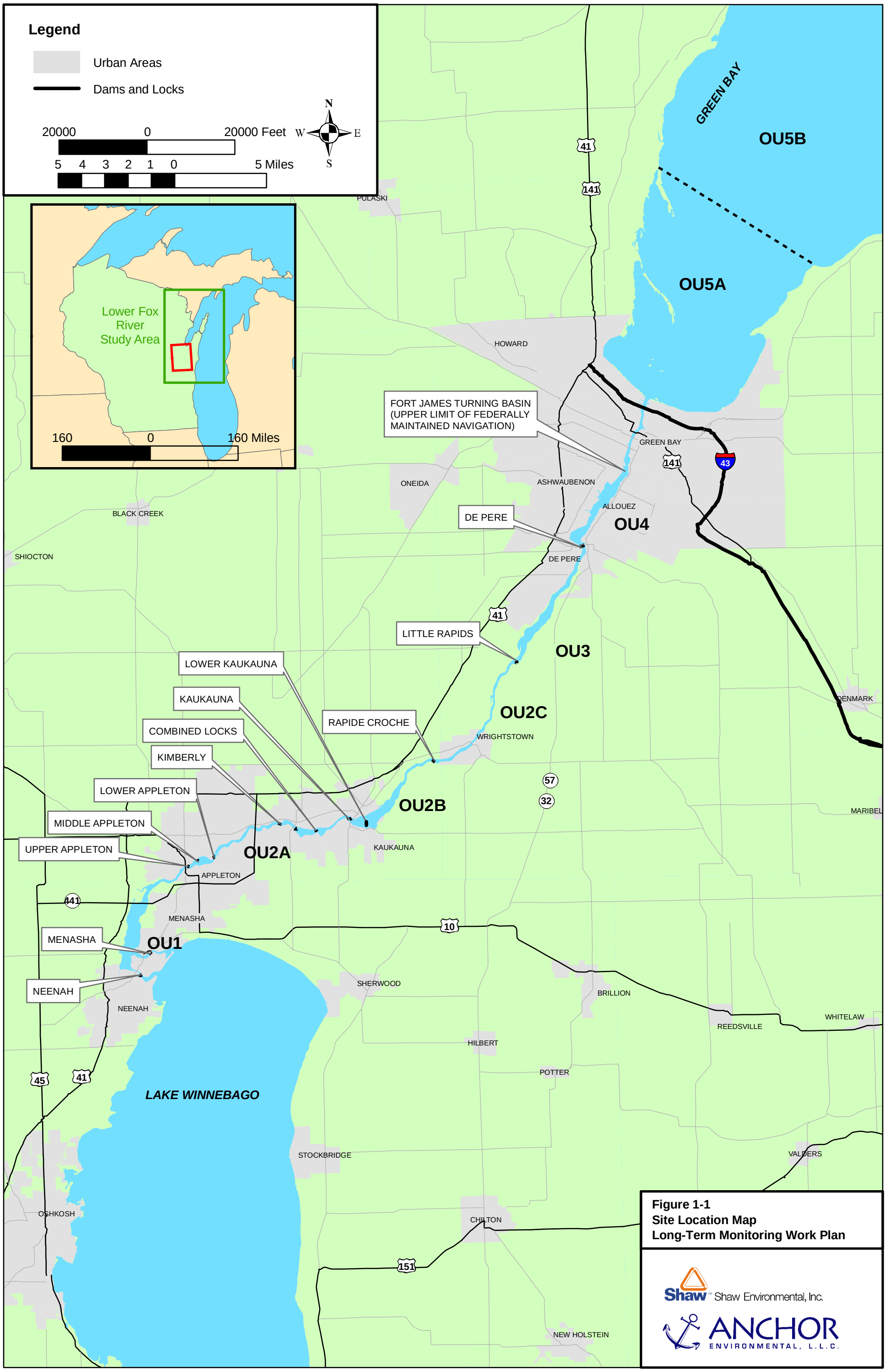

Figure 1-1
Site Location Map
Long-Term Monitoring Work Plan

Shaw Environmental, Inc.

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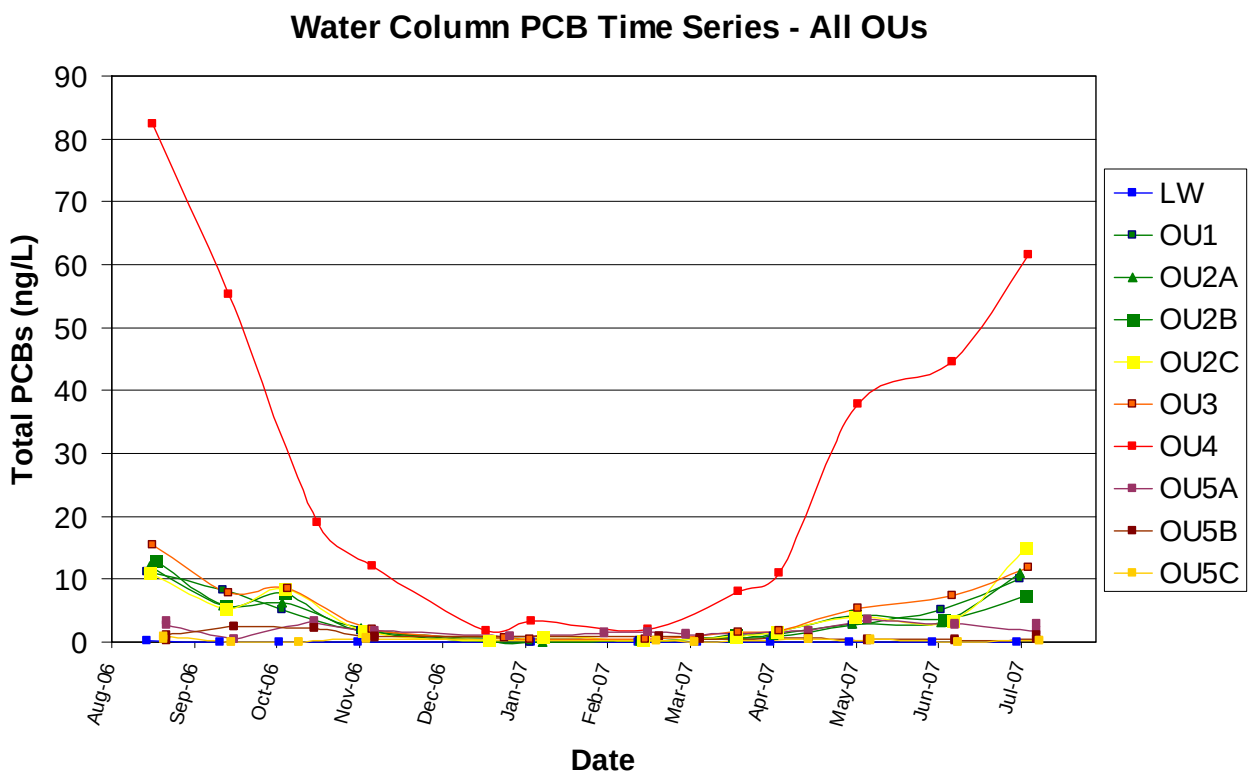

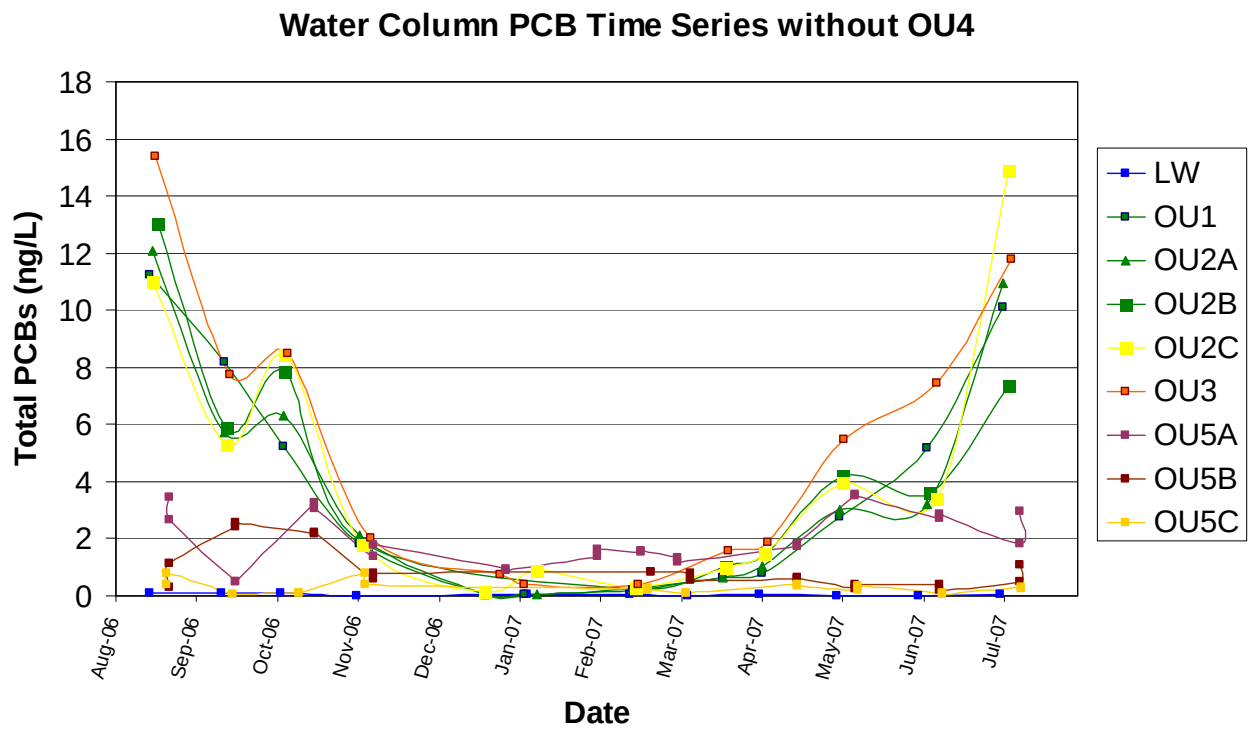

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Figure 1-2
Seasonal Variation in Water Column PCB Concentrations
Long-term Monitoring Plan
Lower Fox River Remedial Design

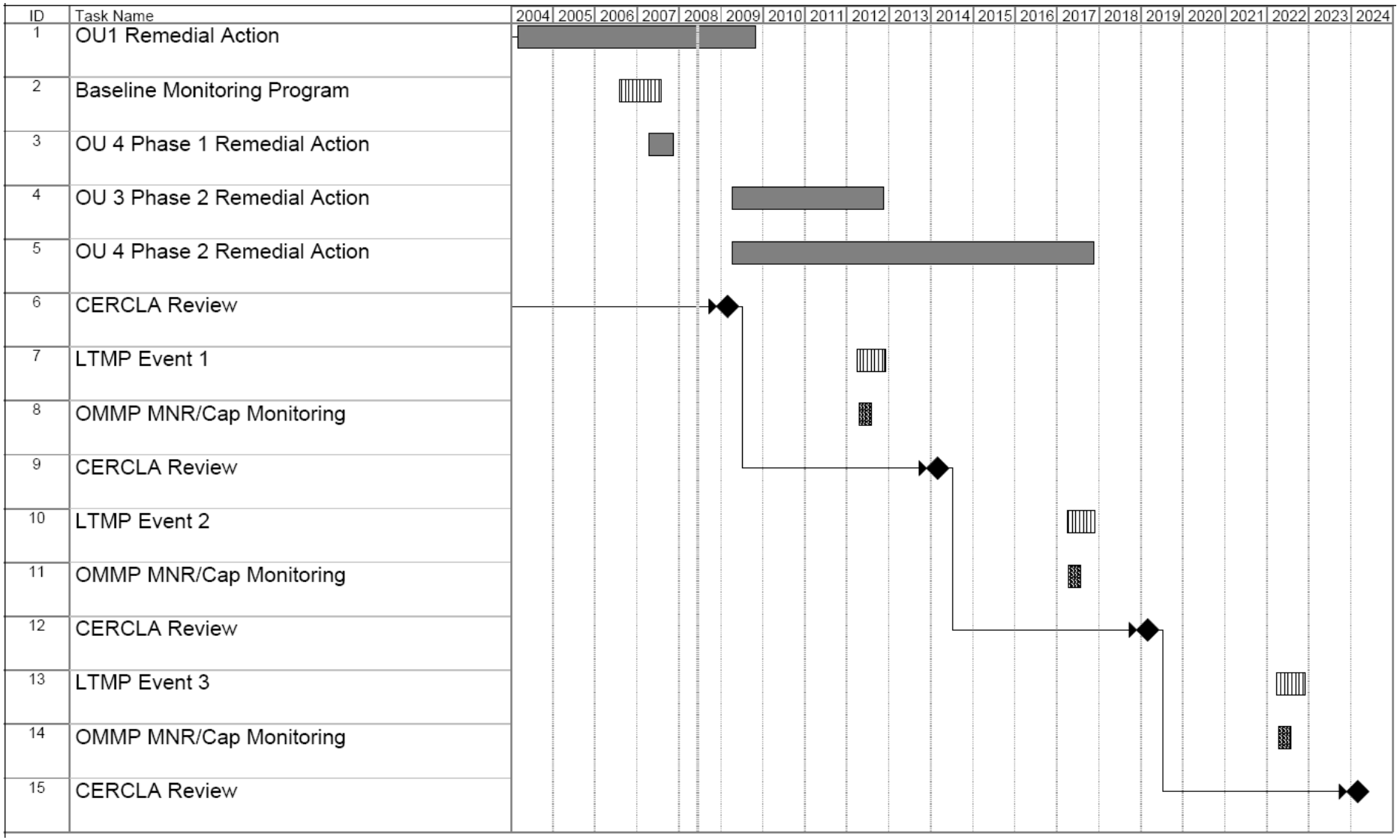

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Figure 1-3
Long-term Monitoring Schedule
Long-term Monitoring Plan
Lower Fox River Remedial Design

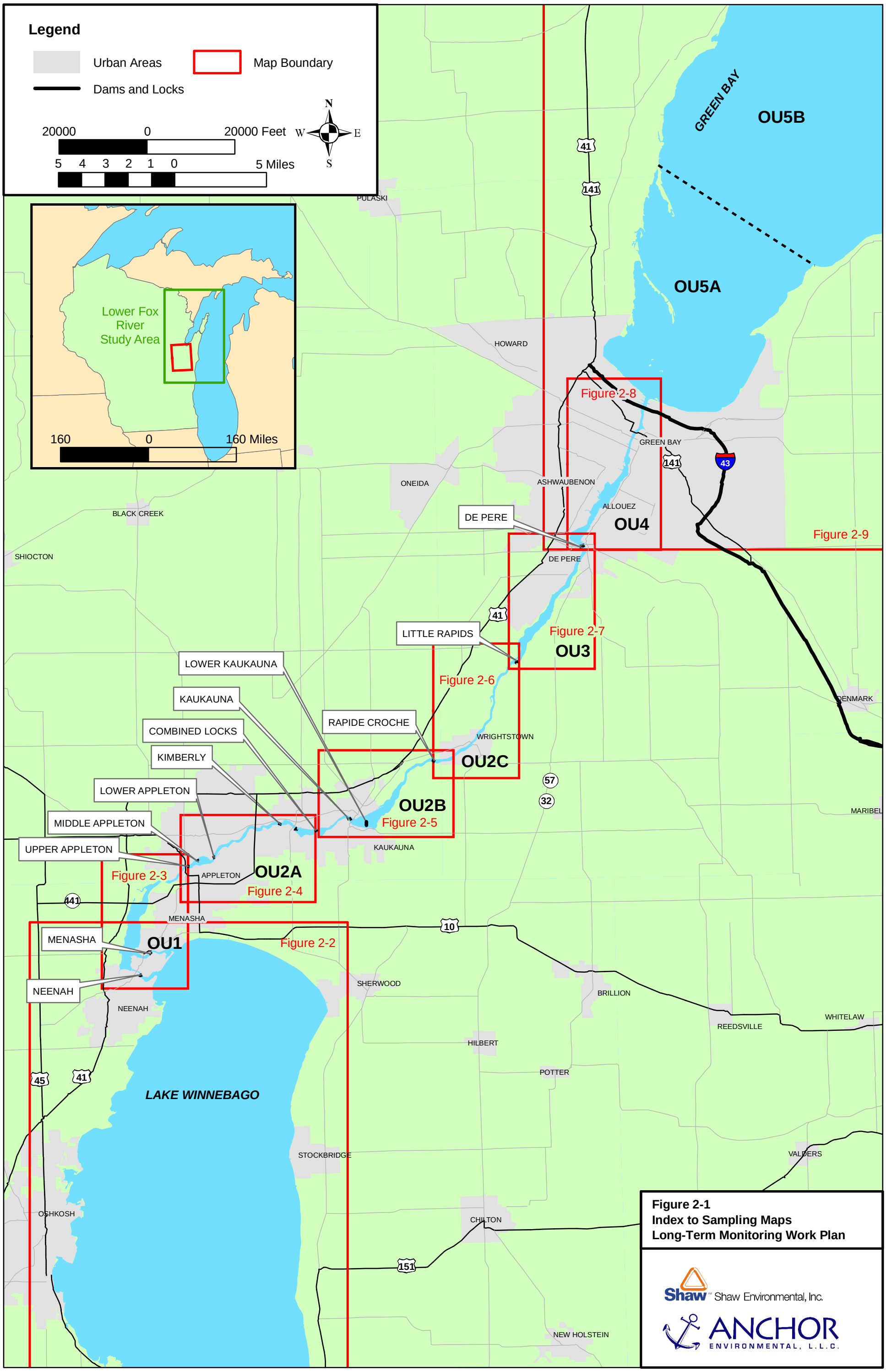

Figure 2-1
Index to Sampling Maps
Long-Term Monitoring Work Plan

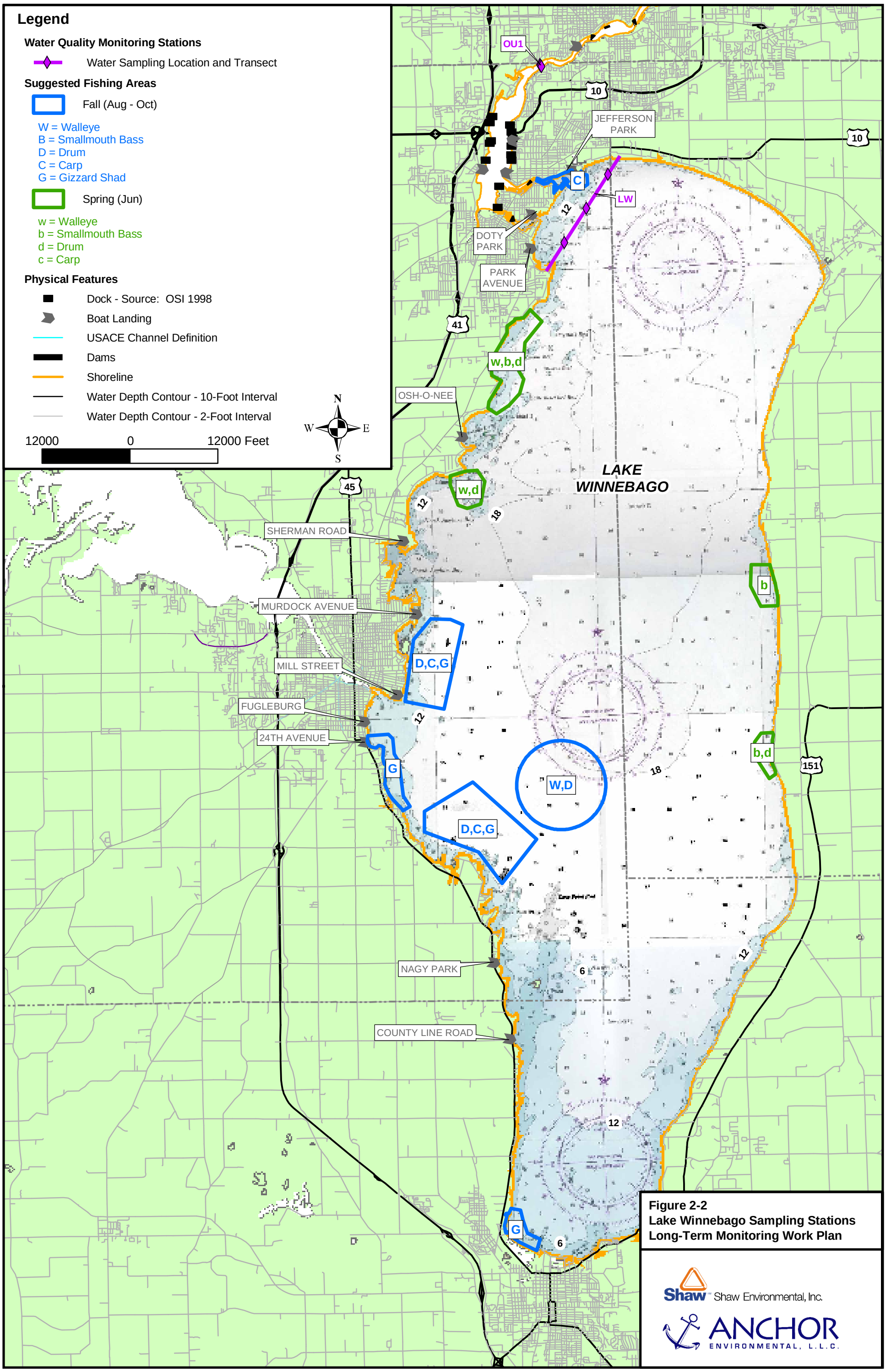

Figure 2-2
Lake Winnebago Sampling Stations
Long-Term Monitoring Work Plan

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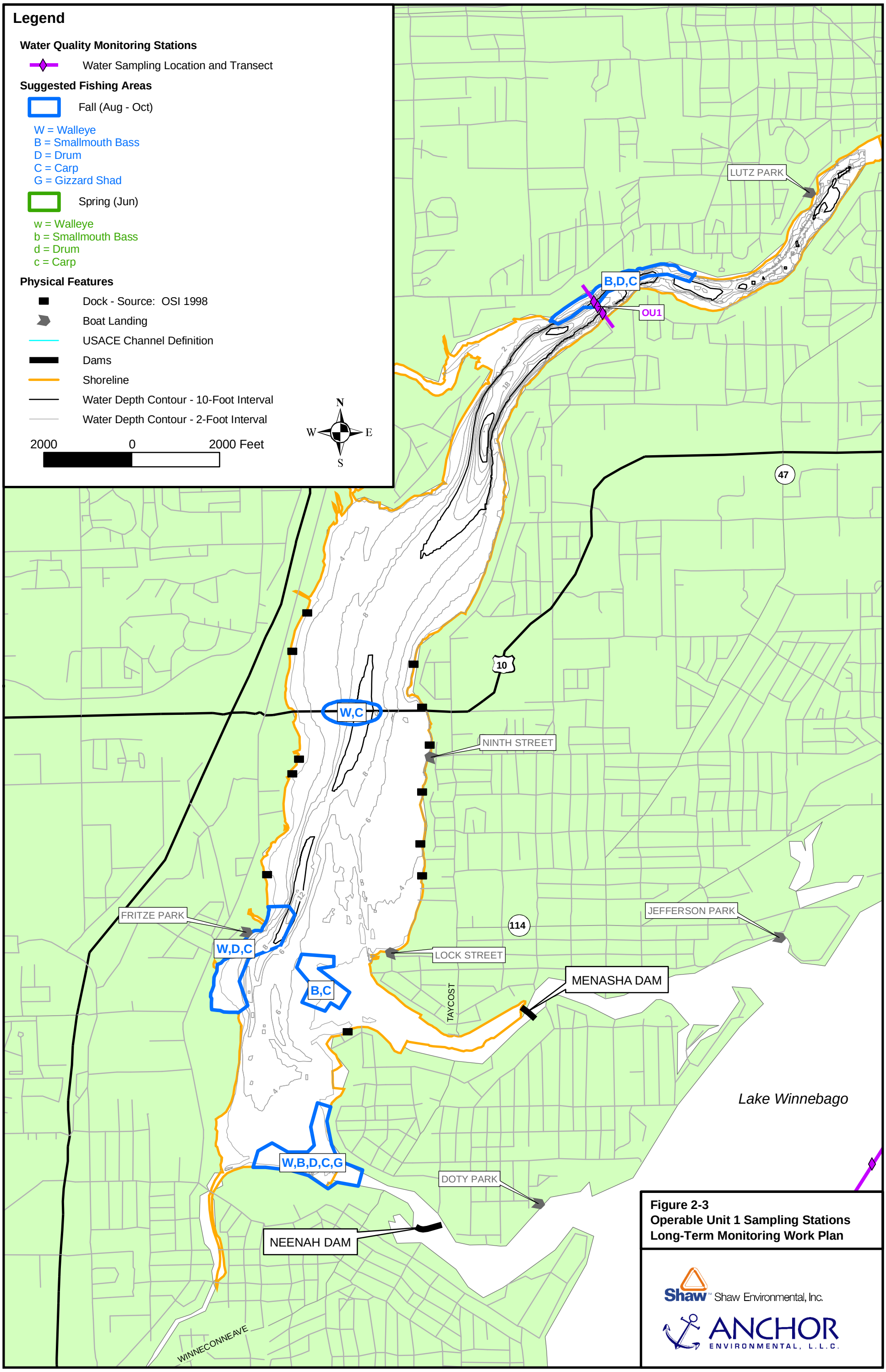

Figure 2-3
Operable Unit 1 Sampling Stations
Long-Term Monitoring Work Plan

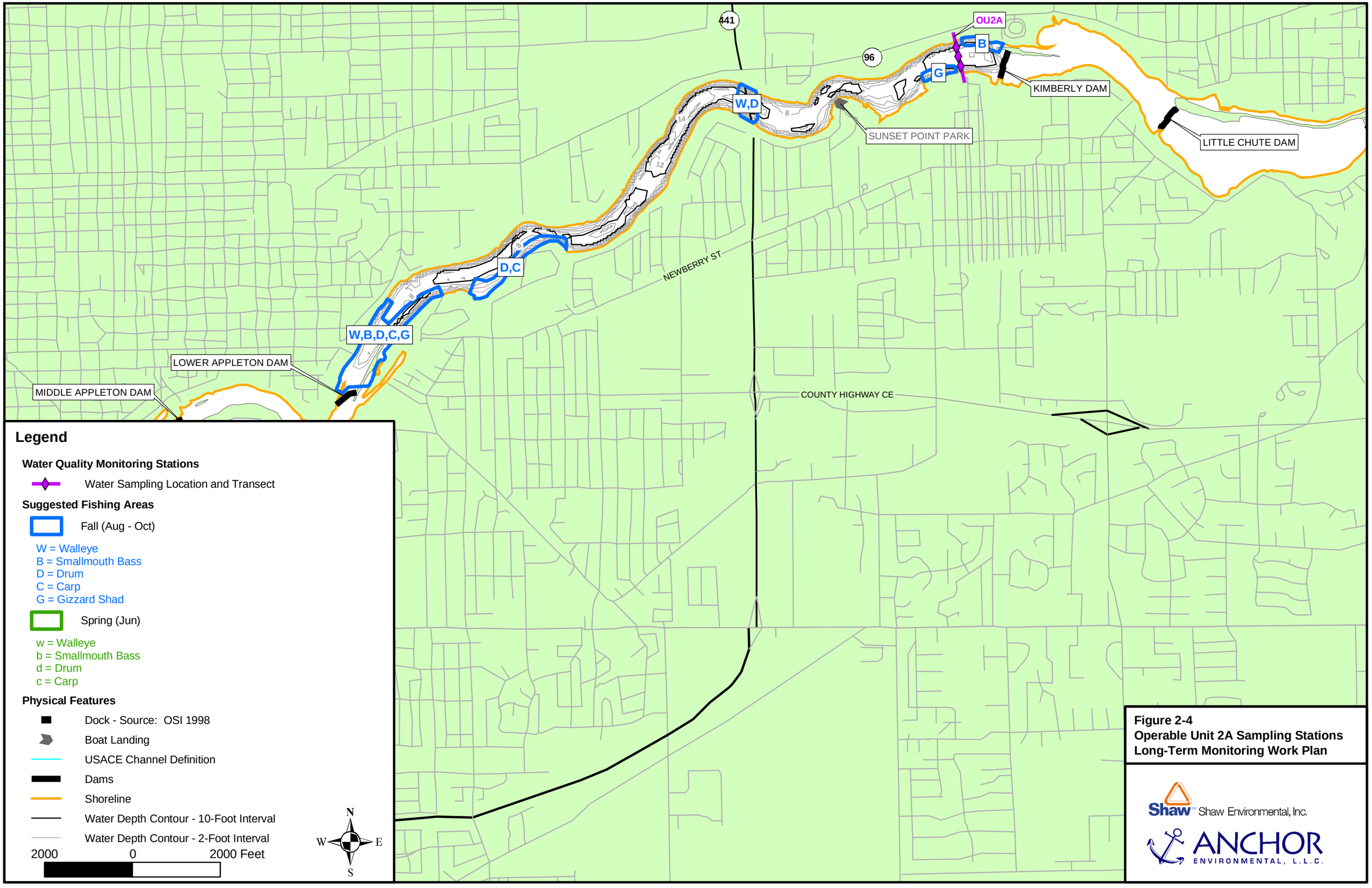

Figure 2-4
Operable Unit 2A Sampling Stations
Long-Term Monitoring Work Plan

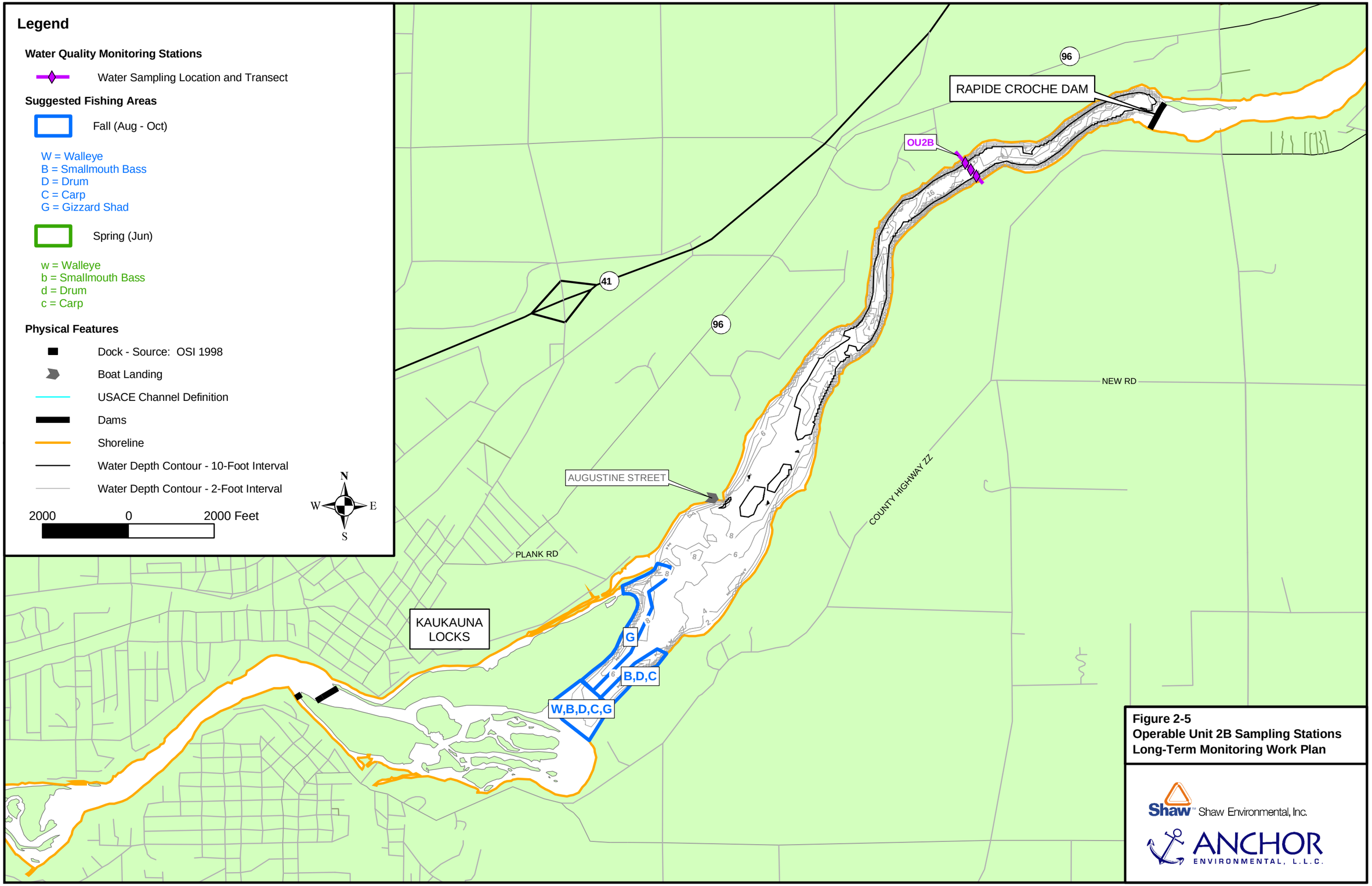

Figure 2-5
Operable Unit 2B Sampling Stations
Long-Term Monitoring Work Plan

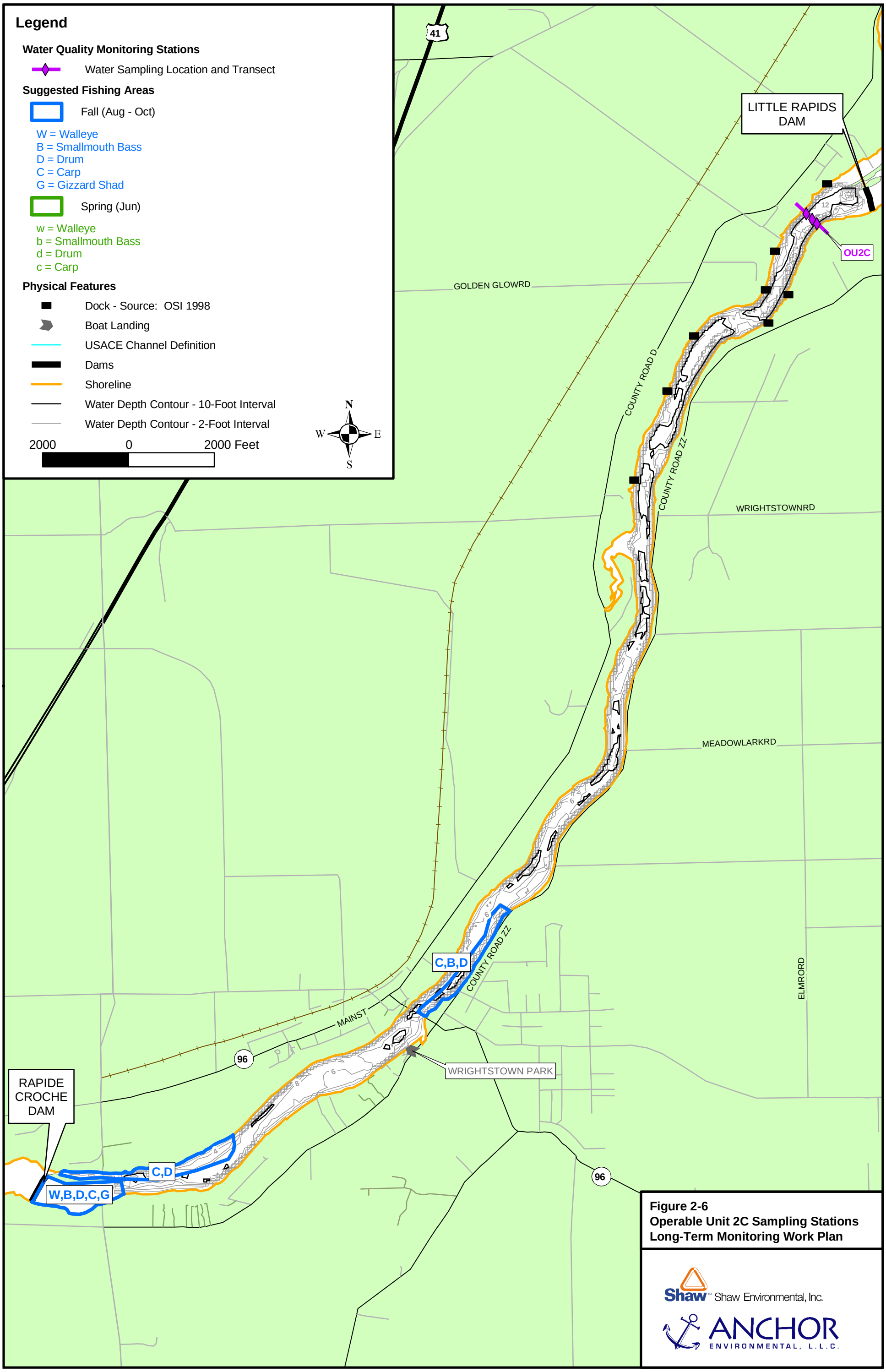

Figure 2-6
Operable Unit 2C Sampling Stations
Long-Term Monitoring Work Plan

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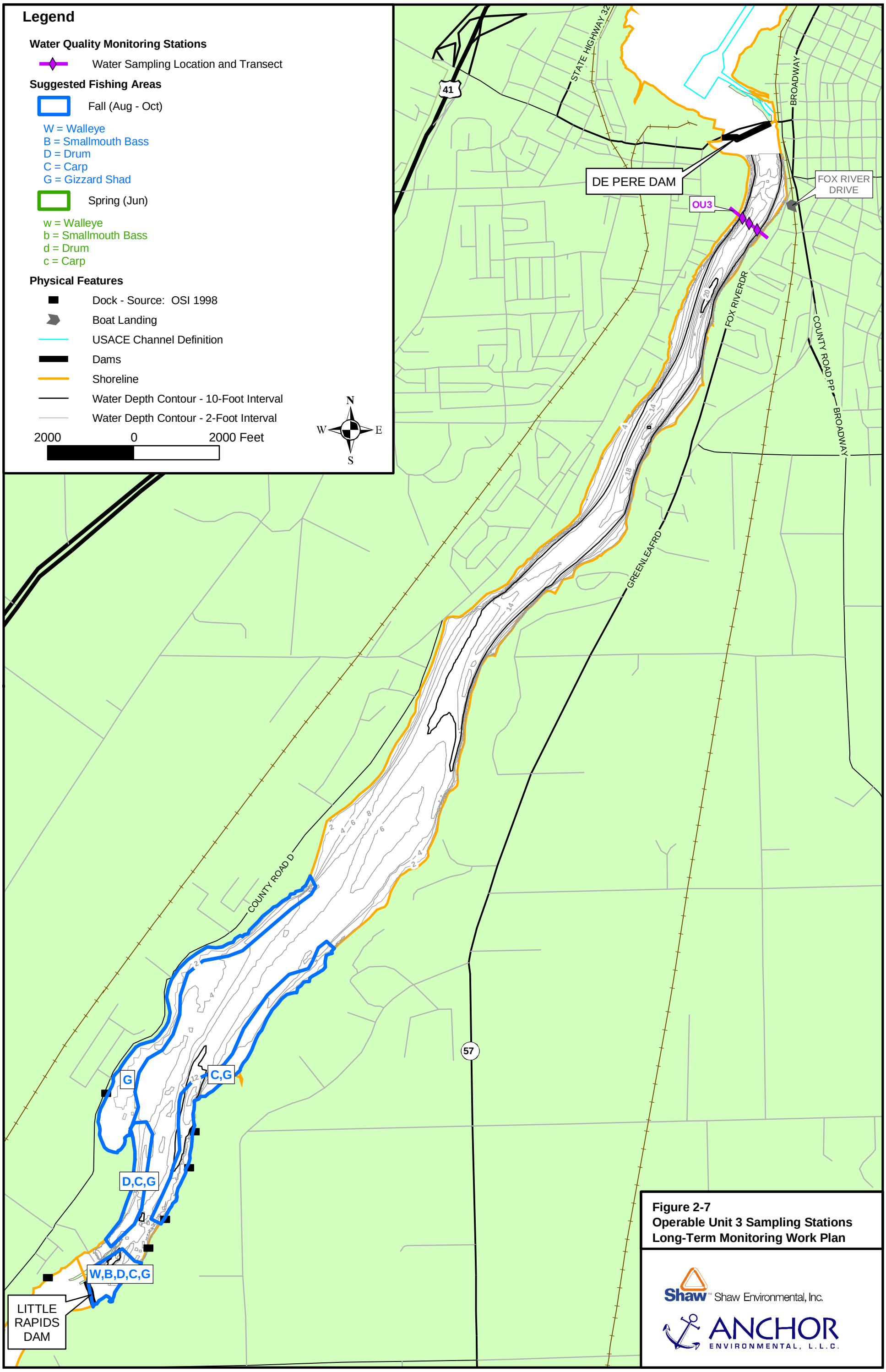

Figure 2-7
Operable Unit 3 Sampling Stations
Long-Term Monitoring Work Plan

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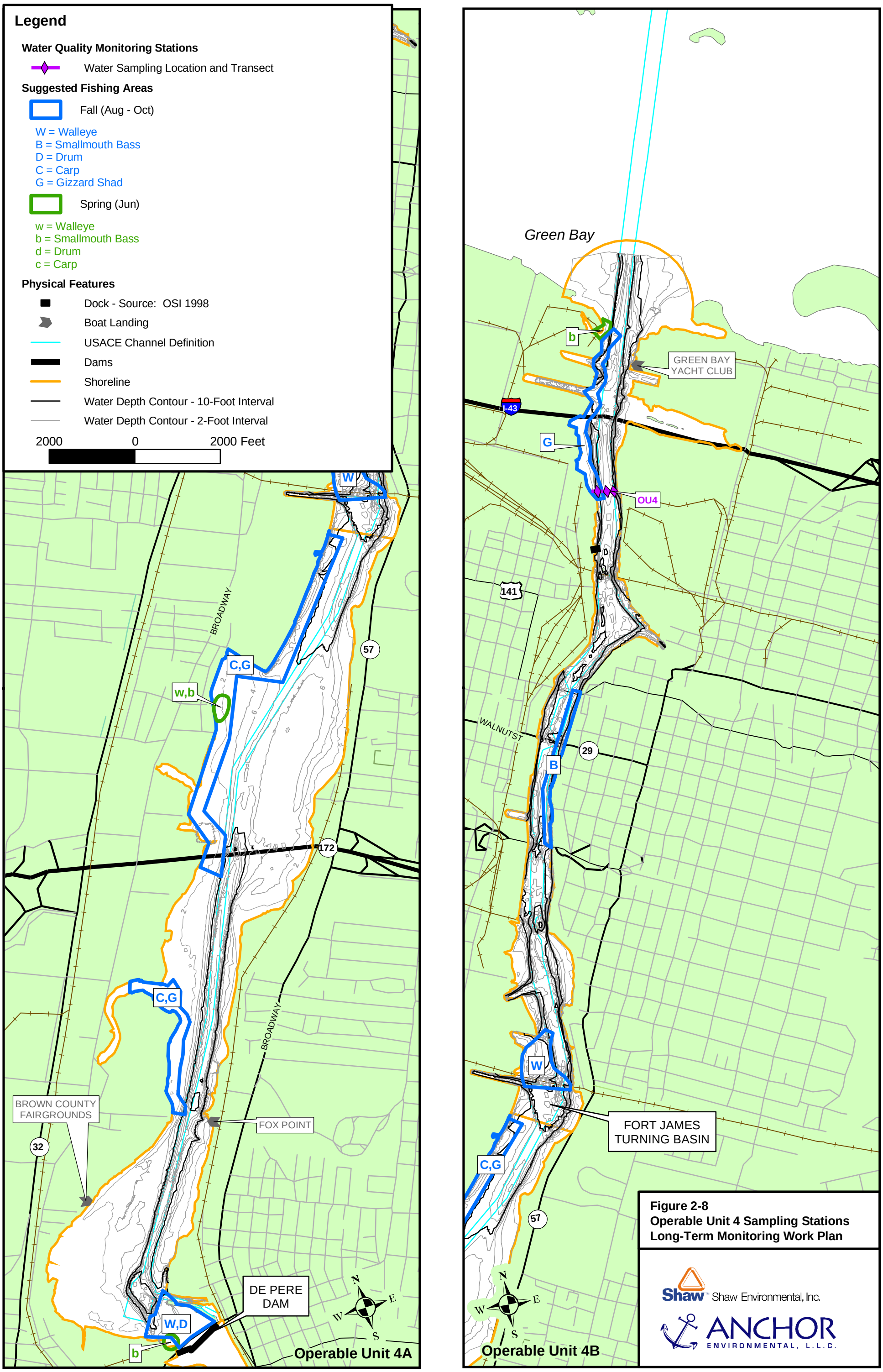

Figure 2-8
Operable Unit 4 Sampling Stations
Long-Term Monitoring Work Plan

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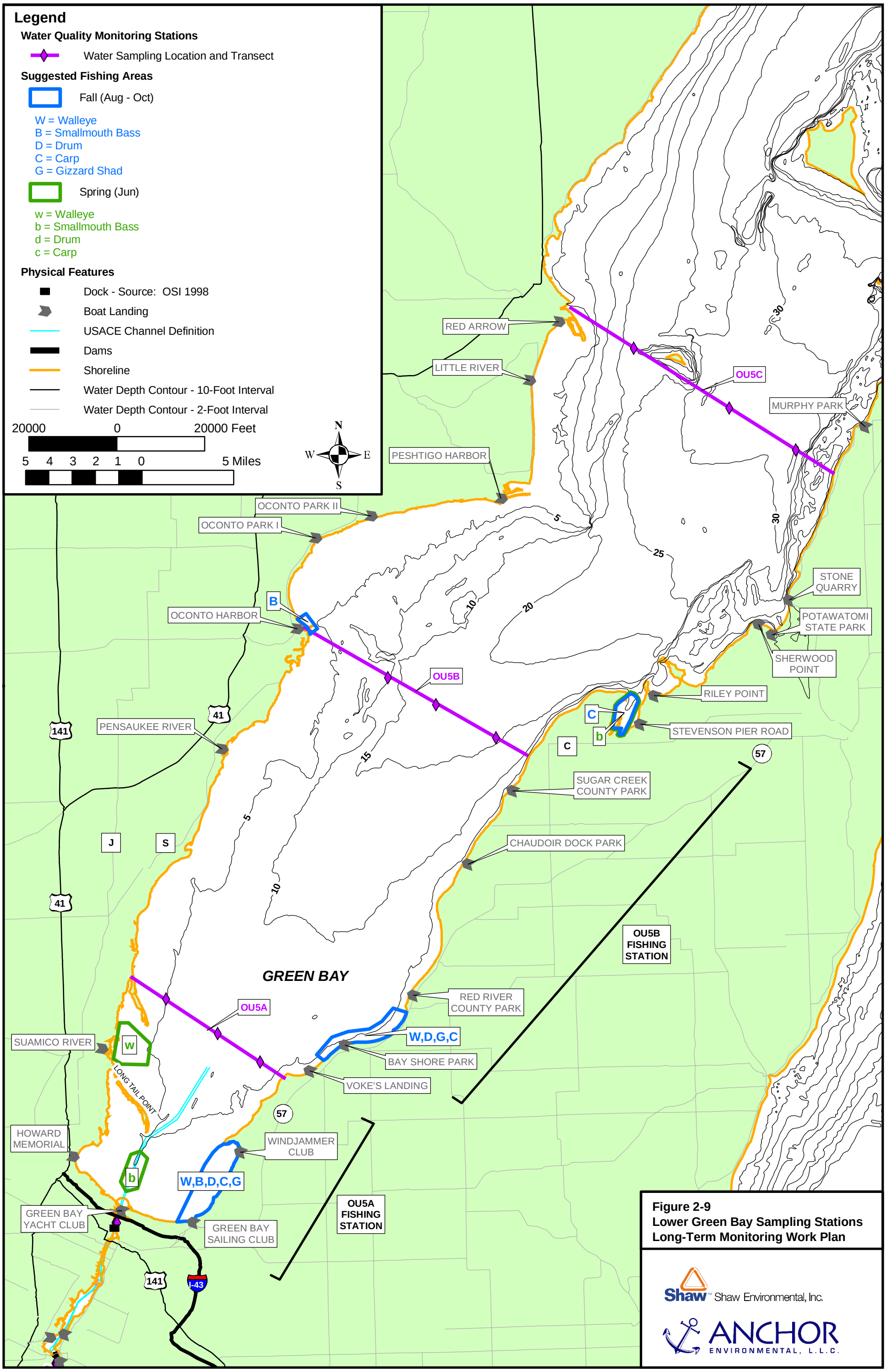

