UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

BEAVER ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 513.0-517.0
CLINTON COUNTY, IOWA

APPENDIX M

ENGINEERING DESIGN

UPPER MISSISSIPPI RIVER RESTORATION
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APPENDIX M

ENGINEERING DESIGN

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UPPER MISSISSIPPI RIVER RESTORATION
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APPENDIX M

ENGINEERING DESIGN

I. PROJECT DESCRIPTION

Refer to the Beaver Island Feasibility Study Main Report.

A. Summary

Table M-1: Project Summary

Project Engineer	Kara Mitvalsky, P.E.
Project Name	Beaver Island Habitat Rehabilitation and Enhancement Project
Project Feature Type	Mechanical excavation/dredging of channels and rock closure structures, plantings, rock protection, chevron, reforestation, mussel substrate.
Project Location	Clinton County, IA, in Pool 14 between Upper Mississippi River, river miles 513 to 517.
Project Map Location	See Figure M-1
Project Description	The work includes, but is not limited to, tree clearing, tree disposal off-site, excavation/dredging of channels, transporting the material to the placement site, shaping the placed material, and rock closure structures.

B. Project Location and Site Map. See Figure M-1, *Site Location and Features.*

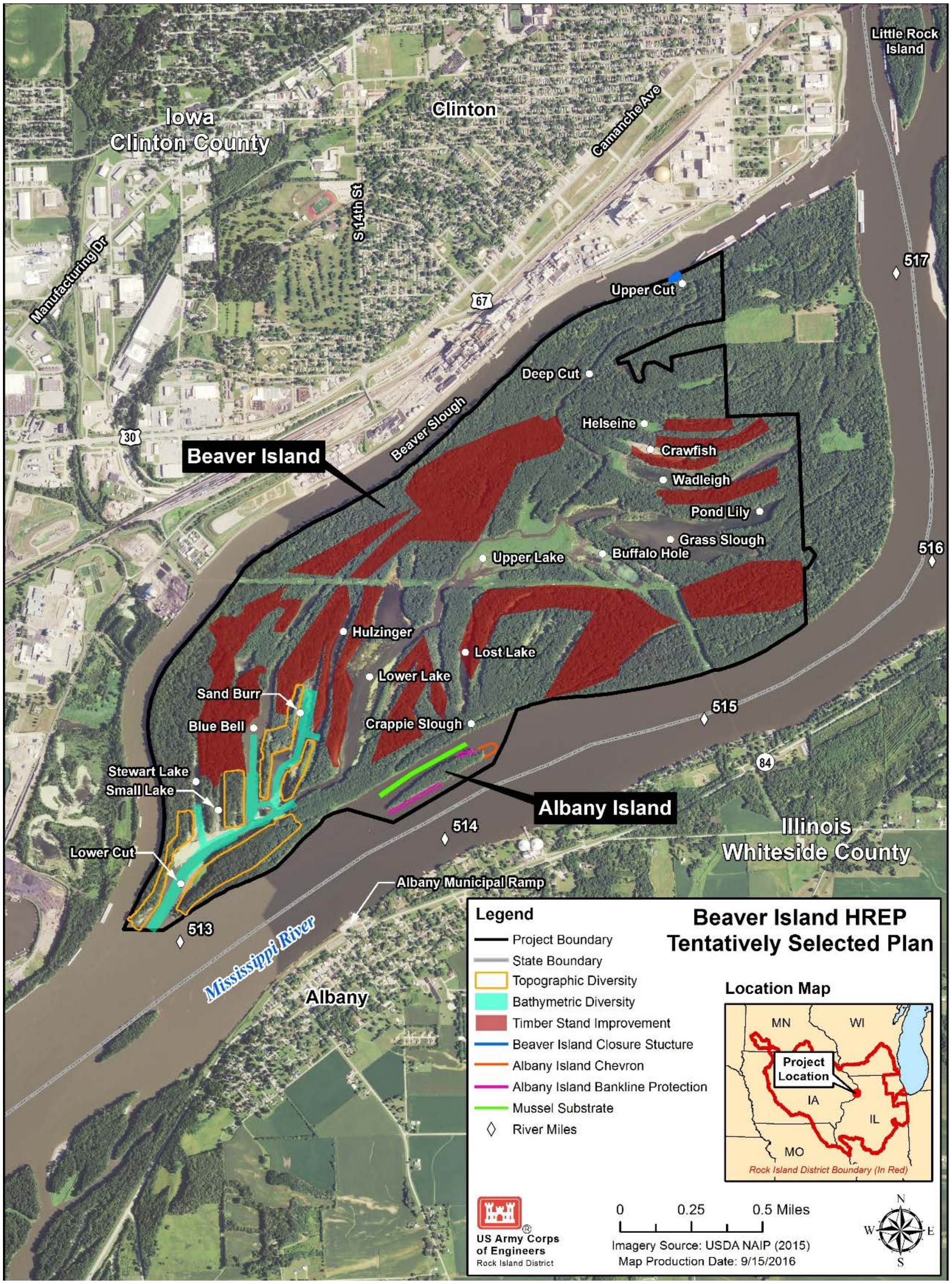

Figure M-1: Site Location and Features

C. Project Authority, Background, Description

1. Authority. The original authorizing legislation was the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662), Section 1103.

The Upper Mississippi River Restoration (UMRR) was originally comprised of five elements:

- Habitat Rehabilitation and Enhancement Projects (HREPs)
- Long-Term Resource Monitoring (LTRM)
- Recreation Projects
- Economic Impacts of Recreation
- Navigation Monitoring

Currently, the UMRR is comprised of two elements: 1) plan, construct, and evaluate measures for fish and wildlife habitat improvement through HREPs; and 2) monitor the natural resources of the river system through the LTRM. The other UMRR elements have either been successfully completed or are now carried out under other authorities.

The original authorizing legislation has been amended several times since its enactment. The 1990 WRDA, Section 405, extended the original UMRR authorization an additional five years to fiscal year 2002, which allowed for ramping up of the program. The 1992 WRDA, Section 107, amended the original authorization by allowing limited flexibility in how funds are allocated between the HREP program and the LTRM element. The 1992 WRDA also assigned sole responsibility for operation and maintenance (O&M) of habitat Projects to the agency that manages the lands on which the Project is located. The 1999 WRDA, Section 509, reauthorized UMRR as a continuing authority with reports to Congress every 6 years and changed the cost sharing percentage from 25 percent to 35 percent. Beaver Island is located on federally-owned refuge lands so the Project is 100 percent federally-funded. The 1999 Water Resources Development Technical Corrections, Section 2, corrected paragraph deletions/additions. The 2007 WRDA, Section 3177, allowed for the inclusion of water quality research in the applied research program for development of remediation strategies on the Mississippi River.

2. Background. Refer to the Beaver Island Feasibility Study Main Report.

3. Description. Refer to the Beaver Island Feasibility Study Main Report.

4. Project Delivery Team

Name	Organization	Email/Phone
Sara Schmuecker	USFWS	sara_schmuecker@fws.gov, 309-757-5800
Ed Britton	USFWS	ed_britton@fws.gov, 815-273-2732
Russ Engelke	USFWS	russell_engelke@fws.gov, 815-273-2732
Sharonne Baylor	USFWS	sharonne_baylor@fws.gov, 507-452-4232
Mike Griffin	IADNR	michael.griffin@dnr.iowa.gov, 563-872-5700
Scott Gritters	IADNR	scott.gritters@dnr.iowa.gov, 563-872-4976
Karla Sparks	USACE	karla.k.sparks@usace.army.mil, 309-794-5046
Darron Niles	USACE	darron.l.niles@usace.army.mil, 309-794-5400
Kara Mitvalsky[1]	USACE	kara.n.mitvalsky@usace.army.mil, 309-794-5623
Lucie Sawyer	USACE	lucie.m.sawyer@usace.army.mil ,309-794-5836
Steve Gustafson	USACE	stephen.j.gustafson@usace.army.mil, 309-794-5202
Elizabeth Bruns	USACE	david.p.bierl@usace.army.mil, 309-794-5581
Chris De Pooter	USACE	christopher.j.depooter@usace.army.mil, 309-794-5052
Nate Richards	USACE	nathan.s.richards@usace.army.mil, 309-794-5286
Cynthia Peterson	USACE	cynthia.l.peterson@usace.army.mil, 309-794-5396
Joe Lundh	USACE	joseph.s.lundh@usace.army.mil, 309-794-4528
Jason Appel	USACE	jason.c.appel@usace.army.mil, 309-794-5489
Justine Womboldt	USACE	justine.a.womboldt@usacearmy.mil, 309-794-5488
Emily Johnson	USACE	emily.j.johnson@usace.army.mil, 309-794-5526
Pat Flynn	USACE	patrick.j.flynn@usace.army.mil, 309-794-5215
Rachel Perrine	USACE	rachel.e.perrine@usace.army.mil, 309-794-5403
Brandon Stevens	USACE	brandon.s.stevens@usace.army.mil, 309-794-5932
Randy Kinney	USACE	randall.s.kinney@ usace.army.mil, 309-794-5843
Mike Scudder	USACE	michael.l.scudder@usace.army.mil, 309-794-5649
Monique Savage (FY13-FY16)	USACE	monique.e.savage@usace.army.mil, 309-794-5342
Felix Castro (FY13-FY14)	USACE	
Jon Schulz (FY13-FY15)	USACE	

[1] Primary Project Engineer

II. PROJECT FEATURES

- Tree Clearing and Removal Off-Site
- Placement Site Preparation
- Mechanical Excavating/Dredging of Channels for Overwintering
- Rock Closure Structure
- Shaping and Seeding Placement Sites
- Plant Forested Wetland Trees
- Plant Forested Wetland Shrubs
- Buffer Seeding and Planting
- Understory Seeding
- Chevron Construction
- Bankline Protection
- Mussel Substrate Habitat

III. REFERENCES

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2010 Report to Congress, Upper Mississippi River System Environmental Management Program. Corps, Rock Island District, Rock Island, IL. This report is the most recent formal evaluation of the UMRR-EMP that evaluates the program; describes its accomplishments, including development of a systemic habitat needs assessment; and identifies certain program adjustments.

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IV. DESIGN DELIVERABLES

The design will involve the submission of multiple design deliverables over the course of the Project including:

- District Quality Control Review (DQCR) and Certification
- Value Engineering Studies
- Agency Technical Review and Certification
- Calculations
- Quantity Take-Offs
- Cost Estimates

V. ENGINEERING – DESIGN

A. Civil Design

1. Survey Data

- Refer to Attachment A, *Survey Data*, including meeting records and emails documenting survey actions and OD-T survey data
- Survey data has come from OD-T hydro survey (several events), UMRR LiDAR, and EC-T ground survey. Additional survey data was obtained in May 2015 near the head of Albany Island and at the Upper Cut/Deep Cut closure structure. Additional LIDAR data was added to the DTM in November 2015. Survey DTM was updated.
- Project is in NAVD88 (converted from MSL1912, which is what the river gages use)
- IL West State Plane NAD 83, US Survey Feet
- EC-T Survey data is located in ProjectWise under 03_Survey_Map
- Flat Pool at the project location (RM 514) is 571.2 NAVD88 (572 MSL1912)
- Survey control drawing is included in Appendix O-Plates (For conversions between survey datums, refer to Plate 3, V-I01)

2. Historic Dredging. Dredging has occurred around Beaver Island for the last eight decades. A list of dredging events and river miles is provided in Attachment D, *Historic Dredging*. Dredged material placement sites can be noted on several historical maps or photographs along the Beaver Slough bank of Beaver Island. These include:

- 1930s UMR Mosaic Dataset [Source: Iowa Department of Natural Resources (IADNR) and State of Illinois State Geological Survey]
- 1937 Orthophoto (Source: IADNR)
- 1969 Orthophoto (IADNR 1967-1974, color)
- 1991 Clinton and Camanche, Iowa Digital Raster Graphicss (Source: USGS)
- LiDAR- Collection Date: 13 Nov. 2007 (Source: Iowa State Web Map Service Server)

3. Project Access

- The Project is located on an island in the Mississippi River, so all access will be by water. Refer to Figure M-2 for nearby boat ramps.
- Albany Marina is located at 1st Avenue and Water Street, Albany, Illinois. The marina is maintained by the City of Albany and is a public boat ramp. It is unlikely that this ramp would be used for barges or equipment.
- Camanche Boat Ramp. There is a public boat ramp downstream on the Iowa side, just south of Camanche. It is owned in fee by the Government and an easement has been granted to the City of Camanche, Iowa for road, boat ramp, and parking purposes. See Attachment C, *Real Estate*, for additional information.

4. Project Staging Area. To Be Determined; likely at Camanche Boat Ramp

5. Public Access and Security. Safety and security are important parameters which would be detailed during the Design Phase. Of specific concern will be the coordination of regional hunting seasons with the construction season. A summary of limitations is provided in the Feasibility Report. The refuge boundaries and closed areas (during waterfowl hunting seasons) is provided in Attachment B, *U.S. Fish and Wildlife Service Refuge Boundaries.*

6. Water Quality Sampling. Water quality sampling may be required during dredging and excavation activities. Turbidity curtains will likely be required during aquatic excavations (Photograph M-1).

7. Water Level Information. Water level information is available at Rivergages.com and in Appendix H, *Hydrology and Hydraulics*.

8. Project Feature Names. The names of the backwater areas were generated from the navigation maps, historic maps, and maps provided in the Beaver Island books (Flippo, 1995, 2001).

9. Permits

a. Section 10/404 Permit. The Project will require a Section 10 and Section 404 permit, which will include Section 401 Water Quality Certification.

b. Sovereign Lands and Floodplain Permits. These permits, issued by the IADNR, will be applied for using the Joint Application Form.

c. National Pollutant Discharge Elimination System. The Contractor is responsible for obtaining the NPDES Storm Water Permit prior to initiating construction.

d. Refuge Special Use. The Government will apply for the Special Use permit during 100 percent Biddability, Constructability, Operability, Environmental and Sustainability review of contract documents. Once the Government receives the permit it will be added to the specifications

10. Utilities. A pipeline and overhead power lines bisect Beaver Island. Refer to Attachment C, for more information and maps. No Project features selected in the Recommended Plan will impact these utilities.

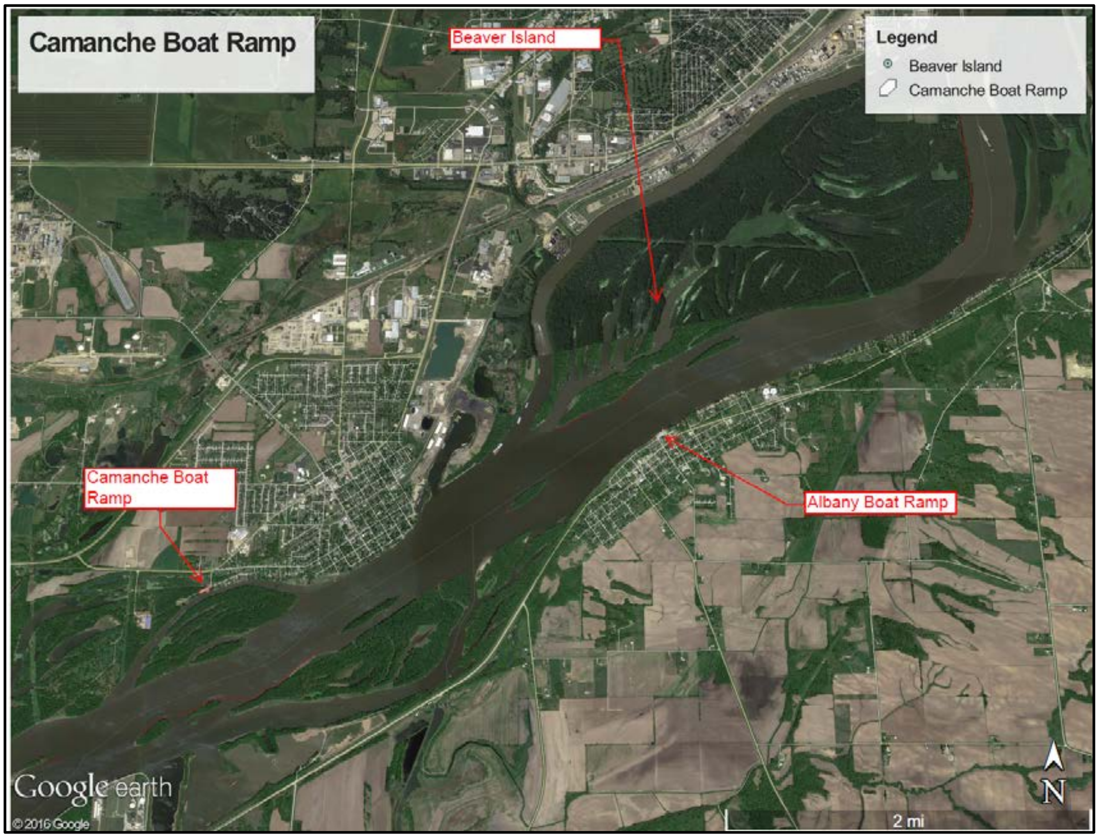


Figure M-2: Nearby Boat Ramps

Photograph M-1: Turbidity Curtain (Huron Island HREP Stage I)

B. Geotechnical Design. The complete geotechnical report can be found in Appendix G. *Geotechnical Considerations*.

C. Hydraulic Design. The complete hydraulics report can be found in Appendix H, *Hydrology and Hydraulics.*

- Information on climate change is provided in Appendix H
- Information on sedimentation rates can be found in Attachment E, *Sedimentation Report*

Numerous elements of the hydraulic design are included in the feature descriptions.

D. Water Quality Design. The complete report can be found in Appendix F, *Water Quality*.

E. Features. This section discusses potential enhancement features that will meet the goals and objectives outlined in the main report's Section III, *Problems and Opportunities*. These potential enhancement features were initially screened based on their contribution to the Project goals and objectives, engineering considerations, and local restrictions or constraints. Features that were determined not feasible or did not meet the Project objectives were not subject to further evaluation and are shown on Plate 9, C-104. Measures that will be evaluated further are found on Plate 8, C-103.

Numerous iterations of features were identified through the Project process. A summary of how these features evolved over time is provided in Attachment L, *Features Over Time*.

1. Aquatic and Topographic Diversity. Excavation has been proposed as a potential measure to provide suitable year-round habitat for fish, which includes critical overwintering habitat for centrarchid fish species. Excavation will also provide material to increase topographic diversity within the floodplain forest. Several potential areas in the Project area were evaluated for excavation.

a. General Design Criteria

- More topographic diversity
- More overwintering fish habitat
- Meeting Project goals and objectives
- Staying in the program authority
- Ensuring features consistent with management of refuge
- Matching state needs for fish
- Using scientific data
- Incorporating fish, bat, tree, heron, and mussel monitoring information
- Adjusting LIDAR/Bathymetry based on ground truth surveys
- Using ground survey information for quantities

- Staying in USACE recommended survey datum
- Incorporating foresters analysis regarding protection and improvement of this area
- Enabling bats to remain in their current roosting trees, allowing for bat reproduction
- Providing winter lodging for fish that is low flow and the proper depth
- Anticipating sedimentation over the Project life by adjusting dredging depths
- Not harming endangered mussels
- Keeping the surface water open
- Keeping connection to wetlands
- Improving wetlands
- Avoiding utilities
- Making sure the new and improved trees will survive
- Avoiding cultural sites
- Making sure this can actually be built
- Avoiding herons
- Working with the existing material types in the lakes
- Excavating some deep holes
- Widening some overwintering areas
- Planning for climate change
- Ensuring no removal of healthy trees
- Raising the ground where low value trees are to make suitable habitat for high value trees
- Making some areas wider and higher
- Following the existing topography
- Listening to requests from the public regarding usage of this area
- Cut and fill balancing
- Making all Project features look natural

b. Aquatic Diversity Design Criteria

- Preferred minimum width: 60 foot bottom or width of channel if less. Maximize dredge cut widths (IADNR/FWS Jan 2015)
- Full lake excavation where possible
- Channel slopes 4H:1V

- Allowable overwintering flow: as close to 0 as possible
- Connect cuts to deep water
- Place cuts in areas fish use
- Make dredge cuts deep enough that they do not freeze (habitat benefits for water depths over 4 feet)
- Make dredge cuts deep enough that they do not fill in during the 50-year period of analysis (expect 1.6 feet of sedimentation in 50 years)
  - Overwintering depth of 6 feet plus 2 additional feet for sedimentation
  - Connection depth of 4 feet plus 2 additional feet for sedimentation
  - Hole depth of 8 feet plus 2 additional feet for sedimentation
- Information regarding fishery substrate recommended by the IADNR is located in Attachment F, *Fish Habitat.*

c. Hydraulic Dredging. Bathymetric diversity was considered using a hydraulic dredge. The dredge could be smaller in size based on narrow channel widths, which would reduce the amount of return water created (Photograph M-2).

Photograph M-2: Small Hydraulic Dredge (Lake Odessa HREP Stage IIA)

Borings BI-14-01 through BI-14-03 were taken at the downstream end of Beaver Island (see Plate 4, B-101). Borings were approximately 14 feet deep from the top of water elevation. Below ground surface, a top layer of approximately 5 feet composed of soft lean clays and fat clays showed gradual change in stiffness with increased depth. Underlying this clay layer, until the bottom of the borings performed, is medium to fine sand approximately 4 to 6 feet down from ground elevation. Atterberg limit tests were performed on several of the clay samples gathered throughout the site, results for liquid limits ranged between 51 and 49, and plastic limits between 22 and 20.

BI-14-04 showed similar soils composition to those found on borings BI-14-01 through BI-14-03. BI-14-05 showed similar materials to those found in all the other borings, although the thickness of the top clay layer was significantly thinner than the one found on all the other borings. The difference in layer thickness can be directly correlated to higher flow velocity. This would not allow the fine sediment to deposit like it was observed in other Project areas.

These materials would be inefficient to hydraulically dredge. There is also significant woody debris in the channel that will make it difficult to use hydraulic techniques. Clay sized particles also settle slowly creating the need for larger confined disposal facilities, which would require larger placement sites. This measure will not be retained for further evaluation.

d. Mechanical Dredging. Bathymetric diversity was considered using a mechanical dredge. Mechanical dredging would necessitate adjacent placement, or handling materials multiple times. A floating excavator, barge mounted crane or barge mounted excavator could be used. For channels with a larger bottom width or long reach for placement of dredged material, a barge mounted crane with a bucket of sufficient size would likely be used. All areas proposed for dredging or excavation are surrounded by trees which overhang the pool, so tree clearing would be required prior to side casting the material. This method will be retained for further evaluation.

The following photographs provide examples of mechanical excavation methods which could be used.

Photograph M-3: *Floating Excavator (Lake Odessa HREP*)
Photograph M-4 *Lake Odessa HREP Stage IIB Barge Mounted Excavator*
Photograph M-5: *Pool 12 Overwintering HREP Stage I Bucket on Crane*
Photograph M-6: *Barge-mounted Crane with Clamshell Bucket (Peoria Islands*)
Photograph M-7: *Partially Drained Pool with Excavators (Huron Island HREP Stage I)*

Photograph M-3: Floating Excavator (Lake Odessa HREP)

Photograph M-4 Lake Odessa HREP Stage IIB Barge Mounted Excavator

Photograph M-5: Pool 12 Overwintering HREP Stage I Bucket on Crane

Photograph M-6: Barge-mounted Crane with Clamshell Bucket (Peoria Islands)

Photograph M-7: Partially Drained Pool with Excavators (Huron Island HREP Stage I)

e. Topographic Diversity Design Criteria. Topographic diversity sites were originally laid out as sites adjacent to the aquatic diversity sites. During the development of the Recommended Plan, additional design considerations such as bat habitat, diverse and non-diverse forest locations, heron rookeries, and existing contours were incorporated into the design. Other design considerations are as follows:

- Avoid diverse forest locations, and in some cases, avoid specific trees
- Place in areas with lower quality forest and lower elevations
- Maximize heights for planting survivability
- Do not impact the floodplain
- Minimize footprint

- Consider flat slopes for erosion control
- Provide sufficient capacity for dredge cuts
- Ensure sites can be constructed using typical construction equipment

Optimum elevations for tree survival were developed using forestry and hydraulics information. A result of this analysis is provided in Appendix H and outlined in Table M-2. Climate change analysis is also provided in Appendix H. Water surface elevations near RM 514 are outlined in Table M-3.

Table M-2: Topographic Diversity Berm Elevations

Design Criteria	Elevation w/o Climate Change (NAVD88)	Elevation w/ Climate Chang (NAVD88)
EFM 25% Exceedance Probability for **Minimally** Tolerant Species (**25** days inundation duration during growing season 4/15 to 10/15)	577.9 (578.7 MSL1912)	579.8 (580.6 MSL1912
EFM 25% Exceedance Probability for **Moderately** Tolerant Species (**35** days inundation duration during growing season 4/15 to 10/15)	576.7 (577.6 MSL1912)	578.3 (579.2 MSL1912

Table M-3: Water Surface Elevations at River Mile 514

Item	Elevation (NAVD88)
Flat Pool	571.2
Aquatic habitat benefits	<572.2
Floodplain habitat benefits	>572.2
50% exceedance of flood (2 year)	578.66
20 % chance exceedance of flood (5 year)	581.36
10% exceedance of flood (10 year)	583.3 NAVD88

All topographic diversity sites will require the existing trees, if present, to be cleared. Photographs M-8 through M-14 show typical clearing.

Photograph M-8: Typical Cleared Area (Huron Island HREP Stage I)

Photograph M-9: Tree Clearing Equipment (Huron Island HREP)

Photograph M-10: Tree Clearing Equipment (Huron Island HREP)

Photograph M-11: Tree Clearing Equipment (Huron Island HREP)

Photograph M-12: Tree Clearing Equipment (Huron Island HREP)

Photograph M-13: Tree Clearing Equipment (Huron Island HREP)

Photograph M-14: Trees Being Transported from Island to Offsite Disposal Location (Huron Island HREP)

Cleared trees shall be removed from site, or utilized as fishery structures on site. Material excavated from the channels within Beaver Island will be placed to construct the site to an optimum elevation for tree survival (Photographs M-15 to M-17). The sites will either be sloped to drain, or will have +/- 1 foot elevation changes to create swales across the wider sites. Once shaping is complete, temporary seeding may be employed if permanent seeding cannot be planted immediately. Each topographic diversity location will be divided into ½ acre plots which will be planted with different tree sizes.

Photograph M-15: Huron Island HREP Stage I Transporting Excavated Material from Adjacent Placement Site to Forest Enhancement Site

Photograph M-16: Huron Island HREP Stage I Shaping Material Transported to Forest Diversity Site

Photograph M-17: Huron Island HREP Stage I Forest Diversity Site

The forest on Beaver Island has always been important as outlined by the description of the Beaver Island War.[1]

> "In the winter of 1842-43, there was burlesque war on Beaver Island. Albany had what was known as a town claim on the Island, whence the people took a great deal of wood, to which the people of Clinton County strenuously objected, claiming that it was on their side of the main channel, and the timber growing thereon belonged to them. Finally, to prevent further wood-cutting by Albany people, Deputy Sheriff Aiken, of Clinton County, with a string posse, heavily armed, came down to the Island fully determined to expel the Albany wood-choppers, and take such energetic and complete possession as would prevent future trespassing. Couriers brought to Albany the news of this action of the Clinton County authorities, and, like angry bees from their hives, the people rallied, "not for their kingdom and crown," but to hold the fort of wood piles and timber at all hazards. Soon upward of fifty men, with a motley armament of rifles, muskets, pistols, swords, pitchforks and other deadly weapons, including loaded bottles, crossed the river and succeeded in effecting a landing unopposed. The bravest marched boldly up to a big fire which had been kindled by the Clintonians, and on one side of which the latter had taken position. A remarkable large proportion, however, preferred scouting duty, and so, deploying as skirmishers, took to the bush instead of advancing within point-blank range of a fusillade from their adversaries. Orders were given in loud enough tones to have echoed from the back bluffs on both sides for these stragglers to join the main body, but a pistol-shot, perhaps accidental, reduced the "scouts" to such a demoralized state that neither threats, orders or coaxing could induce them to change their tactics of "bushwhacking," What the result would have been is hard at this late day to determine, had not flags of truce been hung out on both sides, and the commanding officers of the two armies delegated to consult over the situation of the affairs and imitate the frequent action of Congress in ante-bellum days, by patching up a compromise. Long, loud and vehement were the arguments on both sides, but, finally, as night began to approach and both parties yearned for their firesides and war suppers, a compromise was effected by dividing the timber and allotting Albany 400 acres as her share. No sooner was this agreed to and rarified by hearty hand shaking and quaffing friendly pledges than the Illinois scouts emerged from their coverts and claimed their share of timber on the ground that their deploying as skirmishers was the reason for the Iowan partially yielding a point. For years the recounted, with the air of Falstaff relating his encounters with the men in buckram, the daring deeds when they faced the terrible champions of Clinton County, till in 1861, many of them went to do their duty on fields that proved to be indeed bloody."

[1] Allen, L. P., History of Clinton County, Iowa, Containing A History of the County, its Cities, Towns, Etc. and Biographical Sketches of Citizens, War Record of its Volunteers in the late Rebellion, General and Local Statistics, Portraits of Early Settlers and Prominent Men, History of the Northwest, History of Iowa, Map of Clinton County, Constitution of the United States, Miscellaneous Matters, Etc, Etc., Illustrated. Chicago IL; Western Historical Company, 1879

f. Planting Plans. The initial planting plan is attached to this document (Attachment I, *Forest Data*). This plan was revised in March 2016 by the District forester, biologist, Project engineer, and sponsor. Locations are provided in the feature summary discussed later in this document. Topographic diversity sites are shown on Plate 24, (L-102 Planting Plan). Each site is further detailed in this section. Additional information on plantings are shown on Plates 25 (L-103) through 30 (L-603).

Diversity in heights would be beneficial at some of the wider locations (+/- 1 foot in elevation to create "Swales"). Narrower placement sites will be sloped to drain, potentially with a higher elevation in the middle. Once shaping is complete, temporary seeding may be employed if permanent seeding cannot be planted immediately. Each topographic diversity location will be divided into ½ acre plots which will be planted with one size of tree (#3, #5, or #15). Tree species to be planted are shown in Table M-4. Tree wraps or other measures to prevent herbivory will be provided.

Table M-4: Forested Wetland Trees

#3 RPM (108 trees per acre)	
River Birch	*Betula nigra*
Northern Pecan	*Carya illinoinensis*
Shellbark Hickory	*Carya laciniosa*
Common Hackberry	*Celtis occidentalis*
Common Persimmon	*Diospyros virginiana*
Honey Locust	*Gleditsia triacanthos*
Kentucky Coffeetree	*Gymnocladus dioicus*
American Sycamore	*Platanus occidentalis*
Swamp White Oak	*Quercus bicolor*
Bur Oak	*Quercus macrocarpa*
Pin Oak	*Quercus palustris*
Overcup Oak	*Quercus lyrata*
#5 RPM (48 trees per acre)	
River Birch	*Betula nigra*
Northern Pecan	*Carya illinoinensis*
Shellbark Hickory	*Carya laciniosa*
Common Hackberry	*Celtis occidentalis*
Common Persimmon	*Diospyros virginiana*
Honey Locust	*Gleditsia triacanthos*
Kentucky Coffeetree	*Gymnocladus dioicus*
American Sycamore	*Platanus occidentalis*
Swamp White Oak	*Quercus bicolor*
Bur Oak	*Quercus macrocarpa*
Pin Oak	*Quercus palustris*
Overcup Oak	*Quercus lyrata*
#15 RPM (27 trees per acre)	
River Birch	*Betula nigra*
Northern Pecan	*Carya illinoinensis*
Shellbark Hickory	*Carya laciniosa*
Common Hackberry	*Celtis occidentalis*
Common Persimmon	*Diospyros virginiana*
Honey Locust	*Gleditsia triacanthos*
Kentucky Coffeetree	*Gymnocladus dioicus*
American Sycamore	*Platanus occidentalis*
Swamp White Oak	*Quercus bicolor*
Bur Oak	*Quercus macrocarpa*
Pin Oak	*Quercus palustris*
Overcup Oak	*Quercus lyrata*
MISCELLANEOUS	
TREE WRAPS (#3/#5 Trees)	
TREE WRAPS (#15 Trees)	

A typical Root Pruned Method (RPM) tree root is shown in Photograph M-18. A typical planting action for RPM trees is shown in Photograph M-19.