Figure 2-9
Lower Green Bay Sampling Stations
Long-Term Monitoring Work Plan

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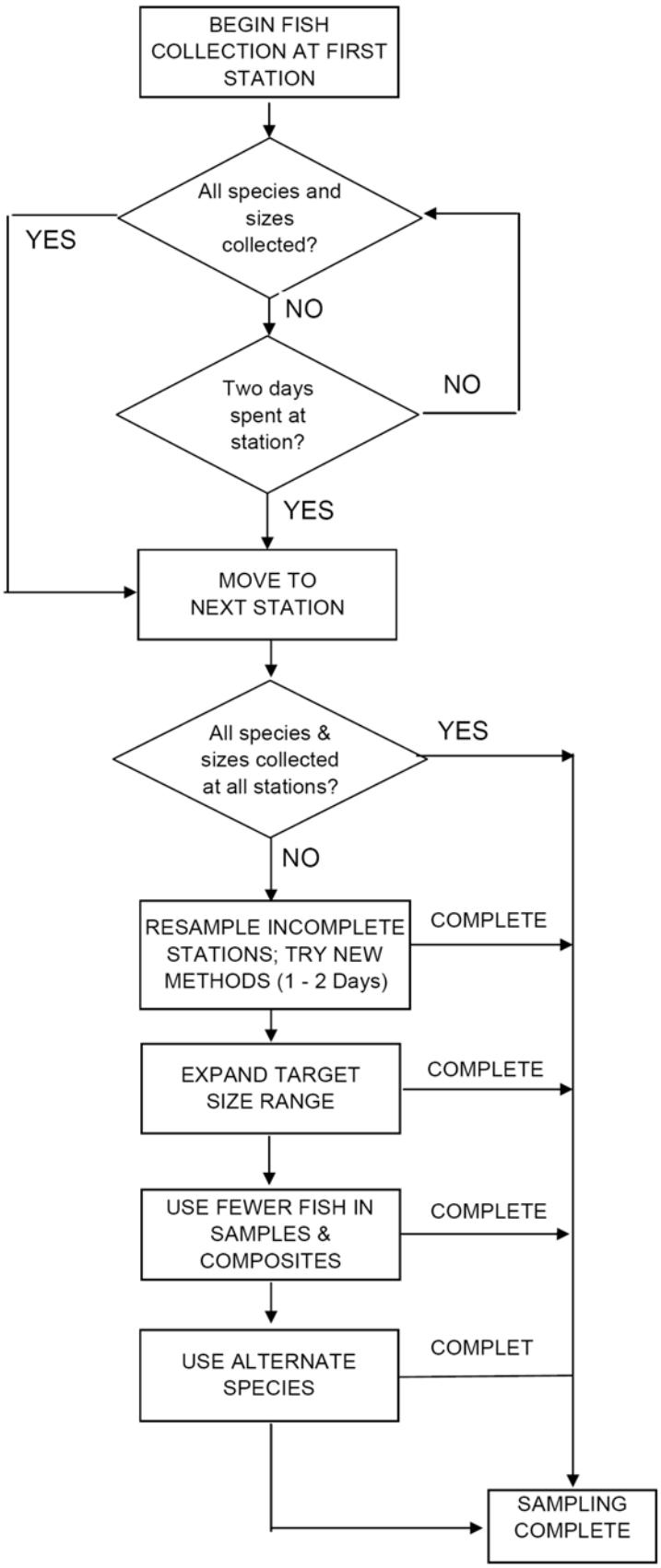

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Figure 3-1
Field Decision Flow Chart for Fish Sampling
Long-term Monitoring Plan
Lower Fox River Remedial Design

APPENDIX J

HEALTH AND SAFETY PLAN

SITE HEALTH AND SAFETY PLAN

VOLUME II

For the

IMPLEMENTATION OF THE REMEDIAL ACTION
2010 and Beyond Remedial Activities

At the

LOWER FOX RIVER
OPERABLE UNITS 2 THROUGH 5

In

Brown, Outagamie, and Winnebago Counties, Wisconsin

Prepared for:
Appleton Papers Inc.
Georgia-Pacific Consumer Products LP
NCR Corporation

For Submittal to:
Wisconsin Department of Natural Resources
U.S. Environmental Protection Agency

Prepared by

Tetra Tech EC, Inc.
Anchor Environmental
J. F. Brennan
Boskalis Dolman

June 2008

Table of Contents

Section **Page**

1.0 INTRODUCTION 1-1

1.1 PURPOSE 1-1
1.2 SITE DESCRIPTION 1-1
1.3 SITE BACKGROUND 1-2
1.4 SCOPE 1-2
1.5 APPLICATION 1-2
1.6 SUMMARY OF MAJOR RISKS 1-2
1.7 ZERO INCIDENT PERFORMANCE 1-2

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES 2-1

2.1 PROJECT MANAGER (PM) 2-1
2.2 CONSTRUCTION MANAGER (CM) 2-1
2.3 PROJECT ENVIRONMENTAL AND SAFETY MANAGER (PESM) 2-2
2.4 ENVIRONMENTAL AND SAFETY SUPERVISOR (ESS) 2-2
2.5 SITE PERSONNEL 2-3

3.0 POTENTIAL HAZARDS OF THE SITE 3-1

3.1 CHEMICAL HAZARDS 3-1
3.1.1 On-site Chemicals 3-1
3.1.2 Fuel 3-1
3.2 BIOLOGICAL HAZARDS 3-3
3.2.1 Insects and Other Arthropods 3-3
3.2.2 Snake Bites 3-5
3.2.3 Wild Animals 3-7
3.2.4 Poisonous Plants 3-7
3.2.5 Bloodborne Pathogens 3-7
3.3 PHYSICAL HAZARDS 3-8
3.3.1 Heavy Equipment Operations and Traffic Control Activities 3-8
3.3.2 Cranes 3-10
3.3.3 Lifting/Rigging 3-11
3.3.4 Sheet Pile Driving 3-12
3.3.5 Fall Protection 3-13
3.3.6 Work on or Around Water 3-15
3.3.7 Underground Utilities 3-15
3.3.8 Hot Work (torching, welding, cutting) 3-16
3.3.9 Heat/Cold Stress 3-16
3.3.10 Noise 3-19
3.3.11 Hand and Power Tools 3-19
3.3.12 Slips, Trips, and Falls 3-22
3.3.13 Manual Lifting 3-22

4.0 ACTIVITY HAZARD ANALYSES 4-1

5.0 PERSONAL PROTECTIVE EQUIPMENT 5-1

5.1 UPGRADE CONDITIONS 5-1
5.2 HAZARD ASSESSMENT FOR SELECTION OF PERSONAL PROTECTIVE EQUIPMENT 5-1

6.0 AIR MONITORING 6-1

6.1 INSTRUMENTATION 6-1
6.2 REAL-TIME AIR MONITORING 6-1

6.3 FREQUENCY AND LOCATION OF MONITORING 6-1
6.4 DATA QUALITY ASSURANCE 6-1
6.4.1 Calibration 6-1
6.4.2 Operations 6-1
6.4.3 Data Review 6-4
6.5 DUST CONTROL PLAN 6-4

7.0 ZONES, PROTECTION, AND COMMUNICATION 7-1

7.1 SITE ZONE 7-1
7.2 CONTAMINATION CONTROL 7-1
7.2.1 Personnel Decontamination Station 7-1
7.2.2 Minimization of Contact with Contaminants 7-2
7.2.3 Personnel Dry Decontamination Sequence 7-2
7.2.4 Heavy Equipment Decontamination 7-2
7.3 COMMUNICATION 7-2

8.0 MEDICAL SURVEILLANCE PROCEDURES 8-1

8.1 MEDICAL SURVEILLANCE REQUIREMENTS 8-1
8.2 MEDICAL DATA SHEET 8-1
8.3 SUBCONTRACTOR MEDICAL SURVEILLANCE AND QUALIFICATIONS 8-1
8.3.1 Hazardous Waste Operations and Emergency Response 8-1

9.0 SAFETY CONSIDERATIONS 9-1

9.1 GENERAL HEALTH AND SAFETY WORK RULES 9-1
9.2 GENERAL CONSTRUCTION HAZARDS 9-1
9.3 HIGH LOSS POTENTIAL HAZARDS 9-1

10.0 EMERGENCY RESPONSE AND CONTINGENCY PLAN 10-1

10.1 RESPONSIBILITIES 10-1
10.1.1 Project Environmental and Safety Manager (PESM) 10-1
10.1.2 Environmental and Safety Supervisor (ESS)/Emergency Coordinator (EC) 10-1
10.1.3 Construction Manager (CM) 10-1
10.1.4 Site Personnel 10-1
10.2 COMMUNICATION 10-2
10.2.1 Cell Phone/Radio Communication 10-2
10.2.2 Hand Signals 10-2
10.2.3 Audio Signals 10-2
10.3 LOCAL EMERGENCY SUPPORT UNITS 10-2
10.4 PRE-EMERGENCY PLANNING 10-2
10.5 EMERGENCY DRILLS 10-5
10.5.1 General Site Emergencies 10-5
10.5.2 Marine Emergencies 10-5
10.6 EMERGENCY MEDICAL TREATMENT 10-5
10.7 EMERGENCY AND NON-EMERGENCY RESPONSE 10-6
10.7.1 Emergency Response 10-6
10.7.2 Serious Injury to Personnel on the Water 10-7
10.7.3 Person in Water (Overboard) 10-7
10.7.4 Non-Emergency Response 10-9
10.7.5 After Emergency and Non-emergency Treatment 10-9
10.8 EMERGENCY SITE EVACUATION ROUTES AND PROCEDURES 10-10
10.9 FIRE PREVENTION AND PROTECTION 10-10
10.10 CHEMICAL EXPOSURE 10-11
10.11 ACCIDENT/INCIDENT REPORTING 10-11
10.12 ADVERSE WEATHER CONDITIONS 10-11
10.12.1 Thunder Storms, Squalls, and Short Duration Wind Storms 10-12
10.12.2 Special Marine Considerations 10-12

10.13 SPILL CONTROL AND RESPONSE 10-14
10.13.1 Notification Requirements 10-15
10.13.2 Minor Spill Less than RQ 10-17
10.13.3 Large Spills Above the RQ 10-17
10.14 UNDERGROUND UTILITIES 10-17
10.14.1 Encountering Underground Utilities 10-18
10.14.2 Contacting Underground Utilities 10-18
10.15 EMERGENCY EQUIPMENT 10-19
10.15.1 Marine Emergency Equipment 10-19
10.15.2 Lifesaving Skiffs 10-21
10.15.3 Flotation Devices 10-23
10.16 POSTINGS 10-23
10.17 RESTORATION AND SALVAGE 10-24

11.0 TRAINING 11-1

11.1 GENERAL HEALTH AND SAFETY TRAINING 11-1
11.2 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE TRAINING 11-1
11.3 INITIAL TRAINING 11-1
11.4 THREE-DAY ACTUAL FIELD EXPERIENCE 11-1
11.5 REFRESHER TRAINING 11-1
11.6 SITE-SPECIFIC HEALTH AND SAFETY TRAINING 11-1
11.7 ON-SITE SAFETY BRIEFINGS 11-2
11.8 FIRST AID AND CPR 11-2
11.9 HAZARD COMMUNICATION 11-2
11.10 TSCA AND PCB AWARENESS 11-2

12.0 LOGS, REPORTS AND RECORDKEEPING 12-1

12.1 FIELD CHANGE REQUEST 12-1
12.2 MEDICAL AND TRAINING RECORDS 12-1
12.3 ON-SITE LOG AND VISITOR LOG 12-1
12.4 WEEKLY SAFETY REPORTS 12-1
12.5 EHS INSPECTIONS 12-1
12.6 ACCIDENT/INCIDENT REPORTS 12-1
12.7 HAZARD COMMUNICATION PROGRAM/MSDS 12-1

13.0 FIELD PERSONNEL REVIEW 13-1

14.0 REFERENCES 14-1

List of Tables

Table **Page**
TABLE 3-1. CHEMICAL DATA 3-2
TABLE 3-2. PROGRESSIVE CLINICAL SYMPTOMS OF HYPOTHERMIA 3-18
TABLE 5-1. PERSONAL PROTECTIVE EQUIPMENT SELECTION 5-2
TABLE 6-1. REAL TIME AIR MONITORING ACTION LEVELS 6-2
TABLE 6-2. FREQUENCY AND LOCATION OF AIR MONITORING 6-3
TABLE 10-1. EMERGENCY (AND NON-EMERGENCY) TELEPHONE NUMBERS 10-3
TABLE 10-1. EMERGENCY (AND NON-EMERGENCY) TELEPHONE NUMBERS (CONTINUED) 10-4
TABLE 10-2. SITE CONTACT NUMBERS 10-5
TABLE 10-3. RELEASE NOTIFICATION REQUIREMENTS AND CONTACT INFORMATION 10-16

List of Appendices

Appendix A Health and Safety Forms
Appendix B Biological Hazards
Appendix C Activity Hazard Analyses
Appendix D Heavy Equipment Inspection Forms
Appendix E Handbook of Wisconsin Boating Laws and Responsibilities
Appendix F Hospital and WorkCare Facility Location Maps

SITE HEALTH AND SAFETY PLAN

Site:	**Lower Fox River, Operable Units 2 through 5**
Location:	**Brown, Outagamie, and Winnebago Counties, Wisconsin**
Prepared By:	**Tetra Tech EC, Inc.**
Date Prepared:	**May 2008**
Project Description:	**Volume II – 2010 and Beyond Site Activities**

TETRA TECH EC, INC., TETRA TECH SUBCONTRACTORS, AND TETRA TECH'S CLIENT DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS.

APPROVALS

By their signature, the undersigned hereby certify that this Site Health and Safety Plan has been reviewed and approved for use at the Lower Fox River, OUs 2 through 5 for the 2010 and beyond activities.

Donald Ray Mangrum Project Manager	Date
Grey Coppi, C.I.H. Project Environmental and Safety Manager	Date
Mike Estess Construction Manager	Date
William Welch Environmental and Safety Supervisor	Date

1.0 INTRODUCTION

1.1 PURPOSE

This Site Health and Safety Plan (SHSP) addresses the health and safety practices that will be employed by all site workers participating in 2010 and beyond remedial activities at the Lower Fox River, Operable Units (OUs) 2 through 5 as identified by the Records of Decision (RODs). The health and safety practices for the 2008 and 2009 remedial activities are addressed in the Volume I SHSP. The remedial action (RA) activities are in response to the two RODs (December 2002 and June 30, 2003) and ROD Amendment (June 26, 2007) issued by the U.S. Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR). The SHSP takes into account the hazards inherent to the planned construction/marine activities. This SHSP also presents procedures to be followed by Tetra Tech EC, Inc. (TtEC), its subcontractors, and all other on-site personnel in order to avoid and, if necessary, protect against health and/or safety hazards. This document is to be used in conjunction with the Work Plans and will be supplemented with Site Specific Health and Safety Plans developed for each phase of the RA.

Activities performed under this SHSP will comply with applicable parts of Occupational Safety and Health Administration (OSHA) Regulations, primarily 29 Code of Federal Regulations (CFR) Parts 1910 and 1926, and TtEC's Environmental Health and Safety (EHS) Program. In addition, since the majority of site activities are being performed on or adjacent to water, they must also comply with 29 CFR 1917 Marine Terminals and the U.S. Coast Guard regulations. Many programs from the EHS Program are referenced in this SHSP and are included in the appendices. Modifications to the SHSP may be made with the approval of the Project Environmental and Safety Manager (PESM) for this project using the Field Change Request (FCR) Form found in Appendix A.

1.2 SITE DESCRIPTION

The project study area includes the Lower Fox River and Green Bay aquatic systems. Approximately 270,000 people live in the communities along the river. The Lower Fox River is located in northeastern Wisconsin within the eastern ridges and lowlands of the state. The Lower Fox River is defined as the 39-mile portion of the Fox River, beginning at the outlet of Lake Winnebago and terminating at the mouth of the river into Green Bay, Lake Michigan. The river flows north and drains approximately 6,330 square miles, making it a primary tributary to Green Bay and a part of the Great Lakes system. Green Bay is a freshwater system approximately 120 miles long which drains into Lake Michigan, and is located on the state border between Wisconsin and Michigan along a northeast- to southwest-trending axis. The bay portion of the site includes all of Green Bay from the city of Green Bay to the point where Green Bay enters Lake Michigan. The site has been divided into five discrete OUs by the WDNR and the USEPA. The river and the bay operable units are:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay

- OU 5 – Green Bay

The river has 12 dams and includes the highest concentration of pulp and paper mills in the world. During the 1950s and 1960s, these mills routinely used polychlorinated biphenyls (PCBs) in their operations, which ultimately contaminated the river.

1.3 SITE BACKGROUND

Historic discharges of PCBs from municipal, industrial, and agricultural sources in the Lower Fox River region have degraded sediment and water quality and adversely impacted the ecology of the river and bay. PCBs in the Lower Fox River pose the major potential threat to human health and ecological receptors due to their tendency to absorb to sediments, persist in the environment, and bioaccumulate in aquatic organisms. Contaminated sediments acting as "sinks" for PCBs and other contaminants are also subject to physical and chemical processes that affect the overlying water column and adjoining water bodies in natural (uncontrolled) environments. For example, PCBs from sediment in the Lower Fox River are discharged into Green Bay at the mouth of the river through sediment transport and PCB dissolution in the water column.

1.4 SCOPE

This SHSP has been developed to address health and safety concerns when implementing the 2010 and beyond activities at the Lower Fox River. This SHSP and a copy of the work plan will be available onsite for review and reference during the entire course of each project. The majority of the activities that will be performed in 2010 and beyond include full-scale dredging operations of both TSCA and non-TSCA materials, sediment capping and cover material placement, dewatering operations, wastewater treatment plant operations, sheet pile installation (potential) and transportation and disposal (T&D) of dewatered sediments.

1.5 APPLICATION

The SHSP applies to all personnel involved in site tasks who wish to gain access to active work areas, including but not limited to:

- Client representatives
- Federal, state or local representatives
- TtEC employees and subcontractors
- Other project visitors

1.6 SUMMARY OF MAJOR RISKS

- Work on/ and around water
- Heavy equipment hazards
- Slips, trips, and falls
- Exposure to PCBs

1.7 ZERO INCIDENT PERFORMANCE

Zero Incident Performance (ZIP) describes our approach and expectations for both safety and project execution. We will achieve this level of performance excellence through teamwork and

partnering with our client and our subcontractors, and through the participation of every person on this project.

We (TtEC and our client) believe that:

- All incidents are preventable through proper planning, tasking, and execution of plans as written.
- Any goal besides *Zero Incident Performance* is unacceptable and sends the message that incidents cannot be prevented and that losses are tolerated. Incidents are defined as OSHA recordables, property damage cases, fires, explosions, spills or releases to the environment and safety-related work stoppages. In addition, an incident includes an event which could have resulted in one of these outcomes had the circumstances been different ("near miss").
- Active participation by all personnel is required to achieve *Zero Incident Performance*. This includes TtEC, the client, and all Subcontractor personnel.
- Each person on this project is individually responsible and accountable for their safety performance.
- If <u>any</u> incident does occur, it must be reported and investigated to identify root causes, take corrective actions, and communicate the lessons learned.

All TtEC and Subcontractor personnel will sign a *ZIP* pledge poster affirming their belief in and commitment to *ZIP*. The *ZIP* Banner will be posted conspicuously at the project site and the hours worked without a loss time incident will also be posted. The TtEC EHS will continually evaluate planning and project execution to ensure that *ZIP* is embedded in the work process. In addition, awareness programs are utilized to assist in implementation of our *ZIP* initiative.

A subcontractor, after award of a contract, shall be required to attend a pre-construction Health and Safety Orientation meeting. This meeting will involve the subcontractor's key personnel, and will cover such items as *ZIP* expectations and the Employee Participation Program (EPP).

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section outlines the TtEC Project Organization and responsibilities for the site activities.

2.1 PROJECT MANAGER (PM)

The Project Manager is Mr. Ray Mangrum for the implementation of the 2010 and beyond activities. It is the responsibility of the Project Manager to:

- Provide the major point of control to ensure that the program's technical, financial and scheduling objectives are achieved.
- Coordinate problem resolution/corrective action implementation.
- Ensure implementation of this program through coordination with the responsible Project Environmental and Safety Manager (PESM).
- Conduct periodic inspections.
- Participate in all incident investigations.
- Ensure the SHSP has all of the required approvals before any site work is conducted.
- Ensure that the PESM or Environmental and Safety Supervisor (ESS) is informed of project changes which require modifications of the SHSP.
- Have overall project responsibility for Project Health and Safety.

2.2 CONSTRUCTION MANAGER (CM)

The Construction Manager is Mr. Mike Estess for the implementation of the 2010 and beyond activities. It is the responsibility of the CM to:

- Lead the day-to-day activities at the site, including team management, field operations, and report development.
- Ensure that the SHSP is implemented in conjunction with the designated PESM and ESS.
- Ensure that field work is scheduled with adequate personnel and equipment resources to complete the job safely.
- Ensure that adequate communication between field crews and emergency response personnel is maintained.
- Ensure that field site personnel are adequately trained and qualified to work at the site.
- Enforce site health and safety rules.
- Investigates all incidents.
- Assist in conducting and documenting daily safety briefings.
- Conduct weekly site inspections.
- Act as the alternate Emergency Coordinator.

2.3 PROJECT ENVIRONMENTAL AND SAFETY MANAGER (PESM)

The PESM is a senior Health & Safety staff member with experience in hazardous and non-hazardous waste site investigations, remediation, mitigation, and construction activities. The PESM for TtEC for the 2010 and beyond activities is Mr. Grey Coppi, CIH. Mr. Coppi's responsibilities include the following:

- Provide for the development and approval of the SHSP.
- Serve as the primary contact to review health and safety matters that may arise.
- Approve revised or new safety protocols for field operations.
- Approve individuals who are assigned ESS responsibilities.
- Approve ESS to fulfill other project roles.
- Coordinate revisions of this SHSP with field personnel.
- Coordinate upgrading or downgrading of personal protective equipment with the ESS.
- Assist in the investigation of all accidents.
- Conduct quarterly inspections for compliance with the SHSP and safety elements of the Construction Management Plan.

2.4 ENVIRONMENTAL AND SAFETY SUPERVISOR (ESS)

The ESS is a person knowledgeable in appropriate safety and health regulations with at least one year of experience or specialized training in serving in a health and safety (H&S) staff role on hazardous waste or non-hazardous sites. The ESS is Mr. Bill Welch for the 2010 and beyond activities. The ESS has the following responsibilities:

- Works as a member of the project team to ensure implementation of the SHSP.
- Ensures that all health and safety activities identified in the SHSP are conducted and/or implemented.
- Identifies operational changes which require modifications to health and safety procedures and the site safety plan, and ensures that the procedure modifications are implemented and documented through changes to the SHSP.
- Directs and coordinates health and safety monitoring activities.
- Ensures that proper personal protective equipment (PPE) is utilized by field teams.
- Assists in conducting and documenting daily safety briefings.
- Monitors compliance with this SHSP.
- Notifies PESM of all incidents.
- Coordinates with the Project Manager in any incident investigation.
- Maintains Incident Report Forms.
- Determines upgrade or downgrade of PPE based on site conditions.
- Reports to PESM to provide summaries of field operations and progress.

- Acts as the Emergency Coordinator.
- Maintains health and safety field log books.
- Displays/maintains postings and handbooks such as:
  - OSHA Job Safety and Health Poster
  - OSHA Noise Regulation
  - Department of Labor Postings (Minimum wage, fair labor standards)
  - Hazard Warning Signs
  - Noise Hazard Warning Sign
  - Do It Right Poster
  - Client Service Quality (CSQ) Poster
  - TtEC Shared Vision
  - TtEC Mission Statement
  - TtEC Hot Line Poster
  - TtEC Work Rules
  - TtEC Environmental Safety Quality (ESQ) Policy Poster
  - Zero Incident Performance (ZIP) Bulletins
  - Flash reports
  - Emergency telephone numbers
  - Diagrams showing the location of fire extinguishers and emergency equipment
  - Emergency exit, evacuation routes and staging area
  - Project Rules Handbook

2.5 SITE PERSONNEL

Site personnel include all other persons entering the site for the purpose of assisting in the completion of the project. This includes but is not limited to client representatives, subcontractors, regulatory personnel, and site workers. It is the responsibility of all site personnel to:

- Report any unsafe or potentially hazardous conditions to the ESS and/or CM.
- Maintain knowledge of the information, instructions, and emergency response actions contained in the SHSP.
- Comply with rules, regulations, and procedures as set forth in this SHSP and any revisions.
- Prevent admittance to work sites by unauthorized personnel.
- Inspect all tools and equipment daily, including PPE, prior to use.

3.0 POTENTIAL HAZARDS OF THE SITE

This section presents an assessment of the chemical, biological, and physical hazards that may be encountered during the site activities at the Lower Fox River project.

3.1 CHEMICAL HAZARDS

3.1.1 On-site Chemicals

Activities will be performed on and around the Lower Fox River whose sediments are known to be contaminated with PCBs some areas with concentrations greater than 50 parts per million (ppm). Worker exposure to PCBs would occur primarily through physical contact, ingestion, or inhalation of contaminated sediments. Potential worker exposure will be primarily during the dewatering operations and transportation and disposal (T&D) activities. There is minimal to no contact using proposed methods to dredge contaminated sediments, and therefore worker exposure to PCBs is not considered a risk. For activities (i.e., dewatering operations and T&D) where exposure through inhalation is expected to be of concern, air monitoring procedures have been established in Section 6.0. Public protection during these activities is addressed in the *Community Health and Safety Plan.* In general, standard safe work practices, good hygiene, and proper PPE will minimize if not eliminate exposure to PCBs via physical contact or ingestion.

Table 3-1 lists the OSHA and/or the American Conference of Governmental Industrial Hygienists (ACGIH) worker exposure limits for PCBs. Also listed are significant physical and chemical data and symptoms of exposure. In addition, potential chemicals brought on-site may pose a potential exposure hazard to site workers. Material Safety Data Sheets (MSDSs) will be made available to site personnel for all chemicals brought on-site and the SHSP will be amended as appropriate.

3.1.2 Fuel

Any fuel stored onsite must meet TtEC's Procedure for Hazardous Material Storage and Transportation (EHS 3-7). Only Underwriters Laboratories (UL) approved metal flammable liquid storage containers will be used at the project site with the exception of outboard motor gas which will be in approved plastic gas tanks. All fuel storage containers will be labeled properly (i.e., Flammable and Diesel/Gasoline) in accordance with the National Fire Protection Association (NFPA). Bulk storage containers will be stored in secondary containment that meets 110 percent of the largest container or double wall storage tanks may be used instead of secondary containment. A properly rated fire extinguisher will be located adjacent to the fuel storage facility. The tank and containment will be inspected regularly (i.e., during the weekly EHS Inspections or monthly if double walled tanks are used) to verify that it is in good condition and that rainwater is emptied from the containment area. MSDSs for onsite fuels will be made available to all site personnel. When refueling, personnel will place a drip pan or spill pads underneath the pump to catch any spillage or overflow.

Table 3-1. Chemical Data

Chemical CAS No.	ACGIH TLV	OSHA PEL	OSHA IDLH	Routes of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Polychlorinated Biphenyls (as Aroclor 1242) 53469-21-9	1 mg/m^3	1 mg/m^3	5 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Skin, eyes, liver, reproductive system	BP: 617-691°F Sp. Gr: 1.39 Insoluble Solid
Polychlorinated Biphenyls (as Aroclor 1254) 11097-69-1	0.5 mg/m^3	0.5 mg/m^3	5 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Skin, eyes, liver, reproductive system	BP: 689-734°F Sp. Gr: 1.38 Insoluble Solid

3.2 BIOLOGICAL HAZARDS

3.2.1 Insects and Other Arthropods

Insects, including bees, wasps, hornets, and spiders, may be present at this site making the chance of a bite or sting possible. Although some of the insects or other arthropods may not be common in the area, care must be taken on equipment that is brought in from other parts of the country. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life threatening condition.

3.2.1.1 Insects

The ESS will instruct the field crew in the recognition and procedures for encountering poisonous insects at the site. Additionally, any individuals who have been bitten or stung by an insect will notify the ESS. The following is a list of preventive measures:

- Apply insect repellent prior to fieldwork and as often as needed throughout the work shift. Apply DEET (vapor-active repellent) to any exposed skin surface (except eyes and lips), and apply the permethrin repellent spray to field clothing. Note: Allow the permethrin to dry before using the treated clothing.
- Wear proper protective clothing (work boots, socks and pants).
- Field personnel who may have insect allergies will provide this information to the ESS prior to commencing work, and shall have allergy medication on site.

Mild insect bites should be treated by applying a baking soda paste or ice wrapped in a wet cloth. Bee stingers should be gently scraped off the skin, working from the side of the stinger. The suction device in commercially available snakebite kits can also be used to remove the stinger. If insect bites become red or inflamed or symptoms such as nausea, dizziness, shortness of breath, etc., appear, medical care will be sought. Immediate care is needed if a person is allergic to insect bites/stings. If an allergic person receives a spider bite or insect bite/sting, seek immediate medical attention, keep the victim calm, and check vital signs frequently. Rescue breathing should be given if necessary to supply oxygen to the victim.

3.2.1.2 Spiders

Various spiders may be encountered at Lower Fox River, however, only one spider in the area is poisonous—the Black Widow. The Black Widow spider varies from dark brown to black in color. Its body is one-quarter inch wide and overall size is one and one-quarter inches with legs extended. Only the female is poisonous and can be determined by the red or yellow hourglass marking the underside of the abdomen. The victim will experience the following if a Black Widow spider has bitten them:

- The spider's bite will feel like a sharp pinprick or may not even be noticed at all. In 15 minutes or less, the person will feel a dull numbing pain in the bitten area. A faint red bite mark appears.
- **Black Widow** – If the bite is in the lower part of the body or legs, the victim will have muscle stiffness or cramps in their abdomen. If the bite is on the upper body or arms, the victim will have muscle stiffness or cramps affecting the shoulders, back, or chest. Additionally, the victim may experience headache, chills, fever, heavy sweating, dizziness, nausea, vomiting, and severe abdominal pain.

First aid procedures for a Black Widow bite are as follows:

- Clean the bitten area with soap and water or rubbing alcohol. Do not apply a constricting band because the Black Widow venom's action is swift; there is little to be gained by trying to slow absorption with a constriction band.
- To relieve pain, place an ice pack over the bite.
- Keep the victim quiet and monitor breathing.
- Seek immediate medical attention.
- If possible, catch the spider to confirm its identity, even if the body is crushed.

3.2.1.3 Ticks

Both Lyme disease and Rocky Mountain Spotted Fever (RMSF) are caused by bites from infected ticks that are common in and near wooded areas, tall grass, and brush. Ticks are small, ranging from the size of a comma up to about one-quarter inch. When embedded into the skin, they may resemble a small freckle. Tick season extends from spring through summer, but may extend year-round in areas without significant cold weather.

3.2.1.3.1 Lyme Disease

Lyme disease is caused by infection from a deer and lone star ticks that carries a spirochete. Deer ticks range in size from approximately one-eighth inch to one-quarter inch and can be black or brick red in color. Lone star ticks are larger and chestnut brown in color. During the painless tick bite, the spirochete may be transmitted into the bloodstream, which could lead to the worker contracting Lyme disease. Lyme disease may cause a variety of medical conditions including arthritis, which can be treated successfully if the symptoms are recognized early and medical attention is received. Treatment with antibodies has been successful in preventing more serious symptoms from developing. The effects of the disease vary from person to person, which often makes it difficult to diagnose. Typically, the incubation period ranges from 2 days to 2 weeks. Early signs may include a flu-like illness, an expanding skin rash and joint pain. If left untreated, Lyme disease can cause serious nerve or heart problems as well as a disabling type of arthritis.

Symptoms can include a stiff neck, chills, fever, sore throat, headache, fatigue and joint pain. This flu-like illness is out of season, commonly happening between May and October when ticks are most active. A large expanding skin rash usually develops around the area of the bite. More than one rash may occur. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. It is easy to miss the rash and the connection between the rash and a tick bite. The rash develops from 3 days to as long as a month after the tick bite. Almost one third of those with Lyme disease never get the rash. Joint or muscle pain may be an early sign of Lyme disease. These aches and pains may be easy to confuse with the pain that comes with other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

Lyme disease can affect the nervous system. Symptoms include stiff neck, severe headache, and fatigue usually linked to meningitis. Symptoms may also include pain and drooping of the muscles on the face, called Bell's Palsy. Lyme disease may also mimic symptoms of multiple sclerosis or other types of paralysis. Lyme disease can also cause serious but reversible heart

problems, such as irregular heartbeat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Often, the effects of Lyme disease may be confused with other medical problems.

3.2.1.3.2 Rocky Mountain Spotted Fever

RMSF is an infection caused by rickettsia bacteria carried by the dog tick in the eastern United States and by the wood tick in the Rocky Mountain states. The lone star tick is also, though rarely, a carrier in the West. It is not as likely that personnel working at the Lower Fox River site will contract RMSF; however, information on RMSF has been included as a precautionary measure. The signs and symptoms of RMSF may follow within 1–14 days of a tick bite. But in many cases, someone who develops the infection does not remember being bitten by a tick. Symptoms of RMSF usually begin suddenly. There is a high fever, often 103 ºF (39 ºC) to 105 ºF (40 ºC); chills; muscle aches; and a severe headache that may center on the forehead area. Eyes may become red, muscles may be tender to the touch, and there may be generalized body swelling.

The rash may begin anytime between 1–10 days after the fever and headache start, but it most often appears on the third to fifth day. The rash looks like small red spots or blotches that begin on the wrists, ankles, palms, and soles. It spreads up the arms and legs toward the trunk, but often spares the face. As the infection progresses, the original red spots may change in appearance to look more like bruises or bloody patches under the skin. Rarely, RMSF may cause either mild symptoms or no symptoms at all. Usually it causes a moderate to severe illness that can damage the liver, kidneys, and lungs.

3.2.1.3.3 Prevention

Control measures to prevent contracting Lyme disease and RMSF include:

- Avoid dense or high brush, when possible.
- Wear light colored clothing.
- Spray DEET on your skin and permethrin on clothing and work boots.
- Tuck pant legs into socks and shirts into gloves, if possible.
- Self/Buddy check of neck, hairline, groin, and body after working in areas that may contain deer ticks. Shower immediately after returning home from the job site.

If a tick is found biting an individual, the ESS will be contacted immediately. The tick can be removed by grasping the tick with tweezers as close to the skin as possible, and pulling gently or using a tick removal system (e.g., Pro-Tick, www.scs-mall.com/store/). The affected area should then be disinfected with alcohol or similar antiseptic. If personnel feel sick or have signs similar to those above, they will notify the ESS immediately. Additionally, employees finding engorged ticks on their body will be given a medical examination.

3.2.2 Snake Bites

There are only two species of poisonous snakes living in the wilds of Wisconsin. These are the timber rattlesnake and the massasauga (erroneously called "pygmy rattler"). Only the massasauga may potentially be encountered at the project site. Pictures are provided in Appendix

B. However, the following precautions should be used when working in areas potentially containing snakes:

- Wear appropriate protective equipment (e.g., work boots, snake chaps).
- Be alert and aware of your surroundings.
- Avoid walking in wooded areas, rock piles, stacks of old boards, heavy brush or tall grass if possible.
- Never handle a "dead snake"; they may not be completely dead and can bite due to reflex action.
- If a snake is encountered, do not attempt to catch or kill it. This is a major safety violation and grounds for dismissal from the site.

Immediately following a snake bite:

- Try to safely and quickly identify the species of snake if practical. DO NOT TRY TO CATCH OR KILL THE SNAKE. Move victim to safety. Try to keep the victim calm and comfortable. The victim's condition is assisted with an observation that calm and competent assistance is being firmly applied.
- Remove any jewelry or tight fitting clothing. Quickly tie a light-restricting band both above and below the bite area a few inches away from the puncture/bite marks. Immobilize the bitten area and keep it lower than the heart.
- Without cutting, apply strong suction using a commercial bite kit, preferably within seconds of the bite, directly on the main or deepest puncture/bite marks. Time is critical, as any venom present will become destructive very quickly.
- Apply antiseptic cleanser to the entire area and place a cold compress as close as possible to the wound without interfering with the suction process.
- Continue strong suction and alternate the location of compress to avoid injury from severe cold.
- Check constriction bands periodically as swelling may occur and loosen as appropriate.
- Monitor for symptoms of shock and be prepared to administer appropriate treatment. At any sign of major stress, shock or unusual/unexplained discomfort, check for the need to apply other first aid techniques – elevate legs from lying down position, keep warm, etc.
- Do not administer alcohol or cause additional stress to victim. Avoid food or liquid intake.
- Keep victim warm and immobilize as practical. Movement to proper treatment facility is more crucial than maintaining immobile status. Maintain above treatment functions throughout.
- Transport safely at the earliest possible time to competent medical service. Ideally, all of the above steps can be administered concurrently with transport phase.

3.2.3 Wild Animals

Wild animals (e.g., skunks, wild turkey, pheasant, snakes) present hazards to site personnel due to their potential to carry diseases (e.g., rabies) and inflict physical injuries. The following rules shall be followed when animals are present:

- Sighted animals will not be approached.
- When an animal is sighted, it should be avoided. A minimal level of disturbance should be employed.
- If the animal appears to behave strangely or aggressively, personnel will leave the area.
- At no time will personnel attempt to feed indigenous wildlife.

Workers shall use discretion and avoid all contact with wild animals. If these animals present a problem, the PESM will be notified and will develop a plan to alleviate the problem.

3.2.4 Poisonous Plants

The potential for contact with poisonous plants (i.e., poison ivy, poison oak, and poison sumac) exists when performing fieldwork in undeveloped and wooded areas. Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison ivy has white berries and red or yellow foliage in the fall of the year. Additional information on Poison ivy is provided in Appendix B. Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, hairy berry clusters.

Contact with poison ivy may lead to a skin rash in susceptible individuals. A rash results from a toxin found in the sap that is extruded from the leaves and contained in the stems and roots. The rash is characterized by reddened, itchy, blistering skin that needs first aid treatment. If you believe you have contacted one of these plants, immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

Avoidance of plant/sap contact is the only effective means of preventing the poisoning. A person experiencing symptoms of poisoning should remove contaminated clothing; wash all exposed areas thoroughly with soap and water, taking care not to touch your face or other body parts. Apply calamine or other poison ivy lotion if the rash is mild. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity. Employees will be trained in the identification of these species and will be advised to wear protective clothing such as gloves and long sleeve shirts when working conditions permit. Employees should also consider applying barrier lotions (e.g., Ivy Block) to skin that has the potential to contact these species. Clorox Wipes, Dawn liquid soap and Technu can be used to decontaminate skin and reusable clothing to prevent exposure to poison ivy. Gloves should be worn when removing and decontaminating clothing potentially exposed to poison ivy.

3.2.5 Bloodborne Pathogens

Bloodborne pathogens enter the human body and blood circulation system through punctures, cuts or abrasions of the skin or mucous membranes. They are not transmitted through ingestion

(swallowing), through the lungs (breathing), or by contact with whole, healthy skin. However, under the principle of universal precautions, all blood should be considered infectious, and all skin and mucous membranes should be considered to have possible points of entry for pathogens.

There are a number of infections that are transmitted by insects and arthropods where the infection cycle includes the human blood system. Examples include malaria and Lyme disease, which are transmitted by mosquitoes and ticks, respectively. These diseases are serious, and the possibility for infection should be considered. However, these diseases cannot be transmitted through personal contact with human blood, and are not covered by the OSHA *Bloodborne Pathogen Standard*. Potential bloodborne pathogen exposure includes:

- Medical emergency response operations such as administering first aid or cardiopulmonary resuscitation (CPR).
- Contact with human wastes such as domestic sewage.

Two primary bloodborne pathogens include Hepatitis B and Acquired Immune Deficiency Syndrome (AIDS).

To reduce the risk of contracting a bloodborne pathogen, take the following precautions:

- Avoid contact with blood and other bodily fluids.
- Use protective equipment when giving first aid/CPR, such as disposable gloves and breathing barriers.
- Thoroughly wash your hands with soap and water immediately after giving care.

When cleaning up blood or other bodily fluids:

- Clean up the spill immediately or as soon as possible after the spill occurs.
- Use disposable gloves and other PPE when cleaning spills.
- Wipe up the spill with paper towels or other absorbent materials.
- After the area has been wiped up, flood the area with a solution of one-quarter cup of liquid chlorine bleach to 1 gallon of fresh water and allow it to stand for at least 20 minutes.
- Dispose of the contaminated material used to clean up the spill in a labeled biohazard container.

The ESS should be notified of any potential contact with blood or bodily fluids resulting from first aid or CPR administered on the job.

3.3 PHYSICAL HAZARDS

Safety hazards specific to the 20010 and beyond activities will be addressed in the Activity Hazard Analyses (AHAs) in Appendix C. In addition to the AHAs, general work rules and other safety procedures are described in Section 9.1 of this SHSP.

3.3.1 Heavy Equipment Operations and Traffic Control Activities

The work activities planned for this project may present physical hazards that are inherent to working around heavy equipment (e.g., potential for “struck by,” “caught between,” noise).

Working with and near heavy equipment poses many potential hazards that can result in serious physical harm.

The following precautions will be taken to help prevent injuries and accidents.

- Prior to the start of on-site equipment operations, all personnel will be briefed on the potential hazards posed by these operations.
- Brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, steering, tires, horn, and other safety devices will be checked and maintained in good working order throughout the duration of field activities. Heavy Equipment Inspection Forms are provided in Appendix D.
- While equipment is in operation, all personnel not directly required in the area will keep a safe distance.
- Personnel directly involved in the activity will avoid moving in the path of operating equipment. Areas blinded from the operator's vision will be avoided. Spotters will be used when personnel may be in areas where the operator's view is obstructed.
- Additional riders will not be allowed on equipment unless it is specifically designed for that purpose and has seats with seat belts.
- Personnel needing to enter the heavy equipment exclusion zone will get the attention (make eye contact) of the operator and signal their intentions. The operator will secure the equipment (e.g., bucket grounded) and motion to the personnel desiring entrance. At that point, entrance is authorized.
- Construction and heavy equipment will be provided with the necessary safety equipment including seat belts, roll-over protection, overhead protection, emergency shut-off during roll-over, backup warning lights, and audible alarms.
- Blades and buckets will be lowered to the ground and parking brakes will be set before shutting off any heavy equipment or vehicle.
- The heavy equipment operator will perform checks and document inspections at the beginning of each shift to assure that parts, equipment, and accessories are in safe operating condition and free of apparent damage that could cause failure while in use.
- The immediate area of the heavy equipment activities should be checked for any electrical wires. A minimum safe distance of 10 feet shall be maintained from power lines rated 50 kilovolts (kV) or less. The minimum safe distance may be calculated as follows: minimum safe distance = 10 ft + 0.4 in for each 1 kV of lines rated over 50 kV or twice the length of the line insulator (but never less than 10 feet).
- Field support vehicles will be equipped with a first-aid kit and appropriate fire extinguisher.
- Heavy equipment operators must be trained and qualified in the operation of the equipment.

If any unauthorized individual does enter the construction area, work shall cease until the person has been escorted out of the area.

3.3.2 Cranes

Crane lifts will be in accordance with OSHA and TtEC Procedure CP-13, Critical Lifts. The following start-up inspection will be conducted:

- All control mechanisms for maladjustment that could interfere with proper operation.
- All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.
- All operator aids, motion and load limiting devices, and other safety devices for malfunction and inaccuracy of settings.
- All chords and lacing.
- All hydraulic and pneumatic systems – with particular emphasis given to those which flex in normal operation of the crane.
- Hooks and lattices for deformation, chemical damage, cracks, and wear.
- Rope for proper spooling onto the drum(s) and sheave(s) and rope reeving for compliance with crane manufacturer's specifications.
- Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.
- Hydraulic system for proper oil level.
- Tires for recommended inflation pressure (mobile cranes).
- Wedges and supports for looseness or dislocation (climbing tower cranes).
- Braces and guys supporting crane masts.
- Anchor bolt base connections for looseness or loss of reload (tower cranes and derricks).
- Derrick mast fittings and connections for compliance with manufacturer's recommendations.

Prior to use of a crane at the site a Critical Lift Plan will be prepared, if required. This plan will specify the exact size and weight of the load to be lifted and all crane and rigging components that add to the weight. The manufacturer's maximum load limits for the entire range of the lift, as listed in the load charts, will also be specified. Additionally, if the crane is set on a barge (i.e., on the water) list should also be taken into account. The plan will specify the lift geometry and procedures, including the crane position, height of the lift, the load radius, and the boom length and angle for the entire lift range. The crane operator, lift supervisor, and rigger will be designated in the plan and their qualifications stated.

The Critical Lift Plan will include a rigging plan that shows the lift points and describes rigging procedures and hardware requirements. The plan will describe the ground conditions, outrigger or crawler track requirements and, if necessary, the design of mats to achieve a level, stable foundation of sufficient bearing capacity for the lift. For lifting cranes or derricks, the plan will describe the operating base (platform) condition. Environmental conditions under which lift operations will be stopped will be listed in the plan. Coordination and communication requirements for the lift operations will also be specified. For tandem or tailing crane lifts, the

plan will specify the make and model of the cranes, the line, boom, and swing speeds as well as requirements for an equalizer beam.

3.3.3 Lifting/Rigging

Mobilization/Demobilization activities will likely require some lifting/rigging activities as well as building construction. Personnel will follow the procedures listed below when performing a lift as well as the requirements in TtEC's Construction Procedure CP-13, Critical Lifts.

- The equipment used for lifting should be positioned as near as possible to the load, while maintaining a safe operating distance. The operator shall verify that the load line is vertical and over the load's center of gravity prior to lifting the load to ensure that the load does not drift when lifted.
- The immediate area of the lift should be checked for any electrical wires. A minimum safe distance of 10 feet shall be maintained from power lines rated 50 kV or less. The minimum safe distance may be calculated as follows: minimum safe distance = 10 ft + 0.4 in for each 1 kV of lines rated over 50 kV or twice the length of the line insulator (but never less than 10 feet).
- The swing area of the lifting equipment is barricaded to protect personnel in the immediate area.
- Loads are not lifted over personnel.
- All loose load objects are secured or removed.
- Tag lines are used to control loads except where their use will create a hazard.
- The equipment performing the lift is not subjected to sudden lifting, stopping or impact loading.
- Riding on loads, hooks, buckets, material hoists, or other material hoisting equipment not meant for personnel use is absolutely prohibited.
- Rigging attachment points are as specified by the equipment vendor, if applicable, or as specified in the Critical Lift Plan.
- Softeners are used at contact points between rigging and load as necessary to avoid damage to the load or the rigging.
- Environmental conditions under which lifting operations should not be performed, such as wind, precipitation, reduced visibility, etc., should be established and communicated to project personnel during the Site Specific Briefing and Daily Tailgate Briefings.
- Prior to performing any lift, the Lift Supervisor should give consideration to a contingency plan should conditions prohibit the load from being placed in its intended position. Contingency plans could include placement back in its original position or an alternate temporary location, and should include ensuring that adequate cribbing, dunnage, or tie downs are provided for the alternate location.
- The Lift Supervisor shall determine that the foundation or supports to receive any load have been reviewed for stability and strength prior to performing the lift.

- Prior to placement of any load in storage or otherwise temporarily staged prior to placement in its final, designed location, consideration shall be given to any access requirements, maintenance activities, ability to perform future lifting or handling, and construction activities to be performed in the vicinity of the stored or staged load.
- Certification of all lift accessories, including the results of proof tests for custom designed accessories, shall be available at the on-site project offices and maintained in a file as part of the project filing system.
- The total weight of the load to be lifted, including all lifting beams, rigging, hooks and attachments, shall be determined before a safe lift can be planned.
- The determination of the exact location of the center of gravity of the load is critical in ensuring that the load is rigged in a stable configuration. The location of the attachments of the rigging to the load should be above the center of gravity where possible. Where the location of attachments is below the center of gravity, extreme care must be taken to ensure stability of the load. Special precautions shall be taken in the selection of sling lengths and attachment configurations to ensure that the load is stable. Rigging of loads in this configuration should only be performed by personnel with extensive experience in rigging.
- Consideration shall be made in any lifting operation for the possibility of a load becoming unstable during lifts intended only to reposition a load, such as uprighting or turning a load over. The center of gravity shall be calculated for the load in all positions anticipated in order to ensure stability.
- The load shall be safely rigged within the rated capacity of all rigging equipment.
- Sling capacities shall be reduced from their full rated capacities based on sling configuration (vertical, choker or basket hitch) and sling leg angle, as well as based on sling condition. Only personnel with extensive experience in rigging should be given the authority to determine the capacity of slings showing signs of wear or other deterioration.
- Custom designed grabs, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof-tested prior to use to 125% of their rated load.

3.3.4 Sheet Pile Driving

Site personnel will follow the procedures specified in 29 CFR 1926.603:

- Overhead protection, which will not obscure the vision of the operator, shall be provided.
- Stop blocks shall be provided for the leads to prevent the hammer from being raised against the head block.
- A blocking device, capable of safely supporting the weight of the hammer, shall be provided for placement in the leads under the hammer at all times while employees are working under the hammer.
- Guards shall be provided across the top of the head block to prevent the cable from jumping out of the sheaves.

- When the leads must be inclined in the driving of batter piles, provisions shall be made to stabilize the leads.
- Fixed leads shall be provided with ladder, and adequate rings, or similar attachment points, so that the loft worker may engage his safety belt lanyard to the leads. If the leads are provided with loft platforms(s), such platform(s) shall be protected by standard guardrails.
- Steam hose leading to a steam hammer or jet pipe shall be securely attached to the hammer with an adequate length of at least 1/4-inch diameter chain or cable to prevent whipping in the event the joint at the hammer is broken. Air hammer hoses shall be provided with the same protection as required for steam lines.
- Safety chains, or equivalent means, shall be provided for each hose connection to prevent the line from thrashing around in case the coupling becomes disconnected.
- Steam line controls shall consist of two shutoff valves, one of which shall be a quick-acting lever type within easy reach of the hammer operator.
- Guys, outriggers, thrustouts, or counterbalances shall be provided as necessary to maintain stability of pile driver rigs.
- Pile driving from barges and floats. Barges or floats supporting pile driving operations shall meet the applicable requirements of 1926.605.
- Engineers and winchmen shall accept signals only from the designated signalmen.
- All employees shall be kept clear when piling is being hoisted into the leads.
- When piles are being driven in an excavated pit, the walls of the pit shall be sloped to the angle of repose or sheet-piled and braced.
- When steel tube piles are being "blown out," employees shall be kept well beyond the range of falling materials.
- When it is necessary to cut off the tops of driven piles, pile driving operations shall be suspended except where the cutting operations are located at least twice the length of the longest pile from the driver.
- When driving jacked piles, all access pits shall be provided with ladders and bulkheaded curbs to prevent material from falling into the pit.

3.3.5 Fall Protection

Fall protection (i.e., personal fall arrest systems and guard rails) will need to be considered while performing work on the barges and in the dewatering and water treatment facility. The use of PPE or alternate, approved methods to prevent falls is required for all personnel working at heights at or greater than, 6 feet above a lower level or surface (including water). Personal Flotation Devices (PFDs) are required on all boats, barges, and structures where the edges are unprotected or guard rails are less then 3’ above the walking surface. Personal fall arrest systems shall meet the criteria specified in 29 CFR 1926.502(d) and ESH 3-8, Fall Protection.

Personal fall arrest systems shall meet the following criteria when stopping a fall:

- Limit maximum arresting force on an employee to 1,800 pounds when using a body harness.
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet. Make sure to consider the elongation of the shock absorber lanyard when calculating the free fall distance.
- Have sufficient strength to withstand twice the maximum fall arrest force of an employee free falling a distance of 6 feet or the free fall distance permitted by the system, whichever is less.
- Body belts are prohibited for the protection against free-fall type hazards.
- Anchorage points (tie offs) for fall arrest systems must be approved or fit an approved engineered model. Anchorage points to which personal fall arrest equipment is attached shall be capable of supporting 5,000 pounds (static load to failure) per person.
- Only locking snaphooks that require two separate forces to open the gate for disengagement are permitted. Non-locking snaphooks (i.e., single-action snaphooks are prohibited. Locking snaphooks shall be connected to compatible hardware.
- Do not attach two snaphooks together, back onto its own lanyard, directly to a horizontal lifeline, or to a webbing loop/lanyard. Do not attach two or more snaphooks to one D-ring. Do not attach a snaphook to a D-ring, eyebolt, rebar or other attachment point that has improper dimensions in relation to the snaphook dimensions. Snaphooks may be attached to D-bolts, D-rings/brackets, or anchorage connectors.
- Do not use steel cable lanyards unless it is a retracting lanyard. Shock-absorbing lanyards are required for fall arrest and the maximum length of the lanyard is 4 feet. Shock-absorbing lanyards must be replaced after being shock loaded and stressed.
- Connect the lanyard so as to limit the potential free fall to as short a distance as possible. Free fall distances shall not exceed 6 feet.
- Lifeline capacity shall be 5,000 pounds static load or two times the maximum fall arrest force per person applied to the center of the lifeline between two fixed anchorages.
- Rope diameters selected for use with a rope grab type fall protection system must meet the grab manufacturer's specifications. Rope grabs must be automatic operating and have no manual feature to move down the line unless it is fail-safe.
- Self-retracting lifelines that automatically limit free fall distances to 2 feet or less shall have components capable of withstanding a minimum static load of 3,000 pounds.
- Personal fall arrest systems shall not be attached to guardrail systems.
- All fall arrest equipment must be inspected prior to putting it into service.

Guardrail systems and their use shall comply with 29 CFR 1926.502(b) and the following provisions:

- Top edge height of top rails, or equivalent guardrail system members, shall be 42 inches plus or minus 3 inches above the walking/working level.

- Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be installed between the top edge of the guardrail system and the walking/working surface when there is no wall or parapet wall at least 21 inches high.
- Midrails, when used, shall be installed at a height midway between the top edge of the guardrail system and the walking/working level.
- Screens and mesh, when used, shall extend from the top rail to the walking/working level and along the entire opening between top rail supports.
- Intermediate members (such as balusters), when used between posts, shall be not more than 19 inches apart.
- Other structural members (such as additional midrails and architectural panels) shall be installed such that there are no openings in the guardrail system that are more than 19 inches wide.
- Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds applied within 2 inches of the top edge, in any outward or downward direction, at any point along the top edge.
- Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 150 pounds applied in any downward or outward direction at any point along the midrail or other member.
- Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.
- The ends of all top rails and midrails shall not overhang the terminal posts, except where such overhang does not constitute a projection hazard.
- Steel banding and plastic banding shall not be used as top rails or midrails.
- Top rails and midrails shall be at least one-quarter inch (0.6 cm) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than 6-foot intervals with high-visibility material.

3.3.6 Work on or Around Water

The majority of the work will be conducted on or around water. This presents hazards unique to this environment, and will be thoroughly addressed in all AHAs that apply. In preparing the AHAs, consideration will be given to the elements of TtEC Environmental, Health and Safety Program EHS 6-6, Boating, and any applicable U.S. Coast Guard regulations. Personnel performing work on water shall receive boating safety training/briefing from the Handbook of Wisconsin Boating Laws and Responsibilities (Appendix E). For more extensive information on working on or around water, refer to the AHAs in Appendix C of this SHSP.

3.3.7 Underground Utilities

Whenever intrusive activities are conducted during the project, whether land or water based, the threat of contact with underground utilities exists. This would include utilities such as water, electrical, gas, sewage, etc. Before the execution of any intrusive activities (or any type of marine activity), an assessment of the presence of underground utilities will be made. All steps

will be taken to locate underground utilities as per TtEC Procedure EHS 3-15 Underground Utilities. This will include white lining the area of intrusive activities, calling the Wisconsin One-Call System (811, (800) 242-8511, (414) 259-1181, emergency only - (877) 500-9592), having utilities located.

3.3.8 Hot Work (torching, welding, cutting)

All welding and hot work creating a spark will be conducted in accordance with TtECs Welding and Hot Work Program, EHS 6-5. This includes, but is not limited to, hot work permit issuance, use of a fire watch, keeping a properly rated fire extinguisher at the work area, and keeping all combustible materials 50 feet from the hot work area or placing barriers between combustibles and the hot work area. Prior to any hot work, notify the ESS and request a Hot Work Permit.

3.3.9 Heat/Cold Stress

3.3.9.1 Heat Stress

There is a potential for heat stress and related injuries during work activities. Specific potential hazards include:

- Heat rash
- Heat cramps
- Fainting
- Heat exhaustion
- Heat stroke

Sweating does not cool the body unless the sweat evaporates. Heat stress related problems include heat rash, fainting, heat cramps, heat exhaustion, and heat stroke. Heat rash occurs because sweat is not evaporating, causing irritation and vesicular inflammation. Standing erect and immobile in the heat allows blood to pool in the lower extremities. As a result, blood does not return to the heart to be pumped back to the brain and fainting may occur. Heat cramps are painful spasms of the muscles due to excessive water and salt loss from profuse sweating. Similarly, heat exhaustion occurs due to the large fluid and salt loss from profuse sweating. Heat exhaustion is characterized by clammy and moist skin, nausea, dizziness, headaches, and low blood pressure.

Heat stroke occurs when the body's temperature regulatory system has failed. Skin is hot, dry, red, and spotted. The affected person may be mentally confused, delirious, and convulsions may occur. A person exhibiting signs of heat stroke should be removed from the work area and moved to a shaded area immediately. The injured person should be soaked with water and fanned to promote evaporation. Medical attention must be obtained immediately. EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH.

Early symptoms of heat stress related problems include the following:

- Decline in task performance
- Lack of coordination
- Decline in alertness

- Unsteady walk
- Excessive fatigue
- Muscle cramps
- Dizziness

Proper training and preventive measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illnesses. To avoid heat stress, the following steps, as necessary, will be implemented at the Lower Fox River site:

- Adjust work schedules.
  - Modify work/rest schedules according to monitoring requirements.
  - Mandate work slowdowns as needed.
  - Perform work during cooler hours of the day, if possible, or at night if adequate lighting can be provided.
- Perform physiological monitoring.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, e.g., 8 fluid ounces (0.23 liter) of water must be ingested for approximately every 8 ounces (0.23 kilogram [kg]) of weight loss. The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
- Maintain water temperature at 50° to 60°F (10° to 16.6°C).
- Provide small disposable cups that hold about 4 ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liter) of fluid, preferably water or dilute drinks, before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
- Train workers to recognize the symptoms of heat-related illnesses.
- Rotate personnel and alternate job functions.
- Utilize cooling vests when impermeable clothing is worn.

Additional procedures to be followed are provided in EHS Program, Temperature Extremes, EHS 4-6.

3.3.9.2 Cold Stress

Exposure to low temperatures presents a risk to employee safety and health through the direct effect of the low temperature on the body and collateral effects such as slipping on ice, decreased dexterity, and reduced dependability of equipment. Work conducted in the winter months can become a hazard for field personnel due to cold exposure. All personnel must exercise increased care when working in cold environments to prevent accidents that may result from the cold. The effects of cold exposure include frostbite and hypothermia. Wind increases the impact of cold on a person's body. Systemic cold exposure is referred to as hypothermia. Local cold exposure is generally labeled frostbite. Recognition of the symptoms of cold-related illnesses will be discussed during the health and safety briefing conducted prior to the onset of site activities.

Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe (Table 3-2). This accounts for the progressive signs and symptoms ranging from sluggishness and slurred speech to disorientation and eventually unconsciousness.

Table 3-2. Progressive Clinical Symptoms of Hypothermia

Core Temperature F°	Clinical Signs
95°	Maximum shivering
87°-89°	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated
84°-86°	Progressive loss of consciousness; muscular rigidity; respiratory rate decreases
79°	Victim rarely conscious
70°-72°	Maximum risk of ventricular fibrillation

Frostbite is both the general and medical term given to areas of cold injury. Unlike hypothermia, frostbite rarely occurs unless environmental temperatures are less than freezing and usually less than 20°F. Frostbite injuries occur most commonly on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction. The three general categories of frostbite are:

- *Frostnip* – A whitened area of the skin which is slightly burning or painful.
- *Superficial frostbite* – Waxy, white skin with a firm sensation but with some resiliency. Symptomatically feels “warm” to the victim with a notable cessation of pain.
- *Deep frostbite* – Tissue damage deeper than the skin, at times, down to the bone. The skin is cold, numb and hard.

In preventing cold stress, the ESS must consider factors related both to the worker and the environment. Training, medical screening, establishment of administrative controls, selecting proper work clothing, and wind-chill monitoring all contribute to the prevention of hypothermia and frostbite.

- Recognizing the early signs and symptoms of cold stress can help prevent serious injury. Thus, workers will be trained to recognize the symptoms of hypothermia and frostbite and have appropriate first-aid instruction. When the air temperature is below 50°F the

ESS will inform workers of the proper clothing requirements and any work practices that are in effect to reduce cold exposure.

- Cold injuries and illnesses recognition and prevention measures will be emphasized during daily safety briefings when the potential for cold injuries and illnesses exists.
- Work will cease under unusually hazardous conditions.
- Phenothiazine (a sedative) and beta blocker drug use will be prohibited.
- A heated area will be available on site.
- Temperature will be recorded daily on site.
- Warm beverages will be available on site.
- The ESS will establish a work/rest schedule based upon worker monitoring. At the first sign of uncontrollable shivering the worker will be rested in a heated shelter. Work will be stopped when the air temperature reaches 0°F.
- Workers will be encouraged to layer clothing when air temperature is below 50°F. Clothing that has a high insulation value will be worn under protective garments. Insulated gloves will be worn when the wind chill index is below 32°F. Insulating dry clothes will be available.

Additional procedures to be followed are provided in EHS Program, Temperature Extremes, EHS 4-6.

3.3.10 Noise

Noise is a potential hazard associated with the operation of heavy equipment, operation of the treatment process equipment, motors, pumps, and dredges. Suspected high noise operations will be evaluated and monitored to determine if hearing protective devices should be worn. A general field rule is to wear hearing protection if you cannot hear normal conversation within an arm length of the person talking. Hearing protection must be worn if noise levels are above the following:

85 dBA – 8-hour time weighted average (TWA)
100 dBA – 15 minute short-term exposure limit (STEL)
140 dBA – instantaneous noise.

Additional details on monitoring and hearing protection requirements are in EHS 4-4, Hearing Conservation, and HSG1-5, Noise Monitoring.

3.3.11 Hand and Power Tools

Tools are such a common part of construction work that hazards are often unrecognized. Workers must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent injuries from those hazards. To prevent accidents resulting from the use of hand and power operated hand tools, the following safe work practices will be implemented and enforced.

Broken, defective, burned, or mushroomed tools will not be used. They will be reported and turned in for replacement. The proper tool and equipment will be selected and used for each task. For example, a wrench will not be used as a hammer or a screwdriver as a chisel. Leaving tools

on scaffolds, ladders, or any overhead working surface is not allowed. Racks, bins, hooks, or other suitable storage space must be provided to permit convenient arrangement of tools. The practice of throwing tools from one location to another, from one employee to another, or dropping them to lower levels will be prohibited. When it is necessary to pass tools or material under the above conditions, suitable containers and/or ropes must be used.

Wooden tool handles must be sound, smooth, and in good condition and securely fastened to the tool. Sharp-edged or pointed tools will never be carried in employee's pockets. Only non-sparking tools will be used in locations where sources of ignition may cause a fire or explosion. Tools requiring heat treating will be tempered, formed, dressed, and sharpened by workmen experienced in these operations.

Tools designed to accommodate guards must be equipped with such guards when in use. All rotating, reciprocating, or moving parts of equipment (belts, gears, shafts, flywheels) must be guarded to prevent contact by employees using such equipment. All hand-held power tools (i.e., circular saws, chain saws, and percussion tools) without a positive accessory holding means must be equipped with a constant pressure switch that will shut off the power when pressure is released. A positive "on-off" control must be provided on platen sanders, grinders with wheels 2 inches in diameter or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws, and jigsaws with blade shanks one-quarter inch wide or less. A momentary contact "on-off" control must be provided on all hand-held powered drills, tapers, fasteners, drivers, horizontal, vertical, and angle grinders with wheels greater than 2 inches in diameter. Besides safety hazards, the use of power tools sometimes creates potential health hazards as well. The use of jackhammering and chiseling equipment often results in silica and nuisance dust exposures that can be controlled by wetting the work surfaces.

In addition to dust hazards, the hand vibration inherent in the use of some power tools may result in a restriction of blood flow to the hands and fingers, causing numbness and tingling. If workers consistently experience these symptoms after the use of power tools, they will contact their supervisor so that steps may be taken to prevent further harm to the nerves and blood vessels in their hands. The use of a different tool, changes to the offending tool to reduce vibrations, and/or the use of gloves are recommended to prevent vibration.

Electric tools – Electric tools present several dangers to the user; the most serious is the possibility of electrocution. The following safe work procedures for electric tools must be implemented and enforced:

- Have a three-wire cord with ground and be grounded, or
- Be double insulated, or
- Be powered by a low-voltage isolation transformer.

Never remove the third prong from the plug. Electrical tools will not be used in damp or wet locations and will always be used within their design limitations. A ground fault circuit interrupter (GFCI) must be used or the tool must be double insulated to protect the worker from electrical shock hazards. Implementing requirements of EHS 3-10, Assured Equipment Grounding, and HSG3-1, Assured Equipment Grounding, will be followed.

Powered Abrasive Wheel Tools – Power abrasive wheel tools present a special safety problem because they may release fragments. The following safe work procedures for powered abrasive wheel tools need to be implemented and enforced. Portable grinding tools must be equipped with

safety guards to protect workers from fragments as well as the moving wheel surface. Inspecting and sound or ring testing abrasive wheels prior to mounting is required to ensure that they are free from cracks or defects. Checking to ensure that the abrasive wheel RPM rating is appropriate for the tool will also help prevent wheel failures. The following work rules are appropriate when using a power grinder:

- Always use eye protection and a face shield.
- Turn off the power when not in use.
- Never clamp a hand-held grinder in a vise.
- To prevent the wheel from cracking, the user will ensure that it fits freely on the spindle.
- Grinding wheel users will never stand directly in front of the wheel during start-up because there is always a possibility that the wheel may disintegrate (explode) when accelerating at full speed.

Pneumatic Tools – Pneumatic tools are powered by compressed air and include chippers, drills, jackhammers, and sanders. The following safe work procedures for pneumatic tools must be implemented and enforced. Pneumatic tools that shoot nails, rivets, or staples that operate at pressures more than 100 lb./in^2 must be equipped with a special device to keep fasteners from being ejected unless the muzzle is pressed against the work surface. Safety lashing will be installed at connections between tool and hose at all quick makeup type connections. All hoses exceeding one-half-inch inside diameter must have a safety device at the supply source or branch line to reduce pressure in the event of hose failure. Eye protection is required for employees working with pneumatic tools.

Airless spray guns that atomize paints and fluids at high pressures (1,000 lbs./in^2 or more) must be equipped with automatic or visual manual safety devices that will prevent pulling the trigger until the safety device is manually released. Workers operating a jackhammer are required to wear safety glasses, safety footwear, and hearing protection. Compressed air guns will never be pointed toward anyone. A safety clip or retainer must be installed to prevent attachments from being unintentionally shot from the barrel of the tool.

Liquid-Fueled Tools – Liquid-filled tools are usually powered by gasoline. Vapors that can burn or explode and give off dangerous exhaust gases are the most serious hazards associated with liquid-filled tools. The following safe work procedures for liquid-filled tools need to be implemented and enforced at the site.

Gas or fuel will be handled, transported, and stored in UL NFPA-approved flammable liquid containers. These containers, also known as safety cans, are no more than 5 gallons in capacity and have a spring-closing lid and spout cover that will safely relieve internal pressure when subjected to fire exposure. Type 2 cans are preferred. Before refilling the tank for a fuel-powered tool, the user must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors. Effective ventilation and/or PPE are necessary when using a fuel-powered tool inside a closed area. Fire extinguishers must be readily available in the work area.

Powder-Actuated Tools – Powder-actuated tools operate like a loaded gun and will be treated with the same respect and precautions. Only assigned, trained, and qualified operators will operate powder actuated tools. The following safe work practices and procedures for powder-actuated tools will be implemented and enforced. All powder-actuated tools must meet American

National Standards Institute (ANSI) A10.3 requirements for design, operation, and maintenance. Powder-actuated tools must never be used in an explosive or flammable atmosphere. Before using a powder-actuated tool, the worker will inspect it to determine that it is clean, that all moving parts operate freely, and that the barrel is free from obstructions.

Never point the tool at anyone. Do not load a tool unless it is being used immediately. Never leave a loaded tool unattended, especially where it would be available to unauthorized persons. Suitable eye and face protection is essential when using a powder-actuated tool. In case of misfire, the operator will hold the tool in the operating position for at least 30 seconds, then attempt to operate the tool for a second time. If the tool misfires again, wait another 30 seconds (still holding the tool in the operating position) and then proceed to remove the explosive load from the tool in accordance with the manufacturer's instructions.

If the tool develops a defect during use, it will be tagged and taken out of service immediately until it is properly repaired. Warning signs will be posted within the area of operation of any powder-actuated tool. Powder-actuated tool operators must be certified by the tool supplier.

3.3.12 Slips, Trips, and Falls

Working on wet surfaces in boats as well as uneven terrain presents a walking/working surface that can lead to difficult footing and overall balance. Boat decks will pose slip, trip and fall hazards due to slippery surfaces that may be covered by or wet from rain. Slips, trips, and falls are a leading cause of injuries in this work setting; therefore, a concerted effort to identify, control, and eliminate these hazards and the measures needed to reduce or eliminate the possibility of injury will be communicated to all site personnel.

Site personnel will be instructed to look for these potential safety hazards and immediately inform the ESS or the Construction Manager about any new hazards. If the hazard cannot be immediately removed, action must be taken to warn site workers about the hazard. Proper housekeeping (tools, equipment, and material will be picked up and stored) must be maintained on site, particularly in pedestrian traffic routes and adjacent to office and decontamination areas. Voids and transition areas along high foot traffic areas will be covered to prevent injury. The use of PPE or alternate, approved methods to prevent falls is required for all personnel working at heights at or greater than, 6 feet above a lower level or surface (including water). PFDs are required on all boats, barges, and structures where the edges are unprotected or guard rails are less then 3 feet above the walking surface.

3.3.13 Manual Lifting

Manual lifting may be required. Failure to follow proper lifting technique can result in back injuries and strains. Back injuries are a serious concern as they are the most common workplace injury, often resulting in lost or restricted time, and long treatment and recovery periods. Basic lifting and material handling techniques will be reviewed with all personnel prior to the on-site activities. All tasks will be evaluated on site prior to commencement or during activities in order to evaluate the potential for injury. Controls may include engineering controls, reducing weight of objects that are carried, distance of carrying, or reducing loss potential by rotating workers.

TtEC's EHS policy states that individual employees are not to lift loads greater than 50 pounds. The following procedure should be used to lift anything, particularly heavier loads, safely:

- Make sure the path of travel is clear.
- Size up the load as to its weight, size and shape.

- Place the feet about a foot apart and close to the object for good balance.
- Bend the knees to a comfortable position and get a good handhold.
- Using both leg and back muscles, lift the load straight up, smoothly and evenly. Pushing with the legs, keep the load close to the body.
- Lift the object into carrying position, avoiding twisting movements until the lift is completed.
- Turn the body with changes of foot position. Do not twist at the waist when lifting.
- Using both leg and back muscles, comfortably lower the load by bending the knees. When the load is securely in place, release the grip. Setting down the load is just as important as picking it up.

The same steps apply to team lifting, with the emphasis on coordination. All should start and finish the lift action at the same time and perform turning movements together.

4.0 ACTIVITY HAZARD ANALYSES

The AHA is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control, and mitigate those hazards. AHAs follow the guidance of the TtEC Corporate Program EHS 3-5. AHAs are developed for all activities and will be used to train workers in proper safety procedures during phase preparatory meetings.

AHAs for the 2010 and beyond site activities are included in Appendix C of this SHSP. AHAs have been developed for the following phases of work:

- General Site Hazards
- Sheet Pile Installation
- Marine Survey
- Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall
- Layout and Placement of Dredge Lines and Booster Stations
- Dredging Toxic Substances Control Act (TSCA) and non-TSCA material
- Sediment Capping and Placement of Cover Material
- Dewatering Operations
- Transportation and Disposal
- Wastewater Treatment Plant Operations
- Sampling (Sediments and Process Operations)
- Laboratory Analysis

5.0 PERSONAL PROTECTIVE EQUIPMENT

The PPE specified in Table 5-1 represents the initial level of PPE selection for each activity required by 29 CFR 1910.132. Specific information on the selection rationale for each activity can be found in the AHAs for these plans. PPE selection shall be made by the ESS and approved by the PESM. Additional tasks not included in Table 5-1 shall be reviewed by the ESS and PESM. Any additional PPE requirements will be incorporated into the SHSP by completing the FCR form found in Appendix A. All FCR forms and PPE selection will require approval by the PESM. Modifications for initial PPE selection may also be made by the ESS in consultation with the PESM using the same form. A written justification for downgrade will be provided to the PESM for approval on a field change request form.

5.1 UPGRADE CONDITIONS

Due to the nature of the activities it is not anticipated that upgrading to Level C or B will be required during the Lower Fox River site activities. Level D or modified Level D is anticipated for all site work but the ESS has the responsibility for monitoring site and work conditions and deciding the appropriate level of protection based on indications of potential exposure.

5.2 HAZARD ASSESSMENT FOR SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

The initial levels of protection were selected by performing a hazard assessment taking into consideration the following:

- Potential site physical hazards present or suspected
- Work operations to be performed
- Potential routes of exposure
- Characteristics, capabilities and limitations of PPE, and any hazards that the PPE presents or magnifies

Table 5-1. Personal Protective Equipment Selection

Task	Head	Eye/Face	Feet	Hands	Body	Hearing	Respirator
Sheetpile installation	HH	SG	STB	LWG	Work Clothes, high visibility vest, PFD if on or near water, Fall protection as required	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Dredging TSCA and non-TSCA material	HH	SG	STB	LWG	Work Clothes, high visibility vest, PFD if on or near water	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Sediment Capping and Placement of Cover Material	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest, PFD if on or near water	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Dewatering Operations	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Transportation and Disposal	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Wastewater Treatment Plant Operations	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Sampling (Sediments and Process Operations)	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest, PFD if on or near water	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.
Laboratory Analysis	HH	SG	STB	LWG as needed	Work Clothes, high visibility vest	EP as needed around power tools and heavy equipment	No Respiratory Protection Required.

Notes: EP – Ear Plugs
HH – Hard Hat
LWG – Leather Work Gloves
PFD – Personal Flotation Device
PFS – Plastic Face Shield
SG – Safety Glasses
STB – Safety Toed Boots

6.0 AIR MONITORING

The following sections contain information describing the types, frequency, and location of real time air monitoring to evaluate potential worker exposures. Air monitoring for community protection will be addressed in the Community HASP.

6.1 INSTRUMENTATION

The following monitoring instruments will be available for use during remediation operations as necessary:

- Dust Meter, MiniRAM or equivalent, aerosol dust monitor.

The dust meter will be used to assess the respirable dust concentrations in the worker breathing zone during dewatering activities and T&D activities. There is minimal to no contact using proposed methods to dredge and cap contaminated sediments and therefore inhalation of PCBs is not considered a risk. There is minimal to no inhalation risk during sampling of PCB contaminated material since the sediments will be wet and will not produce a dust. The Site-Specific Health and Safety Plan lists the response measures if action levels are exceeded.

6.2 REAL-TIME AIR MONITORING

Routine Air Monitoring will be performed by the ESS for dust disturbing activities and during activities requiring handling dry PCB-containing materials. A calibrated aerosol dust monitor will be used to monitor dust levels in personnel breathing zones. A background reading must be obtained from a clean area prior to taking readings with the instruments in any area where measurable airborne contaminants may be present.

6.3 FREQUENCY AND LOCATION OF MONITORING

Tables 6-1 and 6-2 present a breakdown of each main activity and provide the instrumentation, frequency, and location of the real time monitoring for the site. Note that a background reading must be established prior to taking readings with the instruments.

6.4 DATA QUALITY ASSURANCE

6.4.1 Calibration

Monitoring instrument calibration will be documented and included in a dedicated safety and health log book or on separate calibration pages. All monitoring instruments must be calibrated before and after each shift's use of the equipment. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

6.4.2 Operations

All instruments will be operated in accordance with the manufacturer's specifications. Manufacturer's literature, including an operations manual for each piece of monitoring equipment, will be maintained on-site by the ESS for reference.

Table 6-1. Real Time Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level	Site Action	Reason
MiniRAM or equivalent	Worker Breathing Zone during activities which may generate dust (i.e., Earthwork)	<2.5 mg/m^3	No respiratory protection is necessary. Continue work.	½ TLV for respirable dust.
		>2.5mg/m^3	Use dust suppression techniques (i.e., water truck to dampen dry areas). See Section 6.5.	½ TLV for respirable dust.
MiniRAM or equivalent	Worker Breathing Zone during activities which may generate PCB contaminated dust (i.e., dewatering activities and T&D)	<2.0 mg/m^3	No respiratory protection is necessary. Continue work.	Calculated based upon quantitative risk assessment (see Section 4.0 of the *Community HASP*)
		>2.0 mg/m^3	Use dust suppression techniques or revaluate work practices to minimize dust generation	Calculated based upon quantitative risk assessment (see Section 4.0 of the *Community HASP*)

Table 6-2. Frequency and Location of Air Monitoring

Activity	Air Monitoring Instrument	Frequency and Location
Background Readings	MiniRAM or equivalent	Two weeks prior to mobilization and a minimum of twice per day when tasks covered by this plan are performed (e.g., at the beginning and end of work activities); taken upwind and down wind from the site of activity, at the area of activity, and in the worker breathing zone.
Activities which may generate dust (i.e., Earthwork)	MiniRAM or equivalent	In the breathing zone, initially at a minimum, every hour. The frequency may decrease to every 2 hour if results are consistent after the first week of operations. If readings are measured at a level of >2.5 mg/m^3, take an additional reading and document the measurement. Continue to take readings. Document the measurement every 15 minutes. If readings stay above 2.5 mg/m^3, use dust suppression techniques.
Activities which may generate PCB contaminated dust (i.e., dewatering activities and T&D)	MiniRAM or equivalent	In the breathing zone, initially at a minimum, every 30 minutes. The frequency may decrease to every 1 hour if results are consistent after the first few weeks of operations. If readings are measured at a level of >2.0 mg/m^3, take an additional reading and document the measurement. Continue to take readings. Document the measurement every 15 minutes. If readings stay above 2.0 mg/m^3, use dust suppression techniques or revaluate work practices to minimize dust generation.

6.4.3 Data Review

The ESS will interpret all monitoring data based on action levels listed in Tables 6-1 and 6-2 of the Site-Specific Health and Safety Plan and his/her professional judgment. The ESS shall review the data with the PESM to evaluate the potential for worker exposure and upgrades/downgrades in PPE. The previous day's monitoring results will be discussed with all site personnel at the tailgate safety meeting prior to commencing work activities for that day.

6.5 DUST CONTROL PLAN

Dust levels for this project should be kept to below the respirable dust action levels. If fugitive dust levels exceed these requirements, the following dust suppression techniques may be employed to reduce the levels:

- Reduce equipment/vehicle speeds.
- Apply water to traffic areas.
- Apply dust suppressants.
- Cover stockpiles with tarps.

Water used for dust suppression will be clean, non-hazardous, and free of salt, oil, and other deleterious materials. Construction water that has been treated to remove contaminants may also be used for dust control. A dedicated water truck will be used to spray water on travel areas. Enough water should be applied to lower fugitive dust levels, but not so much as to create nuisance conditions (e.g., ponding). Dust suppressants may be added if the CM determines it is necessary in order to reduce fugitive dust levels.

7.0 ZONES, PROTECTION, AND COMMUNICATION

7.1 SITE ZONE

Site zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It will include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ), and a Support Zone (SZ). Specific zones will be established on the work site when operations begin. A map showing these zones will be developed on site and posted in the field office. All maps will be posted at the site and used during initial site-specific training.

The majority of this project is a hazardous waste remediation project, and any person working in an area where the potential for exposure to site contaminants exists, will only be allowed access after providing the ESS with evidence of proper training and medical documentation.

The zones are based upon current knowledge of proposed site activities. It is possible that the zone configurations may be altered due to work plan revisions. Should this occur, the site zones will be adjusted accordingly, and documented through use of a CRF.

The following will be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone – The SZ is an uncontaminated area (trailers, offices, etc.) that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

Contamination Reduction Zone – The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools, and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone – All activities that may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an EZ. For some portions of this project, the EZ may be the area where decontamination activities will occur. This zone will be clearly delineated by cones, tapes, or other means. The ESS may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ will be determined by the site ESS allowing adequate space for the activity to be completed, field members, and emergency equipment. Site personnel and visitors shall sign in and out of the EZ and CRZ daily.

7.2 CONTAMINATION CONTROL

Decontamination areas will be established for the following activities.

7.2.1 Personnel Decontamination Station

Personnel hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure of off-site areas to contaminants from the site. The dewatering operations as well

as T&D is the primary activity where the possibility of worker exposure to PCBs exists. A personnel decontamination station will be constructed adjacent to these operations. In addition, a personnel decontamination station will be set up when the potential for contact with PCBs exists. Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner.

7.2.2 Minimization of Contact with Contaminants

During completion of all site activities, personnel should attempt to minimize contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations. When the potential for contact with PCB-contaminated sediments exists, personnel will wear appropriate PPE described in Section 5.0 to minimize if not prevent exposure.

7.2.3 Personnel Dry Decontamination Sequence

When decontamination of Tyvek or poly protective clothing is needed, a dry decon will be used whenever possible.

1. Perform dry decon if contact with contaminants occurred.
2. Employees shall carefully remove all gross contamination and debris from their protective clothing.
3. Remove gloves without touching outside surface of gloves and dispose.
4. Wash hands and face thoroughly.

7.2.4 Heavy Equipment Decontamination

The following procedure will be used by TtEC personnel for the decontamination of equipment that has come in contact with the contaminated sediments:

- Remove gross contamination from equipment by manually scraping working from top to bottom.
- Remove remaining contamination with a pressure washer/steam cleaner. Decon water should be collected for treatment by the water treatment system.
- Inspect equipment to verify that all visible contaminated material has been removed.

Heavy equipment that has come in contact with contaminated sediments will not be permitted to leave the EZ unless it has been thoroughly decontaminated, visually inspected by the ESS or designee. If heavy equipment has been in contact with contaminated sediments having > 50 ppm PCBs, wipe samples will also be required to verify cleanliness.

7.3 COMMUNICATION

The following communications equipment shall be specified as appropriate:

- Two-way radios are used as appropriate by field teams performing work on the water for communication with the U.S. Coast Guard.
- Telephones – Site personnel will have cell phones for communication with emergency support services/facilities.

- Hand Signals – Hand signals will be used by field teams along with the buddy system. They will be known by the entire field team before operations commence and their use will be covered during site-specific training. Typical hand signals are the following:

SIGNAL	**MEANING**
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist.	Leave the area immediately, no debate.
Hands on top of head	Need general assistance
Hands raised above head	Need immediate assistance
Thumbs up	Okay, I'm all right, I understand.
Thumbs down	No, negative.

8.0 MEDICAL SURVEILLANCE PROCEDURES

All personnel performing fieldwork where potential exposure to contaminants exists are required to have passed a medical surveillance examination in accordance with 29 CFR 1910.120(f).

The TtEC Corporate Medical Surveillance Program is described in detail in EHS 4-5 of the Health and Safety Program. The Corporate Medical Consultant is WorkCare in Anaheim, California. Doctor Greeney may be consulted for injury diagnosis and treatment. He may be reached at 800-455-6155.

8.1 MEDICAL SURVEILLANCE REQUIREMENTS

Proof of a current physician's certification for hazardous waste site work must be provided to the ESS before an individual can work in designated exclusion zones at the site. The certification must be based on a physical examination conducted in accordance with 29 CFR 1910.120, and 29 CFR 1910.134, and signed by the physician. The examination will be repeated annually and upon termination of hazardous waste work. Medical surveillance requirements for individuals performing certain limited on-site tasks where the potential for contaminant exposure does not exist may be waived at the discretion of the PESM and ESS.

Alternative medical monitoring frequencies may be approved by the TtEC CMC for employees whose respirator use is less than 30 days per year. This is consistent with applicable OSHA standards and the TtEC Medical Surveillance Program (EHS 4-5). All medical program certification documents must indicate with a specific statement that the employee is certified to work on hazardous waste sites and wear PPE, and has been evaluated per the requirements of 29 CFR 1910.120 and 29 CFR 1910.134.

Additional medical testing may be required by the PESM in consultation with the CMC and the ESS if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance. Any personnel not involved with direct cleanup activities at the site will not require medical surveillance.

8.2 MEDICAL DATA SHEET

A medical data sheet is provided in Appendix A. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. It is intended to provide basic information that would be useful to professional medical personnel if medical treatment or transport to emergency medical facilities is required. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

8.3 SUBCONTRACTOR MEDICAL SURVEILLANCE AND QUALIFICATIONS

All Subcontractor employers participating in hazardous waste operations or emergency response (or if required by subcontract) will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards.

8.3.1 Hazardous Waste Operations and Emergency Response

Subcontractor personnel expected to participate in on-site hazardous waste operations or emergency response (or if required by subcontract) are required to have a current medical

qualification for performing this work. Medical qualification shall consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. **The physician's written opinion shall state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response**. Documentation of employee medical qualification (e.g., physician's written opinion) will be submitted to TtEC. These records must also be maintained at the site by the subcontractor and made available for inspection by TtEC, the client, or regulatory agencies such as OSHA.

9.0 SAFETY CONSIDERATIONS

9.1 GENERAL HEALTH AND SAFETY WORK RULES

A list of work rules and general safe work practices has been included in this plan from the TtEC Health and Safety Program, EHS 3-6. At a minimum, the work rules and general site work practices will be reviewed with site personnel during their initial site briefing. A copy of the program and work rules / general safe work practices will be present and available for reference by all site personnel for the duration of all on-site activities.

9.2 GENERAL CONSTRUCTION HAZARDS

The following are lists of applicable safety considerations for the major tasks. Further information is provided in the specific AHA in the Site-Specific Health and Safety Plans and the specific TtEC Health and Safety Program sections:

- Injury from working with, or around heavy equipment
- Exposure to site contaminants
- Working on/and around water
- Slips/trips/falls

9.3 HIGH LOSS POTENTIAL HAZARDS

The following activities projected to be conducted at this job-site are those deemed to present the greatest “high loss potential” hazards:

- Injury from working with, or around heavy equipment
- Exposure to site contaminants
- Working on/and around water
- Slips/trips/falls

The basic hazards posed by these operations and the control measures to reduce or eliminate the hazards are described in the AHAs in Appendix C of the Site-Specific Health and Safety Plans.

10.0 EMERGENCY RESPONSE AND CONTINGENCY PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures are addressed and include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred onsite, accident/incident reporting, and emergency site evacuation procedures.

10.1 RESPONSIBILITIES

10.1.1 Project Environmental and Safety Manager (PESM)

The PESM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The PESM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

10.1.2 Environmental and Safety Supervisor (ESS)/Emergency Coordinator (EC)

The EC shall make contact with Emergency Response personnel prior to beginning work onsite. In these contacts the EC will inform them about the nature and duration of work expected on the site and possible health or safety effects of emergencies. EC shall telephone 911 to report any emergency occurrence (personal injury, environmental spill, etc.) and identify hospital routes prior to beginning work on site. The EC shall make necessary arrangements to be prepared for any emergencies that could occur. The EC shall implement the Emergency Response/Contingency Plan whenever conditions at the site warrant such action.

The ESS is required to immediately notify the PESM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the PESM can notify OSHA within the required time frame. The PESM will be notified of all OSHA recordable injuries, fires, spills, releases or equipment damage in excess of $500 within 24 hours.

10.1.3 Construction Manager (CM)

The CM is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The CM also serves as the alternate Emergency Coordinator.

10.1.4 Site Personnel

The contents and requirements of the project-specific Emergency Response/Contingency Plan will be reviewed, at a minimum, with all on-site personnel during their initial briefing and during daily briefings as necessary. Site personnel are responsible for knowing how to initiate emergency response actions and their respective responsibilities in the event the Emergency Response/Contingency Plan must be implemented. Personnel are expected to notify the EC of situations that could constitute a site emergency or result in the occurrence of a site emergency.

10.2 COMMUNICATION

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

10.2.1 Cell Phone/Radio Communication

Cell phones and radios will be the primary sources of communication in the field. The locations of cell phones will be with supervising personnel. Site radios will also be used by field personnel for communication. VHF radios will be used for communication with the Coast Guard.

10.2.2 Hand Signals

Downrange field teams will employ hand signals where necessary for communication during emergency situations. Hand signals are found in Section 7.3, Communication.

10.2.3 Audio Signals

Audio signals will be utilized in the event of an emergency or a need to evacuate the site. Three bursts will be sounded on an air horn or vehicle horn to obtain the attention of site personnel. Site personnel should then follow the procedures listed in Section 10.8, Emergency Site Evacuation Route and Procedures.

10.3 LOCAL EMERGENCY SUPPORT UNITS

In order to be able to deal with any emergency that might occur during activities at the site, an emergency telephone number list (Tables 10-1 and 10-2) will be posted in the field office and placed in all on-site vehicles. Since the Lower Fox River site covers a large area, several hospitals and WorkCare facilities have been identified for use during site activities. Hospital location maps are provided in Appendix F for non-emergency trips to the hospital. The WorkCare facilities that can be used for non-emergency treatment is also listed in Table 10-1 and the location map is provided in Appendix F. Specific directions for each facility could not be developed since the workers will not be working in one TtEC personnel will identify and drive the routes to the hospitals and WorkCare facilities to verify the directions are correct and easy to follow. For procedures to follow in event of an injured work, refer to ZIP Bulletin No. 108 – Injured Worker Case Management (Appendix F) and Section 10.7. Contact WorkCare as soon as possible.

10.4 PRE-EMERGENCY PLANNING

TtEC will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat the injured individual(s). TtEC personnel will make a site visit to the clinic and discuss treatment options with the physician. Instructions for finding the hospital and emergency phone numbers will be posted conspicuously in the site office and in each site vehicle. TtEC will also communicate directly with the local fire departments to determine whether they have the facilities and personnel needed to respond to a fire or hazardous material spill during project activities.

Table 10-1. Emergency (and Non-Emergency) Telephone Numbers

EMERGENCY CONTACT	LOCATION	PHONE NUMBER	OUs	NOTIFIED
Hospitals				
Bellin Hospital	744 S. Webster Avenue Green Bay, WI 54301	911 or 920-433-3500	3,4,5	
St. Vincent Hospital	835 S. Van Buren Street Green Bay, WI 54301	911 or 920-433-0111	3,4,5	
St. Elizabeth Hospital	1506 South Oneida Street Appleton, WI 54915	911 or 920-738-2000	2	
WorkCare Facilities				
Theda Care at Work Contact: Mary Schrader or Cheryl Marx	2009 Memorial Drive Appleton, WI 54915	920-380-4999	2,3	
Prevea Workmed Voyager Contact: Debbie	3021 Voyager Drive Green Bay, WI 54311	920-496-4760	3,4,5	
Fire Department/EMS				
Green Bay Fire Department	501 S. Washington Street Green Bay, WI 54301	911 or 920-448-3280	3,4,5	
Ashwaubenon Fire and Rescue	2155 Holmgren Way Green Bay, WI 54304	911 or 920-492-2312	3,4,5	
De Pere Fire/EMS	400 Lewis Street De Pere, WI 54115	911 or 920-339-4087	2,3	
Wrightstown Fire Department	961 Broadway Street Wrightstown, WI 54180	911 or 920-532-4556	2,3	
Kaukanua Fire Department	206 West 3rd Street Kaukauna, WI 54130	911 or 920-766-6320	2	
Kimberly Fire Department	515 W. Kimberly Avenue Kimberly, WI 54136	911 or 920-788-9805	2	
Police				
Fox Valley Metro	200 West McKinley Ave Little Chute, WI 54140	911 or 920-788-1511	2	
Brown County Sheriff's Department	300 East Walnut Street Green Bay, WI 54301	911 or 920-448-4219	2,3,4,5	
Green Bay Police Department	307 South Adams Street Green Bay, WI 54301	911 or 920-448-3200	3,4,5	
U.S. Coast Guard				
Station Green Bay	P.O. Box 8486 Green Bay, WI 54308	920-435-7042 VHF Radio Channel 16 for distress calls	2,3,4,5	
Poison Control Center				
Poison Control Center		800-222-1222		
Hazardous Materials Spill Response Units				
Fire Department/EMS				
Appleton Fire Department	700 N Drew St Appleton, WI 54911	911 or 920-832-5813	2	
Green Bay Fire Department	501 S. Washington Street Green Bay, WI 54301	911 or 920-448-3280	3,4,5	
Ashwaubenon Fire and Rescue	2155 Holmgren Way Green Bay, WI 54304	911 or 920-492-2312	3,4,5	

Table 10-2. Emergency (and Non-Emergency) Telephone Numbers (continued)

EMERGENCY CONTACT	LOCATION	PHONE NUMBER	OUs	NOTIFIED
De Pere Fire/EMS	400 Lewis Street De Pere, WI 54115	911 or 920-339-4087	2,3	
Wrightstown Fire Department	961 Broadway Street Wrightstown, WI 54180	911 or 920-532-4556	2,3	
Kaukanua Fire Department	206 West 3rd Street Kaukauna, WI 54130	911 or 920-766-6320	2	
Kimberly Fire Department	515 W. Kimberly Avenue Kimberly, WI 54136	911 or 920-788-9805	2	
CHEMTREC[1] Chemical Transportation Emergency Center	1300 Wilson Boulevard Arlington, VA 22209	800-424-9300 (703-741-5525)		
National Response Center[2]	United States Coast Guard (G-OPF) 2100 2nd Street, Southwest – Room 2611 Washington, DC 20593-0001 USA	800-424-8802 (202-267-2675)		

Notes:

1. CHEMTREC® (Chemical Transportation Emergency Center) is a public service of the Chemical Manufacturers Association. However, CHEMTREC is not intended nor equipped to function as a general information source.
   - CHEMTREC® DEALS ONLY WITH CHEMICAL TRANSPORTATION EMERGENCIES!
   - In the event of chemical transportation emergency, CHEMTREC® provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals for more detailed assistance and appropriate follow-up.
   - OPERATES AROUND THE CLOCK – 24 HOURS A DAY, 7 DAYS A WEEK TO RECEIVE EMERGENCY CALLS. IN CASE OF CHEMICAL TRANSPORTATION EMERGENCIES, CALL ONE OF THE FOLLOWING NUMBERS:
     - Continental United States: (800) 424-9300 direct dial, toll free (WATS) number
     - Outside of Continental USA: (703) 527-3887 (This number may be called collect)
   - CHEMTREC® provides hazard information warnings and guidance when given the NAME OF THE PRODUCT and the NATURE OF THE PROBLEM. For more detailed assistance, provide the following information:
   - Name of caller and call-back number; Location of problem; Shipper or manufacturer; Container type; Rail car or truck number; Carrier name; Consignee; Local conditions.