Photograph M-18: RPM Root Mass (Left) Compared to Bare Root Mass (Right) (FK Nursery Library 2012)

Photograph M-19: RPM Tree Planting in Field (Gardner Division HREP)

Forested wetland shrubs will be interplanted with the forested wetland trees (Table M-5). Understory seed mixture will be placed underneath the shrubs and trees (Table M-6).

A buffer mix to include seeds and stakes will be planted on the slopes approaching the planting areas. This mix should help reduce herbivory of the RPM trees (Table M-7).

Crop tree release, girdling and other measures are possible at this Project location.

Table M-5: Forested Wetland Shrubs

Common Name	Scientific Name
Common Buttonbush	*Cephalanthus occidentalis*
Red-Osier Dogwood	*Cornus stolonifera*
Silky Dogwood	*Cornus amomum*
American Elderberry	*Sambucus canadensis*
Northern Spicebush	*Lindera benzoin*
American Bladdernut	*Staphylea trifolia*

Table M-6: Understory Seed Mixture

125,000 seeds per acre	
Common Name	**Scientific Name**
Virginia Wild Rye	*Elymus virginicus*
Canada Wild Rye	*Elymus canadensis*
Partridge Pea	*Chamaechrista fasciculata*
Buttonbush	*Cephalanthus occidentalis*
Rice Cut Grass	*Leersia oryzoides*
Cardinal Flower	*Lobelia cardinalis*
Sneezeweed	*Helenium autumnale*
Swamp Milkweed	*Asclepias incarnata*

Table M-7: Buffer Area

Common Name	Scientific Name
Black Willow	*Salix nigra*
Cottonwood	*Populus deltoids*
River Birch	*Betula nigra*
Buttonbush	*Cephalanthus occidentalis*

2. Specific Measures

a. Lower Cut

i. Lower Cut Aquatic Diversity

(Potential Feature) The dredge cut would be excavated to provide aquatic diversity through the direct act of dredging and to provide sufficient material for floodplain forest topographic diversity. The entire width of this cut was considered to be excavated in the early planning stages, however, sufficient benefits were observed with a narrower channel width. This site would provide access into the Beaver Island interior as well as the numerous side lakes or channels. The cut was situated to ensure it will tie into deeper water in the main channel of the river, and placed in deeper water locations. A deep hole will be constructed within this dredge cut, approximately 100 feet long by 60 feet wide and an additional 4 feet deep. Material excavated from this site will be transported to a topographic diversity site. Refer to Table M-8 for more details.

Table M-8: Lower Cut Aquatic Diversity Input for the Incremental Cost Analysis (ICA)

Item	Quantity	Unit
Length	5,101	FT
Acres Below 4 Feet	11.37	AC
Quantity Excavated	110,189	CY
Bottom Width	100 feet (0 to 6+50), 60 feet (6+50 to end)	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

(ICA) This feature was retained for further evaluation.

(Recommended Plan) The dredge cut would be excavated to provide aquatic diversity through the direct act of dredging and to provide sufficient material for floodplain forest topographic diversity. This site will provide access into the Beaver Island interior as well as the numerous side lakes or channels. The cut was situated to ensure it will tie into deeper water in the main channel of the river, and placed in deeper water locations. A deep hole will be constructed within this dredge cut, approximately 100 feet in length by 60 feet in width and an additional 4 feet deep. Fishery structures such as woody debris or rock piles will be added to this area to provide a diverse habitat. Material excavated from this site will be transported to a topographic diversity site. This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- Narrower channel widths (bank to bank) on the upstream end reduced channel bottom widths from 60 feet to 50 feet wide.
- Wider channel widths on the downstream end of the channel (100 feet to 150 feet).
- Overall length was reduced since the Lower Lake feature was eliminated in the ICA and there was no need to connect with Lower Lake.

Refer to Table M-9 for more details.

Table M-9: Lower Cut Aquatic Diversity Input for the Recommended Plan

Item	Quantity	Unit
Length	3,800	FT
Acres Dredged	14.6	AC
Acres Below 4 Feet	13	AC
Quantity Excavated	124,590	CY
Bottom Width	150 feet (0+00 to 25+50), 50 feet (25+50 to end)	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

ii. Lower Cut Topographic Diversity (North and South Bank)

(Potential Feature) The topographic diversity site on the north bank would help prevent overland flow during flood conditions from entering the channel from Beaver Slough. This is a lower quality forest which would be cleared then constructed to optimum tree survival elevations. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

The topographic diversity site on the south bank was selected as one of the lower quality forest stands on the island. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-10 for more details.

(ICA) This feature was retained for further evaluation.

Table M-10: Lower Cut Topographic Diversity Input for ICA

Item	Quantity	Unit
Length – North Bank	696	FT
Length – South Bank	4,417	FT
Approximate Tree Clearing	19	AC
Topographic Diversity	30.5	AC
Quantity Capacity	184,300	CY
Average Width – North Bank	200	FT
Average Width – South Bank	200	FT
Average Top Elevation	579.80	NAVD

(Recommended Plan) The topographic diversity site on the north bank will help prevent overland flow during flood conditions from entering the channel from Beaver Slough. This is a lower quality forest which would be cleared then constructed to optimum tree survival elevations. This area would be planted. The site would be built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species

The topographic diversity site on the south bank was site was selected as one of the lower quality forest stands on the island. The wide footprint of this site will allow for variations in plantings, and minor variations in elevation height (+/- 1 foot) to provide small swales on top of the placement sites. This site would be cleared then constructed to optimum tree survival elevations. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The north bank placement site was lengthened to adjoin the boundaries of the Stewart Lake site in order to provide a contiguous forest improvement location.
- The south bank placement site was shortened such that the site was accessible via water through the Lower Dredge Cut.

- The south bank placement site was widened to provide a different forest enhancement feature. This lower quality forest can be significantly improved by increasing the overall height.

Refer to Table M-11 for more details.

Table M-11: Lower Cut Topographic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length – North Bank	1,950	FT
Length – South Bank	2,750	FT
Approximate Tree Clearing	43	AC
Topographic Diversity	42	AC
Quantity Capacity	155,800	CY
Average Width – North	90-245	FT
Average Width – South	229-500	FT
Average Top Elevation	579.80	NAVD88

b. Stewart Lake

i. Stewart Lake Aquatic Diversity

(Potential Feature) Stewart Lake is the furthest downstream inlet lake. The lake would likely be the first location fish enter, and possibly the last location fish exit during overwintering periods. Material excavated from this site would be transported to topographic diversity sites (likely Stewart Lake and Lower Cut-South Bank). Refer to Table M-12 for more details.

(ICA) This feature was retained for further evaluation.

Table M-12: Stewart Lake Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	1,695	FT
Acres Below 4 Feet	3.6	AC
Quantity Excavated	47,100	CY
Bottom Width	60	FT
Average Bottom Elevation	563.20	NAVD88

(Recommended Plan) Stewart Lake is the furthest downstream inlet lake. The lake will likely be the first location fish enter, and possibly the last location fish exit during overwintering periods. The cut will extend about halfway up Stewart Lake and encompass most of the lake width. Further excavation north into the lake is not recommended due to potential impacts to bats utilizing the forest on the upstream end of the lake. Fishery structures such as woody debris or rock piles will be added to this area to provide a diverse habitat. Material excavated from this site will be transported to topographic diversity sites (likely Stewart Lake and Lower Cut-South Bank). This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The overall length was shortened to reduce potential impacts on the upstream end to Northern Long-eared bats and to be located further away from a new heron rookery.

Refer to Table M-13 for more details.

Table M-13: Stewart Lake Aquatic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	800	FT
Acres Dredged	2.2	AC
Acres Below 4 Feet	1.7	AC
Quantity Excavated	21,700	CY
Bottom Width	60	FT
Average Bottom Elevation	563.20	NAVD88

ii. Stewart Lake Topographic Diversity (East and West Bank)

(Potential Feature) These sites would be located adjacent to Stewart Lane on the east and west banks. The sites were placed in areas of lower forest diversity, but adjacent to higher diversity areas. This site would be cleared then constructed to optimum tree survival elevations. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-14 for more details.

(ICA) This feature was retained for further evaluation.

Table M-14: Stewart Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length - West Bank	1,297	FT
Length – East Bank	508	FT
Approximate Tree Clearing	11	AC
Topographic Diversity	11	AC
Quantity Capacity	82,300	CY
Average Width	East 150, West 300	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) This site is located adjacent to Stewart Lake on the west bank. The site was placed in an area of lower forest diversity, but adjacent to higher diversity areas. The site was situated to ensure no harm will come to bats or herons. Most of the material at this location will likely come from the Stewart Lake dredge cut. This site would be cleared then constructed to optimum tree survival elevations. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The placement site-east bank of Stewart Lake was eliminated during Recommended Plan development to reduce the number of sites being cleared and to avoid short term forest fragmentation.

- The west bank site was shortened in length to reduce potential impacts to bats.

Refer to Table M-15 for more details.

Table M-15: Stewart Lake Topographic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	475	FT
Approximate Tree Clearing	4	AC
Topographic Diversity	4	AC
Quantity Capacity	19,800	CY
Average Width	300	FT
Average Top Elevation	579.80	NAVD88

c. Small Lake

i. Small Lake Aquatic Diversity

(Potential Feature) This potential feature involved dredging the entire lake to a depth of 8 feet below flat pool. Refer to Table M-16 for more details.

(ICA) This feature was retained for further evaluation.

Table M-16: Small Lake Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	718	FT
Acres Below 4 Feet	2.2	AC
Quantity Excavated	34,600	CY
Bottom Width	100	FT
Average Bottom Elevation	563.20	NAVD88

(Recommended Plan) This site was not selected following the ICA.

ii. Small Lake Topographic Diversity.

(Potential Feature) This site was located between Stewart Lake and Small Lake. The site was placed in areas of lower forest diversity, but adjacent to higher diversity areas. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-17 for more details.

(ICA) This feature was retained for further evaluation.

Table M-17: Small Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length	422	FT
Approximate Tree Clearing	3	AC
Topographic Diversity	3	AC
Quantity Capacity	14,000	CY
Average Width	150	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) The Project sponsor wanted to minimize the number of sites being cleared within the Project, therefore, this small site was removed from further consideration. This site was not selected following the ICA.

d. Blue Bell Lake

i. Blue Bell Lake Aquatic Diversity

(Potential Feature) The Blue Bell Lake dredge cut was selected to have varying widths of channel bottoms. A deep hole would be constructed within this dredge cut, approximately 100 feet in length by 60 feet in width and an additional 4 feet deep. Material excavated from this site would be transported to topographic diversity sites (likely Blue Bell-East and Blue Bell-West). Refer to Table M-18 for more details.

(ICA) This feature was retained for further evaluation.

Table M-18: Blue Bell Lake Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	1,708	FT
Acres Below 4 Feet	5.5	AC
Quantity Excavated	70,089	CY
Bottom Width	150 feet from Sta 0+00 to 10+00 and 18+00 to end, 60 feet Sta 10+00 to 18+00	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

(Recommended Plan) The Blue Bell Lake dredge cut was selected to have varying widths of channel bottoms, with the wider location on the lower end used to hold fish in the later winter months when oxygen levels are depleted. A deep hole would be constructed within this dredge cut, approximately 100 feet in length by 60 feet in width and an additional 4 feet deep. Fishery structures such as woody debris or rock piles would be added to this area to provide a diverse habitat. Material excavated from this site would be transported to topographic diversity sites (likely Blue Bell-East and Blue Bell-West). This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The overall widths were changed to better match existing contours.

Refer to Table M-19 for more details.

Table M-19: Blue Bell Lake Aquatic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	1,708	FT
Acres Dredged	6.2	AC
Acres Below 4 Feet	5.3	AC
Quantity Excavated	59,390	CY
Bottom Width	150 feet from Sta 2+00 to 10+00, 60 feet in all other locations	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

ii. Blue Bell Lake Topographic Diversity Sites (East and West Bank)

(Potential Feature) The west bank site is located between Small Lake and Blue Bell Lake. The site has a lower quality forest which would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

The east bank site is located between Blue Bell and Sand Burr Lakes. The site follows existing contours and is in a lower quality forest. The site would be adjacent to a higher quality forest which may help future regeneration in the area in addition to Project plantings. The site would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-20 for more details.

(ICA) This feature was retained for further evaluation.

Table M-20: Blue Bell Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length – West Bank	1,208	FT
Length – East Bank	575	FT
Approximate Tree Clearing	11	AC
Topographic Diversity	11	AC
Quantity Capacity	75,000	CY
Average Width – West Bank	200	FT
Average Width – East Bank	150	FT
Average Top Elevation	579.80	NAVD8

(Recommended Plan) The west bank site is located between Small Lake and Blue Bell Lake. The site has a lower quality forest which would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

The east bank site is located between Blue Bell and Sand Burr Lakes. The site follows existing contours and is in a lower quality forest. The site would be adjacent to a higher quality forest which may help future regeneration in the area in addition to Project plantings. The site would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The west bank site had the overall length reduced to avoid impacts to diverse trees.
- The east bank site was increased in length to increase heights in more areas of poor forest diversity.

Refer to Table M-21 for more details.

Table M-21: Blue Bell Lake Topographic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length – West Bank	1,030	FT
Length – East Bank	2,200	FT
Approximate Tree Clearing	23	AC
Topographic Diversity	25	AC
Quantity Capacity	135,500	CY
Average Width – West Bank	350-380	FT
Average Width – East Bank	140-440	FT
Average Top Elevation	579.80	NAVD88

e. Sand Burr Lake

i. Sand Burr Lake Aquatic Diversity

(Potential Feature) The Sand Burr Lake dredge cut was selected to have varying widths of channel bottoms, with the wider location used to hold fish in the later winter months when oxygen levels are depleted. A deep hole would be constructed within this dredge cut, approximately 100 feet in length by 60 feet in width and an additional 4 feet deep. Material excavated from this site would be transported to a topographic diversity site (likely Sand Burr, Blue Bell-East, and/or Lower Cut-South Topographic Diversity Sites). Refer to Table M-22 for more details.

(ICA) This feature was retained for further evaluation.

Table M-22: Sand Burr Lake Aquatic Diversity Input for ICA

Sand Burr Lake Aquatic Diversity		
Item	Quantity	Unit
Length	2,466	FT
Acres Below 4 Feet	6.8	AC
Quantity Excavated	88.190	CY
Bottom Width	60 feet Sta 0+00 to 17+00, 150 feet Sta 17+00 to end	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

(Recommended Plan) The Sand Burr Lake dredge cut was selected to have varying widths of channel bottoms, with the wider location on the upper end used to hold fish in the later winter months when oxygen levels are depleted. A deep hole will be constructed within this dredge cut, approximately 100 feet in length by 60 feet in width and an additional 4 feet deep. Fishery structures such as woody debris or rock piles would be added to this area to provide a diverse habitat. Material excavated from this site would be transported to a topographic diversity site (likely Sand Burr, Blue Bell-East, and/or Lower Cut-South Topographic Diversity Sites).

Refer to Table M-23 for more details.

Table M-23: Sand Burr Lake Aquatic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	2,466	FT
Acres Dredged	8.4	AC
Acres Below 4 Feet	6.8	AC
Quantity Excavated	88,190	CY
Bottom Width	60 feet from Sta 0+00 to 17+00, 150 feet from Sta 17+00 to end	FT
Average Bottom Elevation	563.20 (deep hole 559.20)	NAVD88

ii. Sand Burr Lake Topographic Diversity

(Potential Feature) The Sand Burr Lake site is located between Sand Burr and Hulzinger Lakes. The site would follow existing topography. The site would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-24 for more details.

(ICA) This feature was retained for further evaluation.

Table M-24: Sand Burr Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length	1,446 feet east side, 554.49 west side	FT
Approximate Tree Clearing	6	AC
Topographic Diversity	12	AC
Quantity Capacity	96,500	CY
Average Width	200	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) The Sand Burr Lake site is located between Sand Burr and Hulzinger Lakes and was reduced in size to limit impacts to higher quality forest on the north end. The site will follow existing topography and will ensure that an opening will remain between Sand Burr and Hulzinger Lakes for fish passage. The site would be cleared, then built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- The west side was eliminated.
- The east side was increased slightly in length to follow existing contours.

Refer to Table M-25 for more details.

Table M-25: Sand Burr Lake Topographic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	1,229	FT
Approximate Tree Clearing	6	AC
Topographic Diversity	7	AC
Quantity Capacity	40,100	CY
Average Width	150-295	FT
Average Top Elevation	579.80	NAVD88

f. Blue Bell to Sand Burr Lakes Aquatic Diversity

(Recommended Plan) This cut would be excavated to ensure that fish could pass between Blue Bell and Sand Burr Lakes dredge cuts, providing additional access and egress locations during overwintering and oversummering conditions. Material excavated from this site will be transported to a topographic diversity site (likely Lower Cut-South Bank Topographic Diversity Site). This site was developed during Recommended Plan selection as access concerns were raised with the initial layout of sites. The Project sponsor wanted to ensure that there were multiple access and egress points into the proposed aquatic diversity sites, and felt that this location was currently used by fish.

Refer to Table M-26 for more details.

Table M-26: Blue Bell to Sand Burr Lakes Aquatic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	361	FT
Acres Dredged	0.7	AC
Acres Below 4 Feet	0.5	AC
Quantity Excavated	5,400	CY
Bottom Width	30	FT
Average Bottom Elevation	563.20	NAVD88

g. Sand Burr to Hulzinger Lakes Aquatic Diversity

(Recommended Plan) This cut would be excavated to ensure that fish could pass between Hulzinger and Sand Burr Lakes dredge cuts, providing additional access and egress locations during overwintering and oversummering conditions. Material excavated from this site would be transported to a topographic diversity site (likely Sand Burr and Lower Cut-South Bank Topographic Diversity Sites). This site was developed during Recommended Plan selection as access concerns were raised with the initial layout of sites. The Project sponsor wanted to ensure that continued fishery access to the Hulzinger Lake Backwater Area was maintained. The original layout of the topographic diversity sites reduced the opening between these two finger lakes. By providing this additional excavation and relocating the topographic diversity sites, access to Hulzinger will be maintained.

Refer to Table M-27 for more details.

Table M-27: Sand Burr to Hulzinger Lakes Aquatic Diversity Input for Recommended Plan

Item	Quantity	Unit
Length	298	FT
Acres Dredged	0.7	AC
Acres Below 4 Feet	0.4	AC
Quantity Excavated	6,300	CY
Bottom Width	30	FT
Average Bottom Elevation	563.20	NAVD88

h. Lower Lake

i. Lower Lake Aquatic Diversity

(Potential Feature) Lower Lake would be excavated. Initially the entire lake was considered, then the cut was reduced to a 60 foot bottom width at a depth of 8 feet below flat pool. The cut was placed in the deepest part of the lake and would have connected the upper lake and lower cuts. Refer to Table M-28 for more details.

(ICA) This feature was retained for further evaluation.

Table M-28: Lower Lake Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	3,046	FT
Acres Below 4 Feet	6.4	AC
Quantity Excavated	66,700	CY
Bottom Width	60	FT
Average Bottom Elevation	563.20	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

ii. Lower Lake Topographic Diversity.

(Potential Feature) The Lower Lake site is located on the west end of the Lower Lake dredge cut. The site was to be placed in shallow lake depths and would follow existing topography. The site would be built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species.

There were concerns with reducing the open water in the Lower Lake and if the site passed the original ICA, alternative placement scenarios would need to be investigated. Refer to Table M-29 for more details.

(ICA) This feature was retained for further evaluation.

Table M-29: Lower Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length	3,108	FT
Approximate Tree Clearing	3	AC
Topographic Diversity	19	AC
Quantity Capacity	148,400	CY
Average Width	200	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

h. Upper Lake

i. Upper Lake Aquatic Diversity

(Potential Feature) Originally, the entire lake was considered for excavation, but the lake has filled in significantly and excavation in this area would be too substantial. Upper Lake was considered to be excavated, at a width of 60 feet, however only 6 feet below flat pool. The material would have been side cast. Refer to Table M-30 for more details.

(ICA) This feature was retained for further evaluation.

Table M-30: Upper Lake Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	3,500	FT
Acres Below 4 Feet	6.1	AC
Quantity Excavated	64,100	CY
Bottom Width	60	FT
Average Bottom Elevation	565.20	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

ii. Upper Lake Topographic Diversity

(Potential Feature) The Upper Lake site was adjacent to the dredge cut. Placement would be in very shallow water (lake is occasionally dry during summer drought conditions). The site would be built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-31 for more details

(ICA) This feature was retained for further evaluation.

Table M-31: Upper Lake Topographic Diversity Input for ICA

Item	Quantity	Unit
Length	3,311	FT
Approximate Tree Clearing	5	AC
Topographic Diversity	21	AC
Quantity Capacity	135,330	CY
Average Width	200	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

j. Deep Cut/Upper Cut

i. Deep Cut/Upper Cut Dredge Cut Aquatic Diversity

(Potential Feature) Deep Cut/Upper Cut would be excavated with a narrower bottom width to accommodate the existing channel footprint. The bottom elevation would be 6 feet below flat pool to reduce the amount of material excavated from this site. Refer to Table M-32 more details.

(ICA) This feature was retained for further evaluation.

Table M-32: Deep Cut/Upper Cut Aquatic Diversity Input for ICA

Item	Quantity	Unit
Length	7,112	FT
Acres Below 4 Feet	49.5	AC
Quantity Excavated	80,900	CY
Bottom Width	30	FT
Average Bottom Elevation	565.20	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

ii. Deep Cut/Upper Cut Topographic Diversity

(Potential Feature) The site would be a narrow site within the existing tree line and located on both sides of the channel. The site would be built to optimum elevations for tree survival. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and be surrounded by buffer species. Refer to Table M-33 for more details.

(ICA) This feature was retained for further evaluation.

Table M-33: Deep Cut/Upper Cut Topographic Diversity Input for ICA

Item	Quantity	Unit
Length	14,223	FT
Approximate Tree Clearing	5	AC
Topographic Diversity	13	AC
Quantity Capacity	111,952	CY
Average Width	30	FT
Average Top Elevation	579.80	NAVD88

(Recommended Plan) This feature was not selected following the ICA.

k. Beaver Slough to Stewart Lake Cut

(Potential Feature) A new cut would be created. Excavation (bottom) widths would be at 50 feet wide and to a depth of 8 feet below flat pool. The dredge cut would be excavated to provide aquatic diversity through the direct act of dredging and to provide sufficient material for floodplain forest topographic diversity. This would also provide increased flows into the interior complex by creating a direct connection with Beaver Slough.

The mouth of the cut in Beaver Slough was moved away from a shoaling area noted from OD-T surveys, and ensured any added velocities were at the downstream end of the Project, thereby protecting overwintering fish from velocities in the winter. See Attachment J, *Beaver Cut*, for location of sediment deposition areas).

Several potential cut locations, as shown in Attachment J, were considered, including a cut leading from:

- Beaver Slough, through the Island, and back out to Beaver Slough
- Beaver Slough to Lower Cut
- Beaver Slough to Stewart Lake
- Beaver Slough to Blue Bell Lake

Attaching the cut to an overwintering habitat created velocities too high for overwintering fisheries habitat. Concerns were also raised with allowing higher levels of sediment from Beaver Slough into the overwintering areas, causing them to fill in more quickly than designed. The only feature which might have been considered feasible was the Beaver Slough to Beaver Slough cut. This has a very low anticipated benefit for a very high cost, and was eliminated by the PDT from further evaluation. Notes regarding this are included in Attachment J.

(ICA) This feature was not retained for further analysis.

(Recommended Plan) N/A

l. Lower Cut (between Albany Slough and Lower Aquatic Diversity)

(Potential Feature) A deeper cut would be excavated (about 1,000 LF). Excavation (bottom) widths would be at 50 feet wide and to a depth of 8 feet below flat pool. The dredge cut would be excavated to provide aquatic diversity through the direct act of dredging and to provide sufficient material for floodplain forest topographic diversity. This would also provide increased flows into the interior complex by creating a direct connection with the main channel. 4

(ICA) This feature was eliminated due to concerns with impacting mussel habitat on the navigation side of the island and to increasing flows on the interior of the island during overwintering months, harming overwintering habitat. This feature was not retained for further evaluation.

(Recommended Plan) N/A

m. Crappie Slough Cut

(Potential Feature) A deeper cut would be excavated (about 3,000 LF). Excavation (bottom) widths would be at 50 feet wide and to a depth of 8 feet below flat pool. The dredge cut would be excavated to provide aquatic diversity through the direct act of dredging and to provide sufficient material for floodplain forest topographic diversity. This would also provide increased flows into the interior complex by creating a direct connection with the main channel.

(ICA) This feature was eliminated due to concerns with impacting mussel habitat on the navigation side of the island and to increasing flows on the interior of the island during overwintering months, harming overwintering habitat. This feature was not retained for further evaluation.

(Recommended Plan) N/A

3. River Training Structures

a. River Training (Rock Closure) Structures. Closure structures have been proposed as a potential measure to improve aquatic habitat by deflecting sediment and reducing flows in the Project area. Closure structures are generally constructed with rock, though new design concepts involving woody material are being developed. Closure structures were identified for consideration at several sites in the Project area.

b. Beaver Island Closure Structure

(Potential Feature) The closure structure selected is at the upstream end of Upper Cut/Deep Cut and is adjacent to Beaver Slough. The structure would be constructed to reduce sedimentation into the site. Refer to Photograph M-20. Trees would be cleared at the tie in ends of the structure, and the structure would be constructed with riprap.

Photograph M-20: View in June 2015, Looking Downstream at Upper Cut/Deep Cut Entering Upper Lake and the Introduction of Sediment

(ICA) This feature was retained for further evaluation. Refer to Table M-34 for further details.

Table M-34: Beaver Island Closure Structure Input for ICA

Item	Quantity	Unit
Length (bank to bank)	252	FT
Upstream Slope	2	H:1V
Downstream Slope	3	H:1V
Approximate Tree Clearing	0.3	AC
Estimated Quantity	18,200	TN
Top Width	10	FT
Average Top Elevation	575.80	NAVD88

(Recommended Plan) This feature passed the ICA, and was later revised to address the following:

- Elevation increase to address intent to prevent flow down channel year round as sediment reduction feature.

Refer to Table M-35 for more details.

Table M-35: Beaver Island Closure Structure Input for Recommended Plan

Item	Quantity	Unit
Length (bank to bank)	252	FT
Upstream Slope	2	H:1V
Downstream Slope	3	H:1V
Approximate Tree	0.3	AC
Estimated Rock Quantity	5,000	TN
Top Width	10	FT
Average Top Elevation	Top of Bank (approx. 579.5 to 580)	NAVD88

Photograph M-21 provides an example of an emergent rock closure structure, although the photograph includes a notch which is not part of the proposed design at Beaver Island.

Photograph M-21: Notched Closure Structure (Gardner Division HREP)

c. Chevron (Albany Island)

(Potential Feature) This feature would protect Albany Island from further erosion, thereby protecting the adjacent mussel beds. Further details are provided in Table M-36 and in the Hydraulics Appendix. Refer to Attachment A, *Survey Data*, for a map showing the island loss (via perimeter) between 1974 and 2008.

Albany Island chevron was designed based upon the Oquawka Islands, Gardner Division HREP chevron (O&M funded), UMRR Handbook guidance, and design information provided by MVS. Initially the design height was based most similarly to that of Oquawka Islands (near 5% exceedance duration),

(ICA) This feature was retained for further evaluation.

Table M-36: Albany Island Chevron Input for ICA

Item	Quantity	Unit
Length (bank to bank)	682	FT
Upstream Slope	2	H:1V
Downstream Slope	2	H:1V
Approximate Tree Clearing	0	AC
Estimated Rock Quantity	10,600	TN
Top Width	6	FT
Average Top Elevation	578.5	NAVD88

(Recommended Plan) This measure would protect Albany Island from further erosion, thereby protecting the adjacent mussel beds. This structure is designed to be exceeded ~25% of the time. The design criteria (adopted from MVS) indicates a 30 percent exceedance duration, however to account for increasing stage durations due to a changing climate, the design elevation was slightly increased. The risk of increased exceedance duration to the performance of the Albany Island chevron posed by climate change is considered moderate to low.

The shape of the chevron should have a rounded nose (per recommendation from MVS). The opening between the chevron and Albany Island should be maintained (and not increased) relative to what is shown in the feasibility alignment, approximately 85 feet away from the island as measured orthogonally. The chevron is about 250 feet upstream of Albany Island at the furthest point. Civil parameters are shown in Table M-37.

Table M-37: Albany Island Chevron Input for Recommended Plan

Item	Quantity	Unit
Length (bank to bank)	717	FT
Upstream Slope	2	H:1V
Downstream Slope	2	H:1V
Approximate Tree	0	AC
Estimated Rock Quantity	5,300	TN
Top Width	6	FT
Average Top Elevation	575	NAVD88

Albany Island chevron was designed based upon the Oquawka Islands, Gardner Division HREP chevron (O&M funded at an HREP site), the UMRR Environmental Design Handbook (2012), and design information provided by MVS. Photograph M-22 shows the chevron being constructed at Gardner Division HREP.

Photograph M-22: Chevron Construction (Gardner Division HREP 2005)

Initially the design height was based most similarly to that of Oquawka Islands (near 5% exceedance duration), however after additional examination of blunt-nose chevron at Gardner Division HREP and extensive consultation with MVS, the design elevation was revised downward to ~30% exceedance duration. In order to provide greater resilience, the design was increased to ~25% exceedance duration based upon observed increases in stage duration and likely increases into the future. A crown width of 6 feet was identified based on guidance from MVS. A rock size of 450-lb stone with 2H:1V side slopes on the downstream side and 2H:1V side slopes on the upstream side were identified by MVR's Geotechnical Branch. Other recommendations include ensuring rock protection continues far enough on the riverside, downstream of where the structure ties-in to the island to ensure erosion will not take place. ~300 feet of rock protection should also be placed along the Albany Slough side of the island, along the chevron opening in order to prevent erosion along the Albany Island bankline due to chevron-overtopping flows that become concentrated as they egress through the chevron opening.

A mussel impact analysis was conducted in order to ensure construction of the chevron will not impact the existing mussel bed. The analysis was based on physical characteristics diagnostic of mussel presence as identified by Zigler et al. (2007). The physical characteristics identified in the author's Classification and Regression Tree (CART) Model included bed slope, shear stress and relative substrate stability (RSS, defined as the ratio of modeled shear stress to critical shear for erosion) under high, medium and low flow conditions. The premise of the analysis is that if the existing conditions indicate the presence of mussels, which we know exist, we can evaluate the with-chevron condition to determine whether or not the model indicates the presence of mussels or impacts to the known mussel bed. The results of the analysis, detailed in Appendix H, *Hydrology and Hydraulics,* indicated the presence of mussels is supported by the existing conditions and no significant impacts to those parameters were identified due to chevron construction.

This feature passed the ICA, and was later revised in the Recommended Plan to address the following:

- Chevron elevation was lowered. Please note that the higher elevation run through the ICA passed the floodplain analysis.
- Location and shape was changed. This also increased the overall length.

d. Bankline Protection (Albany Island –Head End)

(Potential Feature) Stone protection would be added to the upstream end of Albany Island, covering approximately 900 linear feet. This would tie into bankline protection on the Albany Slough side of the island.