2. The National Response Center (NRC) maintains a 24 hours per day, 7 days a week, 365 days a year Operation Center where all information is received via the toll-free number, entered directly into an on-line data base system, and electronically disseminated as part of the National Response System. Once contacted, the NRC Duty Officer will guide the caller through a detailed series of questions based on the Standard Report Form to gather as much information as possible concerning the spill or release. The information is immediately entered into the Incident Reporting Information System (IRIS) and based on several pre-established criteria including material involved, mode of transportation, injuries, damage, and fatalities, select federal agency notification will take place within 15 minutes of receipt. When any of the following incidents occur, the NRC should immediately be contacted by the responsible party via the toll free number. If you see or discover and oil spill or release of chemicals and are NOT the responsible party, you should contact the NRC with whatever information you have.

Chemical Releases

The Comprehensive Environmental Response, Compensation, and Liability Act requires that all releases of hazardous substances exceeding reportable quantities be reported by the responsible party to the National Response Center. Title 40 of the Code of Federal Regulations Part 302 promulgates reportable quantities and reporting criteria. All the Extremely Hazardous Chemicals (EHC) that overlaps with the CERCLA listed chemicals table (40 CFR Part 302.4) should be reported to NRC.

Other Releases

Discharges from a hazardous waste treatment or storage facility must be reported by the emergency coordinator at the facility. Abandoned dump or waste sites should be reported by anyone having knowledge of such a site.

Table 10-3. Site Contact Numbers

CONTACT	PHONE NUMBER
Project Manager – Ray Mangrum	C (713) 876-8528
CM – Mike Estess	C (803) 646-0938
PESM – Grey Coppi	(973) 630-8101 C (215) 327-0751
Phil Bartley (Director, EHS Services, TtEC)	(509) 372-5818 C (509) 521-4898
Medical Consultant (Dr. Greeney)	(800) 455-6155
ESS/EC – Bill Welch	C (330) 208-5630
Regulatory Specialist – Lee Dixon	(617) 457-8258

10.5 EMERGENCY DRILLS

10.5.1 General Site Emergencies

A general site emergency drill will be conducted during the first 2 weeks of site activities to test the site emergency systems. In addition or as part of the general site emergency drill, if work is being performed on-water, a fire onboard drill should be performed.

The drill(s) will simulate emergency situations and evacuation scenarios that might occur on-site, and may include a mock spill responses and cleanup. Local outside emergency responders may participate.

A critique of the drill(s) according to TtEC Procedure EHS 2-1 will be conducted.

10.5.2 Marine Emergencies

A person overboard or rescue drills will be conducted during the first 2 weeks of site activities. This would involve locations on the water and immediately adjacent to water, such as piers, docks, and bulkheads.

On all vessels that have a regular crew, or on which people are quartered, the following drills will be held at least once (unless the vessel is required, under USCG regulations, to be drilled more frequently): abandon ship/boat drills, fire drills, and person overboard or rescue drills.

Drills will include, where appropriate, how to handle a dewatering pump or pipe rupture, or failure within the hull (proper shutdown procedures, system containment, etc.) and how to handle leaks or failures of the hull or portions of it (what compartments to secure, how to handle power losses, pulling spuds to move to shallow water, etc.).

Emergency lighting and power systems will be operated and inspected weekly to ensure proper operation. Internal combustion engine driven emergency generators will be operated under load for at least a 2-hour check during this project. Storage batteries for emergency lighting and power systems will be tested at least once during this project.

Marine drills will also be critiqued, which will include any deficiencies noted and the associated corrective actions taken.

10.6 EMERGENCY MEDICAL TREATMENT

The procedures and rules in this SHSP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the ESS immediately. The first-aid equipment will be available on site at the following locations:

First Aid Kit with Inventory Sheet: Support Zone/Field Team Vehicle

ANSI Approved Emergency Eye Wash: Support Zone/Field Team Vehicle

At a minimum, two first aid/CPR trained persons will be assigned to each shift. During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

When personnel are transported to the hospital, the ESS will provide a copy of the Medical Data Sheet to the paramedics and treating physician.

Only in **non-emergency** situations will an injured person be transported to the hospital by means other than an ambulance.

10.7 EMERGENCY AND NON-EMERGENCY RESPONSE

10.7.1 Emergency Response

Some physical signs/symptoms that require emergency medical treatment and a call to 911 include chest pain, difficulty breathing, uncontrolled bleeding, bone fracture, loss of consciousness, severe head injury, poisoning, shock, loss of limb, and sudden and prolonged dizziness. In an emergency situation:

- Call 911 for initial employee evaluation and transport to the hospital. A designated TtEC employee shall accompany the injured worker to the hospital.
- Administer first aid to minimize the injury effects.
- Call WorkCare at 1-800-455-6155 for a triage call/discussion with an Occupational Health Nurse or physician. Mention ASAP that the call is regarding an emergency injury. The Occupational Health Nurse will assist the supervisor to determine the best treatment plan.
- Provide the following information to WorkCare:
  - Name of Supervisor calling.
  - Phone number.
  - Location calling from.
  - Name of individual injured and social security number.
  - Date and type of injury.
  - During WorkCare off-hours, dial the 800 number and identify yourself. A WorkCare health care representative will call you back shortly. Do not delay treatment while awaiting a return phone call.
  - Call the PESM, Project Manager, and Client.

10.7.2 Serious Injury to Personnel on the Water

A significant amount of work at the site is performed on or from watercraft, and it is possible that an employee may become sick or injured while located on a watercraft in the harbor. In the event that an employee becomes disabled while on a vessel, then the following procedures should be followed:

- Call 911 (if cell phones work); other wise contact the U.S. Coast Guard (Distress Channel 16 – VHF Radio) for initial employee evaluation and transport to the hospital. A designated TtEC employee shall accompany the injured worker to the hospital.

IMPORTANT: The logistics of the rescue must be communicated to the emergency responders.

- If the watercraft on which the person is located can maneuver to a shoreline rendezvous point, then the location must be provided to the emergency responders. Shoreline meeting point locations to be used in emergencies must be planned in advance by project management personnel, as they may vary depending on the location of work. Each preset location will be visited prior to the beginning or activities to verify the appropriateness of the location.
- If the injured employee cannot be transported on the watercraft where the incident occurred, or in the case of an immobile watercraft, the employee can be transferred (if injuries allow) to another boat, then the employee should be transported to the pre-determined meeting point to rendezvous with the emergency responders.
- If, in the judgment of the First Aid/CPR competent person, the injured individual cannot be moved, the emergency responders will be transported by a site boat to the scene of the incident. If necessary, CPR and first aid will be administered while awaiting the arrival of the emergency response personnel.
- Supervisory personnel will meet EMS personnel at the rendezvous point and direct them to the injured party. The rendezvous point should be coordinated with EMS during the initial mobilization activities.
- The EMS personnel will evaluate the patient's condition.
- If the condition of the patient is immediately life-threatening and waiting for the arrival of the emergency responders is not possible, then the project personnel will take the injured employee from the watercraft, transfer them to the workboat, and transport to shore. The project personnel will then rendezvous with EMS personnel at the on-shore location.
- The site boat or other watercraft used in a rescue will be secured to the barge or other vessel prior to the removal of and placement of the injured person into the rescue boat.

10.7.3 Person in Water (Overboard)

When working on vessels or near water, the possibility exists that a person could fall from the vessel or other location adjacent to water. Since no work on water is to be conducted by one person alone, there will typically be another person to act in the event of an overboard incident. If there is occasion where a single person is working on, over, or adjacent to water, then the person must be equipped with a means of communication with another party (buddy system).

Regular well being checks should be made using this communication method. If a person does go overboard from a vessel or otherwise falls into a water body, then the following applies.

10.7.3.1Small Watercraft (on boats, skiffs, etc.)

- If a person goes overboard, yell "Man Overboard" and what side the person fell off, immediately stop the motor and throw the life ring (Type IV PFD) to the person. If the boat has traveled too far from the person, maneuver the boat closer before throwing the ring. Motor must be in neutral when person in the water is alongside the boat.
- Instruct the person to hold the ring, and slowly bring the person to the side of the boat. Depending on the boat size and configuration, the person may be able to climb back into the boat with assistance. For smaller boats like johnboats, it is almost impossible to bring someone on board without capsizing the boat. In this case have person hang onto the boat and carefully maneuver the boat to nearest shore.
- If the person cannot get into the boat because of the boat limitations, injuries, or unconsciousness, then have the person stay with the boat, or have personnel hold that person alongside the boat until shoreline is reached or assistance arrives.
- Notify other site vessels and emergency responders and the U.S. Coast Guard by VHF radio (if appropriate) and await assistance.

10.7.3.2Large Watercraft (barges, dredges, ships)

- If a person goes overboard, yell "Man Overboard" and the side the person fell off and immediately throw a life ring (Type IV PFD) to the person.
- Give the order to stop all engines.
- Notify the captain or crewmember in charge and the land-based EC.
- With assistance, use the rescue or lifesaving skiff to reach the person.
- If the skiff is suitably configured and assistance is available, the person may be able to be brought onto the skiff.
- If the person cannot get into the boat because of the boat limitations, injuries, or unconsciousness, then have the person stay with the boat, or hold the person alongside so he/she does not drift away.
- On large vessels so equipped, the person may be able to be winched back onto the vessel after a line and sling has been placed around and under their arms.
- Await assistance.

10.7.3.3Land-Based Areas

- If a person goes into the water, yell "Man Overboard" and the location where the person went overboard, and throw a life ring (Type IV PFD) to the person.
- Notify the EC.
- Depending on the configuration of the area, the person may, with the assistance of the life ring and line, be able to come to the shoreline and exit the water.

- If the person cannot exit the water, with assistance, use the lifesaving skiff to reach the person.
- Instruct the person to hold the ring, and slowly bring the person to the side of the skiff. Depending on the skiff size and configuration, the person may be able to climb into the skiff with assistance.
- If the person cannot get into the skiff because of the skiff's limitations, injuries, or unconsciousness, then have the person stay with the boat, or hold the person alongside so he/she does not drift away.
- Await assistance.

10.7.4 Non-Emergency Response

In a non-emergency situation:

- Administer first aid to minimize the injury effects.
- Call WorkCare at 1-800-455-6155 for a triage call/discussion with an Occupational Health Nurse or physician. Mention ASAP that the call is regarding an injury. The Occupational Health Nurse will assist the supervisor to determine the best treatment plan.
- Provide the following information to WorkCare:
  - Name of Supervisor calling
  - Phone number
  - Location calling from
  - Name of individual injured and social security number
  - Date and type of injury
- During WorkCare off-hours, dial the 800 number and identify yourself. A WorkCare health care representative will call you back shortly. Do not delay treatment while awaiting a return phone call.
- Call the PESM, Project Manager, and Client.
- Call the local WorkCare clinic (see Table 10-1) to notify them that you are bringing an injured worker to their clinic for evaluation.
- You may transport the injured employee to the local clinic in a privately owned vehicle. A designated TtEC employee must accompany the injured worker to the local clinic.

10.7.5 After Emergency and Non-emergency Treatment

After emergency and non-emergency treatment:

- Obtain treatment and medical release records for the injured worker and forward to WorkCare.
- Contact TtEC worker's compensation carrier (ESIS at 1-866-615-5923) within 24 hours of injury.
- Seek ways to ensure the worker can work, including alternate work.

- Regularly follow-up with WorkCare and ESIS case representatives.

10.8 EMERGENCY SITE EVACUATION ROUTES AND PROCEDURES

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority will be established. The EC will take charge of all emergency response activities and dictate the procedures that will be followed for the duration of the emergency. The EC will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At his/her discretion, the EC also may order the closure of the site for an indefinite period.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs, including, but not limited to fire or explosion, an air horn will be sounded on the site. The horn will sound for three blasts, signaling that immediate evacuation of all personnel is necessary due to an immediate or impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the designated rally point, which shall be determined upon arrival at the site.

The EC will give directions for implementing whatever actions are necessary. Any project team member may be assigned to be in charge of emergency communications during and emergency. He/she will attend the site telephone specified by the EC from the time the alarm sounds until the emergency has ended.

After sounding the alarm and initiating emergency response procedures, the EC will check and verify that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, a project team member, who has been trained in these procedures and designated at the site safety meeting, will take over these duties until local police and fire fighters arrive.

The EC will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. Evacuation routes, meeting places, and location of emergency equipment and first aid supplies shall be discussed during the site-specific briefing.

10.9 FIRE PREVENTION AND PROTECTION

In the event of a fire or explosion, procedures will include immediately evacuating the site (air horn will sound for a single continuous blast), and notification to the local fire department. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

Adhering to the following precautions will prevent fires:

- Good housekeeping and storage of materials
- Storage of flammable liquids and gases away from oxidizers
- Smoking will be allowed only in designated areas appointed by CM
- No hot work without a properly executed hot work permit
- Shutting off engines to refuel
- Grounding and bonding metal containers during transfer of flammable liquids

- Use of UL approved flammable storage cans
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers, and near all hot work activities
- Monthly inspections of all fire extinguishers
- Daily inspections of vessel fuel tanks and lines, and engines

10.10 CHEMICAL EXPOSURE

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the MSDS or recommended by the Corporate Medical Consultant will be followed, when necessary. Call 911 if required.

SKIN AND EYE CONTACT:	Use copious amounts of water. Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustics, acids, or hydrogen peroxide occurs.
INHALATION:	Move to fresh air. Decontaminate and transport to hospital or local medical provider.
INGESTION:	Decontaminate and transport to emergency medical facility.
PUNCTURE WOUND OR LACERATION:	Decontaminate and transport to emergency medical facility.

10.11 ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Ray Mangrum, Project Manager (713) 876-8528
2. Grey Coppi, CIH (973) 630-8101
3. Bill Welch, ESS (330) 208-5630
4. The employer of any injured worker who is <u>not</u> a TtEC employee

Incident reporting to TtEC needs to occur immediately to ensure that any injury is properly managed. Written confirmation of verbal reports is to be submitted within 24 hours. The accident/incident report is found in the TtEC Corporate Health and Safety Program, Section EHS 1-7. This report will be done by the employee(s) involved in the incident and the ESS, Construction Manager, or Project Manager. If the employee(s) involved is not a TtEC employee, his/her employer shall receive a copy of the report. Any major waterborne incident will be reported to the U.S. Coast Guard as well.

10.12 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the ESS or designee will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries

- Treacherous weather-related working conditions (hail, rain, lightning, snow, ice, or high winds)
- Rough seas
- Limited visibility (fog)
- Potential for electrical storms
- Other major incidents

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The ESS will determine the need to cease field operations, if necessary, in case of severe inclement weather conditions.

All subcontractors must work closely with site management in order to ensure that pre-planning for, and response to, severe weather conditions are adequate.

A detailed weather forecast will be obtained by the ESS for the area for the current and following day's weather forecast to determine the impending weather. The weather forecasts will be discussed at each morning's health and safety briefing.

10.12.1 Thunder Storms, Squalls, and Short Duration Wind Storms

The following actions should be taken to secure the site whenever there is a threatening storm that includes lightning or the chance of winds over 45 miles per hour:

- Secure all loose materials, supplies and equipment.
- Employees working in high wind conditions must be protected from airborne contaminants and flying debris using engineering controls such as wetting of dry soil to prevent particle dispersion and securing all loose objects.
- Stop all work and bring all workers indoors when lightning is within view of the site. Work will not commence until 30 minutes after last sighting of the lightning.
- Reach equipment work will stop and be lowered and secured.
- In the event that lightning is encountered in the area, work will stop and the crew will follow the established procedure for taking shelter. The increased hazard of transporting crew members over water in small boats in these conditions will be addressed by having the crew sheltered on the spudded down, floating barge until the danger has passed. Evacuation of the crew from the floating plant will be at the digression of the ESS and Construction Manager.
- Shut down and disconnect all electrical equipment in an orderly manner. The purpose is to protect the equipment from electrical surges and abrupt power loss.
- Anchor barges and other immovable watercraft with anchor and spuds. Evacuate barge and take shelter from the storm on shore. All other watercraft will return to shoreline locations.

10.12.2 Special Marine Considerations

Pre-planning and response to extreme weather conditions in a marine environment, especially for vessel operations, is very dependent on the specific operations being conducted and the particular

equipment involved. Therefore, in addition to the information in the above sections, there are additional severe weather elements, which must be considered for marine operations.

Special extreme weather considerations for marine activities are discussed below.

10.12.2.1 High Winds

Of particular concern during periods of high winds are 1) the limited communications between persons on vessels to others via the two-way radios; and 2) the potential of strong winds knocking persons on small craft, rafts, and barges over. Sustained wind speeds of 20 knots will initiate the start of the appropriate precautions for suspending operations due to high winds. Should gale force winds (34–47 knots or 39–54 mph) be announced over the marine radio, all operations will cease work a minimum of one hour before the storm arrives, depending upon the work being performed.

Safety procedures for high-risk equipment (i.e., cranes, derricks, or barges) which may need special attention or which may be impacted by lower wind speeds should be established during mobilization activities and communicated to field personnel. All equipment will be lashed to the deck or placed in the storage area and all unnecessary boats and barges will be docked at a marina or removed from the water, and all personnel will be transported to shore. All rafts and johnboats will be removed from the water prior to gale force wind conditions. The watercraft must be equipped with sufficient weight trip anchors, and each anchor must have sufficient chain and line for anchoring. At a minimum, when mooring, one anchor will be put down for windy conditions. Should vessel captains or the ESS determine that additional anchoring/spudding/securing of the boats is needed, additional trip anchors/spuds or lines will be used. Some conditions may require a three-point anchoring system or a minimum of three spuds to secure the watercraft. If this requirement cannot be met, then the watercraft must be pulled from the water.

Should it be determined by the onboard personnel and the captain that the weather conditions being encountered on the watercraft are dangerous and are worsening, all operations will cease, all equipment will be lashed to the deck or placed in the storage area, and all personnel will be transported to shore.

Additionally, when operations are conducted to secure watercraft and other vessels for protection against weather events such as high winds, high tides, hurricanes, etc, a meeting will occur with all responsible parties to discuss proper docking and securing procedures. Provisions and assignments for monitoring the integrity of the secured/docked watercraft at regular intervals, including weekends and nights during the event must be specified and approved by TtEC.

10.12.2.2 Heavy Downpours and Snow Squalls

In the event heavy downpours (where visibility is obscured), or snow squalls are forecasted or encountered, all operations will be suspended until the heavy rains or snow squalls end. Personnel may remain on the watercraft during heavy rain or snow squall events only when leaving poses greater danger. The watercraft will be left in place, secured by anchors. Should it be determined by the TtEC personnel and the captain that the weather conditions being encountered on the watercraft are dangerous and are worsening, all operations will cease, all equipment will be lashed to the deck or placed in the storage area, and all personnel will be transported to shore.

10.12.2.3 Snow, Ice, Hail

In the event snow, ice, or hail is forecasted or encountered, work may continue after the watercraft(s) are cleared of ice and accumulated snow as needed. Ample amounts of sand and salt will be available and applied to the deck surfaces as needed. Should it be determined by the TtEC personnel on board, and the captain, that the weather conditions being experienced on the watercraft are dangerous and are worsening, all operations will cease, all equipment will be lashed to the deck or placed in the storage area, and all personnel will be transported to shore.

10.12.2.4 Thunderstorms

In the event a thunderstorm is forecasted, the ESS, or designee, will monitor the activity on the NWS local Doppler radar. Additionally, all site personnel will keep an "eye to the sky," observing conditions. Operations will cease when it is determined that thunderstorm cells are within 5 miles of the site, based on NWS Doppler radar, or if lightning is observed from any location. All equipment will be lashed to the deck or placed in the storage area and all personnel will be transported to shore. Operations will be allowed to continue 30-minutes after the last lightning is observed, unless NWS local Doppler radar shows other storms approaching.

10.12.2.5 General

- All vessels and personnel will maintain radio and cellular telephone communications/contact with the field office. Radio communication/contact will occur via the site marine radios. The channels to be used must be coordinated in advance.
- NOAA weather forecasts will be monitored daily by TtEC and subcontractor personnel, for predicted inclement weather. Local weather forecasts will be discussed at the daily health and safety meeting.
- All personnel shall be aware of the forecast and keep an "eye to the sky." Unpredicted storms may also occur without warning. The ESS will also monitor NWS Local Doppler radar as required and vessel captains will monitor marine forecasts on the NWS radio frequencies.
- Work will be suspended when a sustained wind of 26 knots or 30 mph is encountered or in the event of gale force winds (34–47 knots or 39–54 mph), per the ESS or Construction Manager.
- Use of any 12- to 16-foot aluminum-hulled tender boat during small craft advisories or greater warnings (18–33 knots or 20–38 mph) will not be allowed.

10.13 SPILL CONTROL AND RESPONSE

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed of. An exclusion zone of 50–100 feet around the spill area should be established depending on the size of the spill.

The following steps should be taken by the Emergency Coordinator:

- Determine the nature, identity, and amounts of major spill components.
- Make sure all unnecessary persons are removed from the spill area.
- Notify the appropriate site response team and the PM and PESM. See Tables 10-1 and 10-2.
- Use proper PPE in consultation with the ESS.
- If a flammable liquid, gas, or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.).
- If possible, try to stop the leak with appropriate material.
- Remove all surrounding materials that can react or compound with the spill.
- Protect storm drains and sewer manholes by surrounding them with sorbent materials or berms.
- Attempt to divert spilled liquids from entering streams, surface waters, or drainage ditches using berms or sorbent materials.

Lee Dixon, CHMM, CPEA – Regulatory Specialist (617-457-8258) may be contacted for spill reporting information and assistance.

10.13.1 Notification Requirements

If an on-site release requires notifications to state and federal regulatory agencies, the TtEC PM in coordination with the PESM will be responsible for making the notification. Table 10-3 presents the regulatory notification requirements and contact information in the event of release. In addition to the agency notification requirements in Table 10-3, if a notification is made there are additional reporting requirements that must be made. Coordinate with Lee Dixon and the PESM to meet these requirements.

Table 10-4. Release Notification Requirements and Contact Information

Contact	Phone Number	Time Frame	Release Notification Requirement
National Response Center	1-800-424-8802	As soon as possible, but no later than 12 hours	Transportation –related (including loading/unloading, and temporary storage) incidents involving hazardous materials (including hazardous wastes) • Hazardous Materials are listed under 49 CFR 172.101 • As a direct result of hazardous material o A person is killed. o A person receives an injury requiring admittance to a hospital. o The general public is evacuated for 1 hour or more. o A major transportation artery or facility is closed or shut down for 1 hour or more. o The operational flight pattern or routine of an aircraft is altered. • There has been a release of a marine pollutant in a quantity exceeding 119 gallons for liquids or 882 lbs. for solids • Release of a hazardous substance equal to exceeding the reportable quantity (see 40 CFR 302 – Table 302.4)
National Response Center (or if direct notification to the NRC is not practical, reports can be made to the Coast Guard)	NRC: 1-800-424-8802 Coast Guard District 9: 216-902-6073	As soon as there is knowledge of the spill.	Report oil spills into or upon the navigable waters of the United States or adjoining shorelines. Reportable discharges of oil include quantities that: • Violate applicable water quality standards • Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines • Cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.
EPA Regional Office Region V	77 West Jackson Blvd Chicago, IL 60604 312-353-2000	Immediate reporting	• Spills of 10 pounds or more by weight of PCBs (any concentration greater than 50 ppm) • Spills of 1 pound or more by weight of PCBs (i.e., Total volume spilled times concentration ≥ 1 pound). are also reportable to the National Response Center.
Wisconsin Emergency Management	1-800-943-0003	Immediate reporting	All discharges to the environment of a hazardous substance (including petroleum products such as diesel, gasoline, oil) *except* the following: • A discharge of gasoline or another petroleum product that is completely contained on an impervious surface. • A discharge of gasoline if < 1 gallon is discharged onto a surface that is not impervious or runs off an impervious surface. • A discharge of a petroleum product other than gasoline if < 5 gallons is discharged onto a surface that is not impervious or runs off an impervious surface. • A discharge of hazardous substances (e.g., PCBs) specifically listed in 40 CFR Part 117 or 302 if the amount discharged in any 24 hour period is less than the RQ listed in 40 CFR Part 117 or 302 (e.g., RQ for PCBs = 1 pound).

10.13.2 Minor Spill Less than RQ

On Vessels:

- Contain the spill on the vessel and clean up with absorbents or absorbent pillows in order to prevent the spill from reaching the water. The EC will follow the notification procedures outlined above.

In the Water:

- Contain and clean up the spill with an absorbent boom, absorbent pillows, or pads. The EC will follow the notification procedures outlined above.
- Note that an appearance of a "sheen" on the water surface from a release of oil or hazardous material constitutes a RQ (i.e., requires agency notification) in Wisconsin and to the NRC under federal requirements, regardless of the actual quantity of oil or hazardous material released.

On Land:

- Prevent the spill from reaching the water or storm drains using an earthen berm or other barrier in order to prevent the spill from reaching the water. Remediate spill area according to state and federal regulations. The EC will follow the notification procedures outlined above.

10.13.3 Large Spills Above the RQ

- Contain spill to the smallest area possible using booms, berms, or any other effective barrier. The EC will follow the notification procedures outlined above.
- In the event that additional emergency cleanup help is needed, TtEC will request assistance from off-site response contractors.
- TtEC will collect all material discharged including contaminated booms and absorbent materials. All residue discharged will be disposed of in accordance with all applicable waste federal and state regulations.
- All emergency equipment will be decontaminated prior to being placed back into routine service.
- Contaminated decontamination water, waste solutions, or residues generated from decontaminating the equipment will be collected and disposed of in compliance with all applicable state and federal regulations.
- TtEC will keep all records related to the spill of hazardous waste for a period of at least 3 years after the spill has been cleaned up or for longer periods of time, if required as part of any unresolved enforcement action.

10.14 UNDERGROUND UTILITIES

Underground utilities present a variety of hazards whenever intrusive activities are conducted. The possibility of the existence of underground utilities must be evaluated as early as possible in the planning phase of any intrusive activity. The requirements for conducting intrusive activities relative to underground utilities are outlined in TtEC Procedure EHS 3-15, Underground

Utilities. This procedure covers means for underground utility identification, location, protection, and avoidance, as well as emergency response procedures.

In the event that encountering or contacting an underground utility occurs, it is imperative that the appropriate actions are taken to minimize damage to the utility, prevent personal injury, and minimize indirect effects. Response measures to be followed in the event of underground utility contact/near contact are outlined below.

10.14.1 Encountering Underground Utilities

It is possible that underground utilities will be encountered in locations that have previously been "cleared" of having underground utilities by the locating service, or are found outside of the area which has been marked as having underground utilities. In either case, if this occurs, the following applies:

- Intrusive activities must be stopped immediately.
- The One-Call agency (i.e., Wisconsin One-Call (811, 800-242-8511, 414-259-1181, or emergency only 877-500-9592) or private location service must be contacted immediately.
- The PM, PESM, and client must be notified.
- No further intrusive activities may be conducted until:
  - The One-Call agency/private location service and/or the subject utility owner visit the site;
  - Identification of the utility owner and the type of material/energy being conveyed by the utility has been made; and
  - The orientation and depth of the subject utility have been determined and suitably marked.
- An Incident Report and Investigation form must be completed per EHS 1-7. The report should be accompanied by photographs clearly showing the marking(s) and the actual location with a distance gauge to document how far off the mark the utility was encountered.

Note: Overhead utilities height clearance data will need to be received for transport up/down river.

10.14.2 Contacting Underground Utilities

If excavation or other equipment being used for intrusive activities makes contact with an underground utility, the following guidelines apply:

- Intrusive activities must be stopped immediately.
- Observe the utility from a safe distance and determine if there is damage. Damage would be all breaks, leaks, nicks, dents, gouges, grooves, scratched coatings, cathodic protection compromise, material leakage, obvious electrical energy.
- Move all personnel to the evacuation meeting point as described in the SHSP. EXCEPTION: If an electrical line has been contacted and it is your belief that equipment

(such as an excavator) is electrically energized, do not approach the equipment. Order the operator to remain in the equipment until emergency personnel can de-energize the source (unless the equipment is on fire, at which time the operator should jump off of the vehicle and shuffle along the ground to a safe area). Shuffling is required because current flows outward through the soil in a ripple pattern called a power gradient, creating a pattern of high and low potential, Shuffling decreases the chance that these gradients could be bridged, causing current to flow through the body, resulting in electrocution.

- Secure the area to prevent the public from entering.
- Contact emergency responders as specified in the SSHP.
- The One-Call agency or, if known, the utility owner must be contacted immediately.
- The PM, PESM, and client must be notified.
- No further intrusive activities may be conducted until:
  - The utility owner inspects the scene and, after repairs, verifies that all danger has passed.
  - The orientation and depth of the subject utility have been determined and suitably marked.
  - Permission from the emergency responders to resume work has been given.
- An Incident Report and Investigation form must be completed per EHS 1-7. The report should be accompanied by photographs clearly showing the marking(s), and the actual location, with a distance gauge to document how far off the mark the utility was encountered.
- State and local regulations must be reviewed to determine if reporting to any additional agencies is required.

10.15 EMERGENCY EQUIPMENT

The following minimum emergency equipment shall be kept and maintained on site:

- First aid kit.
- ANSI approved eye wash with capability of 15 minutes nonstop operation.
- Fire extinguisher (one per trailer/vehicle, and trailer).
- Spill control equipment if hazardous or petroleum-based materials are used to include, but not limited to, absorbent booms, absorbent pads, and absorbent material, scoop or shovel, and disposal container.

10.15.1 Marine Emergency Equipment

- All watercraft > 25 feet having gasoline or liquid petroleum gas powerplants or equipment in cabins, compartments, or confined spaces, shall be equipped with a built-in automatic CO_2 or other equally effective type of fire extinguishing system.
- Each watercraft shall carry UL approved fire extinguishers (only needed if they have an engine) for use in gasoline, oil, and grease fires. Each fire extinguisher shall be inspected by the owner/operator monthly to ensure that it is sufficiently charged and that the

nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately. Extinguisher requirements are as follows:

Length of Watercraft	Extinguisher Type	Number Required
26 feet or less	1-A:10-B:C	1
26 feet or more	1-A:10-B:C	2

- All watercraft shall carry at least one air horn or similar sound-signaling device.
- All watercraft shall carry a non-pyrotechnic visual distress signals. Non-pyrotechnic visual distress signals include an orange distress flag and a flashlight or other electric distress light. No single signaling device is ideal under all conditions and for all purposes.
- All powered watercraft shall carry a tool kit sufficient for the watercraft operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Watercraft operated in remote areas shall also carry appropriate spare parts (propellers, shear pins, patch kits, air pumps, etc.). The tool kit shall be maintained by the watercraft operator, and expended supplies shall be replaced immediately.
- Emergency cutting equipment shall be provided in accessible positions on all towing vessels for freeing lines in an emergency.
- All controls requiring operation in cases of emergency—such as boiler stops, safety valves, power switches, fuel valves, alarms, and fire extinguishing systems—shall be located so that they are protected against accidental operation but are readily accessible in an emergency.
- General alarm systems shall be installed and maintained on all vessels where it is possible for either a passenger or crewman to be out of sight or hearing from any other person. Where general alarm systems are used, they shall be operated from the primary electrical system with standby batteries on trickle charge that will automatically furnish the required energy during an electrical system failure.
- A sufficient number of signaling devices shall be placed on each deck so that they can be distinctly heard above the normal background noise at any point on the deck.
- Smoke alarms are required for all living quarters of a vessel; smoke alarms, if wired, should use the same electrical system as that of the electrical alarms.
- All doors shall be capable of being opened from either side and provided with positive means to secure them in both the open and closed position.
- Escape hatches and emergency exits shall be marked on both sides with letters, at least 2.5 cm (1 in) high, stating “EMERGENCY EXIT - KEEP CLEAR.”
- Each prime mover (engine, turbine, motor) driving a dredge pump shall be capable of being stopped by controls remote from the prime mover locations.

- Where appropriate, vessels should have watertight compartments readily identified and properly maintained in a watertight condition (i.e., sealable doors in place and fully functional) and all penetrations maintained in a watertight condition.
- For watercraft > 25 feet, a shutoff valve shall be installed at the fuel tank connection; arrangements shall be made for operating this valve from outside the compartment in which the tank is located and from outside the engine compartment and outside the house bulkheads at or above the weather deck of the vessel.
- A shutoff valve shall be installed at the engine end of the fuel line unless the length of the supply pipe is 1.8 m (6 feet) or less. Arrangement shall be made for operating this valve from outside the house bulkheads, at or above the weather deck on the vessel.
- Fuel and lubricant containers and tanks shall be diked or curbed to contain the tank contents in case of leakage in accordance with NAVFAC DM-22, Petroleum Fuel Facilities. In lieu of a dike or curb, other means complying with USCG requirements in 46 CFR Parts 64, Marine Portable Tanks, and 98.30, Handling and Storage of Portable Tanks, may be used.
- Fuel oil transfers for barges shall be in accordance with the provisions of USCG regulations, 46 CFR and 33 CFR Parts 155 and/or 156. For uninspected vessels, USCG regulations in 33 CFR 156.120 and 33 CFR 155.320 for fuel coupling devices and fuel oil discharge containment apply. Venting fuel tanks is necessary when using the couplings prescribed by 33 CFR 156.120(1) or (2).
- All vessels need anchors.
- If vessels are operating at night, they need Navigation Lights.

10.15.2 Lifesaving Skiffs

1. At least one lifesaving skiff (a powered johnboat or other smaller boat used in emergencies) shall be <u>immediately available</u> at locations where employees are working over or adjacent to water (based on an assessment by the ESS).
2. OSHA has established the following criteria for determining when a lifesaving skiff is to be considered as being <u>immediately available</u>:
   - The skiff must be in the water or capable of being quickly launched by one person.
   - There must be at least one person present and specifically designated to respond to water emergencies and operate the skiff at all times when there are employees above water.
   - When the operator is on break, another operator must be designated to provide the requisite coverage while employees are above water.
   - The designated operator must either man the skiff at all times or remain in the immediate area such that the operator can quickly reach the skiff and get underway.
   - The skiff operator may be assigned other tasks provided the tasks do not interfere with the operator's ability to quickly reach the skiff and get underway.
   - The communication system, such as a walkie-talkie, must be used to inform the skiff operator of an emergency and to inform the operator where the skiff is needed.

- The skiff must be equipped with both a motor and oars as a secondary means of propulsion:
  a. Personnel trained in launching and operating the skiff shall be readily available during working hours. Lifesaving personnel shall perform a lifesaving drill before the initiation of work at the site and periodically thereafter as specified by the ESS (but at least monthly or whenever new personnel are involved).
  b. Skiffs shall be kept afloat or ready for instant launching.
  c. Required equipment must be on board and meet or exceed USCG requirements. Skiffs shall be equipped as follows:
     - Four oars (two if the skiff is motor powered)
     - Oarlocks attached to gunwales or the oars
     - One ball-pointed boat hook
     - One life ring with at least 70 feet (21 meters) of 3/8 (1 centimeter) solid braid polypropylene line, or equivalent, attached
     - PFDs in number equaling the skiff rating for the maximum number of personnel allowed on board
- In locations where waters are rough, swift, or where manually operated boats are not practical, a powerboat suitable for the waters shall be provided and equipped for lifesaving.
- Skiffs shall have flotation tanks or buoyant material capable of floating the boat and its equipment and the crew.
- On vessels (e.g., skiffs) without permanently mounted navigation lights, portable battery-operated navigation lights will be available and used for night operations.
- According to OSHA's directive relative to the number of skiffs required and the appropriate maximum response time, the following factors must be evaluated:
- The number of work locations where there is a danger of falling into water
  - The distance to each of those locations
  - Water temperature
  - Currents
  - Other hazards such as, but not limited to, rapids, dams, and water intakes
- In addition to the proceeding, the employer is required to comply with all other applicable standards including, but not limited to, the requirements that the injured employee is promptly treated by medical personnel or an employee certified in first aid. This could mean that medical treatment might have to begin in the lifesaving skiff.

10.15.3 Flotation Devices

10.15.3.1 Personal

- A U.S. Coast Guard approved Type II or Type III PFD shall be provided to and properly worn by all persons in the following circumstances:
  - On all watercraft, including barges, floating plants, powered and non-powered vessels and boats, floating work platforms, floating pipelines, pontoons, etc.
  - On structures extending over or next to water except where guardrails or safety nets are provided for employees.
  - Any work on or within 10 feet of water where falling into the water is a potential hazard.
  - Wherever there is a drowning hazard.
- PFDs are required for all marine work.

10.15.3.2 Life Rings - Watercraft

Each watercraft shall be equipped with at least one Type IV PFD, designed to be thrown to a person in the water and grasped and held by the user until rescued. A life ring and horse-shoe buoy are two common examples of a Type IV PFD. All Type IV PFDs must be approved by the ESS prior to use. Life rings (rope attachment not required) and ring buoys (rope attachment required) shall conform to the requirements of 46 CFR 160 (U.S. Coast Guard approval) and shall have at least 70 feet (21 meters) of 3/8-inch (1 centimeter) solid braid polypropylene line, or equivalent, attached. Throw bags may be used in addition to life rings or ring buoys.

Life rings or ring buoys shall be readily available and shall be provided as follows:

- A minimum of one on each vessel.
- A minimum of one on all motor boats up to 40 feet (12 meters) in length and at least two for motor boats 40 feet (12 meters) in length or longer.
- A minimum of two on any other piece or group of floating plant up to 100 feet (30 meters) in length and one additional for each increase in length of 100 feet (30 meters) or fraction thereof.
- Life rings will be required when working on-shore alongside water.

10.16 POSTINGS

The following information shall be posted at the site:

- Emergency telephone numbers
- Emergency VHF channels
- Emergency evacuation routes and staging area
- Route to Hospital/WorkCare Clinic

10.17 RESTORATION AND SALVAGE

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies, and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers
- Refilling medical supplies
- Recharging eyewashes and/or showers
- Replenishing spill control supplies
- Replacing life rings
- Replacing used air horns

11.0 TRAINING

11.1 GENERAL HEALTH AND SAFETY TRAINING

Project personnel shall receive site training during initial site visit including review of this SHSP. This training will address the duties the employees are expected to perform. In addition, site employees will review and sign off on TtEC's Project Rules Handbook for general health and safety procedures.

11.2 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE TRAINING

Employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120, 29 CFR 1926.65 (or if required by subcontract). At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements will not be allowed to engage in hazardous waste operations or emergency response activities.

11.3 INITIAL TRAINING

General site workers engaged in hazardous waste operations shall, at the time of job assignments, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

11.4 THREE-DAY ACTUAL FIELD EXPERIENCE

General site workers for hazardous waste operations shall have received 3 days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor, and the employer shall provide documentation that this training has be completed. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment.

11.5 REFRESHER TRAINING

General site workers shall receive 8 hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

11.6 SITE-SPECIFIC HEALTH AND SAFETY TRAINING

Prior to beginning any construction activities, TtEC will schedule a site-specific training with all personnel who work on the site. This meeting will be documented and signed by all parties attending the training. As work progresses, additional training may be required for new worker(s) entering the site. Personnel who have not received the site-specific training will not be allowed unescorted into the construction zone.

11.7 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given on-site health and safety briefings by the CM or ESS to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. Prior to starting any new activity, a training session using the AHA will be held for workers involved in the activity. A copy of the attendance sheet for these daily briefings is included in Appendix A.

11.8 FIRST AID AND CPR

The ESS will identify those individuals requiring first aid and CPR training in order to ensure that emergency medical treatment is available during field activities. It is expected that a minimum of two field personnel on-site at any one time will have first aid, CPR, and bloodborne pathogen training. The training will be consistent with the requirements of the American Red Cross Association; OSHA 29 CFR 1910.1030, Bloodborne Pathogen Standard; and EHS 4-1.

11.9 HAZARD COMMUNICATION

Hazard communication training will be provided and documented in accordance with the requirements contained in the TtEC Health and Safety Program, EHS 4-2, a copy of which will be maintained onsite. This training will be included, at a minimum, during the initial site briefing and additionally during daily site safety briefings as necessary or indicated.

11.10 TSCA AND PCB AWARENESS

TSCA and PCB awareness training will be conducted to ensure that all site workers understand and comply with the regulations (i.e., TSCA) for working with PCBs.

12.0 LOGS, REPORTS AND RECORDKEEPING

The following is a summary of required health and safety logs, reports, and recordkeeping.

12.1 FIELD CHANGE REQUEST

FCRs are to be completed for initiating a change to the SHSP. The PESM, Project Manager or designee, approval is required. The original will be kept in the project file. Approved changes will be reviewed with affected field personnel at a safety briefing. An FCR form is provided in Appendix A.

12.2 MEDICAL AND TRAINING RECORDS

Copies or verification of training (40 hour, 8 hour, supervisor, site-specific training and documentation of three day on-the-job training) and medical clearance for hazardous waste site work will be maintained on-site by the ESS. Records for all subcontractor employees will also be kept on site. All employee medical records will be maintained by the Corporate Medical Consultant in accordance with TtEC Health and Safety Program, EHS 1-8.

12.3 ON-SITE LOG AND VISITOR LOG

The CM or designee will keep each day a log of personnel on site. Additionally, all visitors will be required to sign in on the daily visitor log. This log shall include the personnel visiting the site, their affiliation, date, arrival and departure time, and purpose of their visit.

12.4 WEEKLY SAFETY REPORTS

The ESS shall complete and submit weekly/monthly safety reports to the PESM. The report is provided in Appendix A.

12.5 EHS INSPECTIONS

TtEC will perform weekly EHS inspections to assess site conditions and verify they are in compliance with all applicable laws and regulations. The ESS or designee will perform the weekly inspections. The Project Manager or designee will perform the monthly inspection. If the project duration extends over 3 months, the PESM will perform a quarterly inspection.

12.6 ACCIDENT/INCIDENT REPORTS

Incident reporting to TtEC needs to occur immediately to assure that any injury is properly managed. The incident reporting and investigation during site work will follow TtEC Health and Safety Program, Section EHS 1-7. Written confirmation of verbal reports is to be submitted within 24 hours.

12.7 HAZARD COMMUNICATION PROGRAM/MSDS

The hazard communication program will be maintained on site and training on the program information and requirements will be provided in accordance with 29 CFR 1910.1200 and 1926.59, *Hazard Communication,* 1910.1201, *Retention of DOT Markings, Placards and Labels,* and TtEC Health and Safety Program, EHS 4-2.

MSDSs will be obtained for applicable substances and included in the site hazard communication file. A copy of the MSDSs will be obtained and maintained in the file for all

chemicals to which the requirements apply; this will apply to both TtEC personnel and any subcontractors for which TtEC has responsibility and/or oversight responsibilities. All chemical containers will be properly labeled in accordance with the requirements of the applicable standards.

13.0 FIELD PERSONNEL REVIEW

These forms serve as documentation that field personnel have read, or have been informed of, and understand the provisions of this SHSP. It is maintained on site by the ESS as a project record.

Each field team member shall sign this section after site-specific training is completed and before being permitted to work onsite.

I have read, or have been informed of, the ***Volume II of the Site Health and Safety Plan for the remedial action at the Lower Fox River OUs 2 through 5 project*** *and understand the information presented. I will comply with the provisions contained therein.*

Name (Print and Sign)	***Date***

Name (Print and Sign)	***Date***

Name (Print and Sign)	***Date***

Name (Print and Sign)	***Date***

14.0 REFERENCES

American Conference of Governmental Industrial Hygienists, Inc. 2007. Threshold limit values for chemical substances and physical agents in the work environment and biological exposure indices. ACGIH, Cincinnati, Ohio.

TtEC, TtEC Health and Safety Program

U.S. Department of Labor, Occupational Safety & Health Administration. 2007. 29 CFR 1910, General Industry, and 29 CFR 1926. Construction Industry Standards.

APPENDIX A

HEALTH AND SAFETY FORMS

TETRA TECH EC
SSHP FIELD CHANGE REQUEST FORM

PROJECT:

TASK OR PHASE: _____

PROJECT LOCATION: _____

DESCRIPTION OF CHANGE: _____

REASON FOR CHANGE: _____

RECOMMENDED DISPOSITION:

PM: _____ _____
Signature Date

Construction Manager: _____ _____
Signature Date

ESS: _____ _____
Signature Date

PESM: _____ _____
Signature Date

DISTRIBUTION:

PESM	_____
ESS	_____
Construction Manager	_____
PM	_____

TETRA TECH EC
SSHP FIELD CHANGE DOCUMENTATION

Field Change Number: _____ Date Effective: _____

Pen and ink changes to be made in the SSHP to alert the reader of this change:

_____

_____

_____

_____

Reason for the change to be incorporated into the SSHP:

_____

_____

_____

_____

_____

_____

TEXT OF CHANGE TO BE INCORPORATED:

SSHP FIELD CHANGE RECORDS

Record of Field Changes:

Initial for attaching any Field Changes to this SSHP. Enter the Field Change Number and Date Issued. File the completed Field Changes to this SSHP at the end as attachments. Make PEN AND INK changes to the text to alert the reader to the changes that are required in the Field Change. As required, distribute revised text pages to holders of controlled copies of the SSHP and document on List of Changes/Additions.

Field Change No.	Date Entered	Synopsis of Change	Initials

TETRA TECH EC, INC.

MEDICAL DATA SHEET

The brief medical data sheet shall be completed on a voluntary basis by on-site personnel and will be kept in the Support Zone by the ESS as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project: _____

Name: _____ Home Telephone: _____

Address: _____

Age: _____ Height: _____ Weight: _____ Blood Type: ____

Name and Telephone Number of Emergency Contact: _____

_____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide A Check List Of Previous Illnesses: _____

_____

_____

What Medications Are You Presently Using? _____

_____

_____

_____

Do You Have Any Medical Restrictions? _____

_____

Name, Address, And Phone Number Of Personal Physician: _____

_____

_____

TETRA TECH EC, INC.

DAILY SAFETY BRIEFING

PROJECT NAME:_____ PROJECT MANAGER:_____

PROJECT NUMBER:_____ H.S.O:_____

DATE: _____ PERSON CONDUCTING MTG.: _____

WEATHER CONDITIONS: _____

_____

TOPIC: _____

_____

_____

TASK: _____

_____

HAZARDS: _____

_____

SAFETY COMMENTS: _____

PRINT NAME	SIGNATURE

TETRA TECH EC, INC.

WEEKLY HEALTH AND SAFETY REPORT

Project Name: _____

Location: _____

SITE INFORMATION

Week Ending _____

Hours Worked:

Craft: PS: Subs: _____

Level of Protection

For the Week: B __ C __ D __

INJURIES AND ILLNESSES

Yes _____ No _____

Describe:

_____

_____

_____

_____

MAJOR ACTIVITIES CONDUCTED THIS WEEK:

(drum handling, sampling, excavation, abatement/T&D, etc.)

_____

_____

_____

SIGNIFICANT EVENTS THIS WEEK:

(regulatory visits, equipment malfunctions, process start-up or shutdown):

_____

_____

_____

FUTURE ISSUES:

(schedule, manpower allocation, monitoring equipment, other resources needed)

_____

_____

_____

_____

SITE AUDIT/INSPECTIONS CONDUCTED Yes _____ No _____

(describe outstanding findings and attach results)

_____

_____

_____

_____

HIPO ACTIVITIES

Hot Work	Yes _____	No _____	Dates: _____
Lockout/Tagout	Yes _____	No _____	Dates: _____
Confined Space Entry	Yes _____	No _____	Dates: _____
Soils Analysis Classification	Yes _____	No _____	Dates: _____
Excavation Daily Check List	Yes _____	No _____	Dates: _____
Crane On-Site	Yes _____	No _____	Dates: _____
Critical Lift Plan Performed	Yes _____	No _____	Dates: _____

AIR MONITORING:
Real Time

Major Activity	Location(s)	Worker Occupation	FID/PID Range	CGI/O2 Range	PDM Range	Other

PERSONAL AIR MONITORING

Analyte	Activity Monitored	Occupation	Location	Result	Type of Sample*

SUBCONTRACTORS ON SITE

Company Name	Task or Function	Return to Site Next Week (Y/N)

_____ _____

Health and Safety Officer - Signature **Date**

TETRA TECH EC, INC.

EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

Project: _____ **Area of Inspection:** _____

Inspection Type: ☐ **Weekly** ☐ **Monthly**

Inspector: _____ **Date:** _____

Signature: _____ **Time:** _____

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
Work Conditions		
1 Walking /Working Surfaces		
2 Aisles and Passageways		
3 Platforms/ Scaffolding		
4 Ladders		
5 Stairs		
6 Exits/Egress		
7 Roadways		
8 Ventilation		
9 Lighting		
10 Noise Exposure		
11 Ergonomics		
Materials		
1 Stacking and Storage		
2 Chemicals and Fuel		
3 Compressed Gases		
Equipment		
1 Hand / Portable Tools		
2 Machine, Tools, Guarding		
3 Mobile/ Heavy Equipment a. Physical inspection of equipment b. Review of daily inspection reports c. Review of equipment deficiency correction logs/records		

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
4 Lifting Gear Equipment		
5 Materials Handling Equipment		
6 Mechanical Power Systems		
7 Hydraulic Power Systems		
8 Pneumatic Power Systems		
9 Electrical Power Systems		
10 Valves and Controls		
Hazard Controls		
1 Other Heavy Equipment		
2 Lock-Out Systems		
3 Signs and Tags		
4 Color Coding		
5 Materials Labeling		
6 Warning Systems		
Emergency Systems		
1 Emergency Instructions		
2 Fire Protection		
3 Eye Wash and Showers		
4 First Aid Kits/ Stations		
5 Emergency Rescue Equipment		
Protective Equipment		
1 Eye Protection		
2 Ear Protection		
3 Respiratory Protection		
4 Head Protection		
5 Hand Protection		
6 Foot Protection		
7 Body Protection		
8 Fall Protection		

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
Hazardous Waste Storage Area(s)/Satellite Accumulation Areas1 2		
1 Designated, secured area with "Hazardous Waste" signage. For SAA area is marked "SAA". (SAA)		
2 Containers:		
a. DOT-spec. containers (for wastes to go off-site only)		
b. Intact/in good condition (SAA)		
c. Waste compatible with containers (e.g., no evidence of corrosion, softening, bulging) (SAA)		
d. Marked "Hazardous Waste"/ visible Accumulation Date. *For SAA, marked "Hazardous Waste" or identify container contents and Accumulation date (SAA)*		
e. Securely closed and stored to prevent rupture/leaking, except when add/remove waste. (SAA)		
f. Labeled with EPA Id. No.		
g. For SAA only, Stored "at the point of generation" and meets quantity limits.		
3 Reactive/ignitable wastes stored at least fifty (50) feet from property.		
4 Liquid wastes within secondary containment.		
5 Incompatible wastes separated by a dike, wall, berm or other device.		
6 Stored for less than 90 days. *(CERCLA projects may have storage variance).3*		
7 Container tracking log accurately reflects containers stored. (SAA)		
8 Area maintained in an orderly fashion and complies with state/EHS plan requirements. (SAA)		
Hazardous Waste Tank Storage Area *(Daily inspection is being conducted and maintained on-site)*		

1 For sites with multiple storage areas or Satellite Accumulation Areas (SAAs), indicate location where deficiencies are noted.
2 For SAAs, evaluate only rows marked with (SAA).
3 If stored on-site 75 or more days, TSDF/transporter has been selected (EHS 1-4), pick-up date scheduled and PM/PESM are aware of 90-day limit.

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
Waste/Stockpiles - State Regulated Non-Hazardous Wastes *(Refer to PESM Checklists, if applicable)*		
TSCA PCB Wastes – must be inspected at least every 30 days (GMP - weekly) *(Refer to PESM TSCA Checklist for inspection items)*		
Point Source Discharges/ Air Emissions		
1 Permit conditions are being met.		
2 Monitoring equipment is fully operational.		
3 Equipment calibrations and maintenance is up-to-date.		
4 Discharge sampling performed at required intervals.		
5 Review monitoring results *(Report permit exceedences per EHS 1-7)*		
6 DMR and Plant Logs properly completed, signed, and submitted (if required).		
7 Fugitive Dust – Appropriate BMPs are instituted for fugitive dust emissions.		
Stormwater Discharge Activities		
1 SWPPP /Soil Plan reflects current activities.		
2 Monitoring/sampling performed at required intervals.		
3 Review monitoring results *(Report permit exceedences per EHS 1-7)*		
4 BMPs in SWPPP/Soil Plan implemented.		
5 Visual observations indicate stormwater meets water quality criteria.		
6 Inspections conducted as required and documented. Corrective actions are implemented and documented.		
Other Conditions or Work Practices		
1		
2		
3		
4		

- End of Checklist-

Monthly Inspections must be sent to PESM and Project Manager.

Review previous week's/month's Action Item Report. Carry forward action items that have not been implemented. Note outstanding action items with an (F) in the "Action Item" column on this report. Note an (F) in the "Date Completed" column on previous week's/month's Action Item Report.

Project:

Area of Inspection:

Inspection Type: ☐ **Weekly** ☐ **Monthly**

Date of Inspection:

ACTION ITEM	RESPONSIBLE PARTY	SCHEDULE	DATE COMPLETED
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			

Reviewed by: _____ _____

Construction Manager Date

cc: Project Manager (monthly only)
PESM (monthly only)

APPENDIX B

BIOLOGICAL HAZARDS

MASSAUGA RATTLESNAKE

APPENDIX C

ACTIVITY HAZARD ANALYSES

ACTIVITY HAZARD ANALYSIS

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: General Site Hazards

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. General Site Hazards	a. Back Injuries and Strains	a. Back Injuries and Strains • Procedures in Section 3.3.14 will be followed. • Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc). • Mechanical devices should be used to reduce manual handling of materials. Team lifting should be utilized if mechanical devices are not available. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	b. Slips/Trips/Falls	b. Slips/Trips/Falls • Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards if feasible. • Maintain work areas safe and orderly. Unloading areas should be on even terrain. • Watch and prepare for uneven terrain, stumps, and vegetation in walk areas. • Replace work boots when worn out or the tread on the sole does not provide traction. • Tools and supplies/equipment will be properly stored.
	c. Dropped Objects	c. Dropped Objects • Steel toe boots meeting ANSI Standard Z41 will be worn as directed. • Secure all radios, cell phones, and equipment.
	d. Noise	d. Noise • Evaluate high noise operations to determine if hearing protective devices should be worn. • Hearing protection with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) will be worn during high noise operations. • All equipment will have manufacturer's required mufflers.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: General Site Hazards**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	e. Heavy Equipment Operation	e. Heavy Equipment Operation • Supervisors and operators will ensure that the procedures in Section 3.3.1 of this document and the equipment manufacturer's instructions and recommendations are followed consistently. • All equipment will be initially inspected to certify safe to use onsite and before each day's use. • Equipment will have rollover protective structures and seat belts. Operators shall wear seat belts when operating equipment. • Unsafe equipment will be taken out of service, tagged, and will not be used until repaired. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies, or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • All slings chains and ropes will be rated for the load in which it is expected to lift. • Spills and absorbent materials will be readily available. Drip pans, polyethylene sheeting, or other means will be used for secondary containment. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. This area will be delineated with cones. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations. • A spotter will be used for backing up equipment in congested areas.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: General Site Hazards**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	f. Temperature Extremes	f. Temperature Extremes • Drink plenty of fluids. • Train personnel of signs/symptoms of heat/cold stress. • Monitor air temperatures when extreme weather conditions are present. • Stay in visual and verbal contact with your buddy. • Controls will be implemented to minimize exposure to temperature extremes including work rest regimens, warm or cool rest areas, protective clothing, and minimize exposure time.
	g. Overhead Hazards	g. Overhead Hazards • Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 when an overhead hazard exists. • All ground personnel will stay clear of suspended loads and equipment swing areas. • All equipment will be provided with guards, canopies, or grills to protect the operator from falling or flying objects. • All overhead hazards will be identified prior to commencing work operations.
	h. Eye Injuries	h. Eye Injuries • Safety glasses meeting ANSI Standard Z87 will be worn for all field operations where eye hazards exist. • A portable eye wash station will be located adjacent to work activities.
	i. Sharp Objects/Punctures	i. Sharp Objects/Punctures • Leather gloves (minimum) or cut resistant work gloves will be worn depending on the material working with. • All hand and power tools will be maintained in a safe condition. When possible, blunt all sharp objects. • First aid kits will be available by the work area.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: General Site Hazards**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	j. Fire	j. Fire • Reference Section 10.9. • Only use NFPA-approved fuel cans with a pouring spout or funnel. • Smoking and open flames are not permitted in fueling areas. • A properly rated fire extinguisher will be located in the refueling area and onsite trucks. • All gasoline-powered equipment will be grounded and bonded. • Equip all heavy equipment with 20A:B:C-type fire extinguishers. • Area(s) for personnel smoking will be designated.
	k. Spills	k. Spills • Reference Section 10.13. • Secondary containment will be provided in storage areas. • Spill and absorbent materials will be readily available. • Absorbent materials will be used during transfer of fuel/oil. • Contain, control and clean up the spill and affected area (soil, water). Manage and dispose of spill material appropriately. • All waste materials generated will be contained in a sealable container appropriate for the size of the spill. • Commercial spill kits are available. • Employees will be instructed on proper fueling techniques. • Fuel nozzles and hose will be secure in holder after use. • Fuel caps will be secured after fueling operations.
	l. Biological Hazards	l. Biological Hazards • Follow and train personnel on the procedures outlined in Section 3.2. • Wear insect repellent and long sleeved shirts as needed. Wear light colored clothing to highlight ticks. • Follow procedures for tick bites. Perform self and buddy checks frequently throughout the day. • Be aware of poisonous plants; poison ivy blocking lotion will be used. See ZIP bulletins 181 and 210. • Approach debris, rock piles, and other snake habitats with caution. • If allergic to bees/wasps, ensure an epinephrine (MSDS needed onsite) kit is readily available and make sure the ESS is informed of the condition.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: General Site Hazards		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	m. Hand and Power Tools	m. Hand and Power Tools • Reference Section 3.3.12. • The proper tools will be used for each task. • All tools will be inspected before each use. Damaged tools will be removed from service and tagged (splintered wood bases, missing guards, "mushroom" head). • Tools will be used in accordance with manufacturer's instructions. • Modifications to tools are prohibited unless approved by the ESS. • GFCIs will be used with all electrical power tools.
	n. Chemicals brought on site	n. Chemicals brought on site • Reference EHS Program EHS 4-2. • Identify all chemical hazards and receive training (Haz Com-Material Safety Data Sheets/MSDSs) regarding safe handling and storage of chemicals. • The ESS maintains copies of all MSDS for chemicals that are onsite. • A portable 15-minute eye wash station will be located by the work area.
	o. Struck By/Against	o. Struck By/Against • Personnel will understand and review hand signals. • All machines will be equipped with backup alarms. • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel within unloading and loading areas are accounted for and out of the way.
	p. Adverse Weather	p. Adverse Weather • National weather forecasts will be monitored daily for predicted inclement weather. The field investigations lead will call for the local conditions and forecast each morning. • All personnel shall be aware of the forecast and keep an "eye to the sky." Unforecasted storms may also occur without warning. • Work will be postponed in the event of very strong winds or at times of very poor visibility. • In the event of lightning in the area, work will cease at the direction of the TtEC Supervisor or ESS, and will not proceed further until return to work permit is issued.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: General Site Hazards**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment 2. Appropriate PPE 3. Hand and Power Tools 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Inspect all heavy equipment prior to use. 2. Inspect all hand and power tools prior to use. 3. Inspect all PPE prior to use. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and test GFCIs weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Qualified operators will be used for heavy equipment and boat operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 5. Instruct personnel of proper use of fire extinguishers. 6. Personnel will be trained on the proper use of hand and power tools, including the steam cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Marine Surveys**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Setup/install a RTK GPS base station on land.	Struck by motorized, non-motorized and congested pedestrian traffic	• Field personnel will need to pay attention to operations around and adjacent to their work and continually evaluate the need for traffic control measures. • Wear safety vest when traffic is present.
	Failure to inspect equipment properly could cause workers to use defective or unsafe equipment causing injury to workers and possible damage to the equipment or the environment.	• Verify that equipment is inspected per manufacturer's recommendation each day before use, and there is an owner/operator's manual available.
	Noise exposure	• Hearing protection is required if working around equipment or tools that produce levels at/or above 85db. (As a rule of thumb, if you have to shout within 3' to be heard, hearing protection is required.)
	Adverse weather. High winds and rain and/or snow storms, high water flow in river. Struck by lightning	• If adverse weather is affecting crew's safety, work will be halted until conditions improve (i.e., wind, snow, rain). • Area is prone to windstorms during the spring, when this work is anticipated to occur. • If road conditions are too bad to access the work site, the work will be postponed until conditions improve. • In the case of extreme weather, vessel operations may be delayed. • At no time will personnel and equipment enter the river, if the flow rate exceeds 1,500 cubic feet per second (CFS). • Follow the 10-second rule (time between lightning strike and thunder) for shutdown of operations. Immediately suspend operations when lightning is in the immediate vicinity and seek shelter. Work will not commence until there are no lightning strikes at least 30 minutes after the last lightning strike.
	Temperature Extremes	• Drink plenty of fluids. • Train personnel of signs/symptoms of heat/cold stress. • Monitor air temperatures when extreme weather conditions are present. • Stay in visual and verbal contact with your buddy. • Controls will be implemented to minimize exposure to temperature extremes including work rest regimens, warm or cool rest areas, protective clothing, and minimize exposure time. • If a potential for cold stress exists, workers will bring extra clothing and food. • Equipment and vehicles will offer protection from wind and rain and have heaters or air conditioning. • If hypothermia symptoms or cold stress symptoms are observed (slurred speech, changes in skin color, shivering,) the victim will be taken to a heated location to warm up.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Marine Surveys**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• If heat stress symptoms are observed (lack of coordination, decline in alertness, unsteady walk, excessive fatigue, muscle cramps) the victim will be taken to a cooled location to cool off.
	Exposure to poisonous plants	• Maintain awareness of presence of poisonous plants. • Use of barrier protection lotions (Ivy Block, etc.) to protect against poison ivy exposure as needed. Wash exposed areas (e.g., Clorox wipes, Dawn dish soap, or Technu) immediately. • Long pants and leather boots should be worn. While working in tall, dense vegetation, long sleeve shirts should be worn to protect against exposure. • When handling plants, leather gloves should be worn.
	Punctures/Cuts from Plants	• Wear leather (minimum) or cut resistant work gloves when handling plants that may cause the possibility of lacerations or other injury. • Wear long pants at all times to avoid lacerations and other injury. Long sleeved shirt should also be worn to protect arms when needed. • Look carefully for injurious vegetation before reaching into any area or before handling any plants. Examples may include yucca and prickly cactus, thistles, and branches.
	Exposure to insects/ticks	• In the event of poisonous bites, contact the emergency response personnel immediately. • Insect repellent must be made available to all workers to prevent exposure to mosquito bites. Insect repellant should be applied according to manufacturer instructions. • Work activities should be avoided during dusk and dawn, when insects carrying virus are most active (i.e., mosquitoes carrying West Niles virus). If work is conducted during this time, long sleeves and pants must be worn, in combination with insect repellent. • Perform tick self-inspection upon exiting wooded or tall grass areas. • Field personnel should look carefully for insects and spiders before stepping into any area or before placing hands near the ground. • Field personnel should be cautious and avoid contact by looking ahead to where they will be walking, standing, sitting, leaning, grabbing, lifting, or reaching.
	Exposure to snakes/animals	• Substantial footwear (boots) and long pants should be worn to protect from bites. • Look carefully for snakes and animals before stepping into any area or before placing hands near the ground. Visual scans should be made periodically during the day.
	Unstable/ Irregular walking surface. Slips/Trips/Falls	• Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards if feasible. Look for depressions and obstructions. • Be conscious of potential footing hazards when walking on slopes or in areas with potential footing hazards.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Marine Surveys**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Maintain awareness, especially in areas where topography varies, and prepare for uneven terrain, stumps, and vegetation in walk areas. • Tools and supplies/equipment will be properly stored to maintain safe and orderly work areas.
2. Conducting bathymetric surveys and geophysical surveys (sub-bottom profiling, GPR etc.) from small boat.	Working around water and in small boat. Falling into water, other boat traffic interactions (large wakes)	• Coast Guard approved flotation equipment, PFDs Type I, II, or selected Type III (i.e., Mustang Survival work suits and jackets, at discretion of ESS) will be worn when in boat or on the dock, in areas without adequate safety rails (<3-ft). • Survey vessels will display day-shapes to communicate to boat traffic that there is gear in the water (i.e., towfish or other instrumentation), and that the survey vessel has limited maneuverability. • Survey vessels will monitor VHF Channel 16. • Survey vessels will avoid operating in shipping channels as much as is practicable, and will be aware of the possibility of large ship wakes. • Set of oars and emergency horn shall be available in the boat prior to operation. • No standing or leaning over edge in small boats. • Comply with Coast Guard right-of-way rules. • Use horn to signal or warn other boats as appropriate. • Suspend work during bad weather or poor visibility. • Have experienced boat crews operate vessel • Ensure boat manufactures recommendation for operation and load limits are followed. • At least one U.S. Coast Guard approved lifesling attached to approximately 100 feet of rope will be located on the boat. The hydrographic and geophysical crew vehicle will also have a rescue throw rope.
	Insufficient information/inadequate training to perform the marine surveys. High potential for injury to untrained personnel	Training will consist of: • Pre-Activity briefing covering this SHSP. Also daily briefing. • Ensure that all operators are trained prior to using equipment. This training will include operator's manual review and actual operation. • Crew familiarization with tasks and H&S controls addressed in this SHSP. • Personnel shall receive boating safety training/briefing from the Handbook of Wisconsin Boating Laws and Responsibilities (See Appendix E). • Emergency response requirements in this SHSP. • At least two members of each field crew (survey boat) shall be CPR/First Aid trained. • An AED shall be kept on the boats, will be operating and close by should it be needed.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Marine Surveys		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	Failure to inspect equipment properly could cause workers to use defective or unsafe equipment causing injury to workers and possible damage to the equipment or the environment.	• Verify that equipment is inspected per manufacturer's recommendation each day before use, and there is an owner/operator's manual available.
	Adverse weather. High winds and rain and/or snow storms, high water flow in river. Struck by lightning	• If adverse weather is affecting crew's safety, work will be halted until conditions improve (i.e., wind, snow, rain). • Area is prone to windstorms during the spring, when this work is anticipated to occur. • If road conditions are too bad to access the work site, the work will be postponed until conditions improve. • In the case of extreme weather, vessel operations may be delayed. • At no time will personnel and equipment enter the river, if the flow rate exceeds 1,500 cubic feet per second. • Follow the 10-second rule (time between lightning strike and thunder) for shutdown of operations. Immediately suspend operations when lightning is in the immediate vicinity and seek shelter.
	Fueling boat	• Check the entire fuel system for leaks. Tighten connections frequently. Engine vibration can loosen them. • Turn off all engines and electrical equipment; shut off all fuel valves; and close all windows, doors and openings. • Try to fuel in daylight. If light is required, use a flashlight or a light that is spark-proof. • Never smoke or strike a match while fueling or when near a fueling dock. • When filling a tank or gas can, follow these guidelines: • Remove portable tanks from the vessel. • Touch the fuel pipe or tank with the spout to prevent buildup of static electricity. • Never fill a tank to the brim. Leave room for gas to expand. • After fueling, put the fill cap on tightly to prevent vapors from escaping. • Immediately wipe up any spilled gas. • Air out the rag after using it. Never throw it in the vessel or the water. • Store gas onboard in a safety-approved storage tank, away from the engine in an area of good ventilation. • Refueling should be performed on land as often as possible (i.e., at auto gas station, not via gas cans). • Funnels will be used when filling gas tanks from portable gas cans. • Sorbent pads will be placed under and/or around item being fueled to capture any spills.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Marine Surveys**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• To the extent possible fuel all systems before launching the boat so that on water refueling is kept to a minimum.
	Chemicals brought on site	• Reference EHS Program EHS 4-2. • Identify all chemical hazards and receive training (Haz Com-Material Safety Data Sheets/MSDSs) regarding safe handling and storage of chemicals. • The ESS maintains copies of all MSDSs for chemicals that are on site. • A portable 15-minute eye wash station will be located by the work area.
	Boating activities	• Boat Captains shall be USCG licensed. • Prior to placing boats, survey equipment and personnel on the river, the river's flow rate will be assessed. At no time will personnel and equipment enter the river if the flow rate exceeds 1,500 cubic feet per second (as measured by the nearly USGS flow monitoring station). • Debris may present a significant hazard to personnel during survey activities. During cold weather (<40° F) blanket shall be on the survey vessel and the vessel will be kept warm, in the event that personnel get wet. • Due to the potential for limited rescue capability and other emergency impedances, activities on the river will be limited to one half hour before sunrise to one half hour after sunset. Personnel should allow sufficient time to shut down operations at the end of each day to ensure personnel are off the river by the specified time. • Survey boats shall have adequate lights (navigation and "head lights"/spot lights) for safe operation during dawn/dusk and after dark if necessary. • Boat launches with adequate lighting will be used to the greatest extent possible • If working in the vicinity of the De Pere Dam, additional precautions will be taken to ensure safe boat operations are conducted. This will include use of one or several of the following safety precautions: inclusion of an auxiliary motor (i.e., "kicker" motor) on the survey vessel, use of a tagline(s) to the river bank, use of one or several points of anchor, and installation of a cable which would prevent the survey boat and/or crew from passing over the dam.
	Failure to have proper medical supplies, emergency supplies, and PFDs during emergency could result in inadequate treatment of personnel or potentially increase injuries.	• Ensure that PFDs are available for each person and in good usable condition. • First-aid kit and supplies are available. • Oars, emergency horn, life ring, fire extinguisher are available. (Fire extinguisher shall be at least a 10lb. ABC type.) • Cell phone is available and working for emergency notifications.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Marine Surveys**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	Back Injuries and Strains	• Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc.). • Mechanical devices should be used to reduce manual handling of materials. Team lifting should be utilized if mechanical devices are not available. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	Communication	• Field personnel will use cellular telephones with adequate coverage to communicate with individuals offsite. • Field personnel will use two-way radios with adequate coverage to communicate with the Coast Guard offsite.
EQUIPMENT USED		
1. Boats 2. Appropriate PPE 3. Hand and Power Tools 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Inspect all boats daily. 2. Inspect all hand and power tools prior to use. 3. Inspect all PPE prior to use. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and test GFCIs weekly.	1. All site personnel will read and comply with this SHSP. 2. All site personnel will receive site-specific training. 3. Qualified operators will be used for heavy equipment and boat operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 5. Instruct personnel of proper use of fire extinguishers. 6. Personnel will be trained on the proper use of hand and power tools, including the steam cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. False Work and Temporary Bracing Installation	a. Noise	a. Noise • Reference General Site Hazards.
	b. Dropped Objects	b. Dropped Objects • Reference General Site Hazards. • A security zone will be established around the crane. No personnel will enter this area when the crane is in operation. • No person will stand under an unsecured load.
	c. Crane Operations	c. Crane Operations • Only qualified persons will operate equipment. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • High Visibility safety vests will be worn in all work areas. • All heavy equipment will be equipped with backup alarms. • Equipment will have guards, canopies, or grills to protect from flying objects. • All vehicles will be equipped with rear-view mirrors on both sides of cab. • Only one spotter will be used to communicate with the crane operator. • All cranes are to have swing protection demarcated and only authorized personnel will be allowed in this area during a lift. • Operators will be aware of their surroundings at all times. • Perform vehicle walk around before operating. • Operators will honk their horn twice before starting equipment or initiating operations after the equipment has set idle for a long period of time. • Do not work at wind speeds or weight loads above those recommended in the operator's manual. • All cranes to be outfitted with anti-two-block protection. • All cranes must have annual inspection reviewed before use; daily inspections and competent person named for conducting inspections; load chart available, operator must know how to read a load chart and be deemed competent by TtEC. • All bolts are to be fully hand torqued and 100% installed before crane (rigging) is released.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Ensure outriggers are fully extended and ground surface is able to support the crane during lift operations. Use equipment mats to provide additional stability if necessary. • List should be taken into account when cranes are mounted to barges.
	d. Lifting/Rigging	d. Lifting/Rigging • The equipment used for lifting should be positioned as near as possible to the load, while maintaining a safe operating distance. The operator shall verify that the load line is vertical and over the load's center of gravity prior to lifting the load to ensure that the load does not drift when lifted. • All overhead hazards will be identified prior to commencing work operations. A minimum safe distance of 15 feet shall be maintained from power lines rated 50 kV or less. • The swing area of the lifting equipment is barricaded to protect personnel in the immediate area. • All rigging will be tagged with its lifting capacity. • All chokers, slings, and lifting gear shall be inspected daily (both nylon and steel) and shall be free from defects prior to use. • Loads are not lifted over personnel. • All loose load objects are secured or removed. • Tag lines are used to control loads except where their use will create a hazard. • The equipment performing the lift is not subjected to sudden lifting, stopping, or impact loading. • Riding on loads, hooks, buckets, material hoists, or other material hoisting equipment not meant for personnel use is absolutely prohibited. • The total weight of the load to be lifted, including all lifting beams, rigging, hooks and attachments, shall be determined before a safe lift can be planned. • The determination of the exact location of the center of gravity of the load is critical in ensuring that the load is rigged in a stable configuration. The location of the attachments of the rigging to the load should be above the center of gravity where possible. • The load shall be safely rigged within the rated capacity of all rigging equipment.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Custom designed grabs, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof-tested prior to use to 125% of their rated load.
	e. Overhead Hazards	e. Overhead Hazards • Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 when an overhead hazard exists. • All ground personnel will stay clear of suspended loads and equipment swing areas. • All equipment will be provided with guards, canopies, or grills to protect the operator from falling or flying objects. • All overhead hazards will be identified prior to commencing work operations. • A 15-foot clearance will be maintained at all times.
	f. Eye Injuries	f. Eye Injuries • Reference General Site Hazards.
	g. Slips/Trips/Falls	g. Slips/Trips/Falls • Reference General Site Hazards. • Personnel will immediately communicate slip/trip/fall hazards to employees and supervisors. • Tripping and poor footing hazards will be repaired as they are discovered or will be clearly identified. • Fall protection (e.g., guardrails or personal fall protection system) is required when working 6’ above the ground. • Personnel will be trained to use and inspect fall protection systems. • All lifelines / harnesses / and lanyards shall be inspected and in acceptable working condition prior to use. • Personal fall arrest systems shall meet the criteria specified in 29 CFR 1926.502(d) and guardrail systems and their use shall comply with 29 CFR 1926.502(b). Refer to Section 3.3.5. • Ensure that loads are properly distributed in all small boats. • All personnel shall wear United States Coast Guard (USCG) Approved Type I, III or V Life Preservers at all times while on the water. • Personnel will use care when exiting entering the craft from the water and ensure they have solid footing before climbing in/out. • Personnel will ensure that they are in no more than 1 foot of water when

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		entering/exiting the craft, unless the personnel are in waders. • The following procedure will be used when launching/docking any water craft ❖ Personnel shall know the weight of the water craft and motor prior to launching docking. ❖ Boat motor will be pulled up before it contacts the river bottom. ❖ Personnel will take note of wind speed and direction, current, and tidal height before shutting off/turning on the boat motor. ❖ All personnel will carefully exit the water craft. ❖ No personnel shall lift in excess of 50 pounds. ❖ Personnel will remove/put in any small boat to the edge of the water with minimal dragging of the boat across the dry land. ❖ Mechanical devices will be used in lieu of manual labor to remove from/put into the water any water craft in excess of 300 pounds weight for boat and motor. ❖ A light duty trailer can be used in lieu of manual lifting; if a light duty trailer is used personnel must lift up the front of the boat, manually with a minimum of two people. • Any hoisting device used to pull up/let down the boat will be properly maintained and serviced according to manufacturer's specifications; capable of lifting the weight of the load being hoisted; checked before each hoist and operated by qualified knowledgeable personnel.
	h. Working Over Water	h. Working Over Water • Personnel working over water will be required to wear PFDs when not in equipment.
	i. Struck By/Against	i. Struck By/Against • Reference General Site Hazards. • Caution will be used offloading the boat from the trailer-clear the area of all nonessential personnel. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Ensure the boat is properly secured to the boat trailer before transporting. • Ensure there is sufficient room to drive through when trailering the boat on narrow streets. • Watch for (know their locations or mark with buoys) objects hidden under water at higher tides i.e., pilings, islands, anchor lines.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Caution will be used offloading the boat; personnel will ensure the boat is securely docked before embarking. All supply transfer work will be done only when boats are docked fore and aft. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Never pitchpole or broach any waves. • Ensure the air horn on each boat used is in proper working order. • Ladders will be free of ice and snow before climbing. • Personnel will understand and review hand signals. • Only one spotter will be used with each piece of equipment. • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel on the barge are accounted for and out of the way. • All cranes are to have swing protection demarcated. • Only operator shall be on crane during operation. • No personnel will be allowed to walk or do any work under any loads being picked. • Personnel will be aware of overhead operations. • On-site personnel working in the loading area will not walk along the blind side of equipment and must not approach heavy equipment with out making eye contact with the operator. • All cranes are to have swing protection demarcated and only authorized personnel will be allowed in this area during a lift. • Operators will be aware of their surroundings at all times. • Operators will honk their horn twice before starting equipment or initiating operations after the equipment has set idle for a long period of time. • Do not work at wind speeds or weight loads above those recommended in the operator's manual. • Tag lines will be used during the picking and setting of the anchors. Use tag lines to minimize swinging of objects being moved. Tag lines are used to control loads except where their use will create a hazard. • Barge will be spudded in place. All personnel not associated with the spud operation will stay a minimum of 20 feet out of the spud dropping area.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Only qualified personnel will drop the spud/operate the winch. The operator will be seated in the winch operators chair and will not operate the winch until given the all clear that personnel are out of the spud drop areas. • The wheels of the spuds are located below deck and therefore do not pose a struck by/caught in hazard. • All winch cables will be clearly marked and/or cordoned off; 90% of the cables are covered by metal plating; the +/- 10 % that is exposed is demarcated by yellow paint on the barge deck. Personnel will not be allowed in this demarcated area when the spuds are being dropped. • The spud winch is located in the barge house on deck. When this winch is in operation, the water tight door to this house will be closed and a sign posted –DO NO ENTER.
	j. Man Overboard/Drowning	j. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) Approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All persons on board will remain seated/standing securely whenever a water craft is moving. • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Personnel on board water craft must be in constant radio contact with shore personnel. • Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All barge deck obstructions will be removed if possible, if not possible to remove them they shall be clearly marked with yellow paint.
	k. Sinking Boat/Barge Damage	k. Sinking Boat/Barge Damage • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it. • The 35-ton crane will be set on mats with outriggers fully extended on mats for stability. • The crane will be anchored to the deck by means of four chain binders of sufficient size and strength to stabilize the crane. These will be secured to anchor points on the barge deck. • The Marine Survey will be done in floating plant mode and will include the crane matting and binder system. • The Marine Survey will be done by competent/qualified person and shall include stability calculations for crane lifts. • The crane operator and Project Engineer will fully understand the stability calculations and adhere to them. • Load test will be performed prior to crane's initial use, and a lift plan will be developed prior to the pile driving.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed.
	l. Water Craft Taking On Water	l. Water Craft Taking on Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks • If the water craft begins to take on water for any reason, it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	m. Water Craft Operation Risks	m. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • Barge will be equipped with day markers and proper lighting if moored at night. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All harbor boating regulations will be strictly observed; prudent speed limits will be followed at all times. • All water craft must have required Coast Guard approved lighting and signaling devices. • Reference the offshore work AHA for boating applications.
	n. Equipment Lost Overboard/Crushed	n. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the moon pool or edge of the barge/boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge/boat. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel.
	o. Emergencies: Fire, Weather, and Medical/Spills/Releases	o. <u>Emergencies</u>: Fire, Weather, and Medical/Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: <u>Length</u> — <u>Extinguisher</u> 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire can not be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.
2. Sheet Pile Installation	a. Slips/Trips/Falls	a. Slips/Trips/Falls • Reference General Site Hazards. • Personnel will immediately communicate slip/trip/fall hazards to employees and supervisors. • Tripping and poor footing hazards will be repaired as they are discovered or will be clearly identified. • Fall protection (e.g., guardrails or personal fall protection system) is required when working 6’ above the ground. • Personnel will be trained to use and inspect fall protection systems. • All lifelines / harnesses / and lanyards shall be inspected and in acceptable working condition prior to use. • Personal fall arrest systems shall meet the criteria specified in 29 CFR 1926.502(d) and guardrail systems and their use shall comply with 29 CFR 1926.502(b). Refer to Section 3.3.5.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	b. Dropped Objects	b. Dropped Objects • Steel toe boots meeting ANSI Standard Z41 will be worn. • A security zone will be established around the crane. No personnel will enter this area when the crane is in operation. • No person will stand under an unsecured load.
	c. Struck By/Against	c. Struck By/Against • Personnel will understand and review hand signals. • Only one spotter will be used with each piece of equipment. Spotter will ensure he has eye contact with the crane operator and the power pak operator. • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel on the barge are accounted for and out of the way. • Only operator shall be on crane during operation. • No personnel will be allowed to walk or do any work under any loads being picked. • Personnel will be aware of overhead operations. • On-site personnel working in the loading area will not walk along the blind side of equipment and must not approach heavy equipment with out making eye contact with the operator. • Operators will be aware of their surroundings at all times. • Operators will honk their horn twice before starting equipment or initiating operations after the equipment has sat idle for a long period of time. • Do not work at wind speeds or weight loads above those recommended in the operator's manual. • Tag lines will be used during the picking and setting of the anchors. Use tag lines to minimize swinging of objects being moved. Tag lines are used to control loads except where their use will create a hazard. • Swing radius of the crane will be demarcated with caution tape or cones. Extreme caution shall be exercised when working in the proximity to the crane aboard the barge. No one shall enter the swing radius while the crane is working. All personnel shall contact the crane operator before entering the swing area when the machine is not working in order to guarantee a safe passage. • Hand signals will be reviewed prior to the start of work.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• The power pak operator and crane operator will have a clear visual field of the pile. • Piles will be initially lifted using the crane and a chain choke. The chain will be properly rated and designed especially for pile picks. Proper rigging of the choke will be done a minimum of 10 feet from the top of the pile. • The crane will lift the pile with the aid of a spotter, and the pile will be lifted to upright position and placed in the location where it is to be driven; operator will ensure the pile is securely in the soil before releasing tension on the choker. • Personnel who remove the choker will not stand under any load or under the block of the crane. • Crane will be equipped with a vibratory hammer, with wood boot, which holds the piles in place (using the wood boot grappler attachment); operator will ensure the piles are securely gripped before proceeding. The piles may then be pushed or vibrated into the sediment based on the type of sediment encountered. • No visitors will be allowed on the barge. • No personnel are permitted up on/or near the crane when pile driving operations are occurring. • Overhead protection, which will not obscure the vision of the operator, shall be provided. • Personnel will be aware of pinch points; no personnel will put their hands or any body part between any moving object and a stationary object. • Barge will be spudded in place. All personnel not associated with the spud operation will stay a minimum of 20 feet out of the spud dropping area. • Only qualified personnel will drop the spud/operate the winch. The operator will be seated in the winch operators chair and will not operate the winch until given the all clear that personnel are out of the spud drop areas. • The wheels of the spuds are located below deck and therefore do not pose a struck by/caught in hazard.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All winch cables will be clearly marked and/or cordoned off; 90% of the cables are covered by metal plating; the +/- 10 % that is exposed is demarcated by yellow paint on the barge deck. Personnel will not be allowed in this demarcated area when the spuds are being dropped. • The spud winch is located in the barge house on deck. When this winch is in operation, the water tight door to this house will be closed and a sign posted –DO NO ENTER. • Guards shall be provided on all sheaves to prevent cables from jumping out of sheaves. • Guys, outriggers, thrustouts, or counterbalances shall be provided as necessary to maintain stability of pile driver rigs. • Keep access steps and ladders free from oil. • Work taking place above 6 feet requires fall protection.
	d. Man Overboard/Drowning	d. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) Approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All persons on board will remain seated/standing securely whenever a water craft is moving, • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sheet Pile Wall Installation		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Personnel on board water craft must be in constant radio contact with shore personnel. • Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All barge deck obstructions will be removed if possible, if not possible to remove them they shall be clearly marked with yellow paint.
	e. Sinking Boat/Barge Damage	e. Sinking Boat/Barge Damage • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it. • The crane will be set on mats with outriggers fully extended on mats for stability. • The crane will be anchored to the deck by means of four chain binders of sufficient size and strength to stabilize the crane. These will be secured to anchor points on the barge deck. • The crane operator and Project Engineer will fully understand the stability calculations and adhere to them. • Load test will be performed prior to cranes initial use and a lift plan will be developed prior to the pile driving. • The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	f. Water Craft Taking On Water	f. Water Craft Taking On Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks. • If the water craft begins to take on water for any reason, it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	g. Hot Work	g. Hot Work • A Hot Work Permit will be issued prior to all chop saw cutting, burning, grinding or any other activities that will cause sparks while working. • A 20 lb. ABC type fire extinguisher will readily available within 50’ of all Hot Work Permit Operations. • Workers performing hot work will wear appropriate PPE as specified in the Hot Work Permit. • Oxygen and acetylene cylinders and hoses will be stored properly (i.e., secured and separated appropriately) and maintained in good condition. • Only qualified workers will perform hot work. Workers will inspect their PPE and equipment prior to performing hot work.
	h. Water Craft Operation Risks	h. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • Barge will be equipped with day markers and proper lighting-if moored at night. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All boating regulations will be strictly observed; prudent speed limits will be followed at all times.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All water craft must have required Coast Guard approved lighting and signaling devices.
	i. Flying Objects and Debris	i. Flying Objects and Debris • ANSI approved safety glasses will be worn at all times while on the water. • All objects pulled up from the water will be brought aboard slowly to check for contamination or entanglement.
	j. Equipment Lost Overboard/Crushed	j. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the moon pool or edge of the barge/boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge/boat. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel.
	k. Emergencies: Fire, Weather, and Medical/Spills/Releases	k. Emergencies: Fire, Weather, and Medical/Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.
	l. Water Jetting	l. Water Jetting • Stop jetting at the specified distance (typically 3 feet) above the final pile tip elevation.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Drive piles the specified remaining distance (typically at least 3 feet) to the required resistance. • Water jetting may affect nearby structures by undermining and should normally not be performed in clay or silt soil. • Check resistance of nearby piles.
	m. Back Injuries	m. Back Injuries • Refer to General Site Hazards.
	n. Hand and Power Tools	n. Hand and Power Tools • Refer to General Site Hazards.
	o. Working Over Water	o. Working Over Water • Personnel working over water will be required to wear PFDs when not in equipment.
	p. Overhead Hazards	p. Overhead Hazards • Personnel will be required to wear hard hats that meet ANSI Standard Z-89-1. • Personnel will not stand under any suspended load. • Personnel will be aware of other personnel working on crane in area.
	q. Eye Injury	q. Eye Injury • Refer to General Site Hazards.
3. Tieback System Installation	a. Hot Work	a. Hot Work • A Hot Work Permit will be issued prior to all chop saw cutting, burning, grinding, or any other activities that will cause sparks while working. • A 20 lb. ABC type fire extinguisher will readily available within 50’ of all Hot Work Permit Operations. • Workers performing hot work will wear appropriate PPE as specified in the Hot Work Permit. • Oxygen and acetylene cylinders and hoses will be stored properly (i.e., secured and separated appropriately) and maintained in good condition. • Only qualified workers will perform hot work. Workers will inspect their PPE and equipment prior to performing hot work.
	b. Fall into Excavation	b. Fall into Excavation • Do not leave excavations open overnight; whenever possible fill them. • Install open trench warning devices/barricades. • If deemed necessary, use the benching and sloping methods to prevent cave-ins (29 CFR 1926.652, Appendix B).