(ICA) This measure was retained for further evaluation. Refer to Table M-38 for more details

Table M-38: Albany Island Bankline Protection – Head End Input for ICA

Item	Quantity	Unit
Length	900	FT
Slope	3	H:1V
Approximate Tree Clearing	2	AC
Riprap Thickness	2	FT
Estimated Quantity Riprap	4,900	TN
Bedding Thickness	1	FT
Estimated Quantity Bedding	2,700	TN
Average Top Elevation	580 (top of bank)	NAVD88

(Recommended Plan) This measure was not selected following the ICA.

e. Albany Island Bankline Protection (Albany Slough and Navigation Channel Banks)

(Potential Feature): Bankline Protection would be placed on the upstream end of Albany Island on the Albany Slough side. Bankline Protection would also be placed in areas of active erosion on the lower end, navigation side of Albany Island. On the downstream, navigation channel side of Albany Island the sponsor reported significant bankline erosion. They indicated the extent of this erosion is ~half the length of the island. There is limited survey coverage for this area; therefore, the AdH model does not capture the geometry with much accuracy. Cross sections of AdH-simulated velocities in the vicinity of the observed erosion do not illustrate attacking flows and velocity-induced erosion. Wind-driven waves are also not likely to be the cause. Vessel position density data do not support erosion due to navigational mooring or wave-action. It is likely that sustained high water results in soil saturation and subsequent felled trees are impacting the bankline stability. Photographs M-23 through M-27 show typical bank preparation and stone placement. Refer to Table M-39 for more details.

Photograph M-23: Bankline Shaping Prior to Receiving Rock Protection (Gardner Division HREP)

Photograph M-24: Rock Barge (Gardner Division HREP)

Photograph M-25: Rock Placement Following Shaping (Gardner Division HREP)

Photograph M-26: Transporting Rock from Barge to Bankline (Gardner Division HREP)

Photograph M-27: Riprap on Bedding Stone (Shot Rock) at Gardner Division HREP

(ICA) This measure was retained for further evaluation.

Table M-39: Albany Island Bankline Protection - Albany Slough and Navigation Channel Banks Input for ICA

Item	Quantity	Unit
Length (Upstream)	300	FT
Length (Downstream)	1,000	FT
Slope	3	H:1V
Approximate Tree Clearing (Upstream)	2	AC
Approximate Tree Clearing (Downstream)	2	AC
Riprap Thickness	2	FT
Estimated Quantity Riprap	1,700 (U/S)+9,000 (D/S)	TN
Bedding Thickness	1	FT
Estimated Quantity- Bedding	900 (U/S) + 4,900 (D/S)	TN
Average Top Elevation	580 (top of bank)	NAVD88

(Recommended Plan). This feature passed the ICA, and no substantial changes were made to the design. Refer to Table M-40 for more details

Some changes which can be pursued during design phase are as follows:

- Side slopes may be reduced to 1.5H:1V depending on surveyed conditions during design.
- Bedding stone may not be required depending on stone source selected during design.

Table M-40: Albany Island Bankline Protection - Albany Slough and Navigation Channel Banks Input for Recommended Plan

Item	Quantity	Unit
Length (Upstream)	300	FT
Length (Downstream)	1,000	FT
Slope	3	H:1V
Approximate Tree Clearing (Upstream)	2	AC
Approximate Tree Clearing (Downstream)	2	AC
Riprap Thickness	2	FT
Estimated Quantity Riprap	1,700 (U/S)+9,000 (D/S)	TN

f. River Training (Rock Closure) Structure – Albany Island. This measure includes the construction of a rock closure structure between Albany Island and Beaver Island. Construction of the closure structure would result in lower flows for fish resting habitat during overwintering conditions and could manipulate flows to improve mussel habitat. This structure would be constructed and could manipulate flows to improve mussel habitat. This structure would be constructed to 4 feet above flat pool, would have a top width of 10 feet, 2H:1V upstream slopes and 3H:1V downstream slopes. The length would be approximately 350 feet (from bank to bank). This feature was not selected for further analyses as constructing the structure could impact downstream mussel habitat.

g. River Training (Rock Closure) Structure – Beaver Island (Lower Lake). This measure includes the construction of a rock closure structure at the downstream end of Lower Lake where the channel narrows. Construction of the closure structure would result in lower flows for fish resting habitat during overwintering conditions and could manipulate flows to improve mussel habitat. This structure would be constructed to 4 feet above flat pool, would have a top width of 10 feet, 2H:1V upstream slopes and 3H:1V downstream slopes. The length would be approximately 300 feet (from bank to bank). This measure was not selected for further analyses as the cut off in this location was not deemed necessary for any habitat types.

h. Lower Cut Deflection Berm. A Lower Cut Deflection berm was considered at the downstream end of Beaver Island to reduce recirculation into the Lower Cut Aquatic Diversity Site. Based on further analysis (see Appendix H, *Hydrology and Hydraulics)*, this berm is not required. This feature was not retained for further evaluation.

i. Beaver Slough Cut Water Control Structure. This measure would include a screw gate or similar structure which would connect Beaver Slough to the proposed Beaver Slough Cut during winter conditions or during high flow conditions. If oxygen levels dropped, the structure could be opened to allow for oxygenation of the backwater area. Increased flows when the structure is opened may allow the channel to self-scour and maintain its depth better over time. This would only be constructed if the Beaver Slough Cut was excavated. The water control structure would need to be wider than the proposed “cut” which is estimated to be 50 feet at the bottom with 4H:1V side slopes. This feature was not considered for further analysis since the Beaver Slough Cut was removed from further consideration.

j. Crappie Slough Cut Water Control Structure. This measure would include a screw gate or similar structure which would connect the main channel to the proposed Crappie Slough Cut during winter conditions or during high flow conditions. If oxygen levels dropped, the structure could be opened to allow for oxygenation of the backwater area. Increased flows when the structure is opened may allow the channel to self-scour and maintain its depth better over time. This would only be constructed if the Crappie Slough Cut was excavated. The water control structure would need to be wider than the proposed "cut" which is estimated to be 50 feet at the bottom with 4H:1V side slopes. This feature was not considered for further analysis since the Crappie Slough Cut was removed from further consideration.

k. Lower Cut Water Control Structure. This measure would include a screw gate or similar structure which would connect the main channel to the proposed Lower Cut during winter conditions or during high flow conditions. If oxygen levels dropped, the structure could be opened to allow for oxygenation of the backwater area. Increased flows when the structure is opened may allow the channel to self-scour and maintain its depth better over time. This would only be constructed if the Lower Cut was excavated. The water control structure would need to be wider than the proposed "cut" which is estimated to be 50 feet at the bottom with 4H:1V side slopes. This feature was not considered for further analysis since the Lower Cut was removed from further consideration.

4. Wetland Development. Information and details regarding herpetology studies was coordinated among various team members. In April 2015, the USFWS investigated the existing wetlands (photographs are provided in Attachment G, *Herpetology Stud*y).

a. Upper Wetland/Herptile Site. This measure includes excavating about 1 acre to a depth of 3 feet below flat pool. Side slopes would be such as to encourage wetland plant growth. Excavated material would be side cast and slopes flattened for wetland growth. Top heights of the placed material would be between 3 to 8 feet above existing ground to protect the wetland from minor river elevation changes. Adjacent diverse forest areas would have limited impacts and clearing would be avoided other than that required to access the site with construction equipment. Due to the existence of similar wetlands in these areas, the Project sponsor does not want to see additional wetlands constructed as of July 2015.

b. Lower Wetland/Herptile Site. This measure includes excavating about 1.5 acres to a depth of 3 feet below flat pool. Side slopes would be such as to encourage wetland plant growth. Excavated material would be side cast and slopes flattened for wetland growth. Top heights of the placed material would be between 3 to 8 feet above existing ground to protect the wetland from minor river elevation changes. Adjacent diverse forest areas would have limited impacts and clearing would be avoided other than that required to access the site with construction equipment. Due to the existence of similar wetlands in these areas, the Project sponsor does not want to see additional wetlands constructed as of July 2015.

c. Grass Slough Wetland/Herptile Site. This measure includes excavating up to 23 acres to a depth of 4 feet below flat pool. Side slopes would be such as to encourage wetland plant growth. Excavated material would be side cast and slopes flattened for wetland growth. Top heights of the placed material would be up to 8 feet above existing ground to protect the wetland from minor river elevation changes. This feature was removed from further consideration due to its isolated location and numerous connections to influent water sources.

d. Buffalo Hole Wetland/Herptile Site. This measure includes excavating up to 11 acres to a depth of 4 feet below flat pool. Side slopes would be such as to encourage wetland plant growth. Excavated material would be side cast and slopes flattened for wetland growth. Top heights of the placed material would be up to 8 feet above existing ground to protect the wetland from minor river elevation changes. This feature was removed from further consideration due to its isolated location and numerous connections to influent water sources.

5. Mussel Habitat. Mussel surveys of the Project sites were conducted by all Project sponsors. More information on these surveys is included in the Beaver Island Feasibility Report, and in Appendix H, *Hydrology and Hydraulics*.

The design for mussel habitat was developed through the review of multiple documents. A summary of this review is included in Attachment H, *Mussel Data*.

a. Locations

i. Mussel Habitat – Albany Slough This area is located between Albany Island and Beaver Island. The addition of substrate in this slough was considered, however flows and anticipated sedimentation in this slough were not amenable to mussel habitat. Protection of Albany Island will protect this habitat from further degradation through other features. This feature will be retained for further evaluation.

ii. Mussel Habitat – Beaver Island. This area is located within the backwaters of Beaver Island, downstream of Lower Lake and extending to the confluence with Blue Bell Lake. This location was removed from further consideration since the primary mussel habitat was located in Albany Slough.

b. Albany Island Mussel Substrate. River stone sized to optimize mussel habitat will be added to the Albany Island bankline protection on the Albany Slough side. Refer to Table M-41 for more details.

Table M-41: Albany Island Mussel Substrate Input for ICA

Item	Quantity	Unit
Length (Upstream)	300	FT
River Stone Thickness	1	FT
Estimated Quantity	900	TN

This feature passed the ICA and no substantial changes were made to the Recommended Plan. Refer to Table M-42 for more details):

Table M-42: Albany Island Mussel Substrate Input for Recommended Plan

Item	Quantity	Unit
Length (Upstream)	300	FT
River Stone Thickness	1	FT
Estimated Quantity	900	TN

VI. ENVIRONMENTAL COORDINATION

A. Cultural Resources. Refer to the Beaver Island Feasibility Report for a summary of cultural resources and any restrictions for working in these areas. Project features were developed to avoid impact to these sites.

B. Endangered Species. Refer to the Beaver Island Feasibility Report for Threatened and Endangered Species and any restrictions for working in these areas. Project features were developed to avoid adverse impacts.

C. Hazardous, Toxic, and Radioactive Waste (HTRW)

- As required for all earth working projects in the Rock Island District, it is also recommended that the Environmental Protection specification section include requirements for HTRW testing of any material to be brought onto the site or removed from the site to ensure the material is not contaminated. If contaminated material is identified, Corps would stop work and follow the steps outlined in ER 1165-2-132.
- Historic photographs are located here and are included in Attachment K, *Photographs.*
- A Phase I HTRW ESA and screening samples were performed. No concerns were identified. Refer to Appendix E, *Hazardous Toxic and Radioactive Wast*e in the main report.
- Phase II HTRW ESA and screening samples were performed. No concerns were identified. Refer to Appendix E*, Hazardous Toxic and Radioactive Wast*e in the main report.
- If any evidence of recognized environmental conditions is discovered during construction activities, operations should cease until an assessment is performed at which the Phase I ESA will be revisited.
- Ensure all construction equipment is cleaned and free of soil residues, plant, pests, noxious weeds and seeds.
- Off-Site Soils. No soils can be removed from site unless tested. The analytical parameters that will be run on the soil can be seen in Table M-43

Table M-43: Soil and Materials Analytical Parameters

Volatiles Testing Requirements	
Item	Method
Volatiles	SW-8260B

Semi-Volatiles Testing Requirements	
Item	Method
Base/Neutrals Extractable Organics	SW-8270C
Acid Extractable Organics	SW-8270C

PCB Testing Requirements	
Item	Method
PCBs	SW-8082

Pesticides Testing Requirements	
Item	Method
Pesticides	8081A

Herbicides Testing Requirements	
Item	Method
Herbicides	8151

Metals Testing Requirements	
Item	Method
Antimony	6010 B
Arsenic	6010 B
Barium	6010 B
Beryllium	6010 B
Cadmium	6010 B
Chromium, total	6010 B
Chromium, hexavalent	6010 B
Cobalt	6010 B
Copper	6010 B
Lead, total	6010 B
Manganese	6010 B
Mercury	7471A
Nickel	6010 B
Selenium	6010 B
Silver	6010 B
Thallium	6010 B
Vanadium	6010 B
Zinc	6010 B
Boron	6010 B
Molybdenum	6010 B
Strontium	6010 B

TCLP Testing Requirements	
Item	Method
Arsenic	6010B
Barium	6010B
Benzene	8021
Cadmium	6010B
Chlordane	8081A
Chlorobenzene	8260B
Chloroform	8260B
Chromium	6010B
o-Cresol	8270C
m-Cresol	8270C
p-Cresol	8270C
2,4,D	8151A
1,4-Dichlorobenzene	8260B
1,2-Dichloroethane	8260B
1,1-Dichloroethylene	8260B
2,4 Dinitrotoluene	8270C
Endrin	8081A
Heptachlor	8081A
Hexachlorobenzene	8270C
Nitrobenzene	8270C
Pentachlorophenol	8270C
Pyridine	8270C
Trichloroethylene	8270C
2,4,5-Trichlorophenol	8270C
Methoxychlor	8081A
Methyl ethyl ketone	8260B
Mercury	7471A
Lindane	8081A
Lead	6010B
Hexachlorethane	8270C
Hexachlorobutadine	8270C
Tetrachloroethylene	8260B
Toxaphene	8081A
Silver	6010B
Selenium	6010B
2,4,6-Trichlorophenol	8270C
2,4,5-TP	8151A
Vinyl Chloride	8260B

VII. PROJECT SEQUENCING, QUANTITY ESTIMATE, COST, AND DURATION

A. Project Sequencing. Refer to the Beaver Island Feasibility Study Main Report.

B. Quantity Estimate. A detailed quantity estimate has been developed for all work.

C. Project Costs. Project Costs are summarized in the Main Report and Appendix I, *Cost Estimate.*

D. Project Duration. Refer to the Beaver Island Feasibility Study Main Report.

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

BEAVER ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 513.0-517.0
CLINTON COUNTY, IOWA

APPENDIX M

ENGINEERING DESIGN

DESIGN ATTACHMENTS

Beaver Island HREP

Appendix M

Design Engineering

Attachment A
Survey Data

CEMVR-EC-DN 29 August 2014

Memorandum for:
CEMVR-EC-T (Survey)

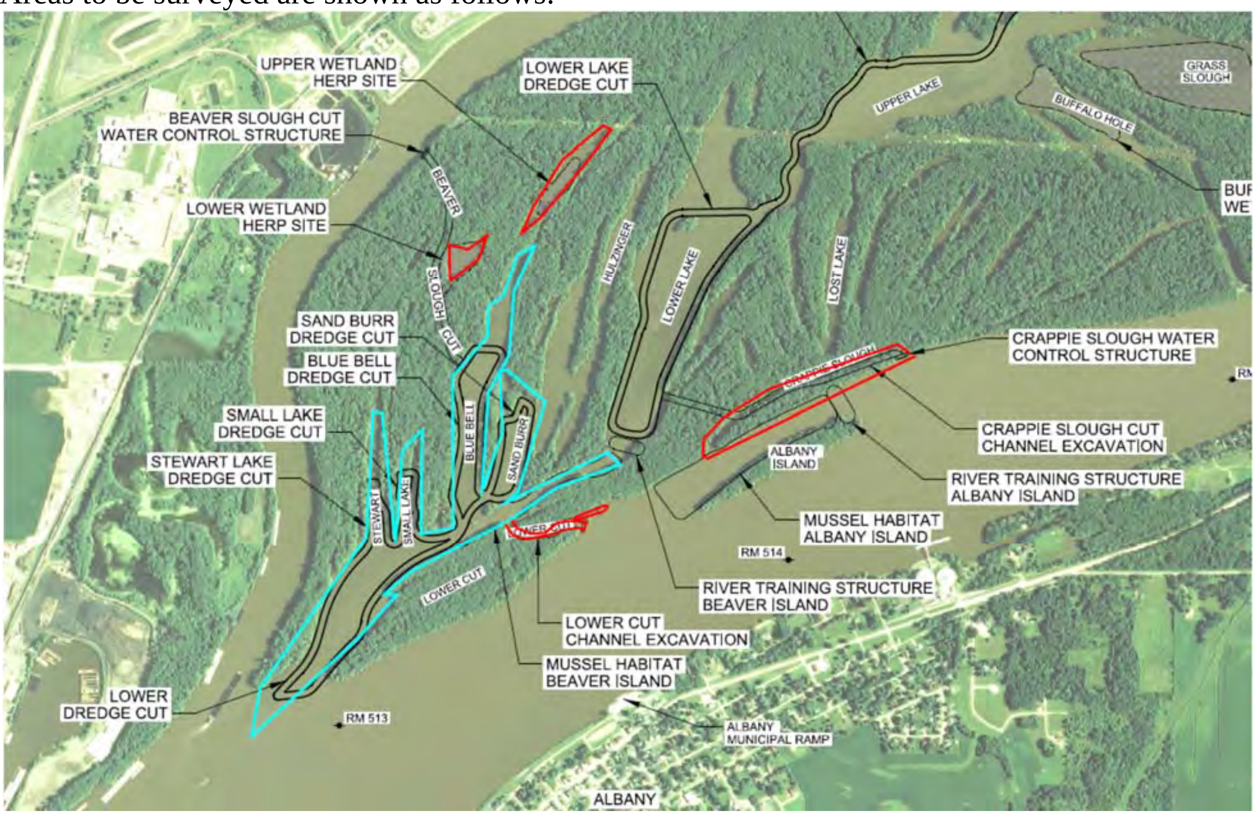
Subject: Beaver Island Survey Request

1. Beaver Island HREP is funded under the UMRR-EMP program. The project is in the feasibility stage of design. Preliminary project features have been identified.

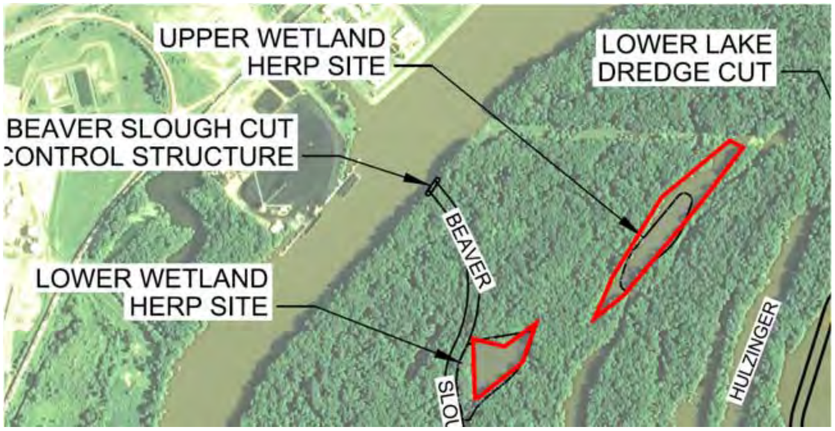
2. Based on the information provided below, please provide a cost estimate for this work. Please let me know if the work will occur in FY14 or FY15.

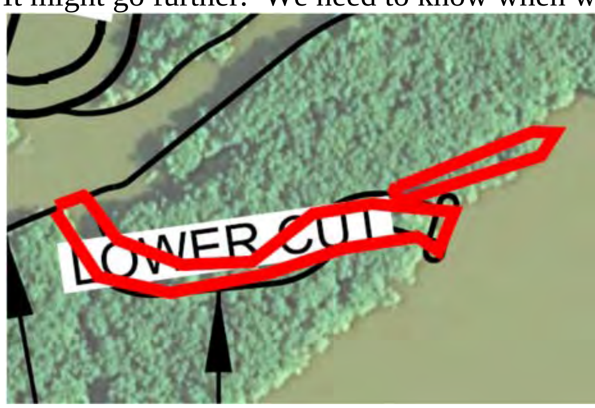
3. LiDAR survey and OD-T bathymetry has been obtained to date. However, there are several areas where dredging is proposed where we need more points to determine accurate quantities for dredging. These areas are shown on draft plate C102.

4. Areas to be surveyed are shown as follows:

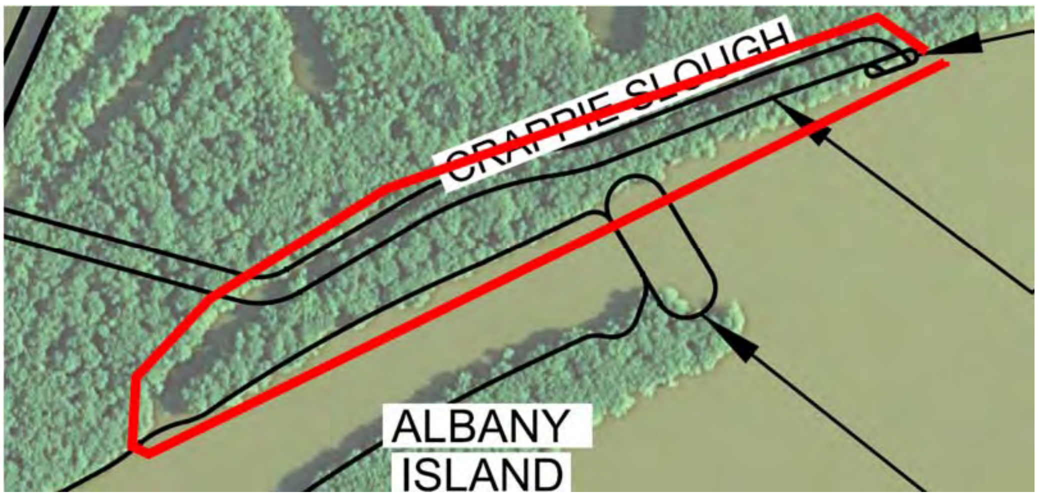


1

a. Upper Wetland Herp Site and Lower Wetland Herp Site:
   i. For these two sites we need enough points to figure out water locations, and the depths of these ponds. We would like survey in the open areas up to the end of the trees.
   ii. 

b. Lower Cut.
   i. There is a channel that cuts from the river to the interior. There is also a dry channel just upstream that connects from the river to the lower cut.
   ii. We need sufficient points to get the channel bottom, channel slopes, and extending up into the high banks on each side. Plan to extend at least 5-10 feet beyond the "top of bank". There is a sand bar on the river side of the cut, so please go out about 50 feet into the river to capture how far this sand bar extends. It might go further. We need to know when we reach deeper water.
   iii. 

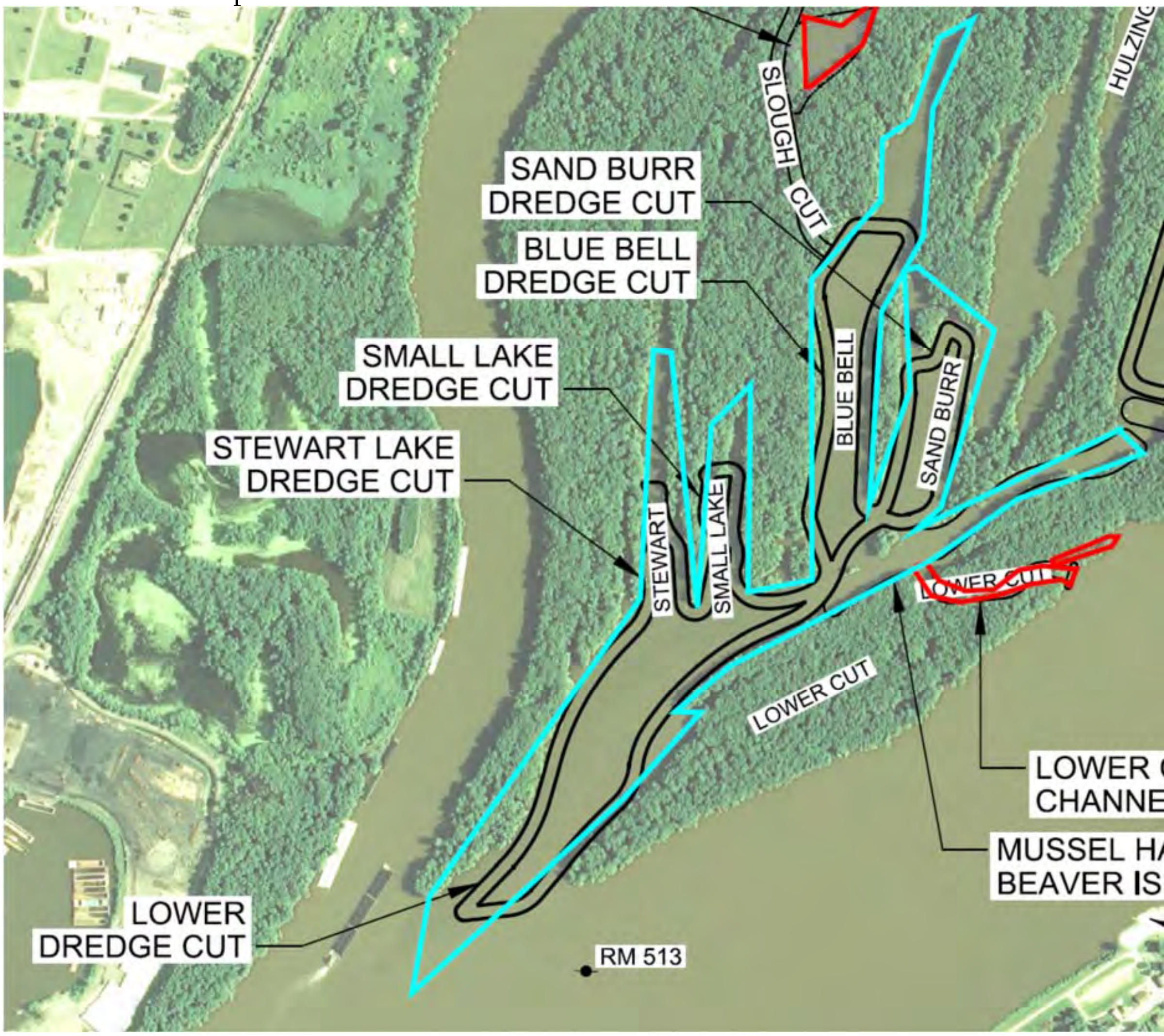
c. Crappie Slough.
   i. For the Crappie Slough cut there is an existing "channel" that starts in the river just across from upstream of Albany Island (on Beaver island), then cuts back out to the river (about half way down across from Albany Island).
   ii. We need sufficient points to get the channel bottom, channel slopes, and extending up into the high banks on each side. Plan to extend at least 5-10 feet beyond the "top of bank"on the interior, and plan to extend past the river bank into the river about 10 feet.
   iii.



   iv.

d. Dredge Cuts.

i. We have tried to find names for many of these dredge cuts. In this lower end we need good survey data of all of the water areas in the locations shown. We would like to get a good idea of the tree line location as well (as field sited, not as is shown on these aerials). Most of these seem to have gradual banks, but if a high bank is spotted, we would like the break lines for the elevated banks as well. Basically, if there are no trees in an area, we would like to know its elevation. Additionally, we need the survey to extend towards the main river (near RM 513) until it reaches deep water.

ii. 

5. Plates are located here on PW: [EP109_35%_fes-20140729]

6. Vertical datum is State Plane Coordinate system, IL west state plane, NAD 1983, US Survey Feet. Vertical datum is 1912.

7. Information obtained will be combined with existing data by PM-M (GIS) to make a DTM file and a TIN file.

8. Survey drawings (V) drawings need to be generated for the plan set by EC-T (survey).

9. Data will ultimately be used for INROADS quantity calculations and for hydraulic models.

10. Questions can be directed to Kara Mitvalsky.

POCs:
PM-M (GIS) Brandon Stevens
EC-H Lucie Sawyer
EC-DN Kara Mitvalsky/Emily Johnson

CEMVR-EC-DN 2015-01-09

Memorandum for Record: Beaver Island Meeting Minutes for January 8, 2015

1. The following personnel, indicated by an "x" were present at the meeting:

Name	Office	Present
Kara Mitvalsky	EC-DN (Project Engineer)	X
Lucie Sawyer	EC-H (H&H)	X
Brant Vollman	PD-C (Archeologist)	
Nate Richards	PD-P (Biologist)	
Jim Ross	PD-C (Archeologist)	
Brandon Stevens	PM-M (GIS)	X
Jason Appel	RE	
Mark Pratt	EC-C	
Steve Gustafson	EC-DN (HTRW)	
Emily Johnson	EC-DN (CAD Tech)	X
Dan Arends	EC-G	
Dave Bierl	EC-H (Water Quality)	
Elizabeth Bruns	EC-H (Water Quality)	
Richard Eberts	Econ	
Chris De Pooter	EC-TE (Cost)	
Dan Johnson	EC-TE (Survey)	X
Mike Scudder	EC-TE (Survey)	X
Pat Flynn	OC	
Jon Schulz	OD-T (Forester)	

Darron Niles	PD-F (Interim Study Manager)	
Monique Savage	PD-F (Study Manager)	
Mike Siadak	PM-M (GIS)	
Chuck Gerdes	PM-M (GIS)	X

2. The primary purpose of this meeting was to discuss the appropriate conversion to be used for the Beaver Island HREP (Pool 14, RM 513.0 to RM 515.5) to convert elevation data from NAVD1988 to MSL1912.

3. Project Datum Selection: The datums were selected on various factors, but in general were selected to match existing gage datums and an existing AdH model. This datum selection was coordinated with EC-H, PM-M (GIS), EC-DN, and EC-T (Survey) in 2013.

    a. Gage information:
        i. Existing gages near the project reference MSL1912, as established during construction of the Locks and Dams.
        ii. These gages include: L&D13, Camanche, and L&D14 gages. OD-T also references intermediate staff gages when collecting hydrosurvey data, such as the Princeton staff gage.
    b. AdH model.
        i. A model was created in 2008 and bathymetry was updated in 2014.
        ii. This model used the vertical datum of MSL1912.

4. EC-DN, in coordination with PM(GIS) and EC-H, sent a survey request to EC-T on 8/29/2014 .
    a. This survey request was done to obtain survey at locations where it was likely we would be constructing project features.
    b. Horizontal datum is State Plane Coordinate system, IL west state plane, NAD 1983, US Survey Feet. Vertical datum is 1912.
    c. A copy of the survey request memo is located here in Projectwise: 20140829 Beaver Island Survey Request.docx
    d. Survey work is nearly complete. A copy of the existing survey (contours) is located here:

    EP109_V-TB0001.dgn
    EP109_V-TB0001.dtm
    e. The survey was obtained in the 1988 vertical datum.

f. Mike Scudder explained how during the recent field survey data collection, the survey crew located amonument with an elevation established in MSL1912 (buried 4’ below the surface) on Beaver Island. This monument was surveyed to obtain an elevation in NAVD88 and a relationship to convert NAVD1988 to MSL1912 specific to the Beaver Island HREP. Additionally known 1912 “monuments” at Meredosia Pump Station, Lock and Dam 13, and Lock Dam 14 were surveyed in NAVD88 to obtain conversions.
g. Using the surveyed data from the monument, the survey data was converted from 1988 to 1912.