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sheet Pile Wall Installation**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• If necessary, stairways, ladders, or ramps shall be provided as means of egress in all trenches 4 feet or more in depth. Travel distance shall be no more than 25 feet between means of exit. • Protective systems are required on all excavations over 5 feet in depth or in excavations less than 5 feet when examination of the ground by a competent person reveals conditions that may result in cave-ins (29 CFR 1926.652, Appendices C & D).
	c. Heavy Equipment Operation	c. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. This area will be delineated with cones. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations.
	d. Noise	d. Noise • Refer to General Site Hazards.
	e. Overhead Hazards	e. Overhead Hazards • Personnel will be required to wear hard hats that meet ANSI Standard Z-89-1. • Personnel will not stand under any suspended load. • Personnel will be aware of other personnel working on crane in area.
	f. Working Over Water	f. Working Over Water • Personnel working over water will be required to wear PFDs when not in equipment.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: Sheet Pile Wall Installation

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	g. Eye Injury	g. Eye Injury • Refer to General Site Hazards.
	h. Back Injuries	h. Back Injuries • Refer to General Site Hazards.
	i. Hand and Power Tools	i. Hand and Power Tools • Refer to General Site Hazards.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Crane/Vibratory Hammer 2. Excavator 3. Fire Extinguishers 4. Spill Control Materials 5. Appropriate PPE 6. Portable Eyewash 7. First Aid Kits 8. GFCI	1. Daily inspections of all equipment will be conducted and documented before use. 2. Daily inspection of all mechanical equipment on deck. 3. Monthly inspections will be performed. 4. Daily safety inspection of spill control materials will be conducted. 5. Daily maintenance (fueling, oil, grease) will be conducted. 6. Daily inspections for oil/grease buildup will be conducted. 7. Daily inspections will be made. 8. Daily inspections will be required before operation 9. Initial review/training prior to commencement of field activities. 10. Inspect all PPE prior to use. 11. Inspect portable eye washes and first aid kits weekly. 12. Inspect fire extinguishers weekly. 13. Check and test GFCIs weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Only a qualified operator will be allowed to run the crane and drive the piles. 4. Personnel will be trained in inspection checklist use. 5. Personnel will be given instructions on proper use of fire extinguishers. 6. Personnel will be given training on how to respond to spilled materials. 7. Operators/pilots will be trained in engine maintenance. 8. Requirements for housekeeping will be reviewed. 9. Operators will be trained in proper use of these safety systems. 10. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 11. Instruct personnel of proper use of fire extinguishers.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. **Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**	a. Noise	a. Noise • Refer to General Site Hazards.
	b. Heavy Equipment Operation	b. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies, or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations.
	c. Equipment Rollover	c. Equipment Rollover • Equipment will have rollover protective structures and seat belts. • Operators will wear seat belts when operating equipment. • Do not operate equipment on grades which exceed the manufacturer's recommendations. • Be aware of weather and road conditions. • A spotter will be used when loading equipment in high traffic areas. • Do not load equipment on unstable ground. • Run articulated equipment up and down slopes – not at an angle.
	d. Caught In/Between	d. Caught In/Between • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel within loading areas are accounted for and out of the way.
	e. Vehicular Traffic	e. Vehicular Traffic • Employees will need to pay attention to operations around and adjacent to their work and continually evaluate the need for traffic control measures.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Establish one-way (if possible) traffic routes for loaded trucks, so that they can keep the same path while moving dirt. • Traffic control patterns may be modified based on changed conditions (as observed) due to weather or due to modified operations at the site.
	f. Struck by Heavy Equipment/ Vehicles	f. Struck by Heavy Equipment/Vehicles • Speed limit for traffic is 15 mph for all areas of the site. • Trucks shall slow down before approaching loading/unloading area. • Operators will remain in truck when being loaded. • On-site personnel working in the loading area will not walk along the blind side of equipment and must not approach heavy equipment without making eye contact with the operator. • Do not approach heavy equipment unless eye contact with appropriate hand signals has been made with the operator to cease activity. Equipment operators will confirm that eye contact has been made by stopping operation and clearly showing their hands are off the controls. • Be aware of heavy equipment operations. • Keep out of the swing radius of heavy equipment. • Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times. • Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. • Ground personnel will not stand directly behind heavy equipment when it is in operation. • Loaded trucks have right of way. • Leave one half a truck length between the truck being loaded and the next truck in line.
	g. Overhead Hazards	g. Overhead Hazards • Reference General Site Hazards.
	h. Eye Injury	h. Eye Injury • Reference General Site Hazards.
	i. Slips/Trips/Falls	i. Slips/Trips/Falls • Reference General Site Hazards. • Maintain work areas in a safe and orderly condition. • Watch for uneven terrain or rocks in walk areas. • Identify any other tripping hazards and remove them if at all possible.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	j. Working Over Water	j. Working Over Water • Personnel working over water will be required to wear PFDs when not in equipment.
	k. Man Overboard/Drowning	k. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) Approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All persons on board will remain seated/standing securely whenever a water craft is moving. • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency. • Personnel on board water craft must be in constant radio contact with shore personnel. • Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All barge deck obstructions will be removed if possible, if not possible to remove them they shall be clearly marked with yellow paint.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	l. Sinking Boat/Barge Damage	l. Sinking Boat/Barge Damage • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it. • The 35-ton crane will be set on mats with outriggers fully extended on mats for stability. • The crane will be anchored to the deck by means of four chain binders of sufficient size and strength to stabilize the crane. These will be secured to anchor points on the barge deck. • The Marine Survey will be done in floating plant mode and will include the crane matting and binder system. • The Marine Survey will be done by competent/qualified person and shall include stability calculations for crane lifts. • The crane operator and Project Engineer will fully understand the stability calculations and adhere to them. • Load test will be performed prior to cranes initial use and a lift plan will be developed prior to the pile driving. • The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed.
	m. Water Craft Taking On Water	m. Water Craft Taking on Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks. • If the water craft begins to take on water for any reason, it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	n. Water Craft Operation Risks	n. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the "Rules of the Road" that regulate movement of boat traffic within the harbor. • Barge will be equipped with day markers and proper lighting if moored at night. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All harbor boating regulations will be strictly observed; prudent speed limits will be followed at all times. • All water craft must have required Coast Guard approved lighting and signaling devices. • Reference the Offshore Work AHA for boating applications.
	o. Equipment Lost Overboard/Crushed	o. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the moon pool or edge of the barge/boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge/boat. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	p. Emergencies: Fire, Weather, and Medical/Spills/Releases	p. Emergencies: Fire, Weather, and Medical/Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire can not be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.
	q. Unstable Soils	q. Unstable Soils • Prior to beginning construction in an area, evaluate and locate areas with unstable soils. • Notify all personnel of areas with unstable soils. Do not run high pressure equipment (i.e., articulating trucks) in these areas until soils have been stabilized. • Build roads suitable to handle equipment traffic prior to beginning dirt/stone hauling. • During hauling operations, keep soft areas/ruts filled and compacted. Do not allow off-road trucks to continually run over ruts. • Off-road trucks should vary their path on the haul roads.
	r. Struck By/Against	r. Struck By/Against • Reference General Site Hazards. • Personnel will understand and review hand signals. • All machines will be equipped with backup alarms. • Personnel will not stand under any suspended loads. • Only qualified dredge personnel will be used.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Personnel will avoid placing themselves between heavy equipment/dredge bucket/dredge and stationary objects and on the blind sides of heavy equipment. • Operations will be suspended and the dredge secured during all severe weather. • Ensure correct position/distance relative to other operations of other activities.
2. Placement of clean fill and/or dredged sand behind the sheetpile wall	a. Slips/Trips/Falls	a. Slips/Trips/Falls • Reference General Site Hazards. • Maintain work areas in a safe and orderly condition. • Unloading area of the clamshell will be demarcated, and all personnel are strictly forbidden from entering this area during dredging. • Extreme caution will be used when disconnecting straps, tie-downs or other hold down devices. • Identify any other tripping hazards and remove them if at all possible.
	b. Noise	b. Noise • Reference General Site Hazards.
	c. Heavy Equipment Operation	c. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations.
	d. Overhead Hazards	d. Overhead Hazards • Reference General Site Hazards.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	e. Eye Injury	e. Eye Injury • Reference General Site Hazards. • Safety glasses that meet ANSI Standard Z-87 will be worn.
	f. Unstable Soils	f. Unstable Soils • Prior to beginning construction in an area, evaluate and locate areas with unstable soils. • Notify all personnel of areas with unstable soils. Do not run high pressure equipment (i.e., articulating trucks) in these areas until soils have been stabilized. • Build roads suitable to handle equipment traffic prior to beginning dirt/stone hauling. • During hauling operations, keep soft areas/ruts filled and compacted. Do not allow off –road trucks to continually run over ruts. • Off-road trucks should vary their path on the haul roads.
	g. Struck By/Against	g. Struck By/Against • Reference General Site Hazards. • Personnel will understand and review hand signals. • All machines will be equipped with backup alarms. • Personnel will not stand under any suspended loads. • All power tools used will have appropriated guards. • Operations will be suspended during all severe weather. • Ensure correct position/distance relative to other operations of other activities.
	h. Man Overboard/Drowning	h. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) Approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All persons on board will remain seated/standing securely whenever a water craft is moving. • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency. • Personnel on board water craft must be in constant radio contact with shore personnel. • Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All barge deck obstructions will be removed if possible, if not possible to remove them they shall be clearly marked with yellow paint.
	i. Sinking Boat/Barge Damage	i. Sinking Boat/Barge Damage • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it. • The 35-ton crane will be set on mats with outriggers fully extended on mats for stability. • The crane will be anchored to the deck by means of four chain binders of sufficient size and strength to stabilize the crane. These will be secured to anchor points on the barge deck.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• The Marine Survey will be done in floating plant mode and will include the crane matting and binder system. • The Marine Survey will be done by competent/qualified person and shall include stability calculations for crane lifts. • The crane operator and Project Engineer will fully understand the stability calculations and adhere to them. • Load test will be performed prior to cranes initial use and a lift plan will be developed prior to the pile driving. • The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed.
	j. Water Craft Taking On Water	j. Water Craft Taking On Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks. • If the water craft begins to take on water for any reason it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	k. Water Craft Operation Risks	k. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • Barge will be equipped with day markers and proper lighting if moored at night. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All harbor boating regulations will be strictly observed; prudent speed limits will be followed at all times.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin** **Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall**		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All water craft must have required Coast Guard approved lighting and signaling devices. • Reference the Offshore Work AHA for boating applications.
	l. Equipment Lost Overboard/Crushed	l. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the moon pool or edge of the barge/boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge/boat. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel.
	m. Emergencies: Fire, Weather, and Medical/Spills/Releases	m. Emergencies: Fire, Weather, and Medical/Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.

Project: Lower Fox River OUs 2 through 5, Volume II Activities		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: Dredging and placement of clean fill and/or dredged sand behind the sheetpile wall		
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	n. Working Over Water	n. Working Over Water • Personnel working over water will be required to wear PFDs when not in equipment.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment/Trucks 2. Dredge/Excavator 3. Spill Control Measures 4. Appropriate PPE 5. Portable Eyewash 6. First Aid Kits 7. 20A:B:C Fire Extinguisher	a. Inspect all vehicles/equipment daily. b. Daily inspections will be conducted unless damage is suspected. c. Monthly inspections will be performed. d. Daily safety inspection of spill control materials will be conducted. e. Daily maintenance (fueling, oil, grease) will be conducted. f. Daily inspections for oil/grease buildup will be conducted. g. Pre and Post Calibrations h. Initial review/training prior to commencement of field activities. i. Inspect all PPE prior to use. j. Inspect portable eye washes and first aid kits weekly. k. Inspect fire extinguishers weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Personnel will be trained in inspection checklist use. 4. Personnel will be given instructions on proper use of fire extinguishers. 5. Personnel will be given training on how to respond to spilled materials. 6. Operators/pilots will be trained in engine maintenance. 7. Requirements for housekeeping will be reviewed. 8. Only Qualified, trained individuals will use the equipment. 9. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Layout and Placement of Dredge Lines and Booster Stations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Boat Launching/Docking and Boarding Boat/Float	a. Slips/Trips/Falls	a. Slips/Trips/Falls • Ensure that loads are properly distributed in all small boats. • Boats must be secured to bank or dock before loading. • Keep boats will be organized to eliminate trip hazards. • Personnel will ascertain the stability of the deck surfaces of the derelict vessels on a vessel by vessel basis before going on board. The use of planks/plywood/ladders and deck stabilization devices will be available and used on a vessel by vessel basis. • Any vessel deemed unsafe by the attendant, inspector, ESS, or pilot of the tender boat will not be boarded. • All means of boat access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • Never exceed boats rated capacity for weight and number of persons. • Do not disembark until boat is secured.
	b. Boat Operations	b. Boat Operations • Spotters will be used when backing up trucks and moving equipment. • When off loading a boat, never back the vehicle so far into the water that the back tail pipe is under water. • Ensure you have sufficient power to pull the boat out of the water once it is trailered. • Provide radio for communication. • Assure fuel tank has sufficient gas before departure.
	c. Dropped Objects	c. Dropped Objects • Ensure the drain plug is tightly secured in the boat. • Secure all radios, cell phones, and equipment.
	d. Struck By/Against	d. Struck By/Against • Personnel will understand and review hand signals. • Keep hands inside boat when approaching dock. • Caution will be used offloading the boat from the trailer; clear the area of all nonessential personnel. • All boats will be securely anchored or docked; docked boats will be positioned with minimum 2 lines. • Ensure the boat is properly secured to the boat trailer before transporting.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Layout and Placement of Dredge Lines and Booster Stations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Ensure there is sufficient room to drive through when trailering the boat on narrow streets.
1. Crane Assisted Barge Launching	a. Crane Inspection	a. Crane Inspection • All cranes must have annual inspection reviewed before use; daily inspections and competent person named for conducting inspections; load chart available, operator must know how to read a load chart and be deemed competent by TtEC. • All cranes to be outfitted with anti-two-block protection.
	b. Contact with objects in boom radius – overhead utilities	b. Contact with objects in boom radius – overhead utilities. • Set crane up in an area free of overhead obstacles including overhead utilities. Minimum distance between crane and 50 kV power lines is 15 feet. This distance increases if the lines are over 50 kV.
	c. Traffic control	c. Traffic Control • If possible, establish one-way traffic routes for trucks bringing in barges. • Traffic cones and orange traffic vests will be used when working in areas of traffic, construction vehicles and near roadways. Implement traffic controls such as flag persons, warning devices, etc., as necessary. • Employees will need to pay attention to operations around and adjacent to their work and continually evaluate the need for traffic control measures. • Spotters will be used when backing up trucks and heavy equipment.
	d. Pinched, caught between, struck by	d. Pinched, Caught Between, Struck By • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel within unloading and loading areas are accounted for and out of the way. • All cranes are to have swing protection demarcated. • Only operator shall be on crane during operation.
	e. Overhead Hazards	e. Overhead Hazards • No personnel will be allowed to walk or do any work under any loads being picked. • Personnel will be aware of overhead operations. Unauthorized personnel will not be in the swing radius.
	f. Unstable Ground	f. Unstable Ground • Set crane up on even terrain. Ground should be stable enough to support the weight of the crane and loads during lifting. • If necessary, use crane mats to provide additional ground stability.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Layout and Placement of Dredge Lines and Booster Stations		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	g. Rigging/Lifting	g. Rigging/Lifting • All rigging hardware will be selected and placed in to use by a competent person. • All rigging hardware shall be of sufficient capacity in the configuration of use, suitable for the lift. • All rigging will be tagged with its lifting capacity. • All chokers, slings and lifting gear shall be inspected daily (both nylon and steel) and shall be free from defects prior to use.
	h. Struck by/Overhead Hazards	h. Struck By/Overhead Hazards • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel within unloading and loading areas are accounted for and out of the way. • All cranes are to have swing protection demarcated. • Only operator shall be on crane during operation. • No personnel will be allowed to walk or do any work under any loads being picked. • Personnel will be aware of overhead operations. Unauthorized personnel will not be in the swing radius. • Tag lines will be used during the picking and setting of the barges. Use tag lines to minimize swinging of objects being moved. • Crane will honk horn prior to starting any lift to warn ground personnel.
	i. Water Craft Operations	i. Water Craft Operations • All barge and tender boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • All persons on board will remain seated/standing securely whenever a watercraft is moving. • Maximum weight capacity for watercraft will not be exceeded. • Watch for other boats in area, avoid close calls or collisions. • Watch for wake from other boats. • Ensure that loads are properly distributed in all small boats.
	j. Man Overboard/Drowning	j. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) Approved Type III Life Preservers at all times while on the water. • Watercraft will not be used without shore support personnel. • Personnel on board watercraft must be in constant radio contact with

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Layout and Placement of Dredge Lines and Booster Stations		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		shore personnel. • Personnel will ascertain the stability of the deck surfaces of the derelict vessels on a vessel by vessel basis before going on board. The use of planks/plywood/ladders/picks and deck stabilization devices will be available and used on a vessel by vessel basis. • Any vessel deemed unsafe by the attendant, inspector, ESS, or pilot of the tender boat will not be boarded. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • Maximum weight capacity for barge will not be exceeded.
	k. Falling Overboard and/or Standing	k. Falling Overboard and/or Standing • All personnel shall wear USCG Approved Type III Live Preservers at all times while on water. • All PFDs will be properly worn, snug, and fully zippered/buttoned. • A USCG approved Type IV flotation device (life ring) with 70 feet of line will be maintained on each tender boat. • Personnel will ascertain the stability of the deck surfaces of the derelict vessels on a vessel by vessel basis before going on board. The use of planks/plywood/ladders/picks and deck stabilization devices will be available and used on a vessel by vessel basis. • Any vessel deemed unsafe by the attendant, inspector, ESS, or pilot of the tender boat will not be boarded. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • Maximum weight capacity for barge will not be exceeded. • Personnel on barges must be in constant radio contact with shore personnel.
	l. Hand Tools	l. Hand Tools • The proper tools will be used for each task. • All tools will be inspected before each use. Damaged tools will be removed from service and tagged (splintered wood bases, missing guards, “mushroom” head). • Tools will be used in accordance with manufacturer’s instructions. • Modifications to tools are prohibited unless approved by the ESS.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Layout and Placement of Dredge Lines and Booster Stations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	m. Equipment Lost Overboard/crushed	a. Equipment Lost Overboard/crushed • Instruments shall not be placed near edge of the barge when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the boat.
2. Layout and Placement of Dredge Lines and Booster Stations	a. Falling Overboard and/or Standing	a. Falling Overboard and/or Standing • Watch personnel position while lifting sounding pole. • All persons on board will remain seated/standing securely whenever a watercraft is moving. • Maximum weight capacity for watercraft will not be exceeded. • Watercraft will not be used without shore support personnel with rescue skiff available onshore. • Personnel on board watercraft must be in constant radio contact with shore personnel.
	b. Man Overboard/Drowning	b. Man Overboard/ Drowning • All personnel shall wear United States Coast Guard (USCG) approved Type III Life Preservers at all times while on the water. • All barges shall be equipped with a guardrail of wood, pipe, or steel around the entire perimeter of the barge. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Watercraft will not be used without shore support personnel with rescue skiff available onshore.
	c. Struck By/Against	c. Struck By/Against • Personnel will understand and review hand signals. • Watch for other boats in area, avoid close calls or collisions. • Watch for wake from other boats. • Watch for (know their locations or mark with buoys) objects hidden under water at higher tides, i.e., pilings, islands, anchor lines.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Layout and Placement of Dredge Lines and Booster Stations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Caution will be used offloading the boat; personnel will ensure the boat is securely docked before embarking. All supply transfer work will be done only when boats are docked fore and aft. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Never pitchpole or broach any waves. • Ensure the air horn on each boat used is in proper working order. • Ladders will be free of ice and snow before climbing.
	d. Hand Tools	d. Hand Tools • Reference Section 3.3.12. • The proper tools will be used for each task. • All tools will be inspected before each use. Damaged tools will be removed from service and tagged (splintered wood bases, missing guards, "mushroom" head). • Tools will be used in accordance with manufacturer's instructions. • Modifications to tools are prohibited unless approved by the ESS. • GFCIs will be used with all electrical power tools. • Personnel welding HDPE pipe will wear leather gloves or heat resistant gloves. Care will be taken when handling the heating iron.
	e. Back Injuries and Strains	e. Back Injuries and Strains • Procedures in Section 3.3.14 will be followed. • Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc). • Mechanical devices should be used to reduce manual handling of materials. Team lifting should be utilized if mechanical devices are not available. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	f. Severe Weather	f. Severe Weather • National weather forecasts will be monitored daily for predicted inclement weather, such as thunderstorms. Each Supervisor will check on the local conditions and forecast each morning. • Personnel working in an exposed marine location shall monitor the NOAA marine weather broadcasts.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Layout and Placement of Dredge Lines and Booster Stations		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All personnel shall be aware of the forecast and keep an "eye to the sky." Unforecasted storms may also occur without warning. • Work will be postponed in the event of very strong winds, high seas, or at times of very poor visibility. • In the event of lightning in the area, work will cease at the direction of the TtEC Supervisor or ESS, and will not proceed further until return to work permit is issued.
	g. Sinking Boat/Barge Damage	g. Sinking Boat/Barge Damage • All watercraft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including picture documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge or boat until enough water returns to refloat it.
	h. Watercraft Operation	h. Watercraft Operations • All tender boat pilots shall be familiar with the "Rules of the Road" that regulate movement of boat traffic within the harbor. • Boat Operators must hold Boater Safety certification. • Kill switch tether must be used. • Charts of the work areas, with depths for mean low water, will be obtained and watercraft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the study area. These will be given a wide berth. • All offshore boating regulations will be strictly observed; prudent speed limits observed. • All watercraft (including pipelines, barges, moored boats, etc.) must have required Coast Guard approved lighting and/or signaling devices.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: Layout and Placement of Dredge Lines and Booster Stations

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	i. Flying objects and debris	i. Flying objects and debris • ANSI approved safety glasses will be worn at all times while on the water. • All objects pulled up from the water will be brought aboard slowly to check for contamination or entanglement.
	j. Equipment Lost Overboard/Crushed	j. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the edge of the boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the boat.
	k. Emergencies: Fire, Weather and Medical /Spills/Releases	k. Emergencies: Fire, Weather and Medical /Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be available to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher.

EQUIPMENT USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
1. Boats 2. Appropriate PPE 3. Hand and Power Tools 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Inspect all boats daily. 2. Inspect all hand and power tools prior to use. 3. Inspect all PPE prior to use. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and Test GFCIs weekly.	1. All site personnel will read and comply with this SHSP. 2. All site personnel will receive site-specific training. 3. Qualified operators will be used for heavy equipment and boat operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 5. Instruct personnel of proper use of fire extinguishers. 6. Personnel will be trained on the proper use of hand and power tools, including the steam cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dredging TSCA and non-TSCA sediments**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Dredge Operations	a. Noise	a. Noise • Refer to General Site Hazards.
	b. Heavy Equipment Operation	b. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations.
	c. Falling Overboard and/or Standing	c. Falling Overboard and/or Standing • Watch personnel position while lifting sounding pole • All persons on board will remain seated/standing securely whenever a watercraft is moving. • Maximum weight capacity for watercraft will not be exceeded. • Watercraft will not be used without shore support personnel with rescue skiff available onshore. • Personnel on board watercraft must be in constant radio contact with shore personnel.
	d. Man Overboard/Drowning	d. Man Overboard/ Drowning • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All personnel shall wear United States Coast Guard (USCG) approved Type I, III or V Life Preservers at all times while on the water.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging TSCA and non-TSCA sediments		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • All barge deck obstructions will be removed if possible; if not possible to remove them, they shall be clearly marked with yellow paint. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • All persons on board will remain seated/standing securely whenever a water craft is moving, • All PFDs will be properly worn, snug, and fully zippered/buttoned. • Maximum weight capacity for water craft will not be exceeded. • Personnel on board water craft must be in constant radio contact with shore personnel. • All heavy, over-the-side work shall be done with the aid of a winch or crane. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency.
	e. Struck By/Against	e. Struck By/Against • Swing radius of the excavator will be demarcated with caution tape or cones. Extreme caution shall be exercised when working in the proximity to the crane aboard the barge. No one shall enter the swing radius while the excavator is working. All personnel shall contact the operator before entering the swing area when the machine is not working in order to guarantee a safe passage. • Hand signals will be reviewed prior to the start of work. • All machines will be equipped with backup alarms. • The excavator operator will have a clear visual field of the excavation area. • Spotter will ensure he has eye contact with the operator. • No visitors will be allowed on the barge.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging TSCA and non-TSCA sediments		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Overhead protection, which will not obscure the vision of the operator, shall be provided. • Personnel will be aware of pinch points; no personnel will put their hands or any body part between any moving object and a stationary object. • Barge will be spudded in place. All personnel not associated with the spud operation will stay a minimum of 20 feet out of the spud dropping area. • Only qualified personnel will drop the spud/operate the winch. The operator will be seated in the winch operators chair and will not operate the winch until given the all clear that personnel are out of the spud drop areas. • The wheels of the spuds are located below deck and therefore do not pose a struck by/caught in hazard. • All winch cables will be clearly marked and/or cordoned off; 90% of the cables are covered by metal plating; the +/- 10 % that is exposed is demarcated by yellow paint on the barge deck. Personnel will not be allowed in this demarcated area when the spuds are being dropped. • The spud winch is located in the barge house on deck. When this winch is in operation, the water tight door to this house will be closed and a sign posted –DO NO ENTER. • Guards shall be provided on all sheaves to prevent cables from jumping out of sheaves. • Keep access steps and ladders free from oil. • Work taking place above 6 feet requires fall protection. • Ensure all personnel on the barge are accounted for and out of the way. • Personnel will not stand under any suspended loads. • All power tools used will have appropriated guards. • Ensure correct position/distance relative to other operations of other activities. • Caution will be used offloading the boat from the trailer; clear the area of all nonessential personnel. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Ensure the boat is properly secured to the boat trailer before transporting.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging TSCA and non-TSCA sediments		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Ensure there is sufficient room to drive through when trailering the boat on narrow streets. • Watch for (know their locations or mark with buoys) objects hidden under water at higher tides, i.e., pilings, islands, anchor lines. • Caution will be used offloading the boat; personnel will ensure the boat is securely docked before embarking. All supply transfer work will be done only when boats are docked fore and aft. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Never pitchpole or broach any waves. • Ensure the air horn on each boat used is in proper working order. • Ladders will be free of ice and snow before climbing.
	f. Sinking Boat/Barge Damage	f. Sinking Boat/Barge Damage • All watercraft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed. • A pre-use inspection of any rented vessel shall be completed, including picture documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge or boat until enough water returns to refloat it.
	g. Watercraft Operation	g. Watercraft Operations • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • Boat Operators must hold Boater Safety certification. • Kill switch tether must be used. • Charts of the work areas, with depths for mean low water, will be obtained and watercraft pilots will be familiar with their use.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Dredging TSCA and non-TSCA sediments		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Locations of rocks, ledges and manmade subsurface obstructions will be noted within the study area. These will be given a wide berth. • All offshore boating regulations will be strictly observed; prudent speed limits observed. • All watercraft (including pipelines, barges, moored boats, etc.) must have required Coast Guard approved lighting and/or signaling devices. • All barges will be equipped with day markers and proper lighting-if moored at night.
	h. Equipment Lost Overboard/Crushed	h. Equipment Lost Overboard/Crushed • Instruments/equipment shall not be placed near the edge of the barge when not in use. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • All sensitive instruments will be placed in a plastic cooler/or other appropriate container for transport on and off the tender boat. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones.
	i. Emergencies: Fire, Weather and Medical /Spills/Releases	i. Emergencies: Fire, Weather and Medical /Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be available to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dredging TSCA and non-TSCA sediments**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	j. Overhead Hazards	j. Overhead Hazards • Reference General Site Hazards.
	k. Eye Injury	k. Eye Injury • Reference General Site Hazards.
	l. Slips/Trips/Falls	l. Slips/Trips/Falls • Reference General Site Hazards. • Ensure that loads are properly distributed in all small boats. • All personnel shall wear United States Coast Guard (USCG) approved Type I, III or V Life Preservers at all times while on the water. • Personnel will use care when exiting entering the craft from the water and ensure they have solid footing before climbing in/out. • Personnel will ensure that they are in no more than 1 foot of water when entering/exiting the craft, unless the personnel are in waders. • The following procedure will be used when launching/docking any water craft: ❖ Personnel shall know the weight of the water craft and motor prior to launching docking. ❖ Boat motor will be pulled up before it contacts the river bottom. ❖ Personnel will take note of wind speed and direction, current, and tidal height before shutting off/turning on the boat motor. ❖ All personnel will carefully exit the water craft. ❖ No personnel shall lift in excess of 50 pounds. ❖ Personnel will remove/put in any small boat to the edge of the water with minimal dragging of the boat across the dry land. ❖ Mechanical devices will be used in lieu of manual labor to remove from/put into the water any water craft in excess of 300 pounds weight for boat and motor. ❖ A light duty trailer can be used in lieu of manual lifting, if a light duty trailer is used personnel must lift up the front of the boat, manually with a minimum of two people. • Any hoisting device used to pull up/let down the boat will be properly maintained and serviced according to manufacturer's specifications; capable of lifting the weight of the load being hoisted; checked before each hoist; and operated by qualified knowledgeable personnel.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dredging TSCA and non-TSCA sediments**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
2. Shut Down Dredge Operations	a. Slips/Trips/Falls	a. Slips/Trips/Falls • Reference General Site Hazards. • Ensure that loads are properly distributed in all small boats. • All personnel shall wear United States Coast Guard (USCG) approved Type I, III or V Life Preservers at all times while on the water. • Personnel will use care when exiting or entering the craft from the water and ensure they have solid footing before climbing in/out. • Personnel will ensure that they are in no more than 1 foot of water when entering/exiting the craft, unless the personnel are in waders. • The following procedure will be used when launching/docking any water craft: ❖ Personnel shall know the weight of the water craft and motor prior to launching docking. ❖ Boat motor will be pulled up before it contacts the river bottom. ❖ Personnel will take note of wind speed and direction, current, and tidal height before shutting off/turning on the boat motor. ❖ All personnel will carefully exit the water craft. ❖ No personnel shall lift in excess of 50 pounds. ❖ Personnel will remove/put in any small boat to the edge of the water with minimal dragging of the boat across the dry land. ❖ Mechanical devices will be used in lieu of manual labor to remove from/put into the water any water craft in excess of 300 pounds weight for boat and motor. ❖ A light duty trailer can be used in lieu of manual lifting; if a light duty trailer is used, personnel must lift up the front of the boat manually with a minimum of two people. • Any hoisting device used to pull up/let down the boat will be properly maintained and serviced according to manufacturer's specifications; capable of lifting the weight of the load being hoisted; checked before each hoist; and operated by qualified knowledgeable personnel.
	b. Dropped Objects	b. Dropped Objects • Reference General Site Hazards.
	c. Noise	c. Noise • Reference General Site Hazards.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dredging TSCA and non-TSCA sediments**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	d. Heavy Equipment Operation	d. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies, or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. • Know hand signals. • All equipment will be equipped with backup alarms. • Equipment will be shut down before and during fueling operations.
	e. Overhead Hazards	e. Overhead Hazards • Reference General Site Hazards.
	f. Eye Injury	f. Eye Injury • Reference General Site Hazards.
	g. Exposure to Site Contaminants (PCBs)	g. Exposure to Site Contaminants (PCBs) • Reference General Site Hazards. • When dredging production stops for a longer period, the sediment residues on the dredge will be hosed down by using a hose with medium water pressure on it.
	h. Struck By/Against	h. Struck By/Against • Reference General Site Hazards. • Personnel will understand and review hand signals. • All machines will be equipped with backup alarms. • Only essential people will be allowed in the unloading area. • Personnel will not stand under any suspended loads. • Only qualified dredge personnel will be used. • All power tools used will have appropriated guards. • Personnel will avoid placing themselves between heavy equipment/dredge bucket and stationary objects. • Operations will be suspended and the dredge secured during all severe weather. • Ensure correct position relative to other operations of other activities.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dredging TSCA and non-TSCA sediments**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Ensure all body parts are kept from between the templates when they are being set.
	i. Security issues	i. Security issues • Cabin of dredge must be locked at the end of each shift. • Dredge will be securely positioned prior to the end of each days activities.
	j. Miscellaneous	j. Miscellaneous • All heavy, over-the-side work shall be done with the aid of a winch. • Oil, mud, and grease will be prevented from building up on walking surfaces.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment/Trucks 2. Dredge/Excavator 3. Spill Control Measures 4. Appropriate PPE 5. Portable Eyewash 6. First Aid Kits 7. 20A:B:C Fire Extinguisher	1. Inspect all vehicles/equipment daily. 2. Daily inspections will be conducted unless damage is suspected. 3. Monthly inspections will be performed. 4. Daily safety inspection of spill control materials will be conducted. 5. Daily maintenance (fueling, oil, grease) will be conducted. 6. Daily inspections for oil/grease buildup will be conducted. 7. Pre and Post Calibrations 8. Initial review/training prior to commencement of field activities. 9. Inspect all PPE prior to use. 10. Inspect portable eye washes and first aid kits weekly. 11. Inspect fire extinguishers weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Personnel will be trained in inspection checklist use. 4. Personnel will be given instructions on proper use of fire extinguishers. 5. Personnel will be given training on how to respond to spilled materials. 6. Operators/pilots will be trained in engine maintenance. 7. Requirements for housekeeping will be reviewed. 8. Only Qualified, trained individuals will use the equipment. 9. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sediment Capping and Placement of Cover Material**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Obtaining Depth Measurements	a. Back Injuries and Strains	a. Back Injuries and Strains • Reference General Site Hazards. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	b. Slips/Trips/Falls	b. Slips/Trips/Falls • Ensure that loads are properly distributed in all small boats. • All personnel shall wear United States Coast Guard (USCG) approved Type I, III or V Life Preservers at all times while on the water. • Personnel will use care when exiting entering the craft from the water and ensure they have solid footing before climbing in/out. • Personnel will ensure that they are in no more than 1 foot of water when entering/exiting the craft, unless the personnel are in waders. • The following procedure will be used when launching/docking any water craft: ❖ Personnel shall know the weight of the water craft and motor prior to launching docking. ❖ Boat motor will be pulled up before it contacts the river bottom. ❖ Personnel will take note of wind speed and direction, current, and tidal height before shutting off/turning on the boat motor. ❖ All personnel will carefully exit the water craft. ❖ No personnel shall lift in excess of 50 pounds. ❖ Personnel will remove/put in any small boat to the edge of the water with minimal dragging of the boat across the dry land. ❖ Mechanical devices will be used in lieu of manual labor to remove from/put into the water any water craft in excess of 300 pounds weight for boat and motor. ❖ A light duty trailer can be used in lieu of manual lifting; if a light duty trailer is used, personnel must lift up the front of the boat manually with a minimum of two people. • Any hoisting device used to pull up/let down the boat will be properly maintained and serviced according to manufacturer's specifications; capable of lifting the weight of the load being hoisted; checked before each hoist; and operated by qualified knowledgeable personnel.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sediment Capping and Placement of Cover Material**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	c. Dropped Objects	c. Dropped Objects • Reference General Site Hazards. • Ensure the drain plug is tightly secured in the boat.
	d. Eye Injuries	d. Eye Injuries • Safety glasses meeting ANSI Standard Z87 will be worn for all field operations where eye hazards exist. • A portable eye wash station will be located adjacent to work activities.
	e. Vehicular Traffic/Problems	e. Vehicular Traffic/Problems • When off loading a boat, never back the vehicle so far into the water that the back tail pipe is under water. • Ensure you have sufficient power to pull the boat out of the water once it is trailered.
	f. Struck By/Against	f. Struck By/Against • Caution will be used offloading the boat from the trailer; clear the area of all nonessential personnel. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Ensure the boat is properly secured to the boat trailer before transporting. • Ensure there is sufficient room to drive through when trailering the boat on narrow streets. • Watch for (know their locations or mark with buoys) objects hidden under water at higher tides, i.e., pilings, islands, anchor lines. • Caution will be used offloading the boat; personnel will ensure the boat is securely docked before embarking. All supply transfer work will be done only when boats are docked fore and aft. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Never pitchpole or broach any waves. • Ensure the air horn on each boat used is in proper working order. • Ladders will be free of ice and snow before climbing.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	g. Man Overboard/Drowning	g. Man Overboard/Drowning • All personnel shall wear United States Coast Guard (USCG) approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All persons on board will remain seated/standing securely whenever a water craft is moving. • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency. • Personnel on board water craft must be in constant radio contact with shore personnel.
	h. Sinking Boat/Barge Damage	h. Sinking Boat/Barge Damage • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• In the event a barge or boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it.
	i. Water Craft Taking On Water	i. Water Craft Taking On Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks. • If the water craft begins to take on water for any reason, it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	j. Water Craft Operation Risks	j. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • All barges will be equipped with day markers. • Barge will be equipped with day markers and proper lighting if moored at night. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All boating regulations will be strictly observed; prudent speed limits will be followed at all times. • All water craft must have required Coast Guard approved lighting and signaling devices.
	k. Flying Objects and Debris	k. Flying Objects and Debris • ANSI approved safety glasses will be worn at all times while on the water. • All objects pulled up from the water will be brought aboard slowly to check for contamination or entanglement.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sediment Capping and Placement of Cover Material**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	l. Equipment Lost Overboard/Crushed	l. Equipment Lost Overboard/Crushed • Instruments shall not be placed near the moon pool or edge of the barge/boat when not in use/not secured. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge/boat.
	m. Emergencies: Fire, Weather, and Medical/Spills/Releases	m. Emergencies: Fire, Weather, and Medical/Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.
2. Placing Sub-Aqueous Caps	a. Slips/Trips/Falls	a. Slips/Trips/Falls • All personnel shall wear United States Coast Guard (USCG) Approved Type I, III or V Life Preservers at all times while on the water. • Maintain work areas clean and orderly.
	b. Man Overboard/Drowning	b. Man Overboard/Drowning • As per OSHA requirements (29 CFR 1926.501(b)(1)) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All personnel shall wear United States Coast Guard (USCG) approved Type I, III or V Life Preservers at all times while on the water.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • All barge deck obstructions will be removed if possible; if not possible to remove them, they shall be clearly marked with yellow paint. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • All persons on board will remain seated/standing securely whenever a water craft is moving. • All PFDs will be properly worn, snug, and fully zippered/buttoned. • Maximum weight capacity for water craft will not be exceeded. • Personnel on board water craft must be in constant radio contact with shore personnel. • All heavy, over-the-side work shall be done with the aid of a winch or crane. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency.
	c. Water Craft Operation Risks	c. Water Craft Operation Risks • All barge and boat pilots shall be familiar with the “Rules of the Road” that regulate movement of boat traffic within the harbor. • Charts of the study areas, with depths for mean low water, will be obtained and water craft pilots will be familiar with their use. • Locations of rocks, ledges, and manmade subsurface obstructions will be noted within the work area. These will be given a wide berth. • All harbor boating regulations will be strictly observed; prudent speed limits will be followed at all times. • All water craft must have required Coast Guard approved lighting and signaling devices. • Boat Operators must hold Boater Safety certification. • Kill switch tether must be used.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All offshore boating regulations will be strictly observed; prudent speed limits observed. • All water craft (including pipelines, barges, moored boats, etc.) must have required Coast Guard approved lighting and/or signaling devices. • All barges will be equipped with day markers. • Barge will be equipped with day markers and proper lighting-if moored at night.
	d. Sinking Boat/Barge Damage	d. Sinking Boat/Barge Damage • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. Marine Surveys on the barges will be done prior to start of work. • Tide tables will be consulted and times of high tide; times when it is safe to move barges will be identified. • In the event the barge becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it. • The provisions of EM 385-1-1 Section 16, Marine Floating Plants, and CFR 29 1926 and 1910 Subparts N, as well as 29 CFR 1926.603, shall be followed. • All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS).
	e. Equipment Lost Overboard/Crushed	e. Equipment Lost Overboard/Crushed • Instruments/equipment shall not be placed near the edge of the barge when not in use. • All small equipment will have a backup tie line attached to the vessel if they are used at or over the edge of the vessel. • Instruments will be kept clear of all tooling lay down areas. Good housekeeping will be critical on the barge. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• All sensitive instruments will be placed in a plastic cooler/or other appropriate container for transport on and off the tender boat. • Equipment will be secured to the deck or to personnel when appropriate. Secure all radios and cell phones.
	f. Water Craft Taking On Water	f. Water Craft Taking On Water • All personnel will ensure the water craft has a working plug firmly in place prior to launch. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to launch/dock, will be identified. • All water craft will have a bailing device on board in case of leaks. • If the water craft begins to take on water for any reason, it shall be brought in to the nearest safe docking facility as soon as possible and the ESS immediately called. • Any water craft which is damaged in any way or has taken on water will be inspected by the ESS or designee prior to the craft being launched.
	g. Flying Objects and Debris	g. Flying Objects and Debris • ANSI approved safety glasses will be worn at all times while on the water. • All objects pulled up from the water will be brought aboard slowly to check for contamination or entanglement.
	h. Dropped Objects	h. Dropped Objects • Steel toe boots meeting ANSI Standard Z41 will be worn as directed. • Secure all radios, cell phones and equipment. • Ensure the drain plug is tightly secured in the boat.
	i. Noise	i. Noise • Reference General Site Hazards. • All equipment will have manufacturer's required mufflers.
	j. Overhead Hazards	j. Overhead Hazards • Reference General Site Hazards.
	k. Eye Injuries	k. Eye Injuries • Safety glasses meeting ANSI Standard Z87 will be worn for all field operations where eye hazards exist. • A portable eye wash station will be located adjacent to work activities.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sediment Capping and Placement of Cover Material**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	l. Emergencies: Fire, Weather and Medical /Spills/Releases	l. Emergencies: Fire, Weather and Medical /Spills/Releases • Fire extinguishers will be carried on all launches, barges, and motorboats. Minimum number and rating are as follows: Length — Extinguisher 26 feet or less — one 1-A: 10-B:C 26 feet or more — two 1-A: 10-B:C • Barge/open boat workers shall be evacuated to shore or secure location by tender boat when lightning is spotted or threatens the area. • Medical emergencies will be handled as they are onshore except when low or no water renders a boat evacuation impossible. • Booms shall be placed in the water around the perimeter of the barge to prevent any fuel or hydraulic spills from spreading. • Personnel shall evacuate the boat/barge if a fire cannot be contained with one 10 lb fire extinguisher. • Spill kits shall be maintained onboard barges to keep any hydrocarbon spill from reaching the water.
	m. Exposure to Site Contaminants (PCBs)	m. Exposure to Site Contaminants (PCBs) • Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep “clean” during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE described in Table 5-1 to minimize if not prevent exposure. • Air monitoring will be performed as specified is Section 6.0. Personnel will follow those response procedures detailed in Section 6.0 as appropriate to the results of the air monitoring. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner. • Care will be taken to avoid splashing of water and sediments to prevent body contact. • Materials which have contacted the sediment or other contaminated materials will not be touched without proper personal protective equipment. • Exclusion zone, contamination reduction zone, and clean zones will be identified on the barge/boat if full Hazmat work will be part of the work task.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Bootwash, handwash, and emergency eyewash facilities will be available onboard for full Hazmat operations/as space permits. Skin will be rinsed with water if contact with hazardous materials occurs. • Gross Decon and encapsulation of PPE will be performed on the boat if full decon is accomplished at the site decon facilities, prior to the end of the day's work. All boat/barge surfaces will be cleaned after sediment contact. • First aid kit with eyewash will be available on all boats; 15-minute free flow eyewashes will be in use on all barges. • All boat barge surfaces will be properly deconned per 40 CFR 761 prior to demobilization/non-Hazmat operations.
	n. Struck By/Against	n. Struck By/Against • Swing radius of the excavator will be demarcated with caution tape or cones. Extreme caution shall be exercised when working in the proximity to the crane aboard the barge. No one shall enter the swing radius while the excavator is working. All personnel shall contact the operator before entering the swing area when the machine is not working in order to guarantee a safe passage. • Hand signals will be reviewed prior to the start of work. • All machines will be equipped with backup alarms. • The excavator operator will have a clear visual field of the excavation area. • Spotter will ensure he has eye contact with the operator. • No visitors will be allowed on the barge. • Overhead protection, which will not obscure the vision of the operator, shall be provided. • Personnel will be aware of pinch points; no personnel will put their hands or any body part between any moving object and a stationary object. • Barge will be spudded in place. All personnel not associated with the spud operation will stay a minimum of 20 feet out of the spud dropping area. • Only qualified personnel will drop the spud/operate the winch. The operator will be seated in the winch operators chair and will not operate the winch until given the all clear that personnel are out of the spud drop areas. • The wheels of the spuds are located below deck and therefore do not pose

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sediment Capping and Placement of Cover Material		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		a struck by/caught in hazard. • All winch cables will be clearly marked and/or cordoned off; 90% of the cables are covered by metal plating; the +/- 10 % that is exposed is demarcated by yellow paint on the barge deck. Personnel will not be allowed in this demarcated area when the spuds are being dropped. • The spud winch is located in the barge house on deck. When this winch is in operation the water tight door to this house will be closed and a sign posted –DO NO ENTER. • Guards shall be provided on all sheaves to prevent cables from jumping out of sheaves. • Keep access steps and ladders free from oil. • Work taking place above 6 feet requires fall protection. • Ensure all personnel on the barge are accounted for and out of the way. • Personnel will not stand under any suspended loads. • All power tools used will have appropriated guards. • Ensure correct position/distance relative to other operations of other activities. • Caution will be used offloading the boat from the trailer; clear the area of all nonessential personnel. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Ensure the boat is properly secured to the boat trailer before transporting. • Ensure there is sufficient room to drive through when trailering the boat on narrow streets. • Watch for (know their locations or mark with buoys) objects hidden under water at higher tides, i.e., pilings, islands, anchor lines. • Caution will be used offloading the boat; personnel will ensure the boat is securely docked before embarking. All supply transfer work will be done only when boats are docked fore and aft. • All boats will be securely anchored or docked-docked boats will be positioned with minimum 2 lines. • Never pitchpole or broach any waves. • Ensure the air horn on each boat used is in proper working order. • Ladders will be free of ice and snow before climbing.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sediment Capping and Placement of Cover Material**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	o. Miscellaneous	o. Miscellaneous • All heavy, over-the-side work shall be done with the aid of a winch. • When practical, all drilling, well installation, and sediment sampling shall be done through a "moon pool" in the deck of the vessel. • Drilling barges shall be anchored by employing a minimum of two spud pipes. • Oil and grease will be prevented from building up on walking surfaces.
	p. Vehicular Traffic/Problems	p. Vehicular Traffic/Problems • When off loading a boat, never back the vehicle so far into the water that the back tail pipe is under water. • Ensure you have sufficient power to pull the boat out of the water once it is trailered.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment 2. Barge Railing Systems 3. Barge Deck/Working Surfaces 4. Lighting/Signaling/Boat Safety Systems 5. Appropriate PPE 6. Hand and Power Tools 7. Portable Eyewash 8. First Aid Kits 9. 20A:B:C Fire Extinguisher 10. GFCI	1. Inspect all heavy equipment prior to use. 2. Daily inspections will be conducted on the barge railing systems unless damage is suspected. 3. Inspect all hand and power tools prior to use. 4. Inspect all PPE prior to use. 5. Inspect portable eye washes and first aid kits weekly. 6. Inspect fire extinguishers weekly. 7. Check and Test GFCIs weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Qualified operators will be used for heavy equipment and barge operation. 4. Personnel will be informed of the rail system requirements. 5. Operators will be familiar with Coast Guard regulations for intercoastal water craft. 6. Personnel will be informed of the float requirements. 7. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 8. Instruct personnel of proper use of fire extinguishers. 9. Personnel will be trained on the proper use of hand and power tools.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dewatering Operations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. System Start-Up	a. Back Injuries	a. Back Injuries • Reference General Site Hazards. • Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	b. Slips/Trips/Falls	b. Slips/Trips/Falls • Reference General Site Hazards. • Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	c. Spills	c. Spills • Reference General Site Hazards. • Secondary containment will be used during system start up to prevent spills of contaminated sediments onto ground surface.
	d. Dropped Objects	d. Dropped Objects • Reference General Site Hazards. • Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	e. Sharp Objects/Punctures	e. Sharp Objects/Punctures • Reference General Site Hazards. • Use hand tools properly and wear appropriate protective equipment; cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	f. Hand and Power Tools	f. Hand and Power Tools • Reference General Site Hazards. • Remove broken or damaged tools from service; use the tool for its intended purpose; and use in accordance with manufacturer's instructions.
	g. Eye Injuries	g. Eye Injuries • Reference General Site Hazards. • Safety glasses meeting ANSI Standard Z87 will be worn.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dewatering Operations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
	h. Chemical Exposure	h. Chemical Exposure • Appropriate protective clothing will be worn; skin will be rinsed with water if contact with hazardous material occurs; a portable eye wash station will be located by work area; conduct hazard communication training for decontamination and sample preservation chemicals. Air monitoring in accordance with Tables 6-1 and 6-2 will be conducted.
	i. Electrocution	i. Electrocution • Do not use unit near any power lines or where water can come in contact with electrical power. • Reference EHS Program EHS 3-10 for electrical considerations. • All electrical wiring and hookups will be completed by a licensed electrician. Lockout/Tagout will be utilized to make sure lines are not hot prior to beginning work on them and making connections. Reference EHS Program EHS 6-4 for lockout/tagout procedures. • The ESS is responsible for providing the training required in the procedure EHS-6-4 to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. • The ESS shall also implement lockout/tagout procedures as required.
2. Dewatering Operations	a. Exposure to Site Contaminants (PCBs)	a. Exposure to Site Contaminants (PCBs) • Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep “clean” during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE described in Table 5-1 to minimize if not prevent exposure. • Air monitoring will be performed as specified is Section 6. Personnel will follow those response procedures detailed in Section 6 as appropriate to the results of the air monitoring. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Dewatering Operations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
	b. Lockout/Tagout (Release of Hazardous Energy)	b. Lockout/Tagout (Release of Hazardous Energy) • Reference EHS Program EHS 6-4. • Reference 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout). • The ESS is responsible for providing the training required in the procedure EHS Program EHS 6-4 to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. • The ESS shall also implement lockout/tagout procedures as required.
	c. Lockout/Tagout (Tags without Locks)	c. Lockout/Tagout (Tags without Locks) • The use of tags without locks is prohibited, except in those cases where it is physically impossible to attach a locking device to an isolation point. In this case, follow steps in EHS Program EHS 6-4. • Employees shall be warned not to tamper with the tag or isolation point.
	d. Lockout/Tagout (Failure to Clear Locks)	d. Lockout/Tagout (Failure to Clear Locks) • Reference EHS Program EHS 6-4. • Supervisor will attempt to contact person who applied lock and resolve issue. • If person cannot be contacted, supervisor will investigate the situation and determine that removal of the lock will not create a hazard in the work zone. • The supervisor will then verify that the work zone is clear, blocking devices have been removed, and the system has been restored to the normal configuration. • The supervisor will then cut the lock off and restore energy to the system. • A written incident and investigation report per EHS Program EHS 1-7, Incident Reporting and Investigating, shall be prepared by the supervisor stating the reason for cutting the lock, why the lock was not removed, and the procedure used to ensure the safety of personnel in the area. • The individual whose lock was cut off must be notified ASAP.
	e. Fire and Explosion	e. Fire • Reference General Site Hazards and Section 10.9. • Equip all heavy equipment with 20A:B:C-type fire extinguishers. • Area(s) for personnel smoking will be designated. • Flammable liquids and gases will be stored away from oxidizers. • No hot work without properly executed work permit.