5. LiDAR data was obtained for UMRR EMP and is also being used for this project. This data was collected in NAVD88 vertical datum.
    a. The datum was converted to MSL 1912 by PM-M(GIS) using the information provided in the Figure 1 and Table 1.
    b. This conversion factor has been consistently used throughout the District. Lucie mentioned how the NAVD1988-MSL1912 conversion that we all (Survey, H&H and GIS included) have been using is displayed in the chart (and corresponding table) shown below (Figure 1 & Table 1). We also discussed the desire to update this conversion (table and chart) if MVR is collecting (or even as we collect?) more accurate conversion information.

c.

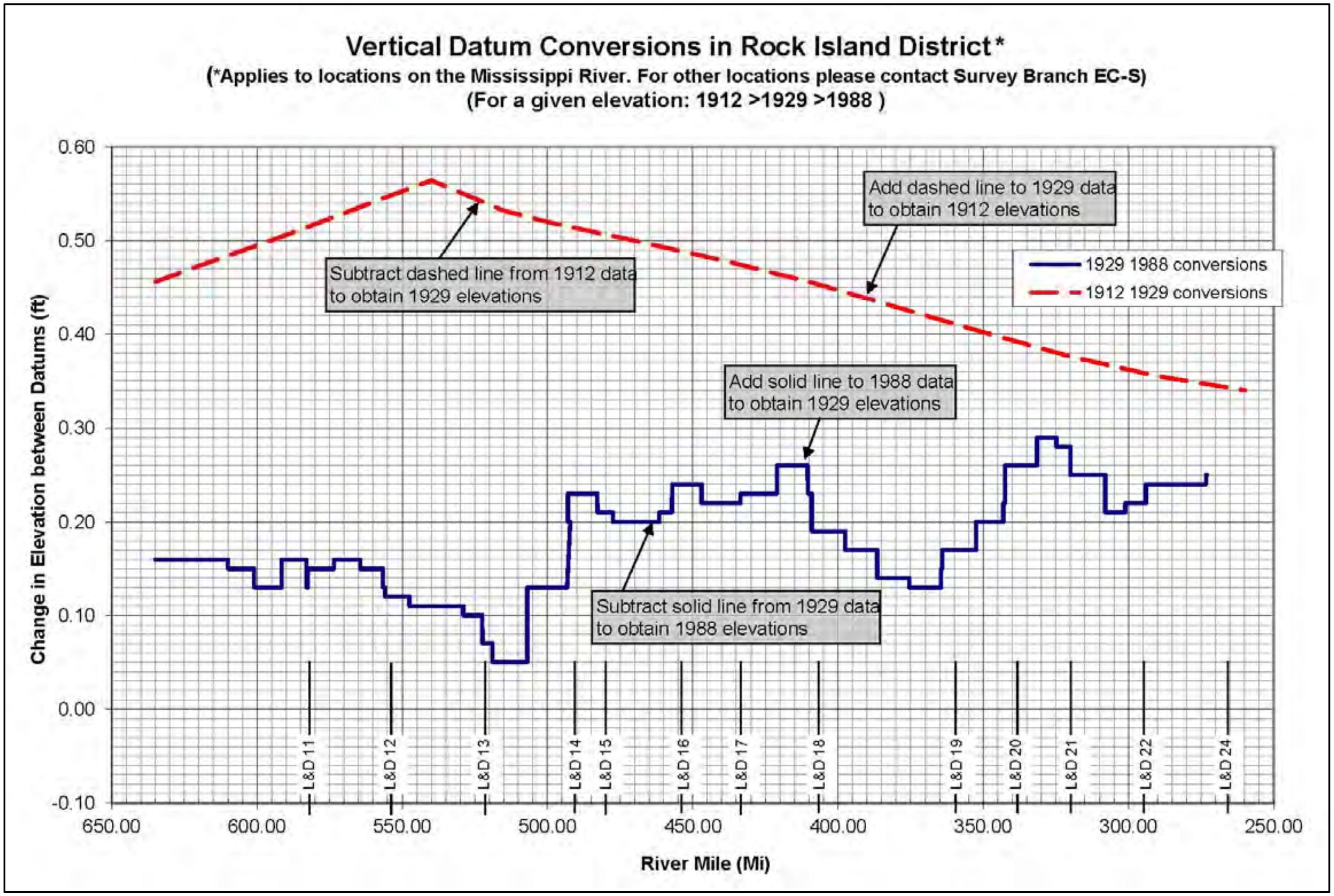


Figure 1. MVR Vertical Datum Conversion for Mississippi River.

4

	River Mile	Vertical Datum Adjustment 1988 to 1929 datum (ft)	River Mile	Vertical Datum Adjustment 1929 to 1912 datum (ft)
	635.00	0.16	635.00	0.46
	627.00	0.16	620.00	0.47
	618.50	0.16	590.00	0.51
	610.00	0.16	560.00	0.54
	609.99	0.15	540.00	0.56
	601.00	0.15	530.00	0.55
	600.99	0.13	515.00	0.53
	591.50	0.13	500.00	0.52
	591.49	0.16	470.00	0.50
Lock and Dam 11	**583.00**	0.16	440.00	0.48
	582.90	0.13	410.00	0.46
	582.50	0.13	380.00	0.43
	582.49	0.15	350.00	0.40
	573.50	0.15	320.00	0.38
	573.49	0.16	290.00	0.36
	564.50	0.16	260.00	0.34
	564.49	0.15		
Lock and Dam 12	**556.70**	0.15		
	556.60	0.13		
	556.00	0.13		
	555.99	0.12		
	547.50	0.12		
	547.49	0.11		
	537.00	0.11		
	536.99	0.11		
	529.00	0.11		
	528.99	0.10		
	522.50	0.10		
Lock and Dam 13	**522.40**	0.07		
	519.00	0.07		
	518.99	0.05		
	507.00	0.05		
	506.99	0.13		
Lock and Dam 14	**493.30**	0.13		
	492.20	0.20		
	493.00	0.20		
	492.99	0.23		
Lock and Dam 15	**482.90**	0.23		
	482.80	0.21		
	477.50	0.21		
	477.49	0.20		
	461.50	0.20		
	461.49	0.21		
Lock and Dam 16	**457.20**	0.21		
	457.10	0.24		
	447.00	0.24		
	446.99	0.22		
Lock and Dam 17	**437.10**	0.22		

Table 1. MVR Vertical Datum Conversion for Mississippi River.

6. Dan explained that the 1912 datum used at each L&D appears to be site specific, not for interpolation across a long reach (i.e. from L&D to L&D). He also mentioned how the conversion from NGVD1929 to NAVD1988 was applicable across large areas and well-established.

7. Lucie asked how widespread the improved (NAVD88 to MSL1912) conversion observations were.

a. Mike Scudder indicated that in addition to the revised NAVD88-MSL1912 conversion determined at Beaver Island, this had also been done at the Keithsburg HREP site (Pool 18).
b. Additionally, in 2010 Eisenbraun Consulting collected survey information at all of MVRs L&Ds and established a relationship between their new monuments and the existing monuments at each L&D (from MSL1912 to NAVD88).
c. Dan indicated that the results of the Eisenbraun conversion from MSL1912 to NAVD88 range from 0.3’ to 1’ across the Mississippi MVR locks. Nicole Manasco is working to plot up these new conversions relative to the conversions shown in Figure1 & Table 1. Survey indicated that there was not currently a plan (or funding) in place to improve NAVD88 to MSL1912 conversions systemically along the entire MVR-Mississippi River reach.

8. Lucie indicated that the hydraulic model could be converted to NAVD88. This would require using the original Lidar data for the project (collected in NAVD88), the newly collected survey data (collected in NAVD88) and converting the OD-T hydrosurvey data to NAVD88 (collected with reference to MSL1912 gages).The hydraulic model reach extends upstream and downstream of the Beaver Island HREP (RM 511.7 to RM 520.3).

9. Dan and Kara recommended the following:

   a. In order to get an improved conversion from MSL1912 to NAVD88 at the gages for conversion of the OD-T hydrosurvey, survey will obtain gage datum elevations in NAVD88 at the L&D13, Camanche, and L&D14 stream gages and the staff gage at Princeton, also used by OD-T. The results of EC-T (Survey) efforts are summarized in Table 2 provided by Dan Johnson.
   b. The original LiDAR data (collected in NAVD88) will be identified by Lucie & GIS and provided to EC-T (Survey).
   c. Lucie will work with OD-T & GIS to convert the OD-T data and provide to EC-T (Survey). (OD-T (Dan McBride) will be developing a workflow to come up with a more accurate conversion of the OD-T hydrosurvey to NAVD88 using surveyed elevations (in NAVD88) at the 4 gages, however this make take some time to develop. In order to avoid schedule impacts to Beaver Island Dan McBride recommended simply using the NAVD88 flat pool elevation at Pool 14 to use as a reference plane for conversion of OD-T datasets.)
   d. Survey will create a DTM of the Beaver Island HREP in NAVD88 using field survey data, LiDAR and bathymetry from OD-T, as provided.
   e. The DTM will be created in NAVD88.
   f. The DTM will be created for EC-DN the week of 1/20/2014.

10. Lucie will work with PM-M(GIS) to create a new terrain in NAVD88 using the new survey data from EC-T (Survey) for interpolation to the AdH mesh by 2/1/2014. The procedure developed by OD-T & PM-GIS for adjusting depth from Flat Pool in MSL1912 hydrosurvey data to depth from Flat Pool in NAVD88 for Pool 14 is as follows:
    I. Subtract the MSL1912 to NAVD88 adjustment factor obtained by EC-T (Survey) at each of the four gages (LD13 Tail, Camanche, Princeton staff gage, and LD14 Pool) from the MSL flat pool elevation for Pool 14 (572').
    II. In GIS assign this value as the elevation at each gage location flow frequency cross-section.
    III. Linearly interpolate elevations at each of the intermediate flow frequency cross sections.
    IV. Build a TIN surface from the flow frequency cross section elevations.
    V. Add the TIN elevation to the OD-T survey points (in depths from Flat Pool) to obtain the elevation of each OD-T survey point in NAVD88.

11. Assuming labor codes and funding is secure, the survey crew will go out the week of January 12th.

12. Please direct any questions to Lucie Sawyer at 309-794-5836 or Kara Mitvalsky at 309-794-5623. Notes were taken by the undersigned.

Lucie M. Sawyer, P.E.
CEMVR-EC-HQ

CF via email:
Beaver Island PDT

Pool 14 Conversions				
Gage Name	RM	Elevation MSL1912 from gage reading	Elevation NAVD88**	Conversion
LD13 Tail Stream Gage	522.4	591.87	590.88	0.99
Camanche Stream Gage	511.8	573	572.2 Water Surface	0.8
Princeton Staff Gage	502.1	563.5	562.58	0.92
LD14 Pool Stream Gage	493.3	577.5	576.76	0.74

**Elevation obtained by EC-TS on 1-13-15 & 1-14-15 using Trimble R8 Receivers with Trimble VRS correction and Trimble Digital Level

Gage Name	RM	Conversion
LD13 Tail Stream Gage	522.4	0.99
Camanche Stream Gage	511.8	0.8
Princeton Staff Gage	502.1	0.92
LD14 Pool Stream Gage	493.3	0.74

Table 2. Summary of EC-T (Survey) NAVD 88 elevation collection for Pool 14 gages.

CEMVR-EC-DN 2015-01-26

Memorandum for Record: Beaver Island Meeting Minutes for January 23, 2015

1. The following personnel, indicated by an "x" were present at the meeting:

Name	**Office**	**Present**
Heather Anderson	EC-DN	X
Kim Ferguson	INTERN	X
Emily Johnson	EC-DN (CAD Tech)	X
Dan Johnson	EC-TE (Survey)	
Kara Mitvalsky	EC-DN (Project Engineer)	X
Lucie Sawyer	EC-H (H&H)	X
Monique Savage	PD-F (Study Manager)	x
Mike Scudder	EC-T (Survey)	X
Mike Siadak	PM-M (GIS)	X
Brandon Stevens	PM-M (GIS)	

2. The primary purpose of this meeting was to discuss how assembling the three data sources is proceeding.

3. Mike Siadak converted OD-T data to NAVD1988.

4. Siadak merged the OD-T data with LiDAR data (already in NAVD 1988).

5. This data sent was sent to Siadak to Mike Scudder.

6. Scudder identified numerous "zeros" in the OD-T data and deleted them from the data set. These "zeros" were empty cells indicating a location with no elevation. Later, Siadak reviewed the data set and noted that the "zeros" or empty cells were not in the project area.

7. Scudder began merging GIS data set with the EC-T ground survey. This is a very large data set and was still running at the time of the meeting.

8. Scudder will compare the data which overlaps between either OD-T or LiDAR and the ground survey to see if there is any consistent inconsistencies. From Siadak's review of LiDAR in other locations, he feels that inconsistencies may be observed, but without a pattern to create a conclusion.

9. Siadak is gone the week of 1/26, so once Scudder has the information available in a DTM for EC-DN he will send the data to GIS. When Siadak returns we will meet to discuss any anomalies.

10. Siadak will use the data sets and create a larger TIN for EC-H upon his return.

11. It was recommended that future meetings invite Dan McBride from OD-T when discussing these data merges.

12. Kara pointed out that the OD-T data is helpful for planning, but since it is a data set covering over a decade, that it may not be the most accurate source for design.

13. Lucie indicated that the OD-T data was sufficient for the H&H model, as it is the best we have, and it would be cost prohibitive to obtain 9 miles of bathymetry for her modeling efforts.

14. A description of how all data is obtained and assembled will be prepared by the PDT.

15. Please direct any questions to Lucie Sawyer at 309-794-5836 or Kara Mitvalsky at 309-794-5623. Notes were taken by the undersigned.

Kara N. Mitvalsky, P.E.
CEMVR-EC-DN

CF via email:

Beaver Island PDT

CEMVR-EC-DN 2015-01-27

Memorandum for Record: Beaver Island Meeting Minutes for January 27, 2015

1. The following personnel, indicated by an "x" were present at the meeting:

Name	Office	Present
Heather Anderson	EC-DN	
Kim Ferguson	INTERN	
Emily Johnson	EC-DN (CAD Tech)	
Dan Johnson	EC-TE (Survey)	
Kara Mitvalsky	EC-DN (Project Engineer)	X
Lucie Sawyer	EC-H (H&H)	X
Monique Savage	PD-F (Study Manager)	
Mike Scudder	EC-T (Survey)	X
Mike Siadak	PM-M (GIS)	
Brandon Stevens	PM-M (GIS)	

2. The primary purpose of this meeting was to discuss how assembling the three data sources is proceeding.

3. Email from Mike Siadak regarding data (including links):

   Mike, I've reprojected and clipped the LiDAR, now in a text file (easting, northing, elevation) in IL State Plane West NAD83 Survey Feet, elevations Survey Feet NAVD88, located here: "\\mvrdfs\egis\Work\EMP\HREP_Projects\Beaver_Island\Data\Data_to_Survey_2015-01-21\lidar_beaver_island_clipped.txt"

   The hydrosurvey has also been reprojected to IL State Plane West and depths were readjusted to elevations in Survey Feet NAVD88 (also easting, northing, elevation) located here:

   "\\mvrdfs\egis\Work\EMP\HREP_Projects\Beaver_Island\Data\Data_to_Survey_2015-01-21\beaver_island_9mile_hydrosurvey_navd88.txt"

Thanks, Mike GIS

4. Scudder pulled in OD-T data and ground survey. Information is very consistent with each other and both data sets can be used. There is no survey of the upper cut or deep cut other than single points leading up the cuts from OD-T. INROADS will not likely be useable in this location, and rough quantity estimates will need to be developed by Kara. Scudder will merge these two data sets and provide a temporary DTM to Kara and Emily to use for the dredge cuts.

5. Scudder compared the LIDAR data to ground survey. The LIDAR data tried to come into the sytem in metric (i.e. elevations were 570 times 3), and projected to the incorrect location. Scudder reprojected and kept the information in feet. A comparison of the data points (various points along the island) consistently showed the LIDAR as reading higher (never lower), at some points over 3 feet higher. On average the difference was 1.5 feet higher.

6. Lucie mentioned that this LIDAR data set came from the State of Iowa. She also mentioned that the 2 year inundation maps based on LIDAR indicated that this island was showing as higher than Huron Island (a previous HREP that used LIDAR flown under UMRR).

7. Lucie will discuss with GIS, however, Siadak is on training until Monday, so resolution of the LIDAR may need to wait until then. Kara will set up a meeting.

8. Please direct any questions to Lucie Sawyer at 309-794-5836 or Kara Mitvalsky at 309-794-5623. Notes were taken by the undersigned.

Kara N. Mitvalsky, P.E.
CEMVR-EC-DN

CF via email:

Beaver Island PDT

Mitvalsky, Kara N MVR

From: Mitvalsky, Kara N MVR
Sent: Monday, May 18, 2015 11:13 AM
To: Sawyer, Lucie M MVR; Scudder, Michael L MVR
Cc: Johnson, Emily J MVR; Siadak, Michael W MVR; Gerdes, Charles A MVR; Johnson, Daniel J MVR
Subject: RE: Beaver Island: Albany Island Chevron Design (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: NONE

Do we have a new DTM that we can use for the chevron? Need to do run INROADS this week.

Thanks,

Kara

From: Sawyer, Lucie M MVR
Sent: Monday, May 11, 2015 9:32 AM
To: Scudder, Michael L MVR
Cc: Mitvalsky, Kara N MVR; Johnson, Emily J MVR; Siadak, Michael W MVR; Gerdes, Charles A MVR; Johnson, Daniel J MVR
Subject: FW: Beaver Island: Albany Island Chevron Design (UNCLASSIFIED)
Importance: High

Classification: UNCLASSIFIED
Caveats: NONE

Mike Scudder,

Please work with Mike Siadak to ensure that the surface you are pointing Kara to is using the same data that GIS used to develop the surface used in the hydraulic model
\\mvrdfs\egis\Work\EMP\HREP_Projects\Beaver_Island\Data\terrain_2015-03-10\terrain_adj_hydro_2015-03-10.gdb

All:
As I recall, following the meeting where it was decided that all of the Lidar data for Beaver Island should be dropped by 1.8 ft and the OD-T data from the interior of the Island would be dropped by 1 ft (based on comparison with field survey data), Mike Scudder made these data adjustments and sent this data to Mike Siadak. Siadak and Sawyer realized that all of the OD-T data (inside of the Island and outside of the Island) had been dropped by 1 ft. Siadak grabbed the original (un-adjusted) OD-T data for everything outside of the Island to create the terrain for the hydraulic model. I verbally communicated this to Kara and she indicated she was not concerned because she was only estimating quantities for the upstream closure. I don't believe that the need to correct all OD-T hydrosurvey data outside of the Beaver Island interior back to the original data ever got passed on to Mike Scudder.

Thanks,

Lucie

Mitvalsky, Kara N MVR

From: Mitvalsky, Kara N MVR
Sent: Tuesday, May 26, 2015 10:31 AM
To: Johnson, Daniel J MVR
Cc: Scudder, Michael L MVR; Johnson, Emily J MVR
Subject: FW: Beaver Island Survey (UNCLASSIFIED)
Attachments: Beaver Closure Structure.JPG; Chevron.JPG

Classification: UNCLASSIFIED
Caveats: NONE

Dan,

We need your crews to head out to Beaver Island and grab us a few more points at a proposed closure structure area and at the upstream end of Albany Island. Existing survey that we have are shown in the attached JPEG files.

Albany Island: We need points from where the water hits the island and extending at least 500 feet upstream of the island and continue over to the Beaver Island bank. The hope is to merge this with OD-T data which is currently located upstream. The footprint of the chevron is shown in the attached image.

Deep Cut Closure Structure: We have some survey here. If Mike can pull in enough LIDAR points to determine the side slopes of the upstream end of that channel, that would be great. Otherwise, if we need a few more field points, please have your folks grab them when they are out for Albany Island.

Please let me know if this is possible.

Thanks!

Kara

-----Original Message-----
From: Johnson, Emily J MVR
Sent: Friday, May 22, 2015 2:11 PM
To: Mitvalsky, Kara N MVR
Subject: Beaver Island Survey (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Kara -
I went to run the closure structure and this (attached photo) is all the survey we have for that area. I talked to Mike Scudder and he said he would look at it Tues and could possibly add in lidar, but I told him to touch base with you and see what you wanted to do. I am out Tues for a field trip, but will be back Wed.

Thanks!

Mitvalsky, Kara N MVR

From: Mitvalsky, Kara N MVR
Sent: Monday, June 01, 2015 11:36 AM
To: Johnson, Emily J MVR
Subject: FW: Beaver Island HREP Survey data (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

With this information you should be able to build the chevron.

Thanks!

From: Scudder, Michael L MVR
Sent: Friday, May 29, 2015 10:22 AM
To: Sawyer, Lucie M MVR; Siadak, Michael W MVR
Cc: Mitvalsky, Kara N MVR; Johnson, Daniel J MVR
Subject: RE: Beaver Island HREP Survey data (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

This time with the LINK: pw: Survey

-----Original Message-----
From: Scudder, Michael L MVR
Sent: Friday, May 29, 2015 10:17 AM
To: Sawyer, Lucie M MVR; Siadak, Michael W MVR
Cc: Mitvalsky, Kara N MVR; Johnson, Daniel J MVR
Subject: Beaver Island HREP Survey data (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Mike:

Please find link to the .txt files for the recent surveys at Beaver Island.

The "beaver_2015-147" and "beaver_2015-147B" file is all control work

Use: BEAVER15-147depths.txt, BEAVER15-147Bdepths.txt, AND BEAVER15-148.txt

Any questions just ask!

Mike
Survey

Classification: UNCLASSIFIED
Caveats: NONE

300 0 300 600 900
Scale 1" = 300'
Single Transducer Survey with 200 Foot Interval Coverage
Channel Contour Fill Legend:
-10 TO -1 FT
0 - 6 FT
7 - 8 FT
9 FT
10 FT
11 - 19 FT
20 - 29 FT
30 - 50 FT

Hydrographic Survey of the **Mississippi River** Ortho photography flown 1995
Horizontal Projection: State Plane, NAD1983, Illinois West - 1202 U.S. Survey Feet
Vertical Datum: MSL 1912 U.S. Survey Feet. All soundings adjusted to Flat Pool: 572.0
Water Surface at time of survey: 572.9 / Water Stage: +0.9 Feet

Survey Vessel: Launch Coot
Conducted by: Sam Hoover and Lee Schweiger
Processed in Autodesk LDDT by: Bob Adams on 20 Jul 2009
File Name: UMR_14_5135-5151_09A.dwg

US ARMY CORPS OF ENGINEERS
MVR - ROCK ISLAND DISTRICT
OPERATIONS DIVISION - TECH SUPPORT BRANCH

Albany Lower to Albany Upper

Survey Date: 8 Jul 2009
UMR / Pool 14 - Reach River Miles: 513.5 - 515.1

M/14

400 0 400 800 1200

Scale 1" = 400'

Single Transducer Survey with 100 Foot Interval Coverage

Peripheral Contour Color Fill Legend

-10' - -1' | 0' - 8' | 9' - 19' | 20' - 29' | 30' - 50'

2 FT MINOR:
5 FT MAJOR:

Hydrographic Survey of the **Mississippi River** Ortho photography flown 1995

Horizontal Projection: State Plane, NAD1983, Illinois West - 1202 U.S. Survey Feet
Vertical Datum: MSL 1912 U.S. Survey Feet. All soundings adjusted to Flat Pool: 572.0
Water Surface at time of survey: 572.6 / Water Stage: +0.6 Feet

Survey Vessel: Launch Coot
Conducted by: Jesse Corgan and Lee Schweiger
Processed in AutoCAD Civil 3D 2012 by Bob Adams on 13 Nov 2012
File Name: UMR_14_5125-5176_12A.dwg

US ARMY CORPS OF ENGINEERS
MVR - ROCK ISLAND DISTRICT
OPERATIONS DIVISION - TECH SUPPORT BRANCH

Beaver Island Slough

Survey Date: 8 Nov 2012

UMR / Pool 14 - Reach River Miles: 512.5 - 517.6

M/1-

500 0 500 1000 1500

Scale 1" = 500'

Single Transducer Survey with 250 Foot and Random Interval Coverage

Off-Channel Contour Fill Legend:

-10' to -1': 0' Depth: 50' Depth

Contour 566:
Contour 568:
Contour 570:
Contour 572:
Contour 574:

Hydrographic Survey of the **Mississippi River** Ortho photography flown 1995

Horizontal Projection: State Plane, NAD1983, Illinois West - 1202 U.S. Survey Feet

Vertical Datum: MSL 1912 U.S. Survey Feet. All soundings adjusted to Flat Pool: 572.0

Water Surface at time of survey: 576.8 / Water Stage: +4.8 Feet

Survey Vessel: Launch Coot

Conducted by: Chris Reger and Justin Coldwater

Processed in Autodesk LDDT by: Bob Adams on 5 Jun 2008

File Name: UMR_14_5129-5170_08A.dwg

US ARMY CORPS OF ENGINEERS
MVR - ROCK ISLAND DISTRICT
OPERATIONS DIVISION - TECH SUPPORT BRANCH

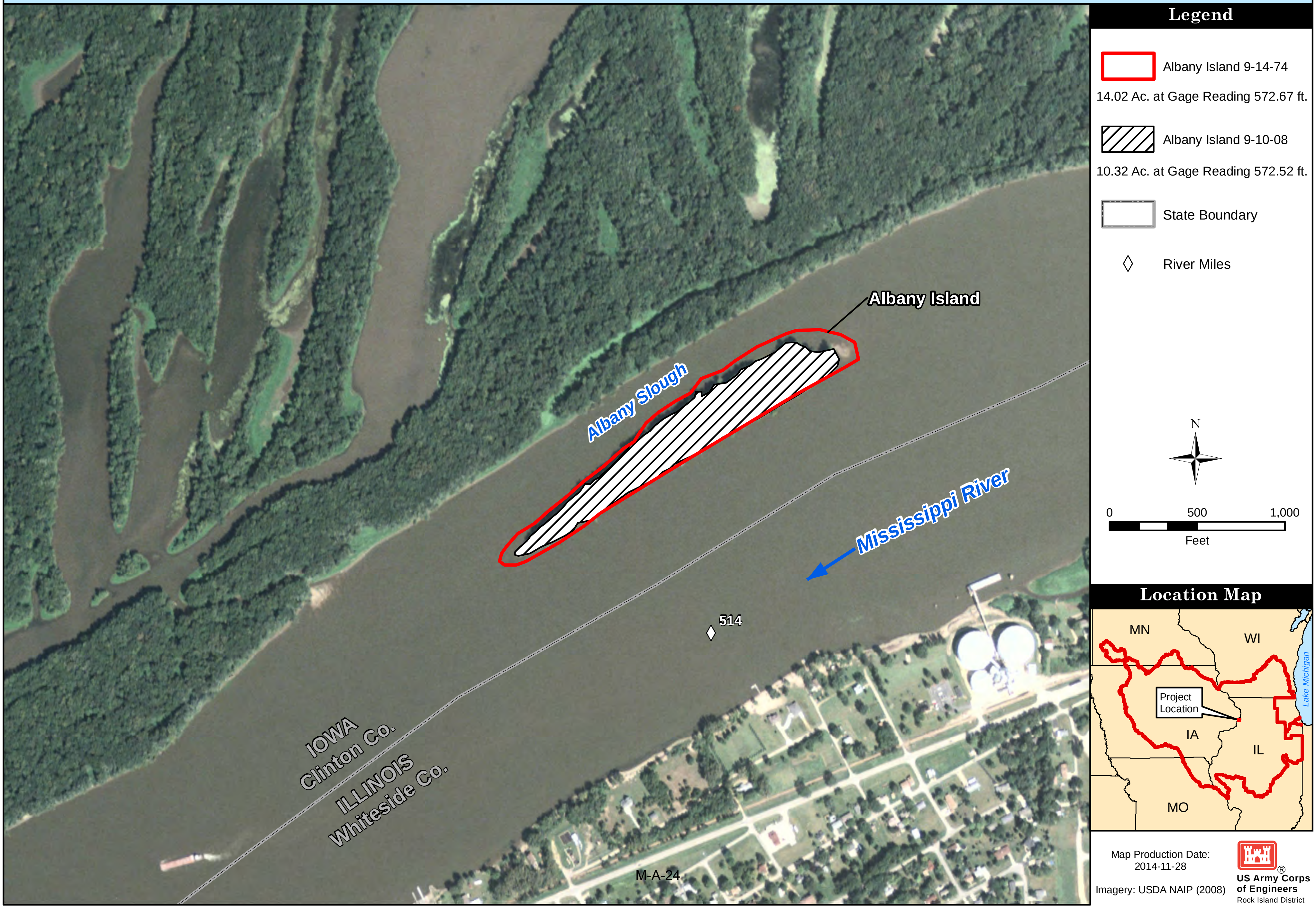
Beaver Island Inland Backwater

Survey Date: 29 May 2008

UMR / Pool 14 - Reach River Miles: 512.9 - 517.0

M/14

Beaver Island HREP - Albany Island Change



Map Production Date: 2014-11-28

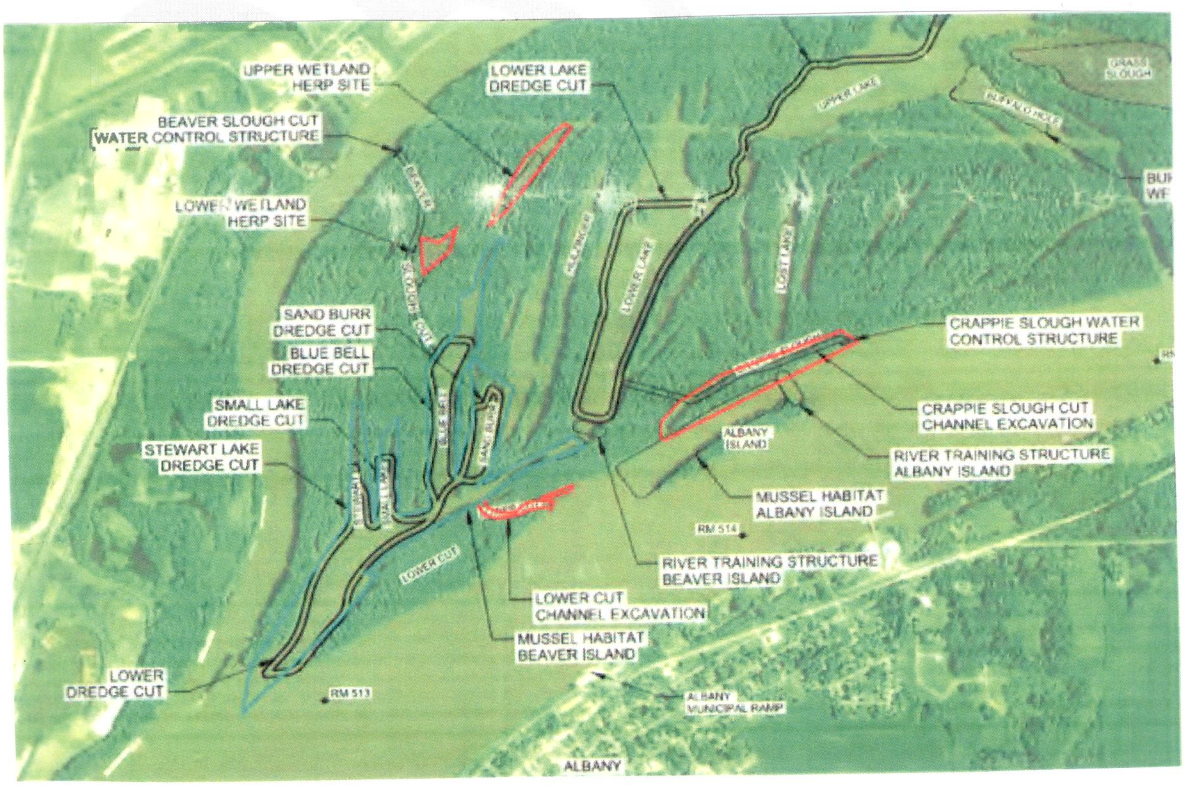
Imagery: USDA NAIP (2008)

US Army Corps of Engineers
Rock Island District

BEAVER ISLAND SURVEY

COMPARISION ~~OD~~ OF CONVENTIONAL SURVEY, LIDAR DATA, AND OD-T BATHYMETRY

BY: MVR SURVEY



2015 Beaver Island HREP EP109 Survey DTM formation description by Michael Scudder MVR Survey

The Data sets used in the formation of the .dtm (existing surface model) EP109_V-TB0006.dgn and .dtm for Beaver Island is a combination of data sets from MVR Survey, OD-T bathymetry, and State of Iowa Lidar .

Survey Data:

MVR Survey was on site at Beaver Island between November 12 and December 10th, 2014. The survey data set is a combination of GPS observations, conventional Total station work, and Manual Soundings (Dunks) as the site is mostly tree covered and backwater sloughs and lakes. Ice formation in these backwater lakes came early this year and hindered the survey progress. Areas of Blue Bell Lake where the water was very shallow had formed solid ice and no data was collected.

The Horizontal control for the site is based on NGS monument "WH 184 1A" PID AH3018 and is NAD 83 Ill West -1202, Vertical control was brought to the site by GPS and is NAVD 88 geiod 09 was used, and the units where us survey feet. The survey was originally intended to be displayed in MSL 1912 and an original 1930's benchmark MRC 160/3 located on Beaver Island approx 2 miles north of the survey was unearthed and Elevated in NAVD88 to obtain a correction factor of 0.88 feet (add correction to NAVD88 to obtain MSL 1912).Later the Team decided to represent the project in NAVD 88. Six secondary control points where set within the project area and a control sheet (v-101) was produced and resides in the "Sheets" folder in Project Wise

OD-T Data:

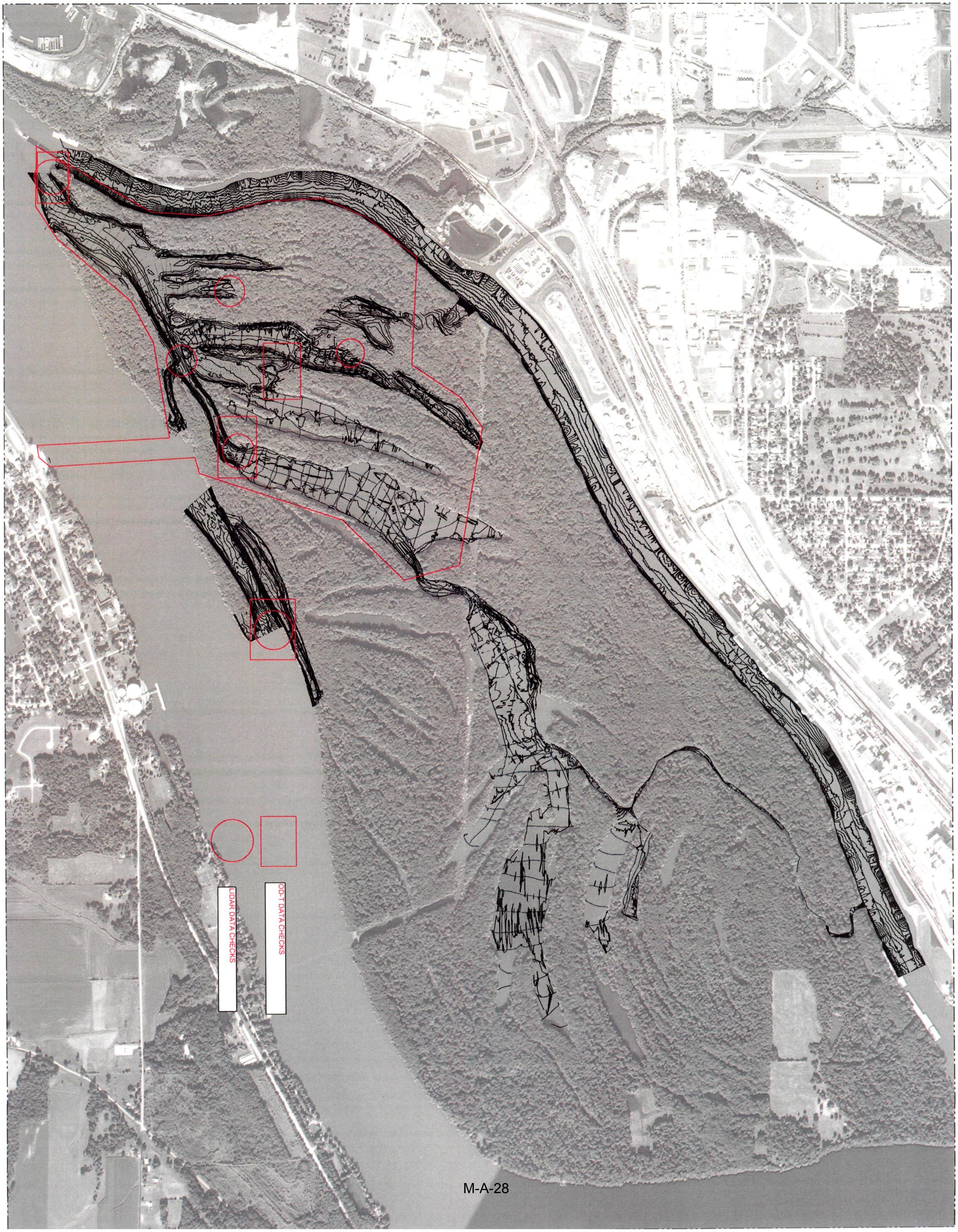
A xyz text file in NAD83 IL West, NAVD88, and survey feet of the entire 9 miles of OD-T data in pool 14 was obtained from the GIS group (10 MB) the data was converted by GIS from its 1912 depth basis to its current NAVD88 basis. It is believed that the OD-T data is a collection of surveys done over the last 10 years. Areas of overlap in the survey data where removed by GIS and the latest data sets used to complete the data set. Survey clipped this data down to the project extents and comparisons of areas that overlap with the conventional survey would indicate the data needs to be raised 1.0 feet.

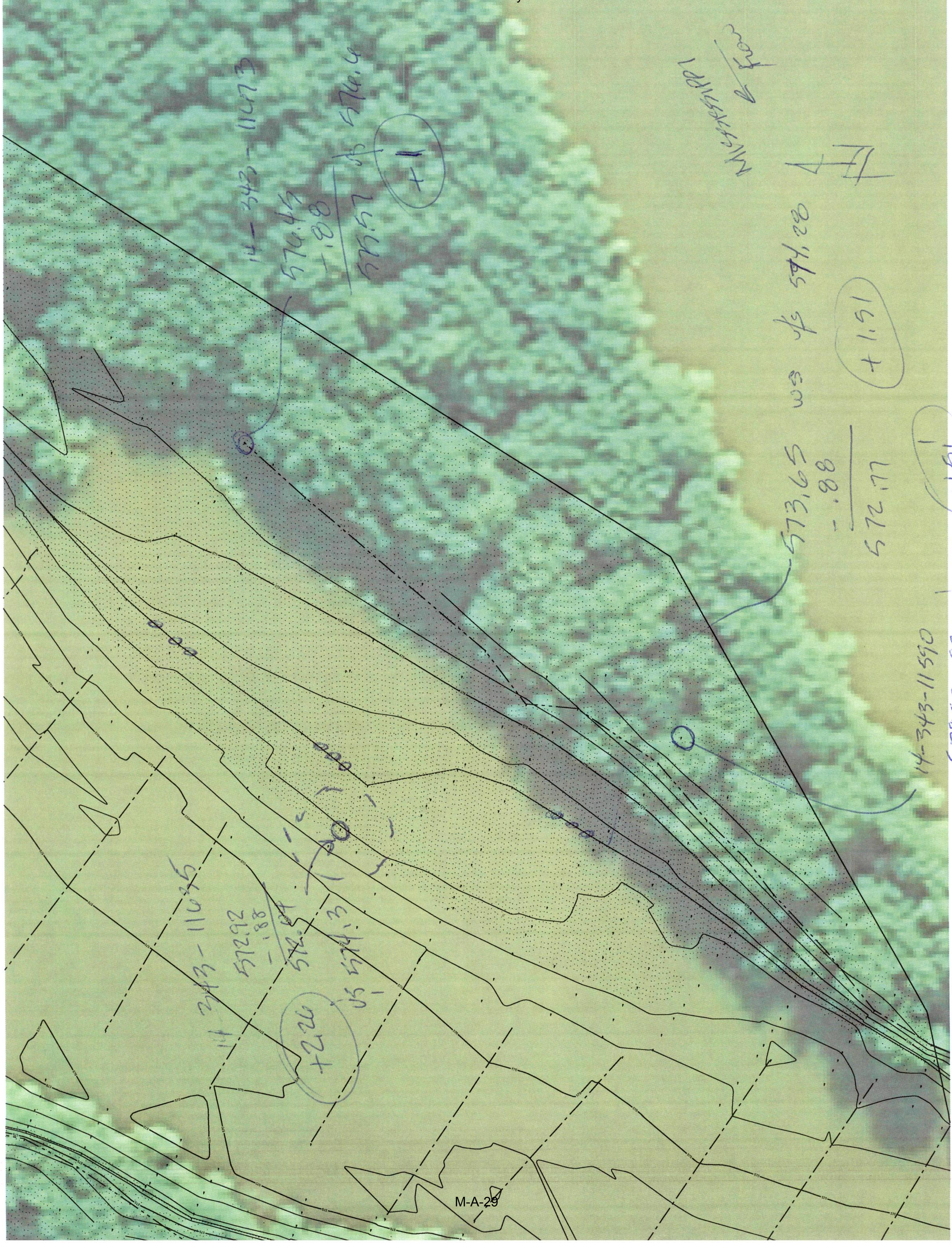
Lidar Data:

A xyz text file (25MB) being part of the latest bluff to bluff Lidar (thought supplied by state of Iowa to Lidar Consultant) and accurate to 0.12 meters was clipped by GIS to a shape supplied by Survey the shape resides in model file EP109_V-TB0001 and is approx 2 miles long with the river and ¾ miles across at the extreme lower end of Beaver Island. When a surface was made with the Lidar data and compared with the conventional Surveyed Data elevation comparisons resulted in an average shift upward in elevation of 1.8 feet. Points compared in each surface where carefully considered for location to be above the water line elevation of ~573.7 during Lidar collection and evenly distributed over project area in areas of overlap with the conventional survey data. The Lidar data does have some erroneous data in water areas like Sand Burr Lake and the South Cut, this data is approx 5 feet higher than the Flat pool and will be clipped out of the final surface. Meetings are scheduled to discuss the path forward with this data and more explanation will be added then.

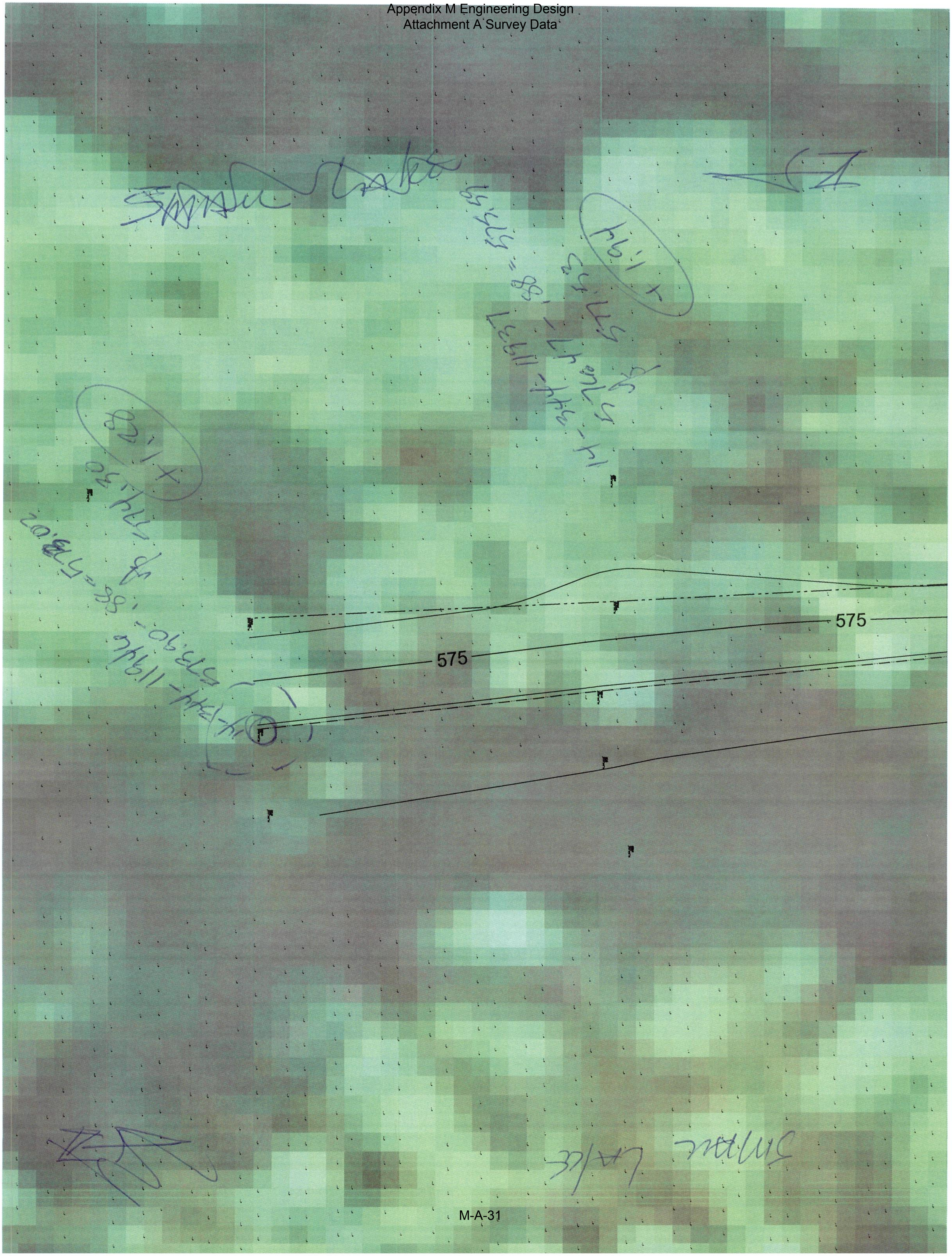
Combining Data:

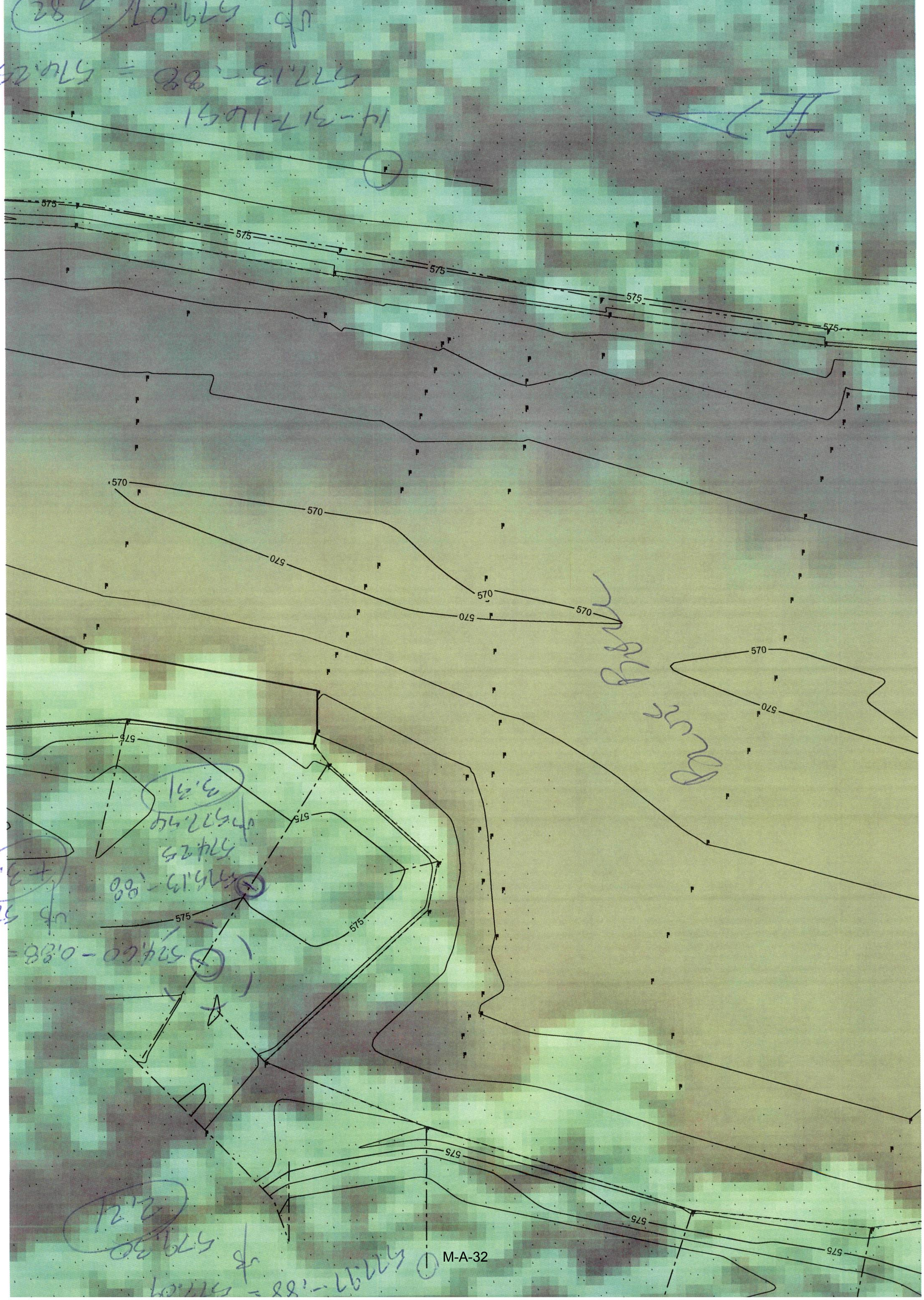
Data sets where very large and the surface was built in Microstation by using point cloud tools to convert the total combined data first to a .pod file (point cloud) that was brought into the Data Acquisition Tool and exported to a Inroads .dtm. The .dtm can then be opened in Inroads thru Microstation and Break Lines were added to best represent the data. Finally one foot contours where generated by Inroads to represent the data.

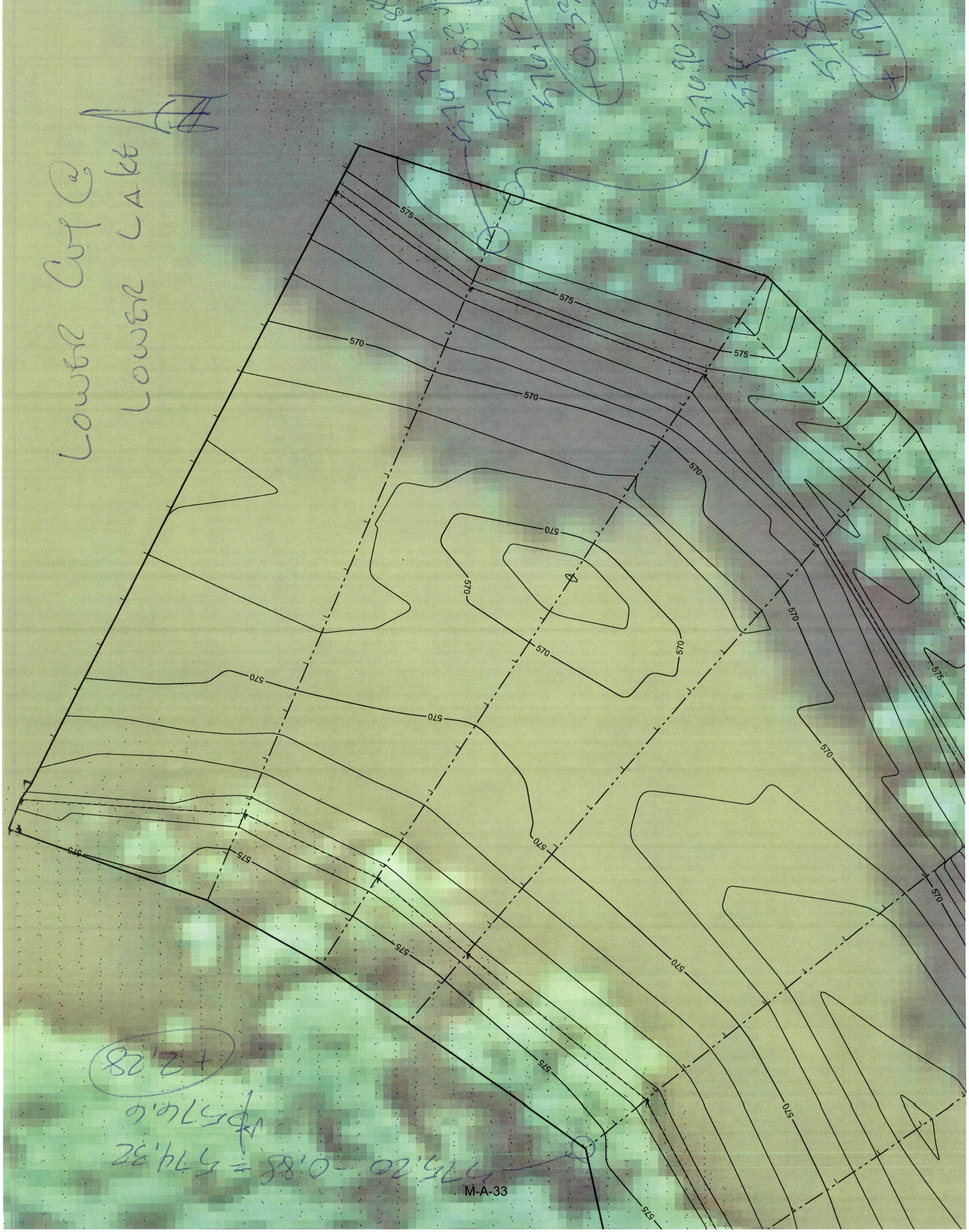

LIDAR DATA CHECKS
OD-T DATA CHECKS

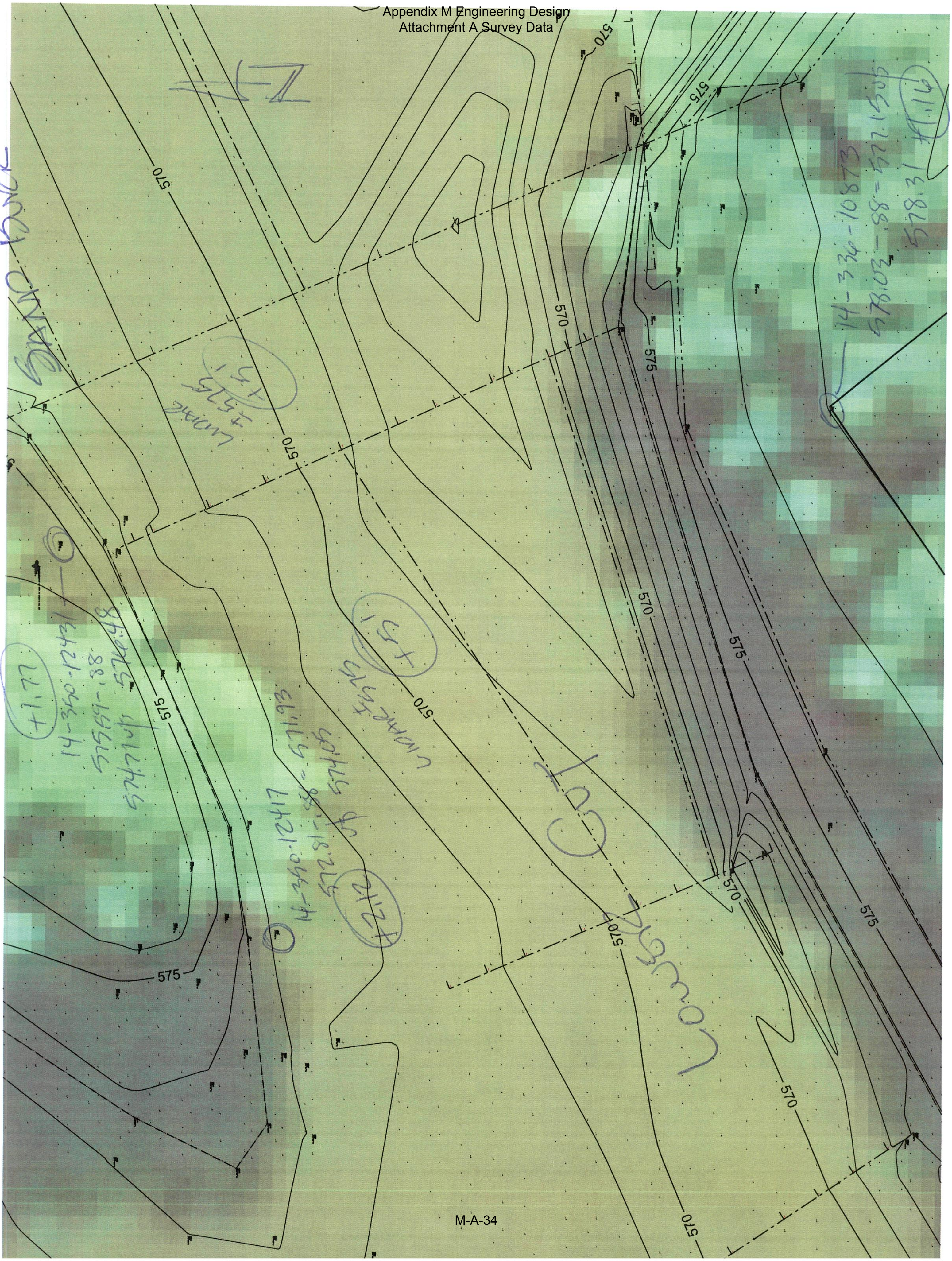

Mississippi flow
14-343-11673
574.45
-.88
573.57
us 574.6
+1
573.65
-.88
572.77
us 574.28
+1.51
14-343-11590
578.50 -.88 - us 579.18 +1.51
14-343-11075
572.92
-.88
572.04
us 574.3
+2.26