	f. Spills	f. Spills • Reference General Site Hazards, Section 10.13, and the Contingency Plan. • Secondary Containment will be provided in storage areas. • Spill and absorbent materials will be readily available.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment 2. Hand and Power Tools 3. Appropriate PPE 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Hand and power tools will be inspected to ensure they are in good condition prior to each day's use. 2. PPE will be inspected before and after each use. 3. Periodic inspections pursuant to EHS Program EHS 3-3, Inspections, shall be completed during the monthly inspections by the ESS, PESM or other qualified personnel to ensure that the lockout tagout program is being effectively implemented. As a minimum the following shall be done: • Existing lockouts will be reviewed for effectiveness; • Permits for each existing lockouts shall be reviewed for adequacy; • Incident reports and past permits shall be reviewed to determine if deficiencies in the program exist; • Corrections to the system will be made as warranted; and • Results will be logged in the health and safety logbook. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and test GFCIs weekly.	1. Authorized employees shall receive training in the following prior to being allowed to use lockout/tagout procedures: • Recognition of hazardous energy sources; • Types and magnitudes of energies available at the site; • Methods and means needed for energy isolation and control; and • The requirements of this procedure and 29 CFR 1910.147. 2. Affected employees shall be instructed in the following: • Purpose of the lockout/tagout program; • Use and requirements of this procedure and 29 CFR 1910.147; • Prohibitions of restarting or tampering with equipment that has been locked out; and • Prohibitions of tampering with locks and tags installed on equipment. 3. All site personnel will read and comply with this HASP. 4. All site personnel will receive site specific training. 5. Only qualified electricians will install electrical wiring and hookups. 6. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 7. Instruct personnel of proper use of fire extinguishers. 8. Personnel will be trained on the proper use of hand and power tools, including the pipe welding machine. 9. Training on lockout/tagout procedures are listed in EHS Program EHS 6-4.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Loading Trucks for T&D**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Loading Trucks for T&D	a. Heavy Equipment Operation	a. Heavy Equipment Operation • Reference General Site Hazards. • Only operators trained and experienced with the specific equipment will operate that equipment. • Equipment will have guards, canopies, or grills to protect from flying objects. • Ground personnel will stay clear of all suspended loads. • Eye contact with operators will be made before approaching equipment. Equipment will not be approached on blind sides. • Avoid equipment swing radius. This area will be delineated with cones. • Know hand signals. • All equipment will be equipped with backup alarms. • The use of headphones for entertainment purposes is prohibited. • A 15-foot minimum safe separation distance will be maintained between equipment and overhead utility lines. • Equipment will be shut down before and during fueling operations.
	b. Struck by Heavy Equipment/Vehicles	b. Struck by Heavy Equipment/Vehicles • Speed limit for traffic is 15 mph for all areas of the site. • Trucks shall slow down before approaching loading/unloading area. • Operators will remain in truck when being loaded. • On-site personnel working in the loading area will not walk along the blind side of equipment and must not approach heavy equipment without making eye contact with the operator. • Do not approach heavy equipment unless eye contact with appropriate hand signals has been made with the operator to cease activity. Equipment operators will confirm that eye contact had been made by stopping operation and clearly showing their hands are off the controls. • Be aware of heavy equipment operations. • Keep out of the swing radius of heavy equipment. • Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times. • Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. • Ground personnel will not stand directly behind heavy equipment when it is in operation.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Loading Trucks for T&D**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Loaded trucks have right of way. • Leave ½ truck length between the truck being loaded and the next truck in line.
	c. Equipment Rollover	c. Equipment Rollover • Equipment will have rollover protective structures and seat belts. • Operators will wear seat belts when operating equipment. • Do not operate equipment on grades which exceed the manufacturer's recommendations. • Be aware of weather and road conditions. • A spotter will be used when loading equipment in high traffic areas. • Do not load equipment on unstable ground. • Run articulated equipment up and down slopes – not at an angle.
	d. Contact with Overhead Utilities	d. Contact with Overhead Utilities • If equipment is being operated or loaded in an area with overhead utilities, a spotter must be used.
	e. Fall into Excavation	e. Fall into Excavation • Install open trench warning devices/barricades.
	f. Caught In/Between	f. Caught In/Between • Do not allow personnel between a moving object and a stationary object. • Ensure all personnel within loading areas are accounted for and out of the way.
	g. Vehicular Traffic	g. Vehicular Traffic • Employees will need to pay attention to operations around and adjacent to their work and continually evaluate the need for traffic control measures. • Establish one-way (if possible) traffic routes for loaded trucks, so that they can keep the same path. • Traffic control patterns may be modified based on changed conditions (as observed) due to weather or due to modified operations at the site.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Loading Trucks for T&D**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	h. Spread of PCB Contaminated Media Off-site	i. Spread of PCB Contaminated Media Off-site • Once loaded, trucks will be processed through a decontamination pad where an automated spray will be used to remove loose material from the wheels. • As necessary, a power washer will be used to wash the exterior of the loaded trucks. • Lined trucks and secure covers will be used to minimize the potential for loss of contaminated sediment is spilled on public roads. • All trucks will be inspected prior to leaving the site to ensure no gross contamination on the trucks. • Once the trucks have left the site, the hauling company is responsible for responding to and cleaning up any material released during transportation to the disposal facility. Prior to selecting waste hauling vendors, TtEC will require each vendor to provide information about their emergency response plan for spill cleanup. For haulers transporting DOT-regulated shipments of PCB-contaminated sediments or debris (i.e., loads containing equal to or more than 1 pound of PCBs), TtEC shall require the transporters to confirm their company has prepared a DOT Hazardous Materials Security Plan.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment 2. Appropriate PPE 3. Portable Eyewash 4. First Aid Kits	1. Inspect all heavy equipment prior to use. 2. Inspect all PPE prior to use. 3. Inspect portable eye washes and first aid kits weekly.	1. All site personnel will read and comply with this HASP. 2. All site personnel will receive site specific training. 3. Qualified operators will be used for heavy equipment operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Wastewater Treatment Plant Operations**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. System Start-Up	a. Back Injuries	a. Back Injuries • Reference General Site Hazards. • Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	b. Slips/Trips/Falls	b. Slips/Trips/Falls • Reference General Site Hazards. • Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	c. Spills	c. Spills • Reference General Site Hazards. • Secondary containment will be used during system startup to prevent spills of contaminated sediments onto ground surface.
	d. Dropped Objects	d. Dropped Objects • Reference General Site Hazards. • Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	e. Sharp Objects/Punctures	e. Sharp Objects/Punctures • Reference General Site Hazards. • Use hand tools properly and wear appropriate protective equipment; cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	f. Hand and Power Tools	f. Hand and Power Tools • Reference General Site Hazards. • Remove broken or damaged tools from service; use the tool for its intended purpose; and use in accordance with manufacturers instructions.
	g. Eye Injuries	g. Eye Injuries • Reference General Site Hazards. • Safety glasses meeting ANSI Standard Z87 will be worn.
	h. Chemical Exposure	h. Chemical Exposure • Appropriate protective clothing will be worn; skin will be rinsed with water if contact with hazardous material occurs; a portable eye wash station will be located by work area; conduct hazard communication training for decontamination and sample preservation chemicals.

	i. Electrocution	i. Electrocution • Do not use unit near any power lines or where water can come in contact with electrical power. • Reference EHS Program EHS 3-10 for electrical considerations. • All electrical wiring and hookups will be completed by a licensed electrician. Lockout/Tagout will be utilized to make sure lines are not hot prior to beginning work on them and making connections. Reference EHS Program EHS 6-4 for Lockout/Tagout procedures. • The ESS is responsible for providing the training required in the procedure EHS-6-4 to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. • The ESS shall also implement lockout/tagout procedures as required.
2. Wastewater Treatment Plant Operations	a. Exposure to Site Contaminants (PCBs)	a. Exposure to Site Contaminants (PCBs) • Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep “clean” during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE described in Table 5-1 to minimize if not prevent exposure. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner.
	b. Lockout/Tagout (Release of Hazardous Energy)	b. Lockout/Tagout (Release of Hazardous Energy) • Reference EHS Program EHS 6-4. • Reference 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout). • The ESS is responsible for providing the training required in the procedure EHS Program EHS 6-4 to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. • The ESS shall also implement lockout/tagout procedures as required.
	c. Lockout/Tagout (Tags without Locks)	c. Lockout/Tagout (Tags without Locks) • The use of tags without locks is prohibited, except in those cases where it is physically impossible to attach a locking device to an isolation point. In this case, follow steps in EHS Program EHS 6-4. • Employees shall be warned not to tamper with the tag or isolation point.

	d. Lockout/Tagout (Failure to Clear Locks)	d. Lockout/Tagout (Failure to Clear Locks) • Reference EHS Program EHS 6-4. • Supervisor will attempt to contact person who applied lock and resolve issue. • If person cannot be contacted, supervisor will investigate the situation and determine that removal of the lock will not create a hazard in the work zone. • The supervisor will then verify that the work zone is clear, and blocking devices have been removed, and the system has been restored to the normal configuration. • The supervisor will then cut the lock off and restore energy to the system. • A written incident and investigation report per EHS Program EHS 1-7, Incident Reporting and Investigating, shall be prepared by the supervisor stating the reason for cutting the lock, why the lock was not removed, and the procedure used to ensure the safety of personnel in the area. • The individual whose lock was cut off must be notified ASAP.
	e. Fire and Explosion	e. Fire • Reference General Site Hazards and Section 10.9. • Equip all heavy equipment with 20A:B:C-type fire extinguishers. • Area(s) for personnel smoking will be designated. • Flammable liquids and gases will be stored away from oxidizers. • No hot work without properly executed work permit
	f. Spills	f. Spills • Reference General Site Hazards, Section 10.13, and the Contingency Plan. • Secondary Containment will be provided in storage areas. • Spill and absorbent materials will be readily available.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
Activity: Wastewater Treatment Plant Operations

EQUIPMENT USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
1. Heavy Equipment 2. Hand and Power Tools 3. Appropriate PPE 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Hand and power tools will be inspected to ensure they are in good condition prior to each day's use. 2. PPE will be inspected before and after each use. 3. Periodic inspections pursuant to EHS Program EHS 3-3, Inspections, shall be completed during the monthly inspections by the ESS, PESM or other qualified personnel to ensure that the lockout tagout program is being effectively implemented. As a minimum the following shall be done: • Existing lockouts will be reviewed for effectiveness; • Permits for each existing lockouts shall be reviewed for adequacy; • Incident reports and past permits shall be reviewed to determine if deficiencies in the program exist; • Corrections to the system will be made as warranted; and • Results will be logged in the health and safety logbook. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and test GFCIs weekly.	1. Authorized employees shall receive training in the following prior to being allowed to use lockout/tagout procedures: • Recognition of hazardous energy sources; • Types and magnitudes of energies available at the site; • Methods and means needed for energy isolation and control; and • The requirements of this procedure and 29 CFR 1910.147. 2. Affected employees shall be instructed in the following: • Purpose of the lockout tagout program; • Use and requirements of this procedure and 29 CFR 1910.147; • Prohibitions of restarting or tampering with equipment that has been locked out; and • Prohibitions of tampering with locks and tags installed on equipment. 3. All site personnel will read and comply with this HASP. 4. All site personnel will receive site specific training. 5. Only qualified electricians will install electrical wiring and hookups. 6. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 7. Instruct personnel of proper use of fire extinguishers. 8. Personnel will be trained on the proper use of hand and power tools, including the pipe welding machine. 9. Training on lockout/tagout procedures are listed in EHS Program EHS 6-4.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sampling (Sediment And Process Operations)**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
3. Sediment sampling from small boat.	a. Working around water and in small boat. Falling into water, other boat traffic interactions (large wakes)	• Coast Guard approved flotation equipment, PFD's Type I, II, or selected Type III (i.e., Mustang Survival work suits and jackets, at discretion of ESS) will be worn when in boat or on the dock, in areas without adequate safety rails (<3-ft). • Survey vessels will display day-shapes to communicate to boat traffic that there is gear in the water (i.e., towfish or other instrumentation), and that the survey vessel has limited maneuverability. • Survey vessels will monitor VHF Channel 16. • Survey vessels will avoid operating in shipping channels as much as is practicable, and will be aware of the possibility of large ship wakes. • Set of oars and emergency horn shall be available in the boat prior to operation. • No standing or leaning over edge in small boats. • Comply with Coast Guard right-of-way rules. • Use horn to signal or warn other boats as appropriate. • Suspend work during bad weather or poor visibility. • Have experienced boat crews operate vessel. • Ensure boat manufacturer's recommendations for operation and load limits are followed. • At least one U.S. Coast Guard approved lifesling attached to approximately 100 feet of rope will be located on the boat. The hydrographic and geophysical crew vehicle will also have a rescue throw rope.
	b. Exposure to Site Contaminants (PCBs)	• Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep "clean" during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE described in Table 5-1 to minimize if not prevent exposure. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sampling (Sediment And Process Operations)		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	c. Adverse weather. High winds and rain and/or snow storms, high water flow in river. Struck by lightning	• If adverse weather is affecting crew's safety, work will be halted until conditions improve (i.e., wind, snow, rain). • Area is prone to windstorms during the spring, when this work is anticipated to occur. • If road conditions are too bad to access the work site, the work will be postponed until conditions improve. • In the case of extreme weather, vessel operations may be delayed. • At no time will personnel and equipment enter the river, if the flow rate exceeds 1,500 cubic feet per second. • Follow the 10-second rule (time between lightning strike and thunder) for shutdown of operations. Immediately suspend operations when lightning is in the immediate vicinity and seek shelter.

	d. Fueling boat	• Check the entire fuel system for leaks. Tighten connections frequently. Engine vibration can loosen them.
		• Turn off all engines and electrical equipment; shut off all fuel valves; and close all windows, doors, and openings.
		• Try to fuel in daylight. If light is required, use a flashlight or a light that is spark-proof.
		• Never smoke or strike a match while fueling or when near a fueling dock.
		• When filling a tank or gas can, follow these guidelines:
		  o Remove portable tanks from the vessel.
		  o Touch the fuel pipe or tank with the spout to prevent buildup of static electricity.
		  o Never fill a tank to the brim. Leave room for gas to expand.
		  o After fueling, put the fill cap on tightly to prevent vapors from escaping.
		  o Immediately wipe up any spilled gas.
		  o Air out the rag after using it. Never throw it in the vessel or the water.
		  o Store gas onboard in a safety-approved storage tank, away from the engine in an area of good ventilation.
		• Refueling should be performed on land as often as possible (i.e., at auto gas station, not via gas cans).
		• Funnels will be used when filling gas tanks from portable gas cans.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sampling (Sediment And Process Operations)		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Sorbent pads will be placed under and/or around item being fueled to capture any spills. • To the extent possible fuel all systems before launching the boat so that on water refueling is kept to a minimum.
	e. Chemicals brought on site	• Reference EHS Program EHS 4-2. • Identify all chemical hazards and receive training (Haz Com-Material Safety Data Sheets/MSDSs) regarding safe handling and storage of chemicals. • The ESS maintains copies of all MSDS for chemicals that are on site. • A portable 15-minute eye wash station will be located by the work area.
	f. Boating activities	• Boat Captains shall be USCG licensed. • Prior to placing boats, survey equipment, and personnel on the river, the river's flow rate will be assessed. At no time will personnel and equipment enter the river if the flow rate exceeds 1,500 cubic feet per second (as measured by the nearly USGS flow monitoring station). • Debris may present a significant hazard to personnel during survey activities. During cold weather (<40° F), a blanket shall be on the survey vessel and the vessel will be kept warm in the event that personnel get wet. • Due to the potential for limited rescue capability and other emergency impedances, activities on the river will be limited to one half hour before sunrise to one half hour after sunset. Personnel should allow sufficient time to shut down operations at the end of each day to ensure personnel are off the river by the specified time. • Survey boats shall have adequate lights (navigation and "head lights"/spot lights for safe operation during dawn/dusk and after dark if necessary. • Boat launches with adequate lighting will be used to the greatest extent possible

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sampling (Sediment And Process Operations)		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• If working in the vicinity of the De Pere Dam, additional precautions will be taken to ensure safe boat operations are conducted. This will include use of one or several of the following safety precautions: inclusion of an auxiliary motor (i.e, "kicker" motor) on the survey vessel, use of a tagline(s) to the river bank, use of one or several points of anchor, and installation of a cable which would prevent the survey boat and/or crew from passing over the dam.
	g. Man Overboard/Drowning	• All personnel shall wear United States Coast Guard (USCG) approved Type III Life Preservers at all times while on the water. • As per OSHA requirements (29 CFR 1926.501[b][1]) and EM 385-1-1 Section 19.A.07, guardrails are required on working platforms for barges that are 6 feet or more above the water. • All means of barge access shall be properly secured, guarded, and maintained free of slipping and tripping hazards. • A Coast Guard approved Type IV flotation device (life ring) will be maintained on each barge. • Water craft will not be used without shore support personnel with rescue skiff available onshore. • All persons on board will remain seated/standing securely whenever a water craft is moving. • Maximum weight capacity for water craft will not be exceeded. • Barges will be equipped with perimeter guardrails. • Water craft will be operated with a minimum of two personnel on board. • Water craft will not be used without shore support personnel. • A line extended from the water craft to the shore will always be available, so that shore personnel are able to retrieve water craft remotely in the event of an emergency. • Personnel on board water craft must be in constant radio contact with shore personnel. • Non slip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways. • All barge deck obstructions will be removed if possible; if not possible to remove them, they shall be clearly marked with yellow paint.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sampling (Sediment And Process Operations)**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	h. Sinking Boat	• All water craft not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS). • A pre-use inspection of any rented vessel shall be completed, including a video documentation of pre-use conditions. • The load ratings of barges and tender boats will be strictly adhered to; overloading of vessels is prohibited. • Tide tables will be consulted and times of high tide, when it is most safe to move barges, will be identified. • In the event a boat becomes grounded at times of low tide, no attempt will be made to move the barge until enough water returns to refloat it.
	i. Failure to have proper medical supplies, emergency supplies, and PFDs during emergency could result in inadequate treatment of personnel or potentially increase injuries.	• Ensure that PFDs are available for each person and in good usable condition. • First-aid kit and supplies are available. • Oars, emergency horn, life ring, fire extinguisher are available. (Fire extinguisher shall be at least a 10lb. ABC type) • Cell phone is available and working for emergency notifications.
	j. Back Injuries and Strains	• Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc). • Mechanical devices should be used to reduce manual handling of materials. Team lifting should be utilized if mechanical devices are not available. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	k. Communication	• Field personnel will use cellular telephones with adequate coverage to communicate with individuals off site. • Field personnel will use two-way radios with adequate coverage to communicate with the Coast Guard offsite.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Sampling (Sediment And Process Operations)**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
4. Sampling during Process Operations	a. Exposure to Site Contaminants (PCBs)	a. Exposure to Site Contaminants (PCBs) • Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep "clean" during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE described in Table 5-1 to minimize if not prevent exposure. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner.
	b. Eye Injuries	b. Eye Injuries • Safety glasses or goggles meeting ANSI Standard Z87 will be worn for all field operations where eye hazards exist. • A portable eye wash station will be located adjacent to work activities.
	c. Lockout/Tagout (Release of Hazardous Energy)	c. Lockout/Tagout (Release of Hazardous Energy) • Reference EHS Program EHS 6-4. • Reference 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout). • The ESS is responsible for providing the training required in the procedure EHS Program EHS 6-4 to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. • The ESS shall also implement lockout/tagout procedures as required.
	d. Lockout/Tagout (Tags without Locks)	d. Lockout/Tagout (Tags without Locks) • The use of tags without locks is prohibited, except in those cases where it is physically impossible to attach a locking device to an isolation point. In this case, follow steps in EHS Program EHS 6-4. • Employees shall be warned not to tamper with the tag or isolation point.
	e. Lockout/Tagout (Failure to Clear Locks)	e. Lockout/Tagout (Failure to Clear Locks) • Reference EHS Program EHS 6-4. • Supervisor will attempt to contact person who applied lock and resolve issue. • If person cannot be contacted, supervisor will investigate the situation and determine that removal of the lock will not create a hazard in the work zone.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Sampling (Sediment And Process Operations)		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• The supervisor will then verify that the work zone is clear, and blocking devices have been removed and the system has been restored to the normal configuration. • The supervisor will then cut the lock off and restore energy to the system. • A written incident and investigation report per EHS Program EHS 1-7, Incident Reporting and Investigating, shall be prepared by the supervisor stating the reason for cutting the lock, why the lock was not removed, and the procedure used to ensure the safety of personnel in the area. • The individual whose lock was cut off must be notified ASAP.
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Boats 2. Appropriate PPE 3. Hand and Power Tools 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Inspect all boats daily. 2. Inspect all hand and power tools prior to use. 3. Inspect all PPE prior to use. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and Test GFCIs weekly.	1. All site personnel will read and comply with this SHSP. 2. All site personnel will receive site specific training. 3. Qualified operators will be used for heavy equipment and boat operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 5. Instruct personnel of proper use of fire extinguishers. 6. Personnel will be trained on the proper use of hand and power tools, including the steam cleaner.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
1. Laboratory Analysis	a. Back Injuries and Strains	a. Back Injuries and Strains • Procedures in Section 3.3.14 will be followed. • Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc). • Mechanical devices should be used to reduce manual handling of materials. Team lifting should be utilized if mechanical devices are not available. • An individual will not lift loads greater than 50 pounds. **This amount may be lowered by ESS's judgment due to individual's stature and lifting ability.**
	b. Electrical Hazards	b. Electrical Hazards • Extension cords are allowed for temporary use provided the weight of the cord is adequate for the load applied. Check to be sure the extension cord is three pronged and that no cords are frayed. • Multiplug devices are allowed provided they are UL listed with a built-in circuit breaker and used in accordance with their intended use. • Fuses must be appropriately rated for each appliance. • Electrical equipment must not be used in the vicinity of flammable or explosive gases. • Electrical equipment must not be used where it may get wet. Equipment that has been wet must never be switched on until the equipment has been tested. • Ensure adequate electrical service is provided in the laboratory to minimize the need for permanent use of extension cords. • Circuit breakers that service laboratory equipment should be identified as such. • Outlets located near sinks or other sources of water should be on a ground fault circuit or otherwise ground fault protected.
	c. Exposure to Site Contaminants (PCBs) and fumes during heating/processing samples	c. Exposure to Site Contaminants (PCBs) • Personnel will take care to minimize contact with contaminated media. This involves a conscientious effort to keep "clean" during site activities. • When the potential for contact with contaminated media exists, personnel will wear appropriate PPE to minimize if not prevent exposure. Standard PPE requirements will be identified and posted for additional chemicals used to process the samples. All laboratory analysis personnel will be trained in the appropriate PPE requirements for their task.

Project: Lower Fox River OUs 2 through 5, Volume II Activities Activity: Laboratory Analysis		Location: Brown, Outagamie, and Winnebago Counties, Wisconsin
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
		• Use proper pipetting or transfer techniques for removal of sample to new vial or container. • Personnel will wash hands and face after leaving the contamination reduction zone with soap and water or waterless hand cleaner. • Whenever heat or chemicals are added to the sample, this will be done under a fume hood to prevent exposure via inhalation. Chemicals that must be used under the hood will be identified and all laboratory personnel will be informed of this requirement. • If operations in the lab involve chemicals which present an inhalation exposure hazard, a fume hood must be available for use. • Fume hood work should be placed approximately 6 inches into the hood, i.e., not right at the front edge. Fume hoods should not be strictly used for storage of chemicals. • Laboratory refrigerators and freezers are not allowed to be used for the storage of food or drink. Ice machines and microwave ovens are not to be used for human use. • Wastes should be removed from the laboratory in a timely manner. • All wastes must be labeled with a hazardous waste label and stored according to the hazards associated with the waste. Abbreviations or trade names must not be used to identify contents. Common chemical or IUPAC nomenclature must be used. Label every constituent added to the container, especially with heavy metals in the parts per million range. • Waste containers must be capped at all times unless material is being added. • Waste containers must be compatible with contents. For example, do not use metal containers to store acids or glass containers for hydrofluoric acid mixtures. • All waste must be stored in a secondary container. • Do not fill liquid waste containers over 90% full.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	d. Slips/Trips/Falls	d. Slips/Trips/Falls • Visually inspect work areas and mark, barricade, or eliminate slip, trip and fall hazards if feasible. • Maintain work areas safe and orderly. • Cables must not be run across the floor in such a way as to cause a tripping hazard or to be susceptible to damage from passing traffic. If it is necessary to run cables across walkways, they must be covered with cable protectors. • Tools and supplies/equipment will be properly stored. • Housekeeping must be maintained so that the aisles are clear to allow for emergency egress. Storage is not permitted in exit ways (hallways). • Floors should be in good repair i.e., no tripping hazards caused by cracks, holes, protrusions, missing tiles, etc. • Excess or surplus equipment should be disposed of or relocated to a storage location. When transferring equipment for disposal, be sure hazardous materials are removed prior to transfer. • If operations cause floors to be wet or slippery, mats to help prevent slippage should be used.
	e. Eye Injuries	e. Eye Injuries • Safety glasses with side shields or goggles meeting ANSI Standard Z87 will be worn for all laboratory operations where eye hazards exist. • A 15 minute eye wash station and personnel shower will be located in the laboratory. These should be inspected every 6 months. • Shields should be used when conducting experiments that could explode.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	f. Gas Cylinders Hazards	f. Gas Cylinders Hazards • Leakage or escape of flammable gases can produce a serious explosive hazard in the laboratory. Gas cylinders, control valves, and pressure regulators and gauges should all be used carefully and according to the manufacturer's recommendations. Broken or damaged equipment should not be used but must be replaced. Only equipment that is appropriate i.e., specially designed for use with toxic, explosive, or corrosive gases, may be used. • Gases can be reactive and highly toxic – leaking gas can react with its surroundings (i.e., equipment, chemicals, skin). There should be regular checks for leaks especially in joints pressure. Prior to introducing a flammable gas into a reaction vessel, the equipment must be purged of oxygen by evacuation or by flushing with inert gas. Naked flames or other sources of ignition must be rigorously excluded from the vicinity. • Inert gases such as nitrogen, carbon dioxide, and argon can cause asphyxiation if released in quantity. Exhaust lines must be properly vented, e.g., to a fume hood. • Containers that receive the gases can explode if not rated to accept the pressure. Receiving containers must be capable of accepting the gas at the required operating pressure. • Gas cylinders should not be stored in laboratories unless they are being used. • Caps should be kept on the cylinders when not in use. • Cylinders need to be individually restrained by chains at approximately two thirds height from the floor. • Regulators should be replaced or recertified on a regular basis. Regulator types are matched to the type of cylinder and gas being used. Contact the gas supplier with questions. • Gas cylinders must be labeled with the contents. Unknown gas cylinders are very hazardous and expensive to dispose of. • Gas supply lines need to be compatible with the gas being used. The suppliers can provide information about proper line material. The lines also must be rated to handle the pressures used. • Some gas companies will accept their cylinders back empty or partially full. Companies such as this should be used to minimize chemical waste.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	g. Sharp Objects/Punctures	g. Sharp Objects/Punctures • Leather gloves (minimum) or cut resistant work gloves will be worn depending on the material working with. • All hand and power tools will be maintained in a safe condition. When possible, blunt all sharp objects. • First aid kits will be available by the work area. • All belts, blades, or other moving parts on equipment should be guarded or otherwise protected. • Check for sharp edges or points sticking out on equipment, furniture, etc., that could cause struck by hazards.
	h. Spills	h. Spills • Reference Section 10.13 and the Contingency Plan. • Secondary containment will be provided in storage areas. • Spill and absorbent materials will be readily available. • Absorbent materials will be used during transfer of fuel/oil. • Contain, control, and clean up the spill and affected area (soil, water). Manage and dispose of spill material appropriately. • All waste materials generated will be contained in a seal-able container appropriate for the size of the spill. • Whenever possible chemicals should not be stored above eye level and liquids should be stored in secondary containers. • Whenever possible, all shelves used to store liquid chemicals should have a lip.
	i. Fire Hazards	i. Fire Hazards • Fire extinguishers should be located nearby and visible from the hallway. They should be inspected monthly to ensure each is charged and not damaged. • If there are smoke detectors or sprinklers in the lab, make sure that nothing is stored near them that would interfere with their intended operation. • Flammables should be stored in flammable storage cabinets wherever possible and always kept away from open flames. • Ensure combustibles are not stored near hot surfaces or equipment.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
	j. Hand and Power Tools	j. Hand and Power Tools • Reference Section 3.3.12. • The proper tools will be used for each task. • All tools will be inspected before each use. Damaged tools will be removed from service and tagged (splintered wood bases, missing guards, "mushroom" head). • Tools will be used in accordance with manufacturer's instructions. • Modifications to tools are prohibited unless approved by the ESS. • GFCIs will be used with all electrical power tools.
	k. Chemicals brought on site	k. Chemicals brought onsite • Reference EHS Program EHS 4-2. • Identify all chemical hazards, PPE requirements, plus special safety procedures, and receive training (Haz Com-Material Safety Data Sheets/MSDSs) regarding safe handling and storage of chemicals. • Store chemicals by hazard class. Remove chemicals in accordance with hazardous waste requirements prior to their expiration date. Pay close attention to special storage requirements such as refrigeration, dry atmospheres, etc. • Flammable/combustibles may not be stored in refrigerators or freezers that are not lab safe or explosion proof. Regular refrigerators and freezers should bear the caution statement prohibiting storage of these materials. • All chemical containers must be labeled and the labels must be securely affixed to the container. Reaction flasks must be labeled as well. Abbreviations or trade names should not be used to label containers. Common chemical or IUPAC nomenclature should be used. • Quantities of chemicals kept in the lab should not be excessive. Outdated chemicals should be disposed of. • The ESS maintains copies of all MSDS for chemicals that are onsite. • A 15-minute eye wash station and personnel shower will be located by the laboratory area. These should be inspected every 6 months.

Project: Lower Fox River OUs 2 through 5, Volume II Activities **Activity: Laboratory Analysis**		**Location: Brown, Outagamie, and Winnebago Counties, Wisconsin**
MAJOR STEPS	**POTENTIAL HAZARDS**	**PROTECTIVE MEASURES/CONTROLS**
EQUIPMENT USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
1. Heavy Equipment 2. Appropriate PPE 3. Hand and Power Tools 4. Portable Eyewash 5. First Aid Kits 6. 20A:B:C Fire Extinguisher 7. GFCI	1. Inspect all heavy equipment prior to use. 2. Inspect all hand and power tools prior to use. 3. Inspect all PPE prior to use. 4. Inspect portable eye washes and first aid kits weekly. 5. Inspect fire extinguishers weekly. 6. Check and test GFCIs weekly.	1. All site personnel will read and comply with this SHSP. 2. All site personnel will receive site specific training. 3. Qualified operators will be used for heavy equipment and boat operation. 4. At least two individuals on-site will have current CPR, First Aid, and Bloodborne Pathogen training. 5. Instruct personnel of proper use of fire extinguishers. 6. Personnel will be trained on the proper use of hand and power tools, including the steam cleaner.

APPENDIX D

HEAVY EQUIPMENT INSPECTION FORMS

TETRA TECH EC, INC

EQUIPMENT TRANSFER/RELEASE FORM

TtEC Asset #: _____ Meter/Mileage: _____

Description: _____

Year/Make/Model: _____ S/N: _____

Project Releasing Equipment: _____

Date Released from Project: _____ Released to: _____

Manuals shipped with equipment:

Transportation Charge No.: _____ G/L _____

GENERAL CONDITION:

Check appropriate boxes: _____ No repairs needed _____ Repairs needed

Describe: _____

Check appropriate column and describe correction needed.

	Condition Good	Correction Needed (description)
Steering System		
Air System		
Hydraulic System		
Brake System		
Drive Sys. (engine/trans/diff)		
Exhaust System		
Undercarriage/tires		
Glass		
Instrumentation		
Controls		
Fluid Levels/Leaks		
Service Sticker Update		
Body (doors/panels/tinwork)		
Safety System (b/u alarm, extinguisher, s. belts, mirrors)		
Cab Systems (heat, a/c, wipers, horn)		

I certify that the above listed equipment is in good working order, all defects and damages have been noted above, and has been properly maintained, and deconned/cleaned prior to demobilization.

Signature Date Print Name Title

Receiving Project concurrence of conditions.

Signature	Date	Print Name	Title

If Receiving Project does not concur with the above report, note findings, sign and forward to the Equipment Yard.

TETRA TECH EC, INC.

Equipment/Vehicle Inspection Report

Date: _____ Unit Number: _____ Description: _____

Miles/ Hours: _____ MFG: _____

Unit to be taken from: _____ to: _____

	Good	Satisfactory	Repair Req.	N/A		Good	Satisfactory	Repair Req.	N/A
1. Tires	☐	☐	☐	☐	16. Interior	☐	☐	☐	☐
2. Brakes	☐	☐	☐	☐	17. Glass	☐	☐	☐	☐
3. Steering	☐	☐	☐	☐	18. Wipers/Review Mirrors	☐	☐	☐	☐
4. Undercarriage	☐	☐	☐	☐	19. Heater	☐	☐	☐	☐
5. Suspension	☐	☐	☐	☐	20. Safety Equipment/Belts	☐	☐	☐	☐
6. Engine	☐	☐	☐	☐	21. Lights/Turn Signals	☐	☐	☐	☐
7. Drive Train	☐	☐	☐	☐	22. Mounted Equipment	☐	☐	☐	☐
8. Fuel System	☐	☐	☐	☐	23. Mounted Attachments	☐	☐	☐	☐
9. Cooling System	☐	☐	☐	☐	24. Blade/Bucket	☐	☐	☐	☐
10. Electrical System	☐	☐	☐	☐	25. Boom	☐	☐	☐	☐
11. Exhaust System	☐	☐	☐	☐	26. Outriggers	☐	☐	☐	☐
12. Hydraulic System	☐	☐	☐	☐	27. Fire Ext./First Aid Kit	☐	☐	☐	☐
13. Transmission	☐	☐	☐	☐	28. Horn/Backup Alarm	☐	☐	☐	☐
14. Clutch	☐	☐	☐	☐	29. _____	☐	☐	☐	☐
15. Body	☐	☐	☐	☐	30. _____	☐	☐	☐	☐

Note percentage of tread usefulness

Comments: _____

_____

_____

_____

_____

_____

_____

_____

Inspected By: _____

DISTRIBUTION: (1) Sent with equipment (2) Tetra Tech FW, Inc. Equipment Department (3) Receiving Copy (4) Originator's Copy

EQUIPMENT TRANSFER REPORT MUST ACCOMPANY THIS FORM

TETRA TECH EC, INC.

DAILY EQUIPMENT INSPECTION

EQUIP. NO. _____ TYPE_____

MANUFACTURER_____ MODEL_____

PROJECT_____ DATE _____

ENGINE HRS/MILEAGE _____ SHIFT_____

Check appropriate column and describe correction needed.

	Condition Good	Correction Needed
Steering		
Service Brakes		
Emergency Brakes		
Retarder		
Transmission		
Controls		
Hydraulic Leaks		
Exhaust System		
Warning Gauges		
Windshield		
Lights		
Mirrors		
Seat and Seat Belts		
Tires/Tread		
Regular Horn		
Back-up Alarm		
Steps, Hand-holds		
Fire Extinguisher		
Rollover Cage		
Oil Level		
Other		

Remarks: _____

_____

_____

Signed _____
Operator

Repairs or adjustments completed:
Date: _____ Signed _____
Equipment Supervisor/Mechanic

APPENDIX E

HANDBOOK OF WISCONSIN BOATING LAWS AND RESPONSIBILITIES

the HANDBOOK!

OF WISCONSIN BOATING LAWS AND RESPONSIBILITIES

Approved by

WISCONSIN DEPT. OF NATURAL RESOURCES

2008 Edition

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BOAT WISCONSIN

A Course on Responsible Boating

Boater education certification is required by law for anyone born on or after 01/01/1989 to operate a motorboat on Wisconsin's waterways. Even if it's not required for you, becoming certified may save you money on boat insurance. You have two ways to be certified.

1. Over the Internet …

Learn what you need to be a safe boat operator online! The complete course with exciting visuals awaits you on the Internet. Interactive graphics help you learn and retain information on how to boat safely in Wisconsin. Successfully complete the online test and you will receive a Wisconsin Department of Natural Resources boater education certificate by mail.

Start today at www.boat-ed.com/wi

2. In a classroom …

Share the learning experience with other interested students and a qualified instructor. Wisconsin Department of Natural Resources can help you find a classroom course in your area.

Call 888-936-7463 for information or visit dnr.wi.gov

Safer Boating Through Partnerships

UNITED STATES POWER SQUADRONS

Be a Smart Boater ... Increase your Boating Skills! DNR–certified classes offered throughout the state. For more information, call **1-888-FOR-USPS** or visit our website at **www.USPS.org**.

UNITED STATES COAST GUARD AUXILIARY

Helping Wisconsin Boaters ... by providing boating courses, courtesy vessel examinations, and surface and air operations. For more information, call the CG Info line at **1-800-368-5647** or visit our website at **www.cgaux.org**.

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the HANDBOOK! of Wisconsin Boating Laws and Responsibilities

This handbook includes a summary of Wisconsin boating laws. For a complete set of what is legal when boating in Wisconsin, see the Wisconsin Statutes and Regulations and federal laws.

- To stay up-to-date on Wisconsin boating laws:
  - Call the Wisconsin Department of Natural Resources at **1-888-936-7463**
  - Or visit our website at **dnr.wi.gov**
- For federal boating laws, visit the U.S. Coast Guard's website at **www.uscgboating.org**

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Table of Contents

It's the LAW!

Before Going Out
Registering Your Vessel 3
Other Facts About Titling and Registration. 4
Hull Identification Number 5
Who May Operate 6
Enforcement 7

Required Equipment
Personal Flotation Devices (PFDs) 8
Sound-Producing Devices 9
Fire Extinguishers 9
Navigation Lights 10
Boat Battery. 12
Ventilation Systems 12
Backfire Flame Arrestors 12
Mufflers and Noise Level Limits 12
Visual Distress Signals (VDSs) 13

On the Water
Unlawful Operation 14
Alcohol and Drugs 16
Obstructing Navigation. 16
Homeland Security Restrictions 17
Boating Accidents 17
Diving Activities 18
Discharge of Waste 19
Discharge of Trash. 20
Discharge of Oil and Other Hazardous Substances. 20
Aquatic Nuisance Species 21

Specifically for PWCs
Requirements Specific to PWCs 22

Specifically for Skiing
Requirements for Towing Skiers. 23

Boating BASICS

Before Going Out
Vessel Capacity 24
Trailering Your Vessel Safely . . .24

On the Water
Navigation Rules 25
Nighttime Navigation 26
Non-Lateral Markers. 28
Boating Emergencies. 29

Sunrise and Sunset–2008 31-32
Required Equipment Checklist 33

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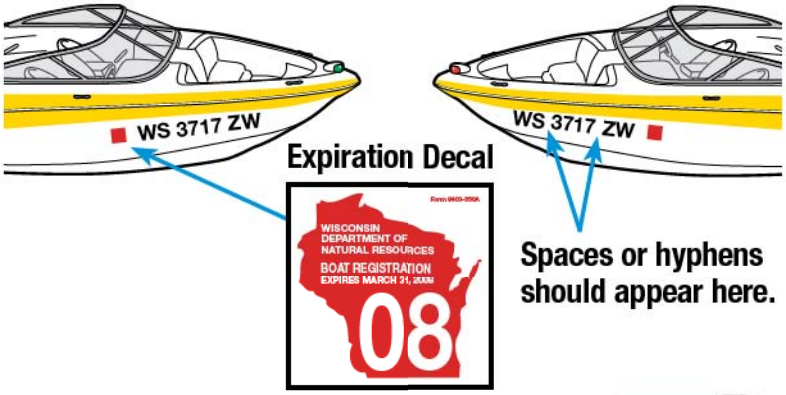
Before Going Out

It's the LAW!

All operators are required to obey laws that regulate your vessel's registration and operation.

Registering Your Vessel

- You must have a Wisconsin Certificate of Number (registration) and expiration decals to operate a recreational vessel legally. Exceptions to the requirement to register a recreational vessel include:
  - Sailboats 12 feet of length or less and not equipped with a motor and sailboards
  - Manually propelled vessels that are not equipped with a motor or sail
  - Vessels registered in another state and using Wisconsin waters for less than 60 consecutive days
- The Certificate of Number is obtained by submitting the proper application and fee to the Wisconsin Department of Natural Resources (DNR).
- *The Certificate of Number (registration card) must be on board and available for inspection by an enforcement officer whenever the vessel is operated.*
- If your vessel requires registration, it is illegal to operate it or allow others to operate your vessel unless it is registered and numbered properly.



For More Information on Registering ...

- Call Wisconsin DNR at **1-888-936-7463**
- Visit the Wisconsin DNR website at **dnr.wi.gov**

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Other Facts About Titling and Registration

- **Titling:** Only vessels 16 feet or more in length require a Certificate of Title.
- **Expiration:** Registration is valid for three years, beginning on April 1 and expiring on March 31 at the end of each three-year period. No vessel may be operated after March 31 without renewing the registration.
- **Duplicates:** If a Certificate of Number is lost or destroyed, the vessel owner must apply to the Department of Natural Resources (DNR) to replace it with a duplicate Certificate of Number.
- **Buying or Selling a Vessel:** Transfer of ownership of a vessel terminates the Certificate of Number and title.
  - The "buyer" must apply for a new registration and/or title on forms furnished by the DNR. The previous owner's Certificate of Number and title must accompany the application.
  - Upon receipt of the required fee and application, the DNR will issue a new Certificate of Number and/or title.
  - After applying, the "buyer" may operate the vessel if a copy of the application is carried on board.
  - It is unlawful to transfer the number designated by the DNR from one vessel to another.
- **Changes Requiring Notification:** The owner of a registered vessel must notify the DNR within 15 days of the occurrence of any of the following events.
  - The owner changes his or her address.
  - The owner transfers all or any part of his or her interest in the vessel.
  - The vessel is destroyed or abandoned.
- **Documented Vessels:** Larger recreational vessels owned by U.S. citizens may (at the option of the owner) be documented by the U.S. Coast Guard. Call the USCG at **1-800-799-8362** for more information. Documented vessels also must be registered in Wisconsin.
  - The expiration decals must be displayed on either side of the vessel's name on the transom, but it is not required to display the registration number.
  - If the expiration decals are not displayed beside the vessel's name, then the registration number and decals must be displayed as they are for undocumented vessels.

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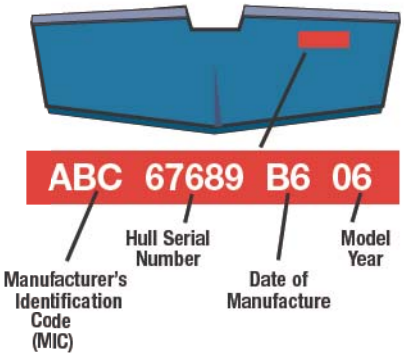
Hull Identification Number

- The Hull Identification Number (HIN) is a unique, 12-digit number assigned by the manufacturer to vessels built after 1972.
- Hull Identification Numbers:
  - Distinguish one vessel from another.
  - Are engraved in the fiberglass or on a metal plate permanently attached to the transom.



- You should write down your HIN and put it in a place separate from your vessel in case warranty problems arise or your vessel is stolen.
- If a vessel has no HIN, or if the manufacturer's HIN has been removed, obliterated, or altered, the condition must be noted in the application for Certificate of Title and the DNR will assign a HIN to the vessel.

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Who May Operate

- It is illegal for a parent or guardian to allow a child to operate in violation of the requirements below.
- Individuals who are required to complete a boater safety course before operating a vessel must carry the course certificate on board.

Motorboats (Other Than a Personal Watercraft)

- **A person under the age of 10** may not operate a motorboat.
- **A person 10 or 11 years old** may operate a motorboat *only if* accompanied by a parent, guardian, or a person at least 18 years old who is designated by the parent or guardian.
- **A person born on or after January 1, 1989 *and* …**
  - **12-15 years old** may operate a motorboat *only if*:
    - Accompanied by a parent, guardian, or a person at least 18 years old who is designated by the parent or guardian ***or* …**
    - He or she has completed a boating safety course that is accepted by the Wisconsin DNR.
  - **16 years old or older** may operate a motorboat *only if* he or she has completed a boating safety course that is accepted by the Wisconsin DNR.

Personal Watercraft (PWC)

- **A person under the age of 12** may not operate a PWC.
- **A person born on or after January 1, 1989 *and* …**
  - **12-15 years old** may operate a PWC *only if* he or she has completed a boating safety course that is accepted by the Wisconsin DNR. (Parental supervision is not a substitute for a boating safety course certificate as with other motorboats.)
  - **16 years old or older** may operate a PWC *only if* he or she has completed a boating safety course that is accepted by the Wisconsin Department of Natural Resources.
- **A person under 16 years old** may not rent or lease a PWC.

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Local Regulations

Many local waterways in Wisconsin have specific equipment requirements, operational restrictions, and restrictions on certain activities in addition to those covered in this handbook. Be sure to check with the local boat patrol or municipality for additional regulations before you go boating.

Enforcement

Wisconsin conservation wardens, county sheriffs, and municipal police enforce the boating laws of Wisconsin. U.S. Coast Guard officers also patrol and have enforcement authority on federally controlled waters.

- Officers have the authority to stop and board your vessel in order to check for compliance with state and federal laws.
- It is illegal to refuse to follow the directive of a person with law enforcement authority.
  - A vessel operator who has received a visual or audible signal from a patrol boat must reduce speed to "slow, no wake" speed and give way to the patrol boat.
  - A vessel operator must stop when requested or signaled to do so by a law enforcement officer or a patrol boat.

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Required Equipment

When preparing to go out, the operator must check that the legally required equipment is on board.

Personal Flotation Devices (PFDs)

- All vessels must have at least one Type I, II, III, or V PFD (life jacket) for each person on board.
- In addition to the requirement for life jackets, one Type IV U.S. Coast Guard–approved PFD must be on board vessels 16 feet or longer (except canoes and kayaks) and immediately available.
- Federal law requires children under the age of 13 to *wear* a USCG–approved PFD while underway in an open vessel on federally controlled waters.
- Sailboarders and windsurfers are exempt from PFD requirements but are encouraged to wear a PFD.
- Every person on board a personal watercraft must *wear* a USCG–approved Type I, II, III, or V PFD.
- Besides being USCG–approved, all PFDs must be:
  - *In good and serviceable condition.*
  - *Readily accessible,* which means you are able to put the PFD on quickly in an emergency.
  - *Of the proper size for the intended wearer.* Sizing for PFDs is based on body weight and chest size.

TYPE I: Offshore Life Jackets
These vests are geared for rough or remote waters, provide the most buoyancy, and will turn most unconscious persons face up.

TYPE II: Near-Shore Vests
These vests are good for calm waters and may not turn some unconscious wearers face up.

TYPE III: Flotation Aids
These vests or full-sleeved jackets are good for calm waters and will not turn most unconscious persons face up.

TYPE IV: Throwable Devices
These cushions and ring buoys are designed to be thrown to someone in trouble and are not designed to be worn.

TYPE V: Special-Use Devices
To be acceptable, these PFDs must be worn whenever the vessel is underway.

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Sound-Producing Devices

In periods of reduced visibility or whenever a vessel operator needs to signal his or her intentions or position, a sound-producing device is essential.

- Although not required on state waters, sound-producing devices are required on federally controlled waters. The requirements are:
  - Vessels less than 65.6 feet in length, which includes PWCs, are required to carry on board a whistle or horn or some other means to make an efficient sound signal audible for at least one-half mile.
  - Vessels that are 65.6 feet or more in length are required to carry on board a whistle or horn, *and* a bell that are audible for at least one mile.
- No vessel may be equipped with a siren, except vessels used by law enforcement officers.