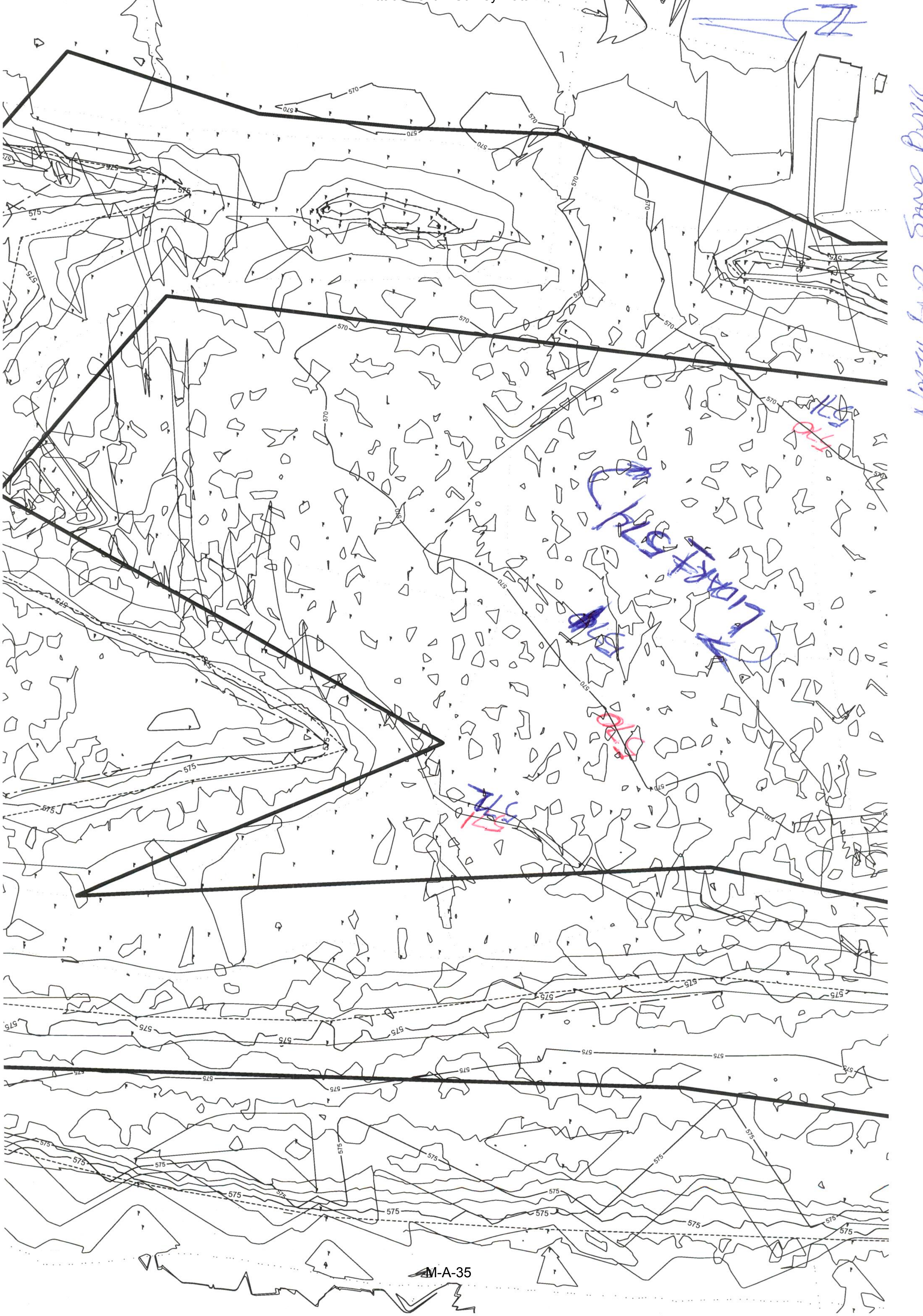

575
575

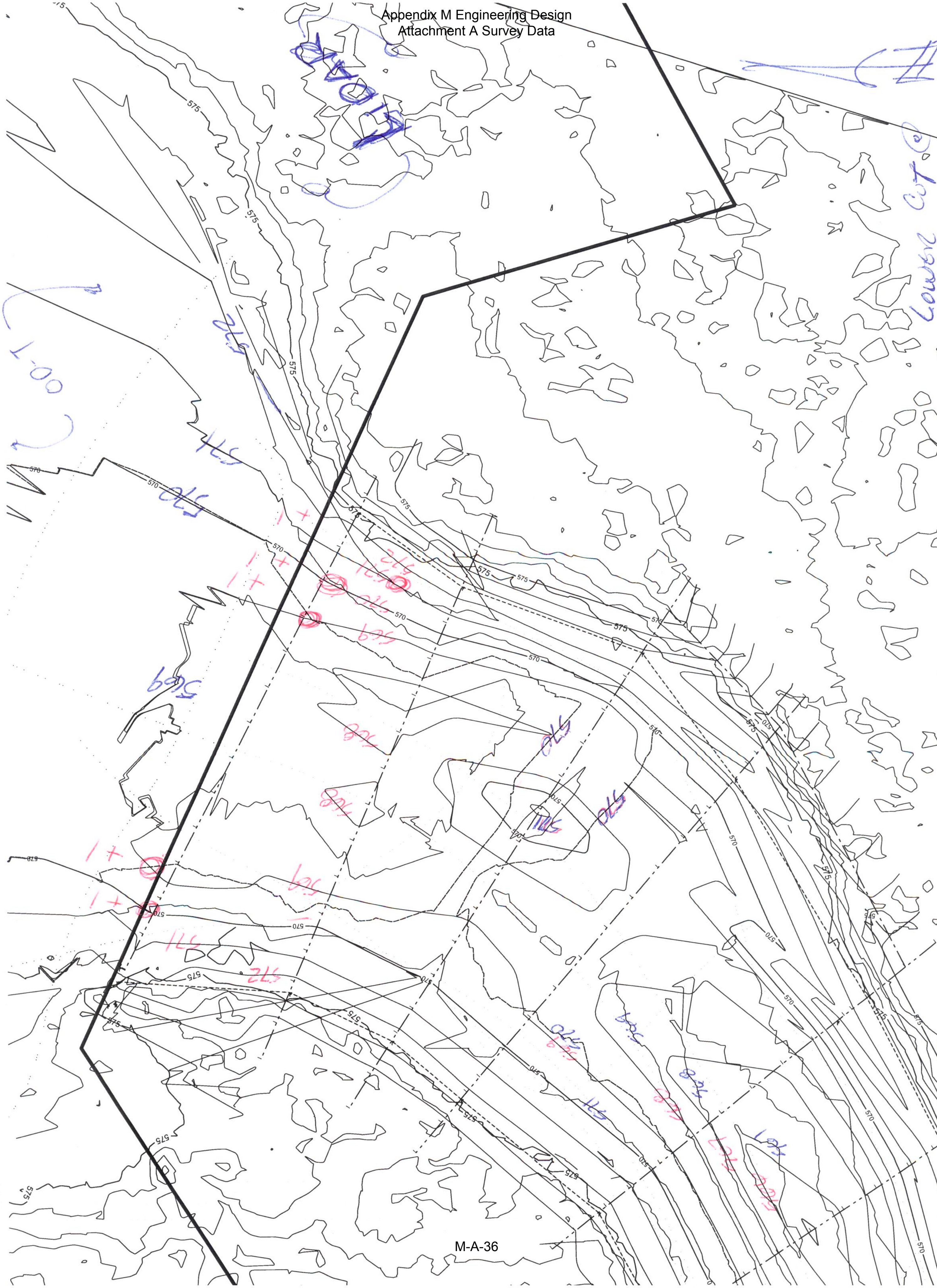

575
575

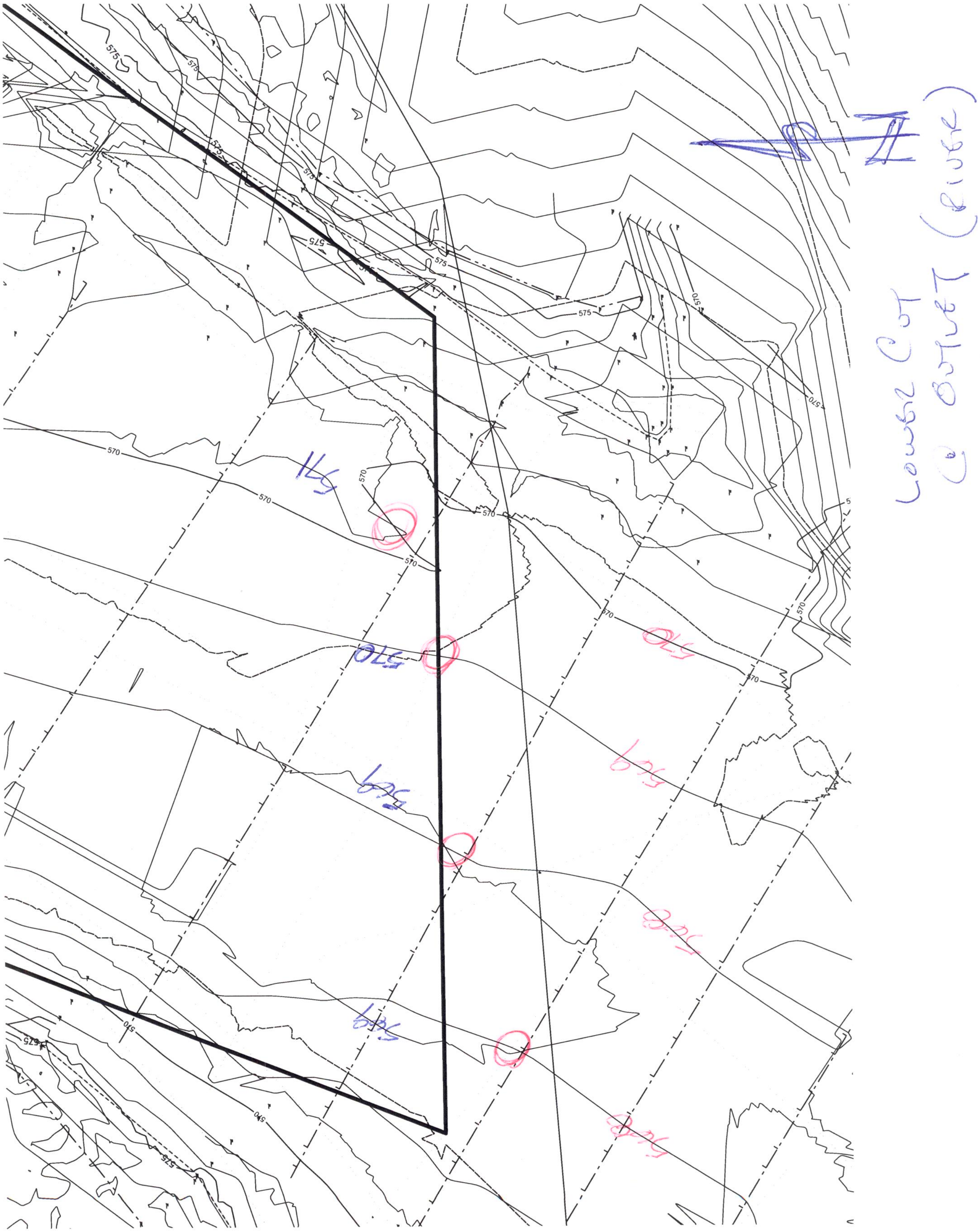

575
570


Lower Cut @ Lower Lake
575
570


570
575


570
575


575
570
Lower Cut
Lower Lake


Lower Cut @ Outlet (River)
575
570
571
569

COMPARE SURVEY DATA TO LIDAR DATA BEAVER ISLAND HREP

Point	gps	lidar	ORIGINAL COMPARISION		TAKE OUT ALL SHOTS BELOW WATER SURFACE 573.8	TAKE OUT HIGH AND LOW
14-343-11267	572.08	574.41	2.33			
14-343-11270	577.19	579.26	2.07		2.07	2.07
14-343-11635	572.04	574.3	2.26			
14-343-11590	578.5	579.13	0.63		0.63	0.63
14-343-11673	575.57	576.6	1.03		1.03	1.03
14-344-11778	572.22	573.85	1.63			
14-343-11782	575.02	576.6	1.58		1.58	1.58
14-343-11961	573.12	574.9	1.78			
14-344-11946	573.02	574.3	1.28			
14-344-11937	575.59	577.53	1.94		1.94	1.94
hand sections at blue bell	574.25	577.56	3.31		3.31	
hand sections at blue bell	573.72	576.77	3.05			
hand sections at blue bell	577.09	579.3	2.21		2.21	2.21
hand section lower cut	574.32	576.6	2.28		2.28	2.28
hand section lower cut	575.82	576.15	0.33		0.33	
hand section lower cut	576.02	578	1.98		1.98	1.98
14-350-12417	571.93	574.05	2.12			2.12
14-350-12431	574.71	576.48	1.77		1.77	1.77
14-336-10873	577.15	578.31	1.16		1.16	1.16
14-317-1651	576.25	579.07	2.82		2.82	2.82
			37.56	sum	23.11	21.59
			1.878	average	1.777692	1.799167

Beaver Island HREP
Feasibility Study
Terrain Data Processing
March 2015

Contact: Mike Siadak, CEMVR-PM-M (GIS)

\\mvrdfs\egis\Work\EMP\HREP_Projects\Beaver_Island\Data\terrain_2015-03-10\readme_terrain_data_processing_2015-03-10.txt.

Terrain Versions:

* terrain_orig_hydro_2015-03-10.gdb - Contains all participating data as described below. ODT Hydrosurvey data use original converted NAVD88 elevations.

* terrain_adj_hydro_2015-03-10.gdb - Same as above, except the OD-T data has been raised by 1.0 feet as per CEMVR-EC-TS suggestion based on ground checks.

See pw:\\MVR-AP01PWINT.mvr.ds.usace.army.mil:CEMVR Rock Island District\Documents\Civil Works\Mississippi River Basin\Beaver Island - HREP\03_Definite Project Report\Design_Info\Basis_for_Design\Survey\Beaver2-5-2015Survey.pdf

Constituent Feature Classes (same for both terrains):

* ODT_Hydrosurvey_MOD

- Generally contains all of the originally assembled OD-T hydrosurvey points except the ones that were handled by EC-TS.

- Points that overlapped the SEAS multibeam wingdam surveys were removed.

- Was adjusted from US Ft. MSL1912 to US Ft. NAVD88 using the gage corrections collected by EC-TS. The adjustment was done by creating a TIN surface between cross sections drawn at the locations of the gage corrections. See e-mail message in this folder titled "Pool 14 NAVD Conversion".

- Ground Truth Adjusted Elevation Field Name (NAVD88 + 1.0 ft): elev_navd88_surveyadjust

- NAVD88 Adjusted Elevation Field Name: elev_navd88

- Original MSL1912 Elevation Field Name: Z

* ODT_Hydrosurvey_Survey_Reclip

- All of the hydrosurvey points that were used by EC-TS in their InRoads surface. Re-imported from a text file, located here on ProjectWise:

pw:\\MVR-AP01PWINT.mvr.ds.usace.army.mil:CEMVR Rock Island District\Documents\Civil Works\Mississippi River Basin\Beaver Island - HREP\03_Definite Project Report\Design_Info\Basis_for_Design\Survey\xyzHydroReclip.txt

- Points that overlapped the SEAS multibeam wingdam surveys were removed.

- Ground Truth Adjusted Elevation Field Name: elev_navd88_surveyadjust

- NAVD88 Adjusted Elevation Field Name: elev_navd88

- In the adj_hydro terrain, more points were removed from this dataset and added back to ODT_Hydrosurvey_MOD after consulting with Lucie Sawyer(EC-HH) and Dan McBride (OD-T). The points that were removed were located in large open-water side channels (as opposed to backwaters)

- Original MSL1912 Elevation Field Name: Z

* SEAS_Wingdam_Surveys_GEN

- Generalized gridded representation of the SEAS 2014 Multibeam wingdam survey data.

- Original Data Location:

\\mvr-netapp1\egis\Data\Elevation\MVR\HydroSurvey\zz_Contracts\UMR_2014\WingDams\Pool14\

- Original multibeam point clouds were run through the ArcGIS IDW (Inverse Distance Weighted) gridding tool to produce 8 foot cell spacing rasters, which were then converted from depths from flat pool to elevations NAVD88 using the same method as the OD-T hydrosurvey data (see ODT_Hydrosurvey_MOD notes). Once grids were created, they were exported using the Raster Values to Points tool

- As noted above, other sources of hydrosurvey data were removed where multibeam wingdam surveys were available -- these surveys are by far the highest resolution hydrosurvey data we have and also the most recent (2014)

- Stored as multipoints, elevation NAVD88 stored in the Z component of the Shape field

* Survey_Dunk_Pts_2014_Nov_Dec

- Converted ground survey points, taken from here:

pw:\\MVR-AP01PWINT.mvr.ds.usace.army.mil:CEMVR Rock Island District\Documents\Civil Works\Mississippi River Basin\Beaver Island - HREP\03_Definite Project Report\Design_Info\Basis_for_Design\Survey\xyzSURVEYdunks.txt

- Elevation NAVD88 field: Z

* Survey_Pts_2014_Nov_Dec

- Converted ground survey points, taken from here:

pw:\\MVR-AP01PWINT.mvr.ds.usace.army.mil:CEMVR Rock Island District\Documents\Civil Works\Mississippi River Basin\Beaver Island - HREP\03_Definite Project Report\Design_Info\Basis_for_Design\Survey\xyzSURVEY.txt

- Elevation NAVD88 field: Z

* Terrain_Boundary

- The outer boundary of the terrain, used to prevent outer edge triangles from forming during the TINning process

* UMRR_LiDAR_Adjusted

- The component of the UMRR LiDAR dataset that we adjusted according to the EC-TS ground truthing analysis documented here:

pw:\\MVR-AP01PWINT.mvr.ds.usace.army.mil:CEMVR Rock Island District\Documents\Civil Works\Mississippi River Basin\Beaver Island - HREP\03_Definite Project Report\Design_Info\Basis_for_Design\Survey\Beaver2-5-2015Survey.pdf

- Points that were clearly located in heavily vegetated areas were chosen for adjustment, because the most likely explanation for the ~1.8 ft discrepancy between the land survey shots and the LiDAR on Beaver Island is systematic error created by inadequate penetration of the LiDAR pulses into the heavy tree canopy on Beaver Island.

- Points that were misclassified as bare earth but were clearly taken over Open Water (determined via air photo interpretation and overlap with hydrosurvey data sources) were removed.

- Ground Truth Adjusted Elevation Field Name: elev_usft_navd88_survey_adjust

- Original NAVD88 elevation field name: elev_usft_navd88_original

- Original UMRR LiDAR data location on the filesystem:

\\mvr-netapp1.mvr.ds.usace.army.mil\egis\Data\Elevation\MVR\LiDAR\UMR\Ms_River_Pools_8-24

* UMRR_LiDAR_NonAdjusted

- Same as UMRR_LiDAR_Adjusted, but these elevations were not adjusted due to being located in more open terrain (road surfaces, open developed areas, bare concrete, grass, etc.)

* LTRMP_P14_Hydrosurvey_Pts

- Original data location: \\mvrdfs\egis\Data\Elevation\MVR\HydroSurvey\zz_Contracts\LTRMP_2010\Eisenbraun_W912EK-10-D-0001_TO3_MR-Bathy\POOL_014

- Supplemental bathymetric data collected under an LTRMP contract from 2010 by Eisenbraun.

- MSL12 elevation field: elevation

- NAVD88 adjusted elevation field: elev_navd88

Beaver Island HREP

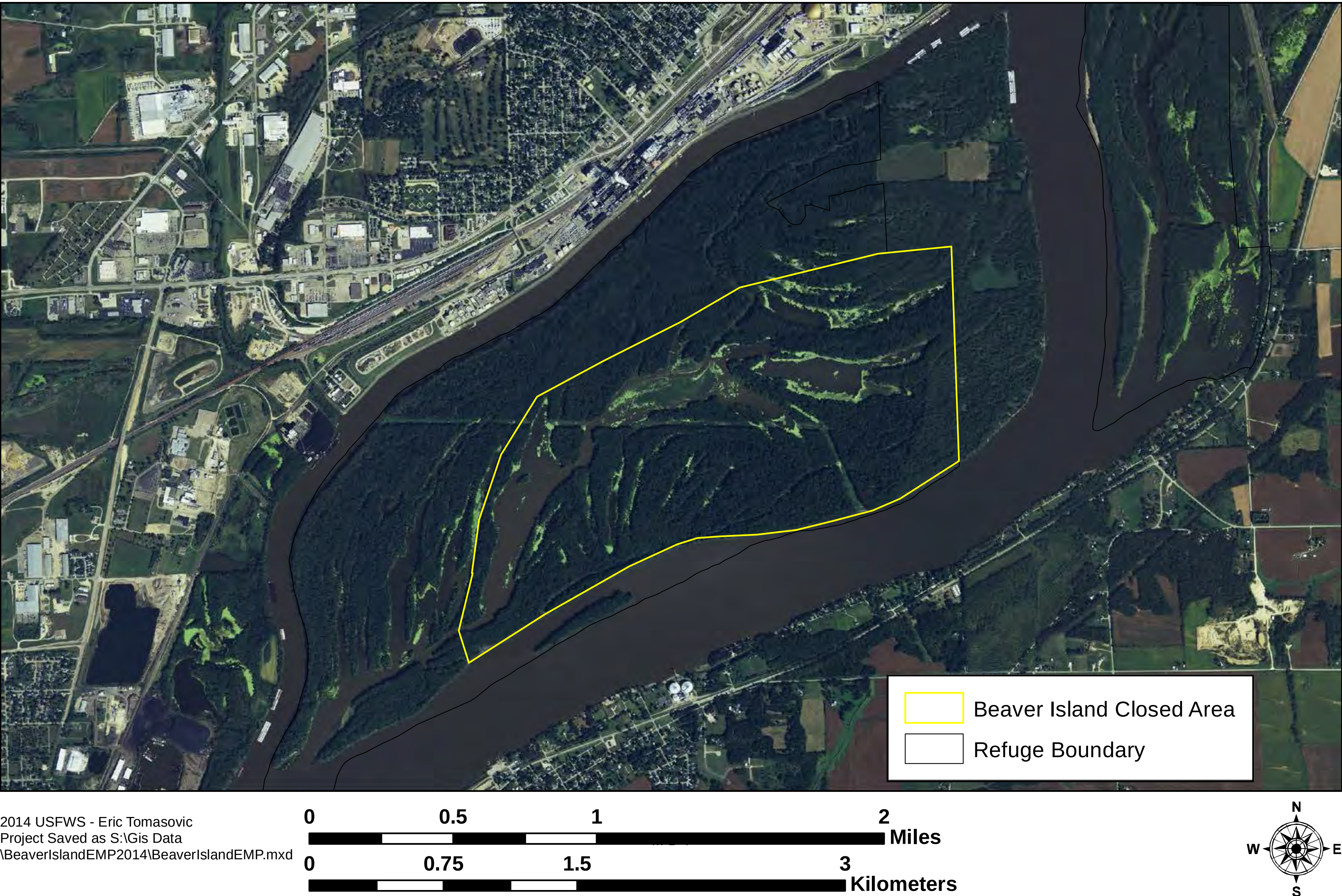
Appendix M

Design Engineering

Attachment B
US Fish and Wildlife Service
Refuge Boundaries

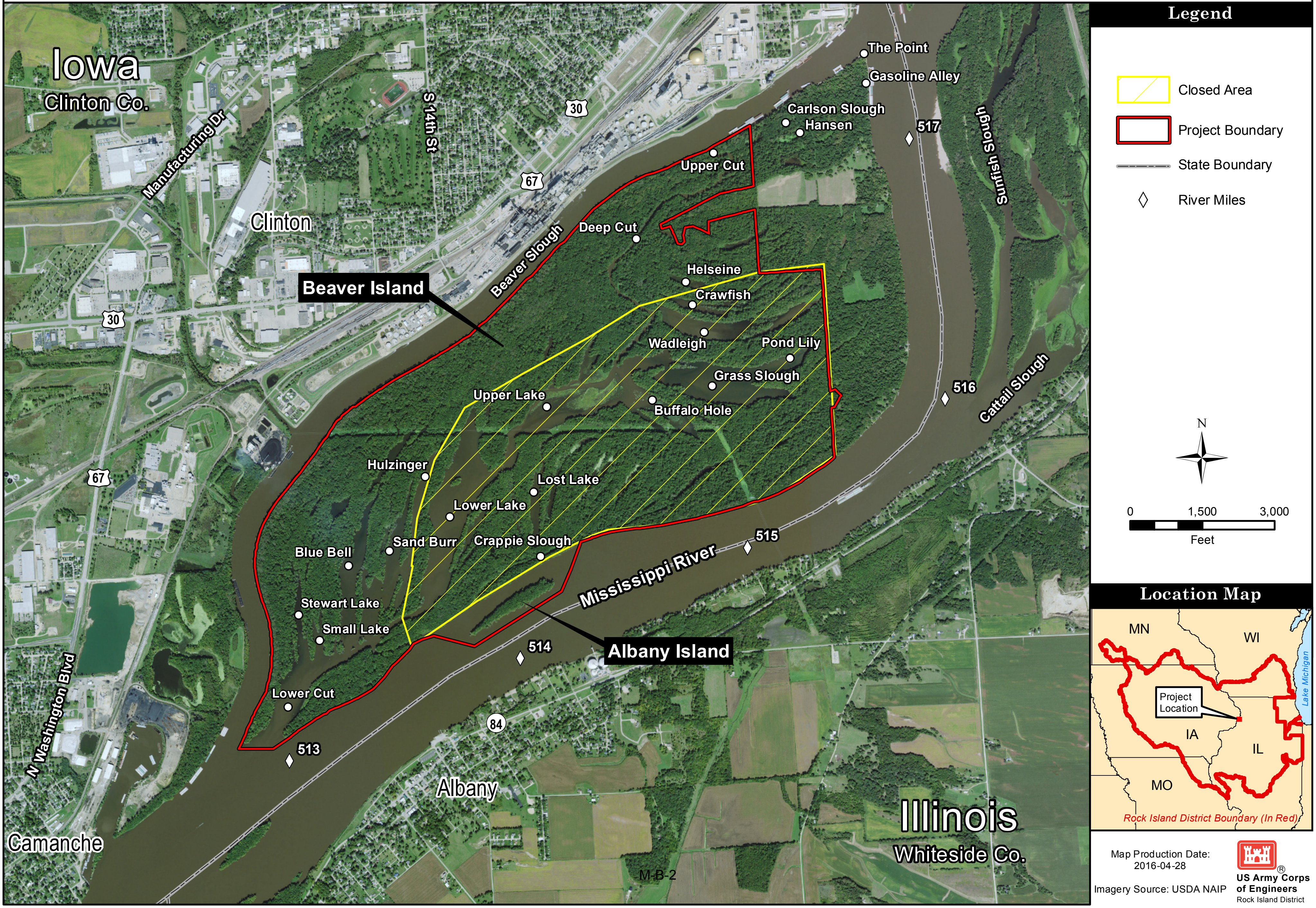
Upper Mississippi River National Wildlife & Fish Refuge

Pool 14



2014 USFWS - Eric Tomasovic
Project Saved as S:\Gis Data
\BeaverIslandEMP2014\BeaverIslandEMP.mxd

Beaver Island HREP - Closed Area



Beaver Island HREP

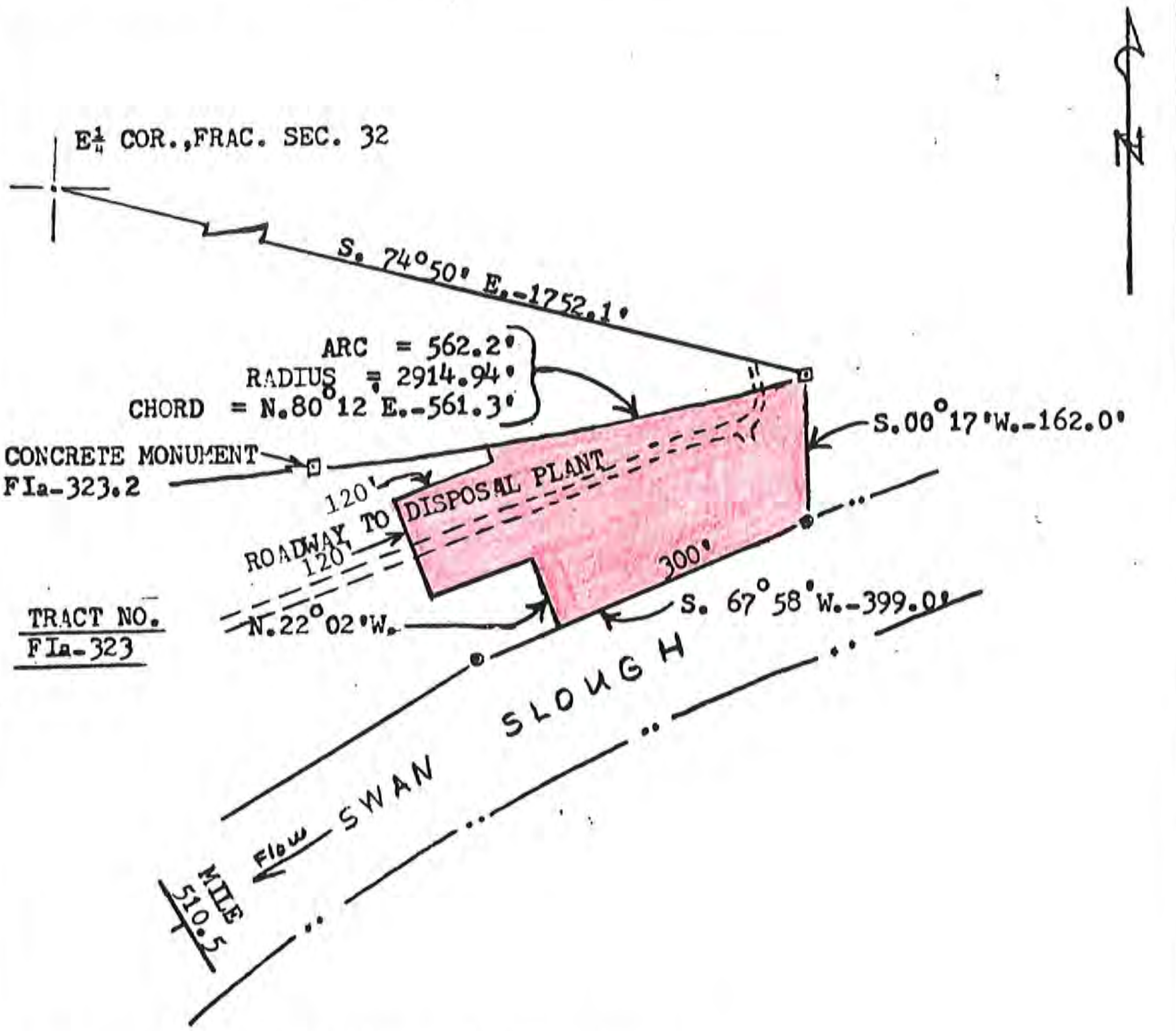
Appendix M

Design Engineering

Attachment C
Real Estate

CORPS OF ENGINEERS

U.S. ARMY



All bearings refer to true north
Mileage refers to distance above Ohio River

Easement Area 1.7 Acres, more or less

Government Boundary

SW¼ FRACTIONAL SEC. 33

TWP. 81 N., R. 6 E. of the 5th P.M.

CLINTON COUNTY, IOWA

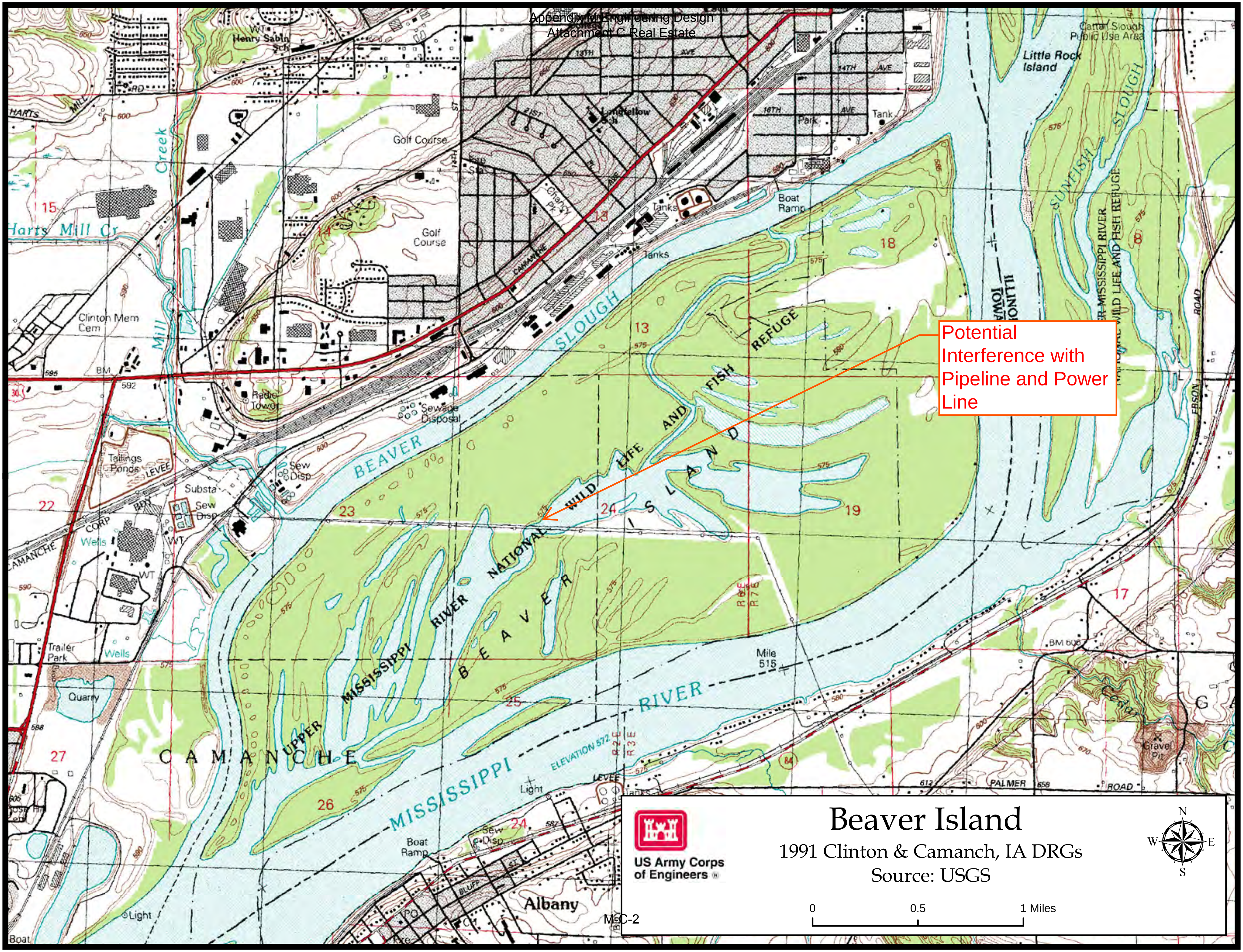
MISSISSIPPI RIVER
POOL NO. 14

EASEMENT FOR BOAT RAMP
AND PARKING AREA

SCALE: 1" = 200'

EXHIBIT A

E14-Ia-144


Potential Interference with Pipeline and Power Line
Beaver Island
1991 Clinton & Camanch, IA DRGs
Source: USGS
US Army Corps of Engineers
0
0.5
1 Miles
N
S
E
W
BEAVER SLOUGH
BEAVER ISLAND
UPPER MISSISSIPPI RIVER NATIONAL WILD LIFE AND FISH REFUGE
MISSISSIPPI RIVER
CAMANCHE
Albany
Little Rock Island
SUNFISH SLOUGH
ILLINOIS
IOWA
Golf Course
Clinton Mem Cem
Harts Mill Cr
Mill Creek
Sewage Disposal
Tailings Ponds
Quarry
Trailer Park
Boat Ramp
Mile 515
ELEVATION 572
Cattail Slough Public Use Area
Henry Sabin Sch
Longfellow Sch
Radio Tower
Gravel Pit
PALMER ROAD
ERSON ROAD

Prepared by:
E.W. Wood, US Army Engineer District Rock Island
Clock Tower, PO Box 2004, Rock Island, Illinois 61204-2004
Easement: Department of Army to ITC Midwest, LLC, 39500 Orchard Hill Place
Novi, Michigan, 48375

Contract No. DACW25-2-08-4037

DEPARTMENT OF THE ARMY

EASEMENT FOR ELECTRIC POWER RIGHT-OF-WAY

LOCATED ON

UPPER MISSISSIPPI RIVER NINE-FOOT CHANNEL PROJECT
POOL 14

Clinton County, Iowa

THE SECRETARY OF THE ARMY under and by virtue of the authority vested in the Secretary by Title 43, United States Code, Section 961, having found that the granting of this easement will be in the public interest and not substantially injure the interest of the United States in the property affected, hereby grants to ITC Midwest, LLC, a company duly organized and existing under and by virtue of the laws of the State of Michigan, with its principal offices located at 39500 Orchard Hill Place, Suite 200, Novi, Michigan, 48375 hereinafter referred to as the Grantee, an easement for construction, operation, and maintenance of a powerline, and appurtences, hereinafter referred to as the facilities, over, across, in and upon lands of the United States as identified in Exhibit A and B, hereinafter referred to as the premises, and which are attached hereto and made a part hereof.

THIS EASEMENT is granted subject to the following conditions:

1. TERM

This easement is hereby granted for a term of fifty years beginning April 24, 2002 and ending April 23, 2052.

2. CONSIDERATION

The Grantee shall pay to the United States upon delivery of this easement the sum of Five Hundred and 00/100 ($500.00) to cover the administrative costs of this easement. All payments are to be made payable to the order of the "FAO, USAED, Rock Island," and delivered to the District Engineer, U.S. Army Engineer District,Rock Island, ATTN: Real Estate Division, Clocktower Building, PO Box 2004, Rock Island, Illinois 61204-2004.

3. NOTICES

All correspondence and notices to be given pursuant to this easement shall be addressed, if to the Grantee, to ITC Holdings, LLC, 1030 Main Street, Suite 301, Dubuque, Iowa, 52001, and if to the United States, to the District Engineer, U.S. Army Engineer District, Rock Island, ATTN: Real Estate Division, Clocktower Building, PO Box 2004, Rock Island, Illinois 61204-2004, or as may from time to time otherwise be directed by the parties. Notice shall be deemed to have been duly given if and when enclosed in a properly sealed envelope or wrapper addressed as aforesaid, and deposited postage prepaid in a post office regularly maintained by the United States Postal Service.

4. AUTHORIZED REPRESENTATIVES

Except as otherwise specifically provided, any reference herein to "Secretary", "District Engineer", "Installation Commander", or "said officer" shall include their duly authorized representatives. Any reference to "Grantee" shall include assignees, transferees and their duly authorized representatives.

5. SUPERVISION BY THE DISTRICT ENGINEER

The construction, operation, maintenance, repair or replacement of said facilities, including culverts and other drainage facilities, shall be performed at no cost or expense to the United States and subject to the approval of the District Engineer, Rock Island District, hereinafter referred to as said officer. Upon the completion of any of the above activities, the Grantee shall immediately restore the premises to the satisfaction of said officer. The use and occupation of the premises for the purposes herein granted shall be subject to such rules and regulations as said officer prescribes in writing from time to time.

6. APPLICABLE LAWS AND REGULATIONS

The Grantee shall comply with all applicable Federal, state, county and municipal laws, ordinances and regulations wherein the premises are located.

7. CONDITION OF PREMISES

The Grantee acknowledges that it has inspected the premises, knows the condition, and understands that the same is granted without any representation or warranties whatsoever and without any obligation on the part of the United States.

8. INSPECTION AND REPAIRS

The Grantee shall inspect the facilities at reasonable intervals and immediately repair any defects found by such inspection or when required by said officer to repair any such defects.

9. PROTECTION OF GOVERNMENT PROPERTY

The Grantee shall be responsible for any damage that may be caused to the property of the United States by the activities of the grantee under this easement and shall exercise due diligence in the protection of all property located on the premises against fire or damage from any and all other causes. Any property of the United States damaged or destroyed by the grantee incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the grantee to a condition satisfactory to said officer, or at the election of said officer, reimbursement made therefor by the grantee in an amount necessary to restore or replace the property to a condition satisfactory to said officer.

10. RIGHT TO ENTER

The right is reserved to the United States, its officers, agents, and employees to enter upon the premises at any time and for any purpose necessary or convenient in connection with government purposes, to make inspections, to remove timber or other material, except property of the grantee, to flood the premises and/or to make any other use of the lands as may be necessary in connection with government purposes, and the Grantee shall have no claim for damages on account thereof against the United States or any officer, agent, or employee thereof.

11. TRANSFERS AND ASSIGNMENTS

Without prior written approval by said District Engineer, the Grantee shall neither transfer nor assign this easement or any partthereof nor grant any interest, privilege or license whatsoever in connection with this easement. The provisions and conditions of this easement shall extend to and be binding upon and shall inure to the benefit of the representatives, successors and assigns of the Grantee.

12. INDEMNITY

The United States shall not be responsible for damages to property or injuries to persons which may arise from or be incident to the exercise of the privileges herein granted, or for damages to the property or injuries to the person of the Grantee's officers, agents, or employees or others who may be on the premises at their invitation or the invitation of any one of them, and the grantee shall hold the United States harmless from any and all such claims not including damages due to the fault or negligence of the United States or its contractors.

13. SUBJECT TO EASEMENTS

This easement is subject to all other existing easements, or those subsequently granted as well as established access routes for roadways and utilities located, or to be located, on the premises, provided that the proposed grant of any new easement or route will be coordinated with the Grantee, and easements will not be granted which will, in the opinion of said officer, interfere with the use of the premises by the grantee.

14. REQUIRED SERVICES

The Grantee shall furnish through said facilities such services as may be required from time to time for governmental purposes, provided that payment for such service will be made by the United States at rates which shall be mutually agreeable but which shall never exceed the most favorable rates granted by the grantee for similar service.

15. RELOCATION OF FACILITIES

In the event all or any portion of the premises occupied by the said facilities shall be needed by the United States, or in the event the existence of said facilities is determined to be detrimental to governmental activities, the Grantee shall from time to time, upon notice to do so, and as often as so notified, remove said facilities to such other location on the premises as may be designated by said officer. In the event said facilities shall not be removed or relocated within ninety (90) days after such notice, the United States may cause such relocation at the sole expense of the grantee.

16. TERMINATION

This easement may be terminated by the Secretary upon 180 days written notice to the Grantee if the Secretary shall determine that the right-of-way hereby granted interferes with the use or disposal of said land by the United States, or it may be revoked by the Secretary for failure of the Grantee to comply with any or all of the conditions of this easement, or for non-use for a period of two (2) years, or for abandonment.

17. SOIL AND WATER CONSERVATION

The Grantee shall maintain, in a manner satisfactory to said officer, all soil and water conservation structures that may be in existence upon said premises at the beginning of or that may be constructed by the grantee during the term of this easement, and the Grantee shall take appropriate measures to prevent or control soil erosion within the right-of-way herein granted. Any soil erosion occurring outside the premises resulting from the activities of the Grantee shall be corrected by the Grantee as directed by said officer.

18. ENVIRONMENTAL PROTECTION

a. Within the limits of their respective legal powers, the parties hereto shall protect the premises against pollution of its air, ground, and water. The grantee shall promptly comply with any laws, regulations, conditions or instructions affecting the activity hereby authorized if and when issued by the Environmental Protection Agency, or any Federal, state, interstate or local governmental agency having jurisdiction to abate or prevent pollution. The disposal of any toxic or hazardous materials within the premises is strictly prohibited. Such regulations, conditions, or instructions in effect or prescribed by the said Environmental Protection Agency or any Federal, state, interstate or local governmental agency are hereby made a condition of this easement. The grantee shall not discharge waste or effluent from the premises in such a manner that the discharge will contaminate streams or other bodies of water or otherwise become a public nuisance.

b. The use of any pesticides or herbicides within the premises shall be in conformance with all applicable Federal, state and local laws and regulations. The Grantee must obtain approval in writing from said officer before any pesticides or herbicides are applied to the premises.

c. The Grantee will use all reasonable means available to protect the environment and natural resources, and where damage nonetheless occurs arising from the Grantee's activities, the grantee shall be liable to restore the damaged resources.

19. PRELIMINARY ASSESSMENT SCREENING

A Preliminary Assessment Screening (PAS) documenting the known history of the property with regard to the storage, release or disposal of hazardous substances thereon, is attached hereto and made a part hereof as Exhibit C. Upon expiration, revocation or termination of this easement, another PAS shall be prepared which will document the environmental condition of the property at that time. A comparison of the two assessments will assist the said officer in determining any environmental restoration requirements. Any such requirements will be completed by the Grantee in accordance with the condition on RESTORATION.

20. HISTORIC PRESERVATION

The Grantee shall not remove or disturb, or cause or permit to be removed or disturbed, any historical, archeological, architectural or other cultural artifacts, relics, remains or objects of antiquity. In the event such items are discovered on the premises, the Grantee shall immediately notify said officer and protect the site and material from further disturbance until said officer gives clearance to proceed.

21. NON-DISCRIMINATION

The Grantee shall not discriminate against any person or persons because of race, color, age, sex, handicap, national origin, or religion in the conduct of operations on the premises.

22. RESTORATION

On or before the expiration or termination of this easement, the Grantee shall, without expense to the United States, and within such time as said officer may indicate, remove said facilities and restore the premises to the satisfaction of said officer. In the event the Grantee shall fail to remove said facilities and restore the premises, the United States shall have the option to take over said facilities without compensation, or to remove said facilities and perform the restoration at the expense of the Grantee, and the Grantee shall have no claim for damages against the United States or its officers or agents for such action.

23. DISCLAIMER

This instrument is effective only insofar as the rights of the United States in the property are concerned, and the Grantee shall obtain such permission as may be required on account of any other existing rights. It is understood that the granting of this easement does not eliminate the necessity of obtaining any Department of the Army permit which may be required pursuant to the provisions of Section 10 of the Rivers and Harbors Act of 3 March 1899 (30 Stat. 1151; 33 U.S.C. § 403), Section 404 of the Clean Water Act (33 U.S.C. § 1344) or any other permit or license which may be required by Federal, state or local statute in connection with use of the premises.

IN WITNESS WHEREOF I have hereunto set my hand by authority of the Secretary of the Army this 12th day of March, 2008.

Stuart P. Jackson
Chief, Real Estate Division
Corps of Engineers
Rock Island Distrcit

THIS EASEMENT is also executed by the grantee this 28th day of

February 2008

ITC Midwest LLC

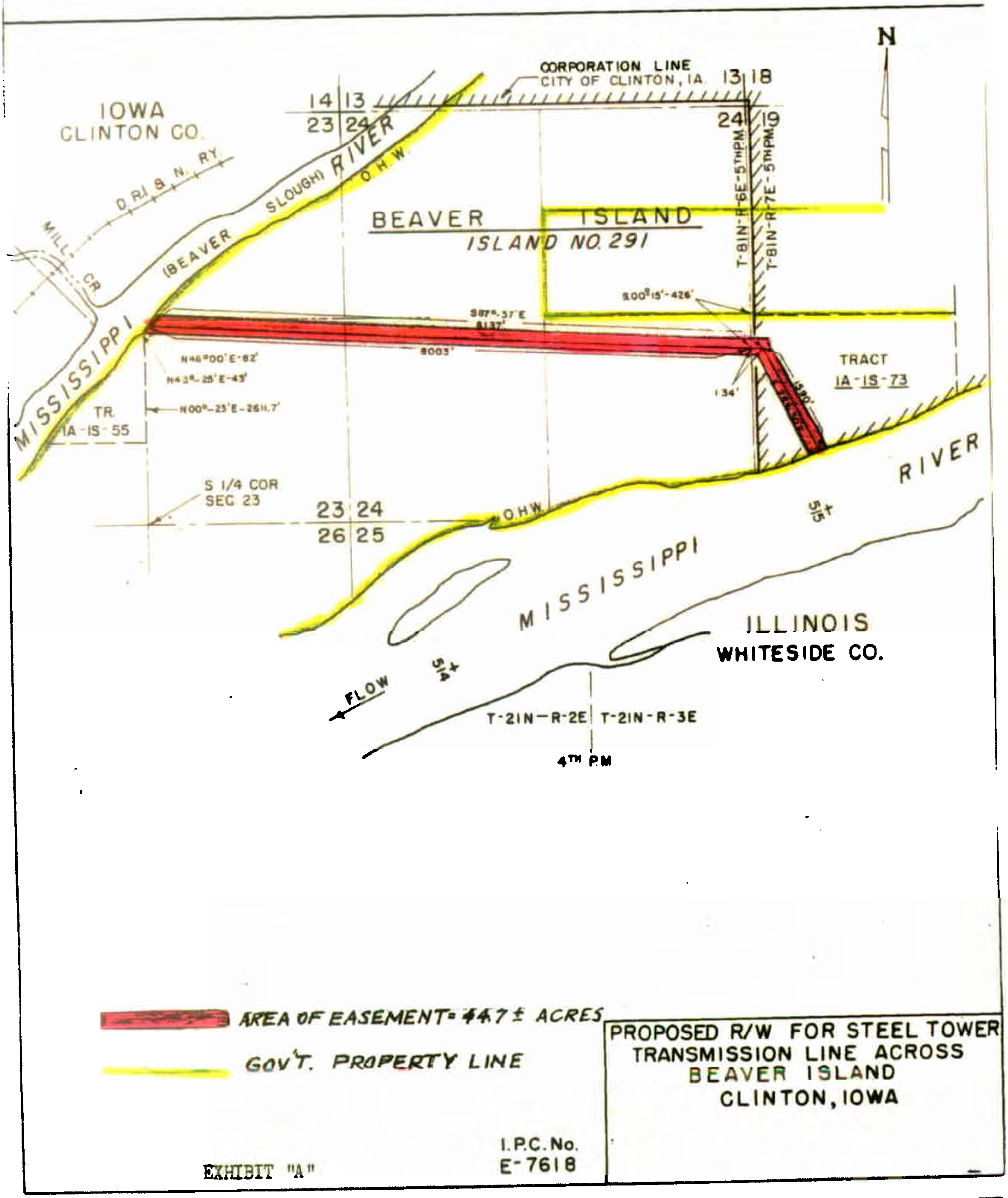
By: ITC Holdings Corp., its Sole Member

BY________________________
NAME (Signature)

Christine Mason Soneral
NAME (PRINT OR TYPE)

Vice President & General Counsel—Utility Operations
POSITION

39500 Orchard Hill Place
Novi, Michigan, 48375


N
CORPORATION LINE
CITY OF CLINTON, IA.
IOWA
CLINTON CO.
D. RI. & N. RY.
MILL CR.
14 13
23 24
13 18
24 19
(BEAVER SLOUGH) RIVER
O.H.W.
BEAVER ISLAND
ISLAND NO. 291
T-81N-R-6E-5TH PM.
T-81N-R-7E-5TH PM.
S.00°15'-426'
S87°-37'E
8137'
8003'
N46°00'E-82'
N43°-25'E-43'
N00°-23'E-2611.7'
134'
TRACT
IA-IS-73
TR.
IA-IS-55
MISSISSIPPI
S 1/4 COR
SEC. 23
23 24
26 25
O.H.W.
RIVER
515+
MISSISSIPPI
ILLINOIS
WHITESIDE CO.
FLOW
514+
T-21N-R-2E
T-21N-R-3E
4TH P.M.
AREA OF EASEMENT = 44.7± ACRES
GOV'T. PROPERTY LINE
PROPOSED R/W FOR STEEL TOWER
TRANSMISSION LINE ACROSS
BEAVER ISLAND
CLINTON, IOWA
I.P.C. No.
E-7618
EXHIBIT "A"

EASEMENT CONTRACT DACW25-2-08-4037
EXHIBIT B

UPPER MISSISSIPPI RIVER NINE-FOOT CHANNEL PROJECT
POOL 14

A tract of land situated on Beaver Island in the County of Clinton, State of Iowa, located in Section 19, Township 81 North, Range 7 East of the 5th Principal Meridian, and in Sections 23 and 24, Township 81 North, Range 6 East, of the 5th Principal Meridian, being a strip of land 200 feet in width, 100 feet on each side of the following described centerline, all bearings being referred to true north:

> From the southwest corner of the SE 1/4 of said Section 23, North 00°23' East, 2611.7 feet, more or less, along the West line thereof to a point on the ordinary high water line along the right bank of Beaver Island; thence upstream along said high water line North 43°25' East, 43.0 feet, thence North 46°00' East 82.0 feet, more or less, to the point of beginning; thence South 87°37' East, 8137 feet to a point in the SW 1/4 of Section 19, said point being South 00°15' East, 426.0 feet, more or less, and South 87°37' East, 134.0' feet, more or less, from the northwest corner of said SW 1/4 of said Section 19; thence South 28°30' East, 1590 feet, more or less, to a point on the ordinary high water line on the left bank of said Beaver Island, containing 44.7 acres, more or less.

E X H I B I T "C"

PRELIMINARY ASSESSMENT SCREENING (PAS)

Easement Contract No. DACW25-2-08-4037

1. REAL PROPERTY TRANSACTION: This action consists of transferring a fifty-year easement from Interstate Power and Light Company to the ITC Midwest, LLC to use 44.7 acres (+/-) of Federal land for the construction, operation and maintenance of an aerial electric power line, and related structures.

2. COMPREHENSIVE RECORDS SEARCH: A search of the Real Estate records was conducted in May 2001, and included the following:

A. Acquisition files for Tracts IaIs 73 and IaIs 60 dated April 7, 1942 and January 11, 1943 respectively.

B. Acquisition map dated May 23, 1939.

C. Aerial photograph of area.

D. Easement file with information dating from November 1950.

The District Engineering, Operations and Programs and Project Management Divisions reviewed this action. They were asked to identify any records of hazardous materials being stored, released or disposed of on the property; however, no such records were identified in their review.

3. SITE INSPECTION: There was not a site inspection performed specifically for this PAS. There was no information revealed in the records search to indicate potential for hazardous materials to warrant a site investigation specifically for this PAS.

4. FINDINGS: The conclusion of this PAS is that there is no known history or present existence of hazardous materials on the property included in the easement.

5. This PAS is a real property transaction record to serve as documentation for the hazardous substance contamination condition of the property. The proposed real property transaction of granting an easement on the property to the ITC Midwest, LLC should proceed.

Prepared by: ______________________ Date: 3.10.08
E.W. Wood, Realty Specialist

Approved by: ______________________ Date: March 12, 2008
Stuart P. Jackson
Chief, Real Estate Division

Exhibit C Page 2 of 3

ACCEPTANCE

The ITC Midwest LLC accepts the findings of this PAS and hereby agrees that there is no known history or present existence of hazardous materials on the property included in the easement. ITC Midwest, LLC understands that this PAS will be used as a basis for determining any environmental restoration required under the terms of the easement.

ITC Midwest LLC

BY: ITC Holdings Corp., its Sole Member

By: Christine Mason Soneral

Christine Mason Soneral

Vice President & General Counsel—Utility Operations

Date: February 28, 2008

CERTIFICATE OF AUTHORITY

I, DANIEL J. OGINSKY, certify that I am the
(name of certifying officer)

VICE PRESIDENT & GENERAL COUNSEL of ITC Holdings Corp., the Sole

Member of ITC Midwest LLC and that Christine Mason Soneral

who signed this easement on behalf of the grantee, was then

Vice President, General Counsel—Utility Operations Corp., the Sole

Member of ITC Midwest LLC for and in behalf of ITC Midwest LLC.

(Signature of certifying officer)

(CORPORATE SEAL)

Mitvalsky, Kara N MVR

From: Appel, Jason C MVR
Sent: Tuesday, January 27, 2015 10:46 AM
To: Mitvalsky, Kara N MVR
Cc: Savage, Monique E MVR
Subject: Beaver Island Gas Lines (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Kara,

The gas lines are under the control of Interstate Power and Light Company, PO Box 769, Dubuque, IA 52004-0769. They also list an address of 200 first street, SE, Cedar Rapids, IA 52401. A simple Google search will probably give you the contact information you're looking for. As I understand it there are two 8 inch gas lines that run within the same easement area as the overhead power lines. I don't have any information on how deep those lines were buried.

Jason Appel
Realty Specialist
Planning & Acquisition Branch
Regional Real Estate Division North
Rock Island District
(309)-794-5489

Classification: UNCLASSIFIED
Caveats: NONE

Beaver Island HREP

Appendix M

Design Engineering

Attachment D
Historic Dredging

CENCR-PD-W/OD-T
8/5/96

MISSISSIPPI RIVER HYDRAULIC DREDGING
POOLS 11-22
1940-1995

POOL 14

Dredge Cut	Year Dredged	Dredging Amount (yd3)	Dredging Site	Placement Site	Placement Type
521.1-522.4 Lock #13 Lower	1940	57,409	521.1-521.5	521.1L, 521.3L, 521.5L	
	1940	12,117	522.2-522.4	522.2-522.4R	
	1942	38,589	521.2-521.5	521.3-521.5L	
	1943	3,353	522.3-522.4	522.3R	
		111,468	4 Events	Average 27,867	
518.5-519.9 Joyce's Island	1940	26,526	518.6-518.8	518.7-518.8L, 518.9L	
	1940	59,570	519.3-519.7	519.4R, 519.5R, 519.5-519.7L	
	1943	78,057	519.3-519.7	519.5-519.7L	
	1943	35,639	518.7-519.0	518.8-518.9L, 519.0L	
	1944	89,384	518.6-519.0	518.6-518.8R	
	1945	83,384	519.2-519.7	519.4-519.5R, 519.6-519.7R	
	1946	80,674	518.6-519.0	518.7-518.8L, 518.8-519.0L	
	1946	56,823	519.4-519.9	519.5-519.6R, 519.8R, 520.0R	
	1947	29,063	519.4-519.7	519.4-519.7R	
	1948	74,058	518.7-519.0	518.7-519.0L	
	1950	30,832	518.7-519.0	518.8-518.9R	
	1951	117,587	518.5-519.0	518.9R	
	1952	74,653	518.5-518.9	518.8-519.0R, 518.7-518.9L	
	1954	73,766	518.5-519.0	518.7L, 518.8-518.9L, 519.0-519.1L	
	1966	48,110	518.6-519.0	518.7-518.8L, 518.9L, 519.0-519.1L	
	1971	55,050	518.6-519.0	518.5-518.8L	
		1,013,176	16 Events	Average 63,324	
515.8-517.6 Beaver Island	1940	34,505	516.5-516.8	516.5-516.6L, 516.8L	
	1943	38,302	516.4-516.8	516.6-516.8L	
	1943	20,463	517.4-517.6	517.4R, 517.7-517.8L	
	1946	12,589	517.3-517.5	517.2-517.4R	
	1955	38,422	516.4-516.7	516.5-516.8R	
	1968	43,518	515.8-516.3	515.7-515.8L, 516.0-516.2L	
	1968	63,008	516.6-517.2	516.9-517.3R	
	1986	45,450	516.1-516.6	517.0-517.3L	
	1991	37,786	516.3-516.6	517.0-517.2L	
		334,043	9 Events	Average 37,116	
513.0-517.6 Beaver Slough	1942	94,513	517.5	517.3-517.4R	
	1943	49,837	517.4	517.3R	
	1944	31,463	517.5	517.5R, 517.4R	
	1945	23,306	517.3-517.6	517.2-517.4R	
	1946	28,629	517.4	517.3R, 517.4R	
	1963	48,480	517.4	517.0R, 517.3R	
	1964	12,962	513.0-513.2	513.1-513.2L	
	1964	27,155	513.7-514.0	513.8-514.0L	
	1965	34,377	516.5-516.9	516.5R, 516.6-516.7R	
	1969	16,155	516.6-516.8	516.6-516.7R	
	1969	10,442	515.5-515.9	516.6-516.7L, 516.9L	
	1969	33,593	514.4-515.2	514.5L, 514.9-515.0L, 515.1L, 515.2-515.3L	
	1972	38,385	514.8-515.1	514.8-515.0L	
	1975	120,018	514.3-515.3	514.2-515.2L	
		569,315	14 Events	Average 40,665	
513.4-514.4 Albany Lower	1956	55,595	513.9-514.4	513.9-514.3R	
	1967	53,556	513.9-514.3	514.1-514.5R	
	1972	88,330	513.4-514.3	513.6-513.7L, 513.7-514.0L, 514.3-514.4R	
		197,481	3 Events	Average 65,827	

Dredge Cut	Year Dredged	Dredging Amount (yd3)		Dredging Site	
521.1-522.4 Lock #13 Lower	1940	57,409		521.1-521.5	521.1L, 521.3L, 521.
	1940	12,117		522.2-522.4	522.2-522.4R
	1942	38,589		521.2-521.5	521.3-521.5L
	1943	3,353		522.3-522.4	522.3R
		111,468	4	Events Average:	27,867
518.5-519.9 Joyce's Island	1940	26,526		518.6-518.8	518.7-518.8L, 518.9.
	1940	59,570		519.3-519.7	519.4R, 519.5R, 519
	1943	78,057		519.3-519.7	519.5-519.7L
	1943	35,639		518.7-519.0	518.8-518.9L, 519.0.
	1944	89,384		518.6-519.0	518.6-518.8R
	1945	83,384		519.2-519.7	519.4-519.5R, 519.6
	1946	80,674		518.6-519.0	518.7-518.8L, 518.8-
	1946	56,823		519.4-519.9	519.5-519.6R, 519.8
	1947	29,063		519.4-519.7	519.4-519.7R
	1948	74,058		518.7-519.0	518.7-519.0L
	1950	30,832		518.7-519.0	518.8-518.9R
	1951	117,587		518.5-519.0	518.9R
	1952	74,653		518.5-518.9	518.8-519.0R, 518.7
	1954	73,766		518.5-519.0	518.7L, 518.8-518.9
	1966	48,110		518.6-519.0	518.7-518.8L, 518.9.
	1971	55,050		518.6-519.0	518.5-518.8L
		1,013,176	16	Events Average:	63,324
515.8-517.6 Beaver Island	1940	34,505		516.5-516.8	516.5-516.6L, 516.8.
	1943	38,302		516.4-516.8	516.6-516.8L
	1943	20,463		517.4-517.6	517.4R (5,000), 517.
	1946	12,589		517.3-517.5	517.2-517.4R
	1955	38,422		516.4-516.7	516.5-516.8R
	1968	43,518		515.8-516.3	515.7-515.8L, 516.0
	1968	63,008		516.6-517.2	516.9-517.3R
	1986	45,450		516.1-516.6	516.2-516.6L
	1991	37,786		516.3-516.6	517.0-517.2L
	2013	31,231		516.3-516.8	517.0-517.3L
		365,274	10	Events Average:	36,527
513.0-517.6 Beaver Slough Industrial Channel	1942	94,513		517.5	517.3-517.4R
	1943	49,837		517.4	517.3R
	1944	31,463		517.5	517.5R, 517.4R
	1945	23,306		517.3-517.6	517.2-517.4R
	1946	28,629		517.4	517.3R, 517.4R
	1963	48,480		517.4	517.0R, 517.3R
	1964	12,962		513.0-513.2	513.1-513.2L
	1964	27,155		513.7-514.0	513.8-514.0L
	1965	34,377		516.5-516.9	516.5R, 516.6-516.7
	1969	16,155		516.6-516.8	516.6-516.7R
	1969	10,442		515.5-515.9	516.6-516.7L, 516.9.
	1969	33,593		514.4-515.2	514.5L, 514.9-515.0.
	1972	38,385		514.8-515.1	514.8-515.0L
	1975	120,018		514.3-515.3	514.2-515.2L
	1999	4,493		517.3	517.3R' head of islan
		573,808	15	Events Average:	38,254
513.4-514.4 Albany Lower	1956	55,595		513.9-514.4	513.9-514.3R
	1967	53,556		513.9-514.3	514.1-514.5R
	1972	88,330		513.4-514.3	513.6-513.7L, 513.7-
		197,481	3	Events Average:	65,827

509.6-510.0 Marais D'osier Slough	1940	136,809		509.6-510.0		509.8R, 509.9R, 510
	1959	41,666		509.6-509.9		509.7-509.8R, 509.8
	1968	17,056		509.7-509.8		509.8-509.9R
	2013	11,750		509.6-509.8		503.7-503.9R mech
		207,281	4	Events	Average:	51,820
508.4-509.1 Adams Island Upper	1950	67,407		508.5-509.1		508.8-508.9R
	1966	53,139		508.4-508.7		508.6-508.8R
	1968	80,083		508.6-509.0		508.7-509.1R
		200,629	3	Events	Average:	66,876
				Events	Average:	
505.6-506.0 Wapsipinicon River	1972	50,200		505.6-506.0		505.8-506.1L
		50,200	1	Event	Average:	50,200
503.3-504.0 Steamboat Slough	1961	72,766		503.3-503.7		503.5-503.8R
	1968	150,731		503.4-504.0		504.1L (46,193)
	1972	119,999		503.3-503.9		503.3-503.6R, 503.6
	1973	72,506		503.5-504.0		503.3-503.4L, 503.5
	1985	26,666		503.6-503.9		503.7R, 503.8-504.0
	1986	34,222		503.6-504.0		503.5-503.7R
	1988	23,400		503.6-503.9		503.5-503.9R
	1990	56,495		503.7-504.0		502.9Thalweg (38,44
Approx. 381,591	1991	48,729		503.4-504.0		502.7-503.1Thalweg
placed on "beach	1995	29,193		503.2-503.8		events '95
to date (60%)	1995	13,738		503.2-503.8		events '95
	1999	24,352		503.3-503.8		503.7-504.0R (20,74
	2002	24,148		503.3-503.8		503.7-504.0R (8,650
	2006	35,143		503.3-503.7		502.7-503.1Thalweg
	2009	21,308		503.3-503.8		502.7-503.1Thalweg
	2011	37,507		503.3-503.9		502.7-503.1Thalweg
		790,903	16	Events	Average:	49,431
496.1-496.6 Le Claire Canal	1941	111,129		496.1-496.6		--
	2001	14,384		494.3-494.6		493.9R (Smith Island
	2002	4,403		494.3-494.6		493.9R (Smith Island
	2012	2,118		494.5		526.0-526.2L mech
		132,034	4	Event	Average:	33,009
493.7-494.8 Lock #14 Upper	1952	244,165		493.7-494.8		493.7-494.1R, 494.5
	1963	69,988		493.8-494.3		493.9-494.0R
	1966	68,345		493.9-494.3		493.7R, 493.8R, 493
	1969	11,590		494.4-494.5		494.4-494.5R
	1971	48,312		494.5-494.8		494.7-494.8L
	1971	86,822		494.0-494.3		493.8-494.0R
	1999	162		493.25		Dredge Lwr 493.25R,
	2003	276		493.2		493.9R (Smith Island
	2005	7,008		493.8-494.1		481.8L - stockpile me
	2005	6,996		493.8-494.1		481.8L - stockpile me
	2006	1,312		493.8-494.1		493.9R (Smith Island
		544,976	11	Events	Average:	49,543

POOL 14 TOTALS

Events:	**87**
Yardage:	**4,187,317**
Average:	**48,130**

Beaver Island HREP

Appendix M

Design Engineering

Attachment E
Sedimentation Report

SEDIMENTATION STUDY

1984 - 1994

Sedimentation data was taken on the Mississippi River during the summer of 1994. This information was added to the study that was carried out from 84 to 89. The results of these studies have been broken down into two segments, 84-89 and 89-94

Data is given for each station in Pools 9 thru 19 with the exception of Pool 15 which was omitted from the study.

The Pools have from 5 to 12 stations and each station has from 2 to 5 substations. The figures presented here are the average of the substation readings. All readings are in feet. A + preceding the number indicates sediment buildup. A - indicates scouring. "No data" indicates the station was abandon or lost.

Maps are included in this report to identify station locations. The arrows show the location of the station and the direction from shore that the readings are taken.

Annual photo records are taken at each station to record vegetive changes.

Observations & Comments

Five of the Pools - 9, 10, 13, 16, and 18 have sedimentaion rates above the ten year average of the remaining Pools. Each of these five Pools have a relatively large tributary entering it. It could be concluded that these tributaries contribute to the higher sedimentation rate.