Fire Extinguishers

- All vessels are required to have a Type B fire extinguisher(s) on board if one or more of the following conditions exist:
  - Inboard/outboard or inboard engine
  - Closed compartments
  - Closed living spaces
  - Closed storage compartments in which flammable or combustible materials may be stored
  - Permanently installed fuel tanks
- Approved types of fire extinguishers are identified by the following marking on the label—"Marine Type USCG Approved"—followed by the type and size symbols and the approval number.

Fire Extinguisher Requirements

Classification type & size	Foam minimum gallons	Carbon Dioxide minimum pounds	Dry Chemical minimum pounds
B-I	1¼	4	2
B-II	2½	15	10

Length of Vessel	Without Fixed System	With Fixed System*
Less than 26 ft.	one B-I	None
26 ft. to less than 40 ft.	two B-I ***or*** one B-II	one B-I
40 ft. to less than 65 ft.	three B-I ***or*** one B-II and one B-I	two B-I ***or*** one B-II

** refers to a permanently installed fire extinguisher system*

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Navigation Lights

The required navigation lights must be displayed between sunset and sunrise and during periods of restricted visibility.

Power-Driven Vessels When Underway

If less than 65.6 feet long, these vessels must exhibit the lights as shown in illustration 1. Remember, power-driven vessels include sailboats operating under engine power. The required lights are:

- Red and green sidelights visible from a distance of at least two miles away—or if less than 39.4 feet long, at least one mile away—on a dark, clear night.
- An all-round white light or both a masthead light and a sternlight. These lights must be visible from a distance of at least two miles away on a dark, clear night. The all-round white light (or the masthead light) must be at least 3.3 feet higher than the side-lights.

Unpowered Vessels When Underway

Unpowered vessels are sailboats or vessels that are paddled, poled, or rowed.

- **If less than 65.6 feet long**, these vessels must exhibit the lights as shown in illustration 2. The required lights are:
  - Red and green sidelights visible from at least two miles away—or if less than 39.4 feet long, at least one mile away.
  - A sternlight visible from at least two miles away.
- **If less than 23.0 feet long**, these vessels should:
  - If practical, exhibit the same lights as required for unpowered vessels less than 65.6 feet in length.
  - If not practical, have on hand at least one lantern or flashlight shining a white light as in illustration 3.

All Vessels When Not Underway

All vessels are required to display a white light visible in all directions whenever they are moored or anchored outside a designated mooring area between sunset and sunrise.

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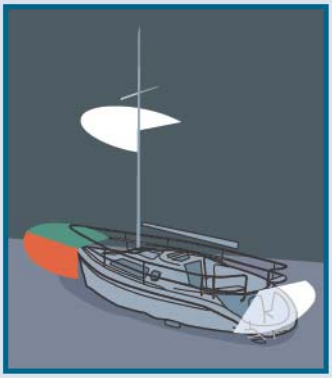
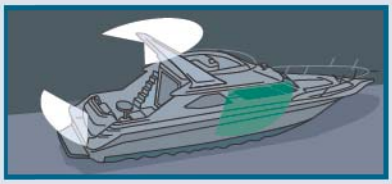
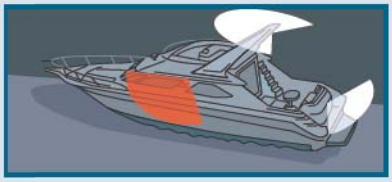
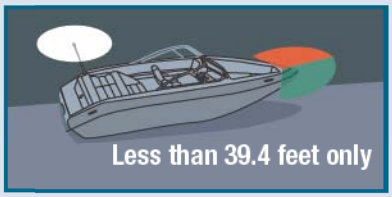
1. Power-Driven Vessels Less Than 65.6 Feet



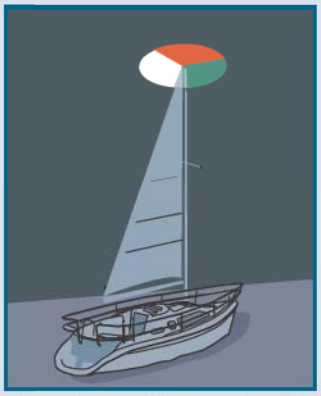




The masthead light and sternlight may be combined as an all-round white light on vessels less than 39.4 feet long.



2. Unpowered Vessels Less Than 65.6 Feet



An alternative to the sidelights and sternlight is a combination red, green, and white light, which must be exhibited near the top of the mast.

3. Unpowered Vessels Less Than 23.0 Feet

Vessel operators should never leave shore without a flashlight. Even if you plan to return before dark, unforeseen developments might delay your return past nightfall.

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Boat Battery

It is unlawful to operate a motorized vessel equipped with a storage battery unless the battery is secured against shifting. The battery must be equipped with nonconductive terminal shields to prevent accidental shorting. Both positive and negative terminals must be covered. A covered battery box with a strap is best.

Ventilation Systems

The purpose of ventilation systems is to avoid explosions by removing flammable gases.

- All gasoline-powered vessels, constructed in a way that would entrap fumes, must have at least two ventilation ducts fitted with cowls to remove the fumes.
- If your vessel is equipped with a power ventilation system, turn it on for at least four minutes after fueling and before starting your engine.
- If your vessel is not equipped with a power ventilation system (for example, a personal watercraft), open the engine compartment and sniff for gasoline fumes before starting the engine.

Backfire Flame Arrestors

Backfire flame arrestors are designed to prevent the ignition of gasoline vapors in case the engine backfires.

- All powerboats (except outboards) that are fueled with gasoline must have an approved backfire flame arrestor on each carburetor.
- Backfire flame arrestors must be:
  - In good and serviceable condition ***and …***
  - U.S. Coast Guard–approved (must comply with SAE J-1928 or UL 1111 standards).
- Periodically clean the flame arrestor and check for damage.

Mufflers and Noise Level Limits

- The exhaust of every internal combustion engine on any vessel must be effectively muffled. That is, the engine's exhaust must be muffled or suppressed at all times so as not to create excessive noise.
- It is unlawful to operate a vessel that exceeds a noise level of 86 dBA.

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Visual Distress Signals (VDSs)

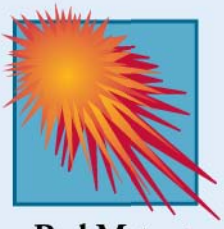
Visual Distress Signals (VDSs) allow vessel operators to signal for help in the event of an emergency.

- Vessels on federally controlled waters must be equipped with visual distress signals.
- An operator who observes another vessel or operator displaying one of these distress symbols must stop and render aid. It is prohibited to display visual distress signals unless assistance is needed.

VDSs are classified as day signals (visible in bright sunlight), night signals (visible at night), or both day and night signals. VDSs are either pyrotechnic (smoke and flames) or non-pyrotechnic (non-combustible).

Pyrotechnic Visual Distress Signals

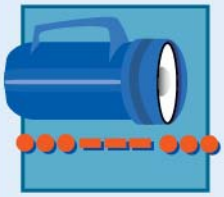
Orange Smoke
Day Signal



Red Meteor
Day and Night Signal

Red Flare
Day and Night Signal

Non-Pyrotechnic Visual Distress Signals



Electric Light
Night Signal

Orange Flag
Day Signal

Arm Signal
Although this signal does not meet VDS equipment requirements, wave your arms to summon help if you do not have other distress signals on board.

Federally Controlled Waters

Vessels must observe federal requirements on these waters:

- Coastal waters
- The Great Lakes (including Lake Michigan and Lake Superior)
- Territorial seas
- Waters which are two miles wide or wider and are connected directly to one of the above

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On the Water

In addition to the laws mentioned previously, here are some other Wisconsin regulations that apply when vessel operators are on the water.

Unlawful Operation

Wisconsin law states that these dangerous operating practices are illegal.

- **Negligent or Reckless Operation** of a vessel or the reckless manipulation of water skis, a surfboard, or a similar device is operating in a manner that causes danger to the life, limb, or property of any person. Examples of negligent or reckless operation are:
  - Jumping the wake of any vessel that is towing a skier, tuber, wakeboarder, etc.
  - Operating a vessel within any area marked off or set aside as a prohibited area or a swim area
  - Weaving your vessel through congested waterway traffic
  - Operating a vessel in a manner to create hazardous wave or wake conditions while approaching or passing another boat
  - Steering toward another object or person in the water and swerving at the last possible moment in order to avoid collision
  - Chasing, harassing, or disturbing wildlife with your vessel
- **Riding on Bow or Gunwales** is allowing passengers to ride on the bow decking, gunwales, seat backs, or any other position where there is a danger of falling overboard.

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- **Overloading** is defined as operating a vessel that has been loaded beyond the recommended capacity shown on the capacity plate installed by the vessel manufacturer. The operator must limit the vessel's load to the total weight or maximum number of persons shown on the capacity plate, whichever is more restrictive.
- **Improper Speed or Distance** is not maintaining a proper speed and/or distance while operating a vessel. Specifically, it is illegal to:
  - Operate a vessel at a distance from other vessels or at a speed that exceeds safe and reasonable limits given the waterway traffic, marked speed limits, weather, and other boating conditions
  - Exceed the speeds posted or charted in any specific zone or area
  - Operate a vessel repeatedly in a circuitous manner within 200 feet of another vessel or person in the water
  - Operate a vessel within 100 feet of any dock, raft, pier, or restricted area at greater than "slow, no wake" speed
  - Operate a vessel at greater than "slow, no wake" speed on lakes that are 50 acres or less and have public access, unless such lakes serve as thoroughfares between two or more navigable lakes

> **"No Wake Speed"** means a speed at which a vessel moves as slowly as possible while still maintaining steerage control

  - Operate within 100 feet of a swimmer
- **Unsafe Condition** is placing or leaving in public waters any vessel that is not safe to operate. Law enforcement officers may instruct the operator to take immediate corrective action or return to mooring if any of the following "unsafe conditions" exist
  - The vessel is overloaded.
  - There are insufficient personal flotation devices, fire extinguishers, backfire flame arrestors, ventilation or navigation lights.
  - The vessel is leaking fuel or has fuel in the bilges.

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Alcohol and Drugs

Wisconsin law prohibits operating a motorboat or manipulating water skis or similar devices while under the influence of alcohol or drugs. Alcohol and drugs cause impaired balance, blurred vision, poor coordination, impaired judgment and slow reaction time.

- Anyone who operates or attempts to operate a vessel is deemed to have given consent to an alcohol and/or drug test.
- It is illegal for a person to operate a motorboat or use water skis, a surfboard, or other device if he or she:
  - Is under the influence of an intoxicant or a controlled substance ***or ...***
  - Has a blood alcohol concentration of 0.08% or greater.

Obstructing Navigation

It is illegal to:

- Operate any vessel in such a way that it will interfere unnecessarily with the safe navigation of other vessels.
- Anchor a vessel in the traveled portion of a river or channel that will prevent or interfere with any other vessel passing through the same area.
- Moor or attach a vessel to a buoy (other than a mooring buoy), beacon, light, or any other navigational aid placed on public waters by proper authorities.
- Move, displace, tamper with, damage, or destroy any navigational aid.
- Obstruct a pier, wharf, boat ramp, or access to any facility.

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Homeland Security Restrictions

- Violators of the restrictions below can expect a quick and severe response.
  - Do not approach within 100 yards and slow to minimum speed within 500 yards of any U.S. Naval vessel. If you need to pass within 100 yards of a U.S. Naval vessel for safe passage, you must contact the U.S. Naval vessel or the U.S. Coast Guard escort vessel on VHF-FM channel 16.
  - Observe and avoid all security zones. Avoid commercial port operation areas, especially those that involve military, cruise-line, or petroleum facilities.
  - Observe and avoid other restricted areas near dams, power plants, etc.
  - Do not stop or anchor beneath bridges or in the channel.
- Keep a sharp eye out for anything that looks peculiar or out of the ordinary. Report all activities that seem suspicious to the local authorities, the U.S. Coast Guard, or the port or marina security.

Boating Accidents

- An operator involved in a boating accident must:
  - Stop his or her vessel *immediately* at the scene of the accident ***and …***
  - Assist anyone injured or in danger from the accident, unless doing so would seriously endanger his or her own vessel or passengers ***and …***
  - Give, in writing, his or her name, address, and vessel identification to anyone injured and to the owner of any property damaged by the accident.
- A vessel operator is required to make an oral and written report whenever a boating accident results in:
  - Loss of life or disappearance of a person ***or …***
  - Injury to any person ***or …***
  - Property damage in excess of $2,000.
- Oral reports must be made immediately to a DNR conservation warden or a local law enforcement officer.
- A written report must be submitted within 10 days on a DNR *Form 4100-20* to DNR-Boat Safety, Box 7921, Madison, WI 52707.

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Diving Activities

Diver-Down Flag

Persons scuba diving, skin diving, snorkeling, or underwater spearfishing must display a diver-down flag unless within 150 feet of shore.

- A diver must stay within 150 feet of the flag. Unless there is an emergency, a diver may not surface more than 50 feet from the flag. It is unlawful to display a diver-down flag when not diving.
- Vessels not engaged in diving operations must stay at least 100 feet from any displayed diver down flag. The diver down flags are:

Alfa Flag

Divers Flag

A rectangular red flag, at least 12 x 15 inches with a three-inch white diagonal stripe, mounted on a float or buoy to be clearly visible

A blue and white International Code Flag A (or Alfa flag), usually flown from a vessel and used on federally controlled waters

Diving Wisconsin's Historic Shipwrecks

The Wisconsin Historical Society has published information about many historic shipwreck sites in Wisconsin waters, some of which are marked by seasonal mooring buoys. Damaging or removing material from a wreck site not only diminishes the enjoyment for future visitors, it is also a crime that can result in fines, imprisonment, and the loss of a diver's gear, boat, trailer, and vehicle.

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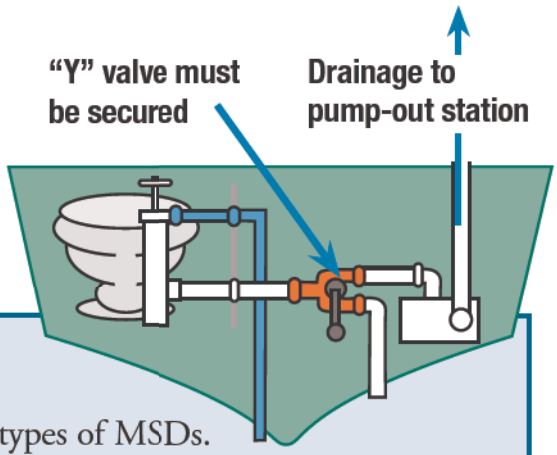
Discharge of Waste

It is unlawful to place, leave, or discharge waste or waste containers into or near any Wisconsin waters.

- Every vessel with an installed toilet must have an operable marine sanitation device (MSD).
- All installed marine sanitation devices must be U.S. Coast Guard–certified and working properly.

Typical Marine Sanitation Device



Types of MSDs

There are three types of MSDs.

- Types I and II MSDs are usually found on large vessels. Waste is treated with special chemicals to kill bacteria before the waste is discharged. Types I and II MSDs with "Y" valves that would direct the waste overboard must be secured so that the valve cannot be opened. This can be done by placing a lock or non-reusable seal on the "Y" valve or by taking the handle off the "Y" valve in a closed position.
- Type III MSDs provide no treatment and are either holding tanks or portable toilets. Collected waste should be taken ashore and disposed of in a pump-out station or onshore toilet.

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Discharge of Trash

It is illegal to dump refuse, garbage, or plastics into any state or federally controlled waters.

- You must store trash in a container while on board and place it in a proper receptacle on shore.
- If boating on federally controlled waters and your vessel is 26 feet or longer, you must display a Garbage Disposal Placard that is at least 4 x 9 inches and notifies passengers and crew about discharge restrictions.

Discharge of Oil and Other Hazardous Substances

- You are not allowed to discharge oil or hazardous substances into the water.
- You are not allowed to dump oil into the bilge of the vessel without means for proper disposal.

If your vessel discharges oil or hazardous substances into the water, immediately call the U.S. Coast Guard at **1-800-424-8802**.

- You must dispose of oil waste at an approved reception facility. On recreational vessels, a bucket or bailer is adequate for temporary storage prior to disposing of the oil waste at an approved facility.
- If boating on federally controlled waters and your vessel is 26 feet or longer, you must display a 5 x 8-inch placard made of durable material, fixed in a conspicuous place in the machinery spaces or at the bilge pump control station, stating the Federal Water Pollution Control Act's law.

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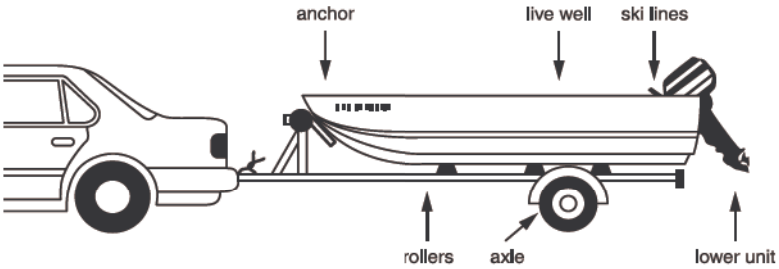
Aquatic Nuisance Species

Introducing non-native species into Wisconsin waters can upset the balance of the ecosystem. Aquatic nuisance species, such as zebra mussels, Eurasian milfoil, and hydrilla, are most often spread between waterways by hitching a ride on vessels and trailers. When transplanted into new waters, these organisms proliferate, displacing native species and damaging the water resource.

- Wisconsin law prohibits launching a vessel, a trailer, or any boating equipment if there are any aquatic plants or zebra mussels attached.
- To help prevent spreading aquatic nuisance species:
  - Inspect your vessel and trailer, and remove any plants and animals you see before leaving the area. Be sure to check the locations labeled below.



  - Drain water from your outboard or lower unit, live well, and bilge on land before leaving the area.
  - Dispose of your bait properly on land. Never release live bait into a body of water or release aquatic animals from one body of water into another.
  - Destroy any remaining nuisance species by:
    - Rinsing your vessel and equipment with hot water (at least 104° Fahrenheit) especially if moored for more than a day ***or ...***
    - Air drying your vessel and equipment for at least five days.
  - If you think you have found a zebra mussel, save it and contact your nearest Wisconsin Department of Natural Resources office.

For more information on aquatic nuisance species found in Wisconsin, visit **http://dnr.wi.gov/invasives/**

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Specifically for PWCs

PWC operators must obey laws that apply to other vessels as well as obey additional requirements that apply specifically to the operation of personal watercraft.

Requirements Specific to PWCs

- Every person on board a PWC must *wear* a U.S. Coast Guard–approved Type I, II, III, or V PFD.
- If the PWC is equipped with a lanyard-type ignition safety switch, the lanyard must be attached to the person, clothing, or PFD of the operator.
- A PWC may not be operated between sunset and sunrise.
- A PWC operator must always face forward.
- A PWC may not be operated faster than "slow, no wake speed" within:
  - 100 feet of any other vessel
  - 100 feet of a dock, pier, raft, or restricted area
  - 200 feet of shore on any lake
- There are minimum age and boater education requirements for operators of PWCs. See page 8.
- A PWC must be operated in a responsible manner. Maneuvers that endanger people or property are prohibited, including:
  - Jumping a wake with a PWC within 100 feet of another vessel
  - Operating within 100 feet of a vessel that is towing a skier, tuber, or wakeboarder, or operating within 100 feet of the tow rope or person being towed
  - Weaving a PWC through congested waterway traffic
  - Steering toward another object or person in the water and swerving at the last possible moment in order to avoid collision
  - Chasing, harassing, or disturbing wildlife with a PWC

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Specifically for Skiing

Vessel operators towing a person(s) on water skis, a surfboard, or any other device have additional laws.

Requirements for Towing Skiers

- A person may not be towed behind a vessel between sunset and sunrise.
- When a vessel is towing a person on water skis, a surfboard, or other device, the operator must have a competent person on board to act as an observer.
- A PWC operator may not tow a person on water skis or other devices unless the PWC is designed and recommended by the manufacturer to accommodate at least three people.
- Those towing skiers on water skis, a surfboard, or similar devices and those being towed must act in a safe and prudent manner.
  - Vessels towing persons may not come within 100 feet of other vessels, persons in the water, a swimming area, or a public boat landing.
  - Persons being towed behind a vessel on water skis, a surfboard, or other device, or their towing rope, may not come within 100 feet of a PWC.

Avoid Propeller Strike Injuries!

Most propeller strike accidents result from operator error. Victims include swimmers, scuba divers, fallen water-skiers, and boat operators or passengers. Most propeller accidents can be prevented by following basic safe boating practices.

- Maintain a proper lookout. The primary cause of propeller strike accidents is operator inattention.
- Make sure the engine is off so that the propeller is not rotating when passengers are boarding or leaving a boat.
- Never start a boat with the engine in gear.
- Slow down when approaching congested areas and anchorages. In congested areas, always be alert for swimmers and divers.

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Before Going Out

Before going out on the water, take steps to make the outing safe and enjoyable.

Vessel Capacity

- Always check the capacity plate, which is usually found near the operator's position or on the vessel's transom. This plate indicates the maximum weight capacity and maximum number of people that the vessel can carry safely.

- PWCs and some other vessels are not required to have a capacity plate. Follow the recommended capacity in the owner's manual and on the manufacturer's warning decal.

Trailering Your Vessel Safely

- **Before leaving home:**
  - Secure and evenly distribute all gear in the vessel.
  - Properly secure the vessel with tie-down straps.
  - Tilt and secure the engine to increase clearance.
  - Crisscross the safety chains when attaching them.
  - Test the trailer brakes and lights.
- **Launching your vessel from a trailer:**
  - Prepare your vessel well away from the boat ramp.
  - Back the vessel into the water until the engine's lower unit can be submerged while on the trailer.
  - Warm up the engine. Back the trailer further until the vessel floats, and back slowly off the trailer.
- **Retrieving your vessel:**
  - Back the trailer into the water so that two-thirds of the rollers or bunks are submerged.
  - Move the vessel onto the trailer far enough to attach the winch line to the bow eye of the vessel. Finish pulling it onto the trailer by cranking the winch.
  - Tow the vessel off the ramp out of the way of others. While at the ramp area, remove all weeds from the vessel, remove the drain plug, and drain live wells.

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On the Water

Safe navigation on Wisconsin waterways is everyone's responsibility. All operators are equally responsible for taking action necessary to avoid collisions.

Navigation Rules

There are two terms that help explain these rules.

- **Stand-on vessel:** The vessel that should maintain its course and speed
- **Give-way vessel:** The vessel that must take early and substantial action to avoid collision by stopping, slowing down, or changing course

Meeting Head-On

Power vs. Power: Neither vessel is the stand-on vessel. Both vessels should keep to their right.

Power vs. Sail: The powerboat is the give-way vessel.

Power vs. Power

Power vs. Sail

Crossing Situations

Power vs. Power: The vessel on the left is the give-way vessel. The vessel on the right is the stand-on vessel.

Power vs. Sail: The powerboat is the give-way vessel.

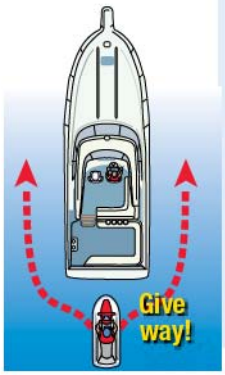
Power vs. Power

Power vs. Sail

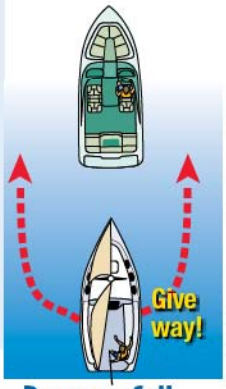
Overtaking

Power vs. Power: The vessel that is overtaking another vessel is the give-way vessel.

Power vs. Sail: The vessel that is overtaking another vessel is the give-way vessel.



Power vs. Power



Power vs. Sail

Note: Powered vessels and sailing vessels should give way to unpowered vessels.

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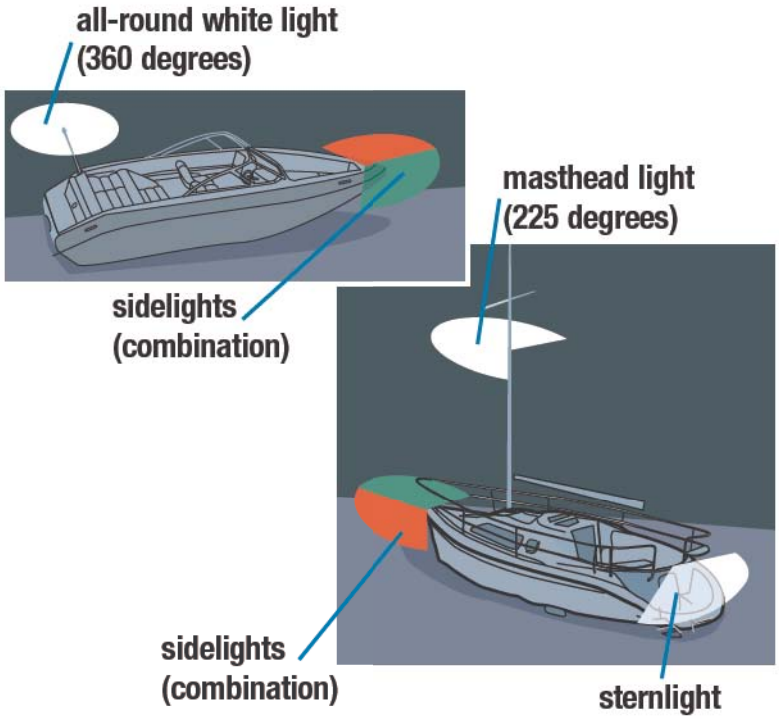
Nighttime Navigation

Be on the lookout for the lights of other vessels when boating at night. Several types of lights serve as navigational aids at night. There are four common navigation lights.

- **Sidelights:** These red and green lights are called sidelights (also called combination lights) because they are visible to another vessel approaching from the side or head-on. The red light indicates a vessel's port (left) side; the green indicates a vessel's starboard (right) side.
- **Sternlight:** This white light is seen from behind the vessel.
- **Masthead Light:** This white light shines forward and to both sides and is required on all power-driven vessels. A masthead light must be displayed by all vessels when under engine power. The absence of this light indicates a sailboat under sail.
- **All-Round White Light:** On power-driven vessels less than 39.4 feet in length, this light may be used to combine a masthead light and sternlight into a single white light that can be seen by other vessels from any direction. This light serves as an anchor light when sidelights are extinguished.



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Encountering Vessels at Night

When you see a white and a green light, you are the stand-on vessel. However, remain alert in case the other vessel operator does not see you or does not know the navigation rules.

When you see only a white light, you are overtaking another vessel. It is the stand-on vessel whether it is underway or anchored. You may go around it on either side.

When you see a red and a white light, you must give way to the other vessel! Slow down and allow the vessel to pass, or pass to the right behind the vessel.

Encountering a Sailboat at Night

When you see **only a green light or only a red light**, you are approaching a sailboat under sail and you must give way. The sailboat under sail is always the stand-on vessel unless it is overtaking another vessel.

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Non-Lateral Markers

Non-lateral markers are navigational aids that give information other than the edges of safe water areas. The most common are regulatory markers which are white and use orange markings and black lettering. These markers are found on lakes and rivers.

Information

Squares indicate where to find food, supplies, repairs, etc. and give directions and other information.

Controlled

Circles indicate a controlled area such as speed limit, no fishing or anchoring, ski only or no skiing, or "slow, no wake."

Exclusion

Crossed diamonds indicate areas off-limits to all vessels such as swimming areas, dams, and spillways.

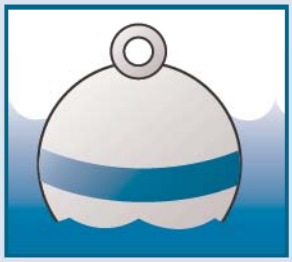
Danger

Diamonds warn of dangers such as rocks, shoals, construction, dams, or stumps. Always proceed with caution.

Other Non-Lateral Markers

Inland Waters Obstruction Markers are white with black vertical stripes and indicate an obstruction to navigation. You should not pass between these buoys and the nearest shore.

Mooring Buoys are white with a blue horizontal band and are found in marinas and other areas where vessels are allowed to anchor.



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Boating Emergencies

A safe boater knows how to prevent and respond to boating emergencies.

Falling Overboard

- **To prevent persons from falling overboard:**
  - Don't sit on the gunwale, bow, seat backs, motor cover, or any other area not designed for seating.
  - Don't sit on pedestal seats when underway at greater than idle speed.
  - On fishing boats with carpeted decks (such as bass boats), don't sit or stand on the deck when the boat is moving faster than idle speed.
  - Don't stand up in or lean out from the boat.
  - Don't move about the boat when underway.
- **If someone on your boat falls overboard:**
  - Reduce speed and toss the victim a throwable PFD.
  - Turn your boat around and slowly pull alongside the victim, approaching the victim from downwind or into the current, whichever is stronger.
  - Turn off the engine. Pull the victim on board over the stern, keeping the weight in the boat balanced.

Capsizing or Swamping

- **To reduce the risk of capsizing or swamping:**
  - Don't overload your boat. Balance the load.
  - Slow your boat appropriately when turning.
  - Secure the anchor line to the bow, never to the stern.
  - Don't boat in rough water or in bad weather.
- **If you capsize or swamp your boat, or if you have fallen overboard** and can't get back in:
  - Stay with the boat.
  - Try to reboard or climb onto it in order to get as much of your body out of the cold water as possible.
- **If the boat sinks or floats away,** don't panic.
  - If wearing a PFD, remain calm and await help.
  - If you aren't wearing a PFD, look around for one or for other buoyant items to use as a flotation device.
  - In cold water, float rather than tread.

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Hypothermia

- **If you are boating in cold water:**
  - Dress in several layers of clothing under your PFD or wear a wetsuit or dry suit.
  - Learn to recognize the symptoms of hypothermia. Symptoms begin with shivering and bluish lips and nails, and progress to a coma and, ultimately, death.
- **To reduce the effects of hypothermia:**
  - Put on a PFD if not wearing one. It helps you to float without excessive movement and insulates your body.
  - Get as much of your body out of the water as possible.
  - Don't take your clothes off unless necessary—clothes can help you float and provide insulation.
  - Don't thrash or move about. Excess motion consumes energy and increases loss of body heat.
  - Draw your knees to your chest and your arms to your sides, protecting the major areas of heat loss.
  - If others are in the water with you, huddle together with your arms around their shoulders.

Carbon Monoxide Poisoning

Carbon monoxide is an invisible, odorless, tasteless gas that can be deadly. To prevent carbon monoxide poisoning, keep air flowing through the boat and take extreme caution when running a generator at a dock or at anchor.

- Whenever people are using a swim platform or are in the water close to the stern, turn off all gasoline-powered generators with transom exhaust ports.
- Swimmers should never enter the cavity between the swim platform and the stern of the boat.
- When boating, be careful running downwind as exhaust gases may blow back on board. On cabin cruisers, be aware that exhaust gases can blow back into the stern when traveling into the wind.

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Sunrise and Sunset

Reference Location: Kenosha, Wisconsin

	JAN 08		FEB 08		MAR 08		APR 08		MAY 08		JUN 08		JUL 08		AUG 08		SEP 08		OCT 08		NOV 08		DEC 08	
Day	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1	7:21	4:28	7:06	5:04	6:26	5:42	6:33	7:18	5:46	7:52	5:16	8:23	5:18	8:33	5:44	8:11	6:17	7:25	6:49	6:32	7:26	5:44	7:02	4:19
2	7:21	4:29	7:05	5:06	6:25	5:43	6:31	7:19	5:44	7:53	5:16	8:24	5:18	8:32	5:45	8:10	6:18	7:23	6:50	6:30	6:27	4:42	7:03	4:19
3	7:21	4:30	7:04	5:07	6:23	5:44	6:29	7:20	5:43	7:54	5:15	8:24	5:19	8:32	5:46	8:08	6:19	7:21	6:51	6:28	6:28	4:41	7:04	4:18
4	7:21	4:31	7:03	5:08	6:21	5:45	6:28	7:21	5:42	7:55	5:15	8:25	5:20	8:32	5:47	8:07	6:20	7:20	6:52	6:27	6:29	4:40	7:05	4:18
5	7:21	4:32	7:02	5:10	6:20	5:47	6:26	7:22	5:40	7:56	5:15	8:26	5:20	8:32	5:48	8:06	6:21	7:18	6:54	6:25	6:31	4:39	7:06	4:18
6	7:21	4:33	7:00	5:11	6:18	5:48	6:24	7:24	5:39	7:58	5:14	8:26	5:21	8:31	5:49	8:05	6:22	7:16	6:55	6:23	6:32	4:38	7:07	4:18
7	7:21	4:34	6:59	5:12	6:16	5:49	6:23	7:25	5:38	7:59	5:14	8:27	5:21	8:31	5:50	8:03	6:23	7:14	6:56	6:22	6:33	4:36	7:08	4:18
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9	7:21	4:36	6:57	5:15	7:13	6:51	6:19	7:27	5:35	8:01	5:14	8:28	5:23	8:30	5:52	8:01	6:25	7:11	6:58	6:18	6:36	4:34	7:10	4:18
10	7:21	4:37	6:56	5:16	7:11	6:53	6:18	7:28	5:34	8:02	5:13	8:29	5:24	8:30	5:53	7:59	6:26	7:09	6:59	6:17	6:37	4:33	7:11	4:18
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13	7:20	4:41	6:52	5:20	7:06	6:56	6:13	7:32	5:31	8:05	5:13	8:30	5:26	8:28	5:56	7:55	6:30	7:04	7:03	6:12	6:41	4:30	7:13	4:18
14	7:19	4:42	6:50	5:21	7:04	6:57	6:11	7:33	5:30	8:06	5:13	8:31	5:27	8:27	5:58	7:54	6:31	7:02	7:04	6:10	6:42	4:29	7:14	4:19
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17	7:18	4:45	6:46	5:25	6:59	7:01	6:06	7:36	5:27	8:09	5:13	8:32	5:29	8:25	6:01	7:49	6:34	6:57	7:07	6:05	6:46	4:27	7:16	4:20
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20	7:16	4:49	6:42	5:29	6:54	7:04	6:02	7:40	5:24	8:12	5:14	8:32	5:32	8:23	6:04	7:44	6:37	6:51	7:11	6:01	6:49	4:24	7:18	4:21
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31	7:07	5:03			6:35	7:17			5:17	8:22			5:43	8:12	6:16	7:26			7:24	5:45			7:21	4:28

Times for Zone A. See map on next page.

Source: U.S. Naval Observatory, http://aa.usno.navy.mil

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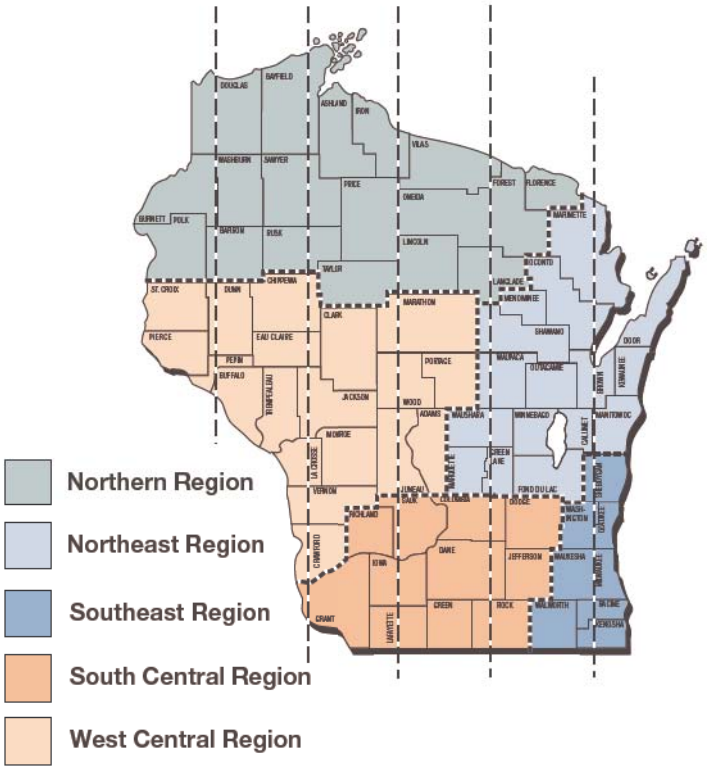
Use this map to adjust sunrise/sunset times:

Zone F	Zone E	Zone D	Zone C	Zone B	Zone A
+ 20 min.	+ 16 min.	+ 12 min.	+ 8 min.	+ 4 min.	in table



REGION DNR OFFICE COVERAGE

Boating Safety Instructors and **Boating Ambassadors** are people like you who want to make a difference on the lakes in their community.

A Boating Safety Instructor:

- Is a certified volunteer instructor whose main responsibility is to teach boating safety education classes in their community.
- As the name "volunteer" would imply, the compensation for instructors is in the satisfaction of knowing that what you are doing is important, that your contribution may save lives and positively influence the attitudes and actions of those who share or will share Wisconsin waterways with you.

Are you interested in getting involved with your community? Contact your local Recreational Safety Warden (see back cover for contact information) to learn more about this program.

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Wisconsin
Required Equipment Checklist

	Unpowered Boat	PWC	Boat Less Than 16 Ft.	Boat 16 Ft. to Less Than 26 Ft.
Boater Safety Course Certificate On Board		✓1	✓1	✓1
Certificate of Number On Board		✓	✓	✓
Expiration Decals Displayed		✓	✓	✓
PFDs: Type I, II, III, or V	✓	✓2	✓3	✓3
PFD: Type IV				✓
Type B-I Fire Extinguisher		✓	✓	✓
Ignition Safety Switch		✓		
Backfire Flame Arrestor		✓	✓4	✓4
Ventilation System		✓	✓	✓
Muffler		✓	✓	✓
Horn, Whistle, or Bell		✓5	✓5	✓5
Daytime Visual Distress Signals				✓5
Nighttime Visual Distress Signals		N/A	✓5	✓5
Navigation Lights	✓	N/A	✓	✓

Numbers correspond with the chart above.

1. Applicable if born on or after January 1, 1989. See page 8 for details.
2. Those on PWCs must *wear* a PFD at all times.
3. Those under the age of 13 years must *wear* a PFD when on federally controlled waters.
4. Required on inboard and stern drives only.
5. Required when operating on federally controlled waters.

Note: Some items are not applicable to personal watercraft (PWCs) because PWCs are not allowed to operate between sunset and sunrise.

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WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Northeast Region
2984 Shawano Ave.
Box 10448
Green Bay, WI 54307
920-662-5100

Northern Region
107 Sutliff Ave.
Box 818
Rhinelander, WI 54501
715-365-8900

Northern Region
810 W. Maple St.
Spooner, WI 54801
715-635-2101

Southeast Region
2300 N. Dr. Martin Luther King Jr. Dr.
Milwaukee, WI 53212
414-263-8500

South Central Region
3911 Fish Hatchery Rd.
Fitchburg, WI 53711
608-275-3266

West Central Region
1300 W. Clairemont Ave.
Box 4001
Eau Claire, WI 54702
715-839-3700

Find out about...

- **online boat license renewal**
- **fishing and hunting permits**
- **places to boat, fish, and hunt**
- **education and outdoor programs**
- **state parks, trails, and campgrounds**

Everything you need to know about boating in Wisconsin is just a click away!

Visit our website:
dnr.wi.gov

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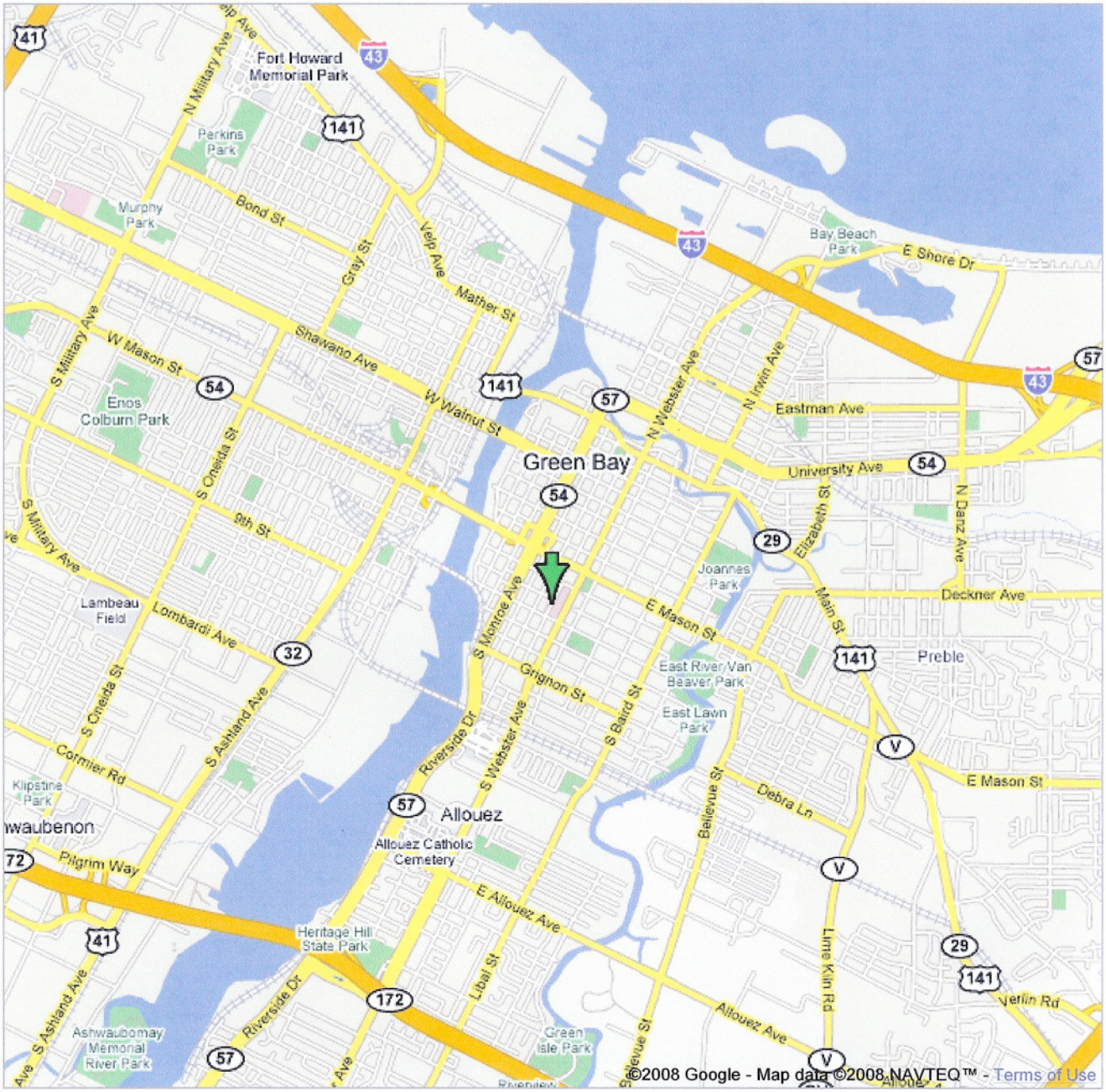
APPENDIX F

HOSPITAL AND WORKCARE FACILITY LOCATION MAPS

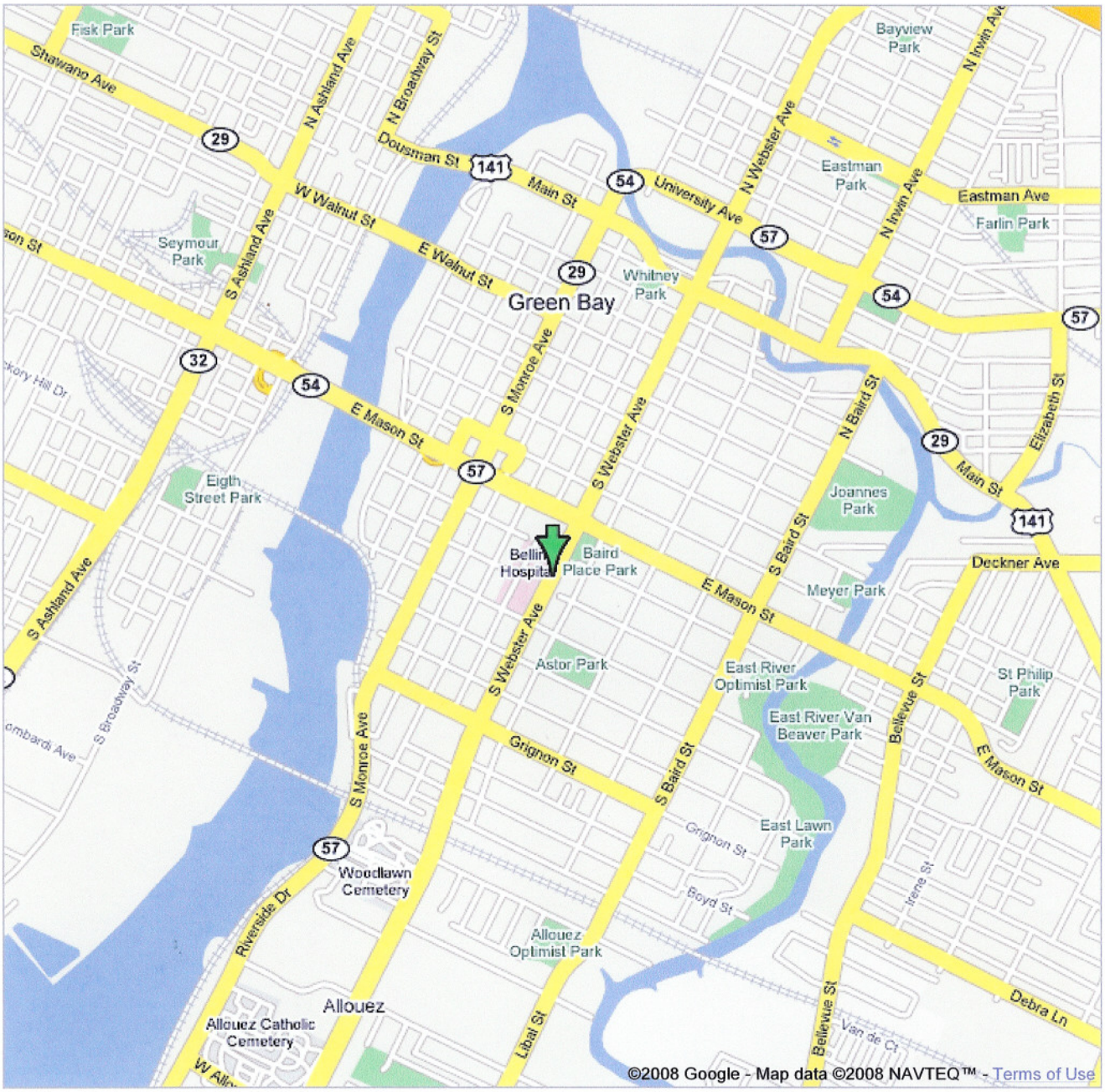
Google Maps

Address **835 S Van Buren St**
Green Bay, WI 54301

Notes Saint Vincent Hospital
Green Bay, WI
Phone (920) 433-0111



Google Maps

Address **744 S Webster Ave**
Green Bay, WI 54301

Notes Bellin Hospital
Green Bay, WI
Phone (920) 433-3500