Pool 14, with the Wapsipinicon River entering at mid-pool, was only slightly below the ten year average.

Sedimentation in Pools 11, 12, and 17 was almost non-existatnt. These Pools have no major tributaries.

The average sedimentation for Pool 19, over the ten year period, is 0.00. This is hard to understane as this Pool has a large tributary that carries a heavy silt load. One theory could be that the Pool was created 35 to forty years ahead of the others and that an equalibrium has been reached or is approaching and the silt load passes on through without settling out.
-- only a thought.

If this study is continued, in future years, it is suggested that more time be alloted so that the stations can be upgraded by installing new post or by replacement of the bench marks. In some cases it might be advisable to add new stations or delite some of the existing ones.

Submitted by,

W. H. Aspelmeier
Professional RiverRat - Retired

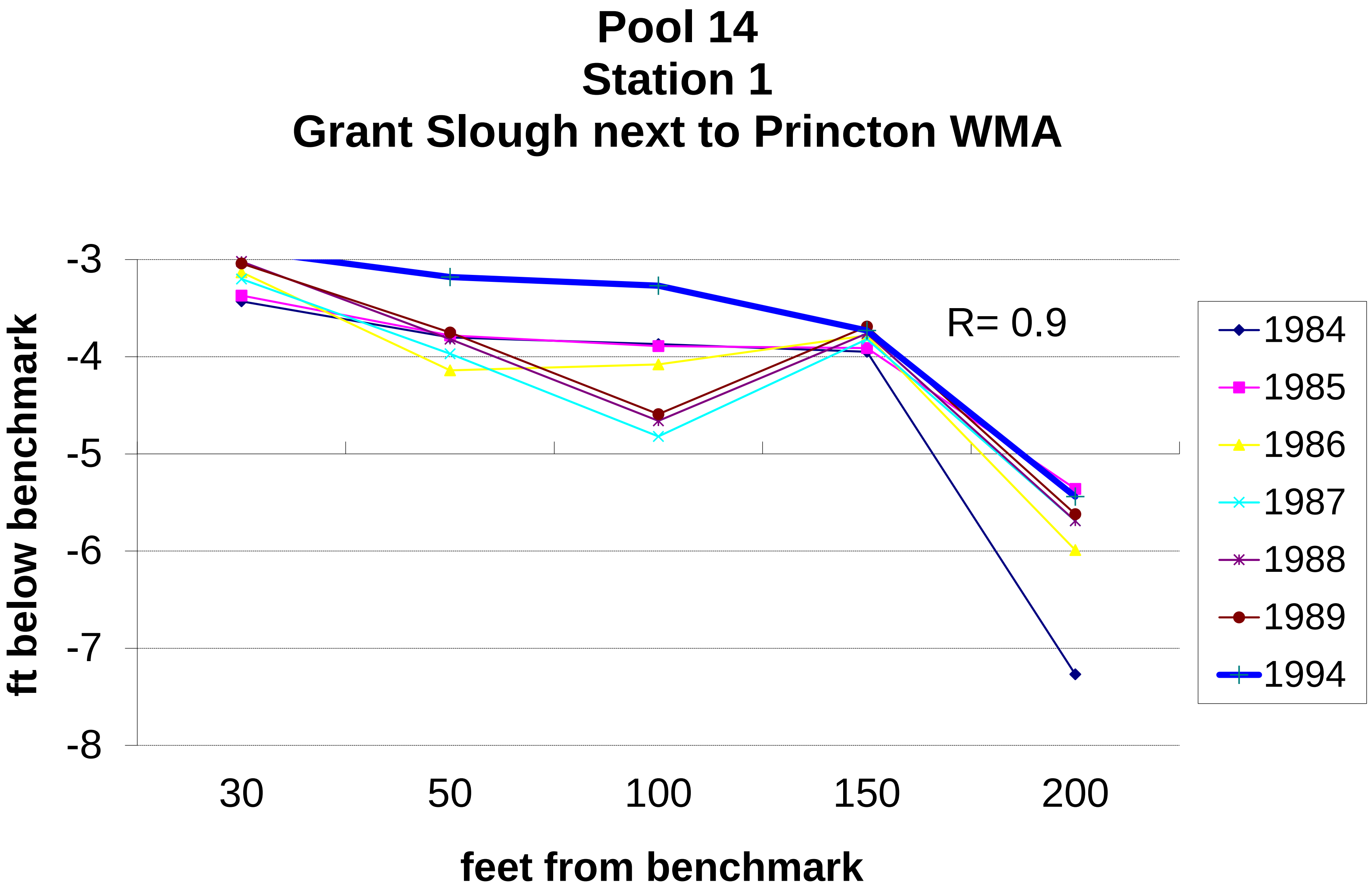
Iowa Department of Natural Resources
Sedimentation Data
Pool 14

Pool 14			-0.2	0.9	-0.2	0.6	0.4	0.8	0.5	0.4
	Station 1	10/11/1984			1984	1994		Rate		
30	2.22	5.65	-3.43		-3.43	-2.9	0.636	0.9		
50	2.22	6.02	-3.8		-3.8	-3.18	0.744			
100	2.22	6.09	-3.87		-3.87	-3.27	0.72			
150	2.22	6.17	-3.95		-3.95	-3.73	0.264			
200	2.22	9.49	-7.27		-7.27	-5.44	2.196			
		8/19/1985								
30	3.24	6.61	-3.37							
50	3.24	7.02	-3.78							
100	3.24	7.13	-3.89							
150	3.24	7.15	-3.91							
200	3.24	8.6	-5.36							
		8/19/1986								
30	3.26	6.39	-3.13							
50	3.26	7.4	-4.14							
100	3.26	7.34	-4.08							
150	3.26	7.04	-3.78							
200	3.26	9.25	-5.99							
		6/11/1987								
30	2.51	5.71	-3.2							
50	2.51	6.48	-3.97							
100	2.51	7.33	-4.82							
150	2.51	6.33	-3.82							
200	2.51	8.2	-5.69							
		5/25/1988								
30	2.77	5.79	-3.02							
50	2.77	6.59	-3.82							
100	2.77	7.43	-4.66							
150	2.77	6.53	-3.76							
200	2.77	8.46	-5.69							
		6/28/1989								
30	2.84	5.88	-3.04							
50	2.84	6.59	-3.75							
100	2.84	7.43	-4.59							
150	2.84	6.53	-3.69							
200	2.84	8.46	-5.62							
		7/6/1994								
30	2.97	5.87	-2.9							
50	2.97	6.15	-3.18							
100	2.97	6.24	-3.27							
150	2.97	6.7	-3.73							
200	2.97	8.41	-5.44							
		2000	Lost							

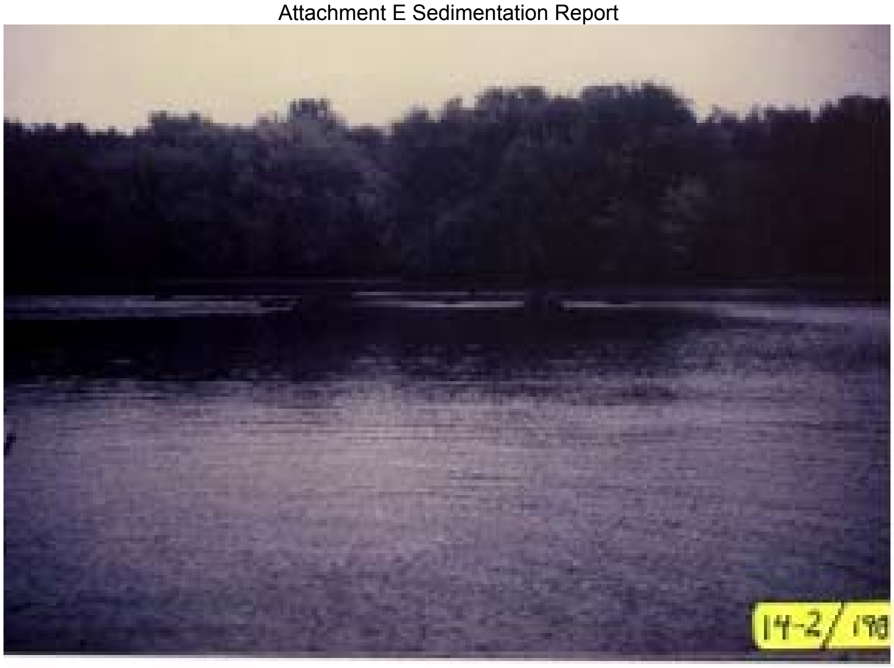

14-1 / 19


14-1 / 19


14-1/1994

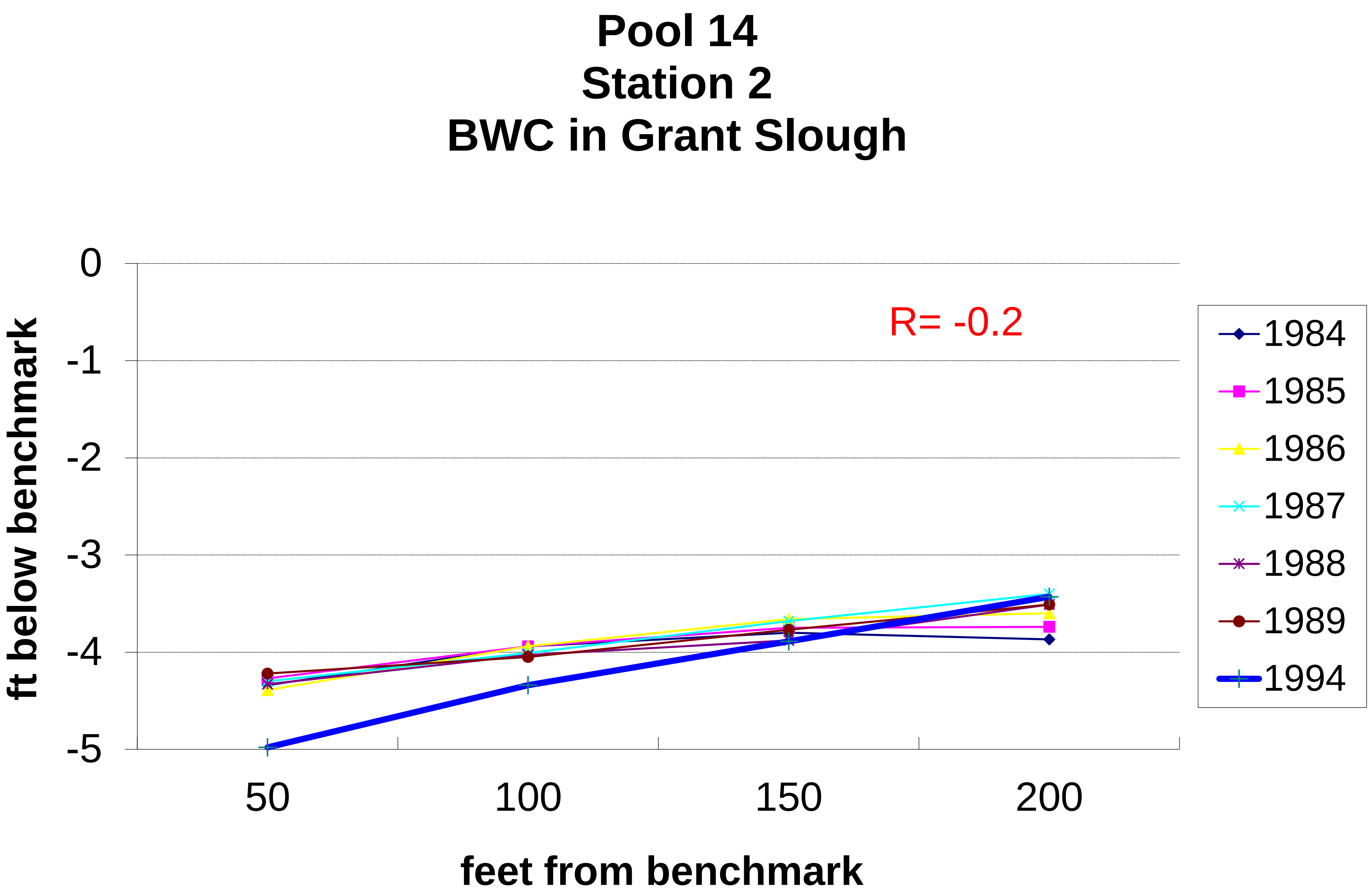

Pool 14
Station 1
Grant Slough next to Princton WMA
-3
-4
-5
-6
-7
-8
ft below benchmark
30
50
100
150
200
feet from benchmark
R= 0.9
1984
1985
1986
1987
1988
1989
1994

	Station 2	10/11/1984		1984	1994		Rate	
50	2.88	7.22	-4.34	-4.34	-4.98	-0.768	-0.2	
100	2.88	6.82	-3.94	-3.94	-4.34	-0.48		
150	2.88	6.68	-3.8	-3.8	-3.89	-0.108		
200	2.88	6.75	-3.87	-3.87	-3.43	0.528		
		8/19/1985						
50	3.5	7.77	-4.27					
100	3.5	7.44	-3.94					
150	3.5	7.25	-3.75					
200	3.5	7.24	-3.74					
		8/21/1986						
50	3.35	7.74	-4.39					
100	3.35	7.29	-3.94					
150	3.35	7.01	-3.66					
200	3.35	6.95	-3.6					
		6/11/1987						
50	3.47	7.77	-4.3					
100	3.47	7.48	-4.01					
150	3.47	7.15	-3.68					
200	3.47	6.87	-3.4					
		5/25/1988						
50	3.29	7.62	-4.33					
100	3.29	7.32	-4.03					
150	3.29	7.17	-3.88					
200	3.29	6.8	-3.51					
		6/28/1989						
50	3.4	7.62	-4.22					
100	3.4	7.45	-4.05					
150	3.4	7.17	-3.77					
200	3.4	6.91	-3.51					
		7/6/1994						
50	3.51	8.49	-4.98					
100	3.51	7.85	-4.34					
150	3.51	7.4	-3.89					
200	3.51	6.94	-3.43					
	2000	lost						

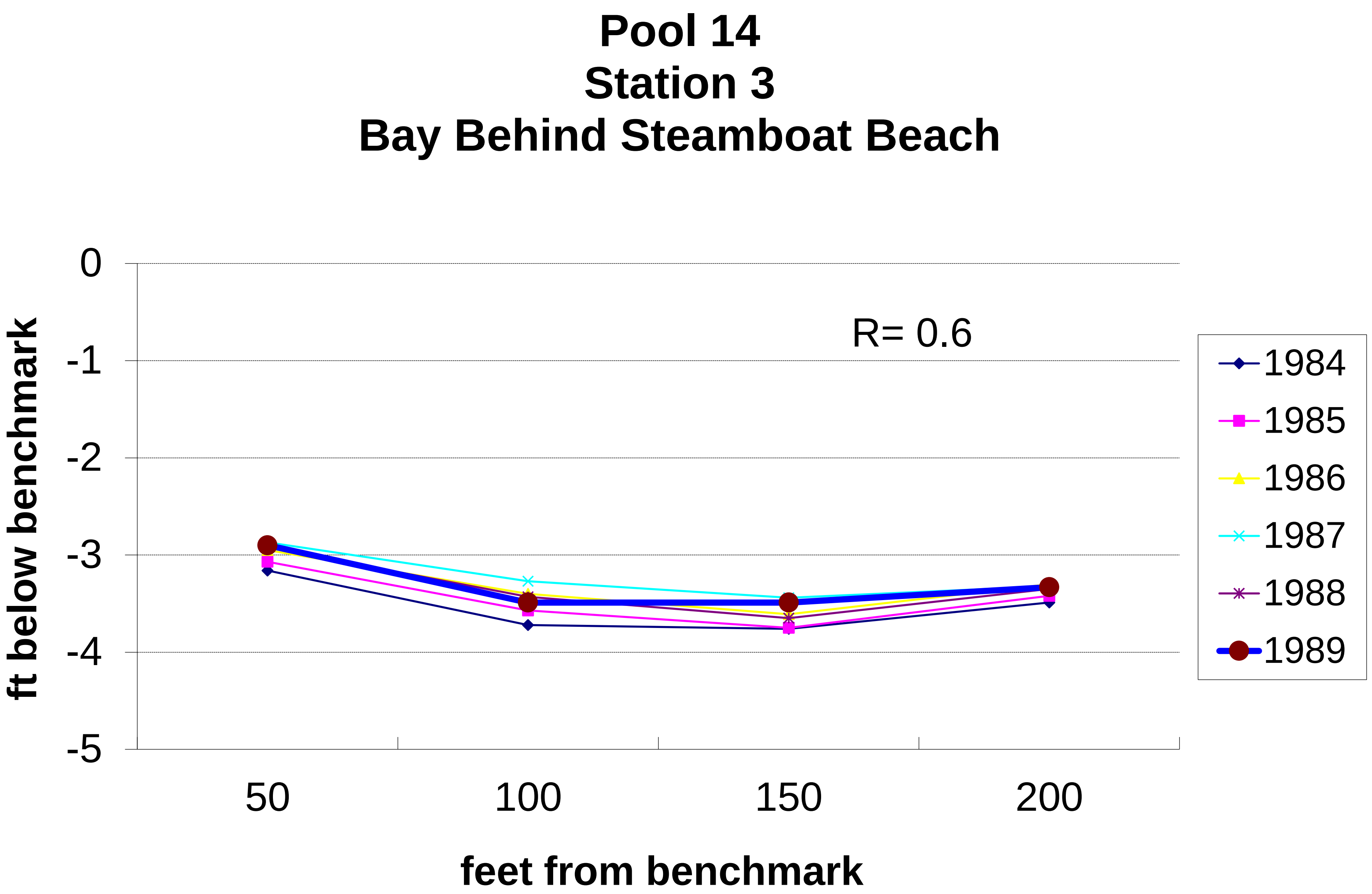

14-2/ 198


14-2 198

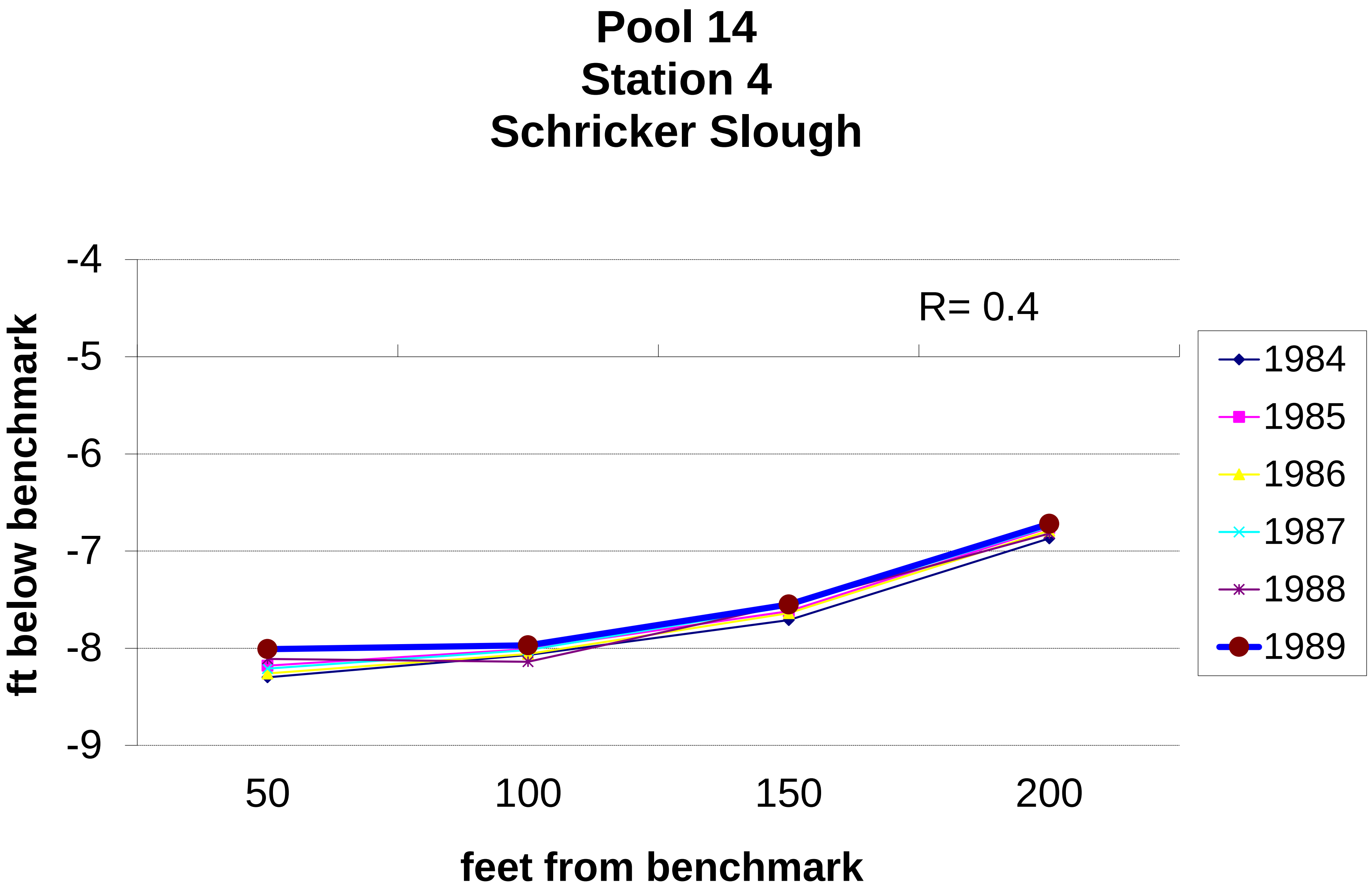

14-2/1994


Pool 14
Station 2
BWC in Grant Slough
R= -0.2
ft below benchmark
0
-1
-2
-3
-4
-5
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989
1994

	Station 3	10/11/1984			1984	1989		Rate
50	2.45	5.61	-3.16		-3.16	-2.9	0.624	0.6
100	2.45	6.17	-3.72		-3.72	-3.49	0.552	
150	2.45	6.21	-3.76		-3.76	-3.49	0.648	
200	2.45	5.94	-3.49		-3.49	-3.33	0.384	
		8/14/1985						
50	2.49	5.56	-3.07					
100	2.49	6.06	-3.57					
150	2.49	6.24	-3.75					
200	2.49	5.91	-3.42					
		8/21/1986						
50	2.65	5.6	-2.95					
100	2.65	6.05	-3.4					
150	2.65	6.26	-3.61					
200	2.65	5.95	-3.3					
		6/11/1987						
50	2.13	5	-2.87					
100	2.13	5.4	-3.27					
150	2.13	5.57	-3.44					
200	2.13	5.45	-3.32					
		5/25/1988						
50	2.15	5.07	-2.92					
100	2.15	5.58	-3.43					
150	2.15	5.8	-3.65					
200	2.15	5.5	-3.35					
		6/28/1989						
50	3.07	5.97	-2.9					
100	3.07	6.56	-3.49					
150	3.07	6.56	-3.49					
200	3.07	6.4	-3.33					
	1994	lost						
	2000	lost						


Pool 14
Station 3
Bay Behind Steamboat Beach
R= 0.6
0
-1
-2
-3
-4
-5
ft below benchmark
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989

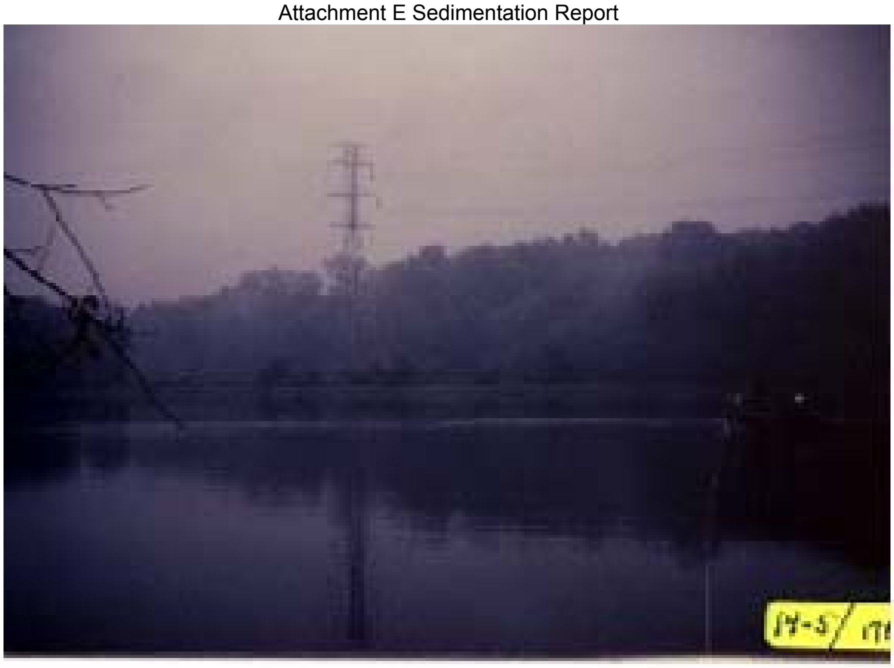
	Station 4	10/11/1984			1984	1994		Rate
50	0.68	8.98	-8.3		-8.3	-8.01	0.696	0.4
100	0.68	8.75	-8.07		-8.07	-7.97	0.24	
150	0.68	8.39	-7.71		-7.71	-7.55	0.384	
200	0.68	7.55	-6.87		-6.87	-6.72	0.36	
		8/19/1985						
50	0.14	8.32	-8.18					
100	0.14	8.15	-8.01					
150	0.14	7.76	-7.62					
200	0.14	6.9	-6.76					
		8/21/1986						
50	0.54	8.8	-8.26					
100	0.54	8.6	-8.06					
150	0.54	8.18	-7.64					
200	0.54	7.33	-6.79					
		8/11/1987						
50	0.15	8.36	-8.21					
100	0.15	8.17	-8.02					
150	0.15	7.72	-7.57					
200	0.15	6.9	-6.75					
		5/25/1988						
50	1.05	9.16	-8.11					
100	1.05	9.19	-8.14					
150	1.05	8.6	-7.55					
200	1.05	7.87	-6.82					
		6/28/1989						
50	0.3	8.31	-8.01					
100	0.3	8.27	-7.97					
150	0.3	7.85	-7.55					
200	0.3	7.02	-6.72					
	94	lost						
	2000	lost						


Pool 14
Station 4
Schricker Slough
R= 0.4
ft below benchmark
-4
-5
-6
-7
-8
-9
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989

Station 5

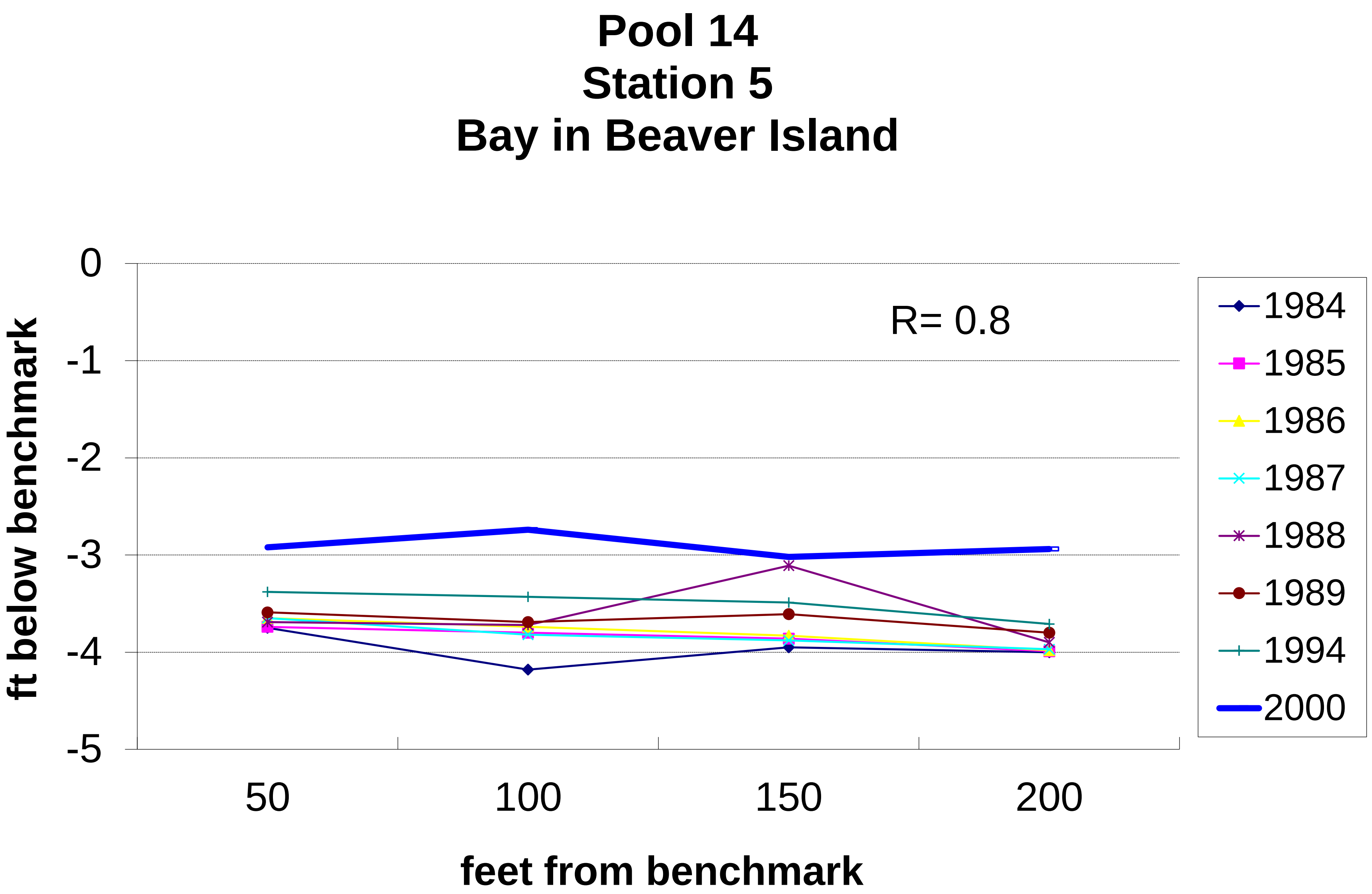
		10/12/1984		1984	2000		Rate	
50	2.52	6.27	-3.75	-3.75	-2.92	0.6225	0.8	
100	2.52	6.7	-4.18	-4.18	-2.74	1.08		
150	2.52	6.47	-3.95	-3.95	-3.02	0.6975		
200	2.52	6.52	-4	-4	-2.94	0.795		

		8/19/1985	
50	3.75	7.49	-3.74
100	3.75	7.55	-3.8
150	3.75	7.61	-3.86
200	3.75	7.74	-3.99
		8/21/1986	
50	3.09	6.74	-3.65
100	3.09	6.83	-3.74
150	3.09	6.92	-3.83
200	3.09	7.07	-3.98
		6/11/1987	
50	3.23	6.88	-3.65
100	3.23	7.05	-3.82
150	3.23	7.11	-3.88
200	3.23	7.2	-3.97
		5/25/1988	
50	1.7	5.39	-3.69
100	1.7	5.42	-3.72
150	1.7	4.81	-3.11
200	1.7	5.6	-3.9
		6/28/1989	
50	2.56	6.15	-3.59
100	2.56	6.25	-3.69
150	2.56	6.17	-3.61
200	2.56	6.36	-3.8
		7/6/1994	
50	4.21	7.59	-3.38
100	4.21	7.64	-3.43
150	4.21	7.7	-3.49
200	4.21	7.92	-3.71
		8/2/2000	
50	3.33	6.25	-2.92
100	3.33	6.07	-2.74
150	3.33	6.35	-3.02
200	3.33	6.27	-2.94


14-5


14-5


14-5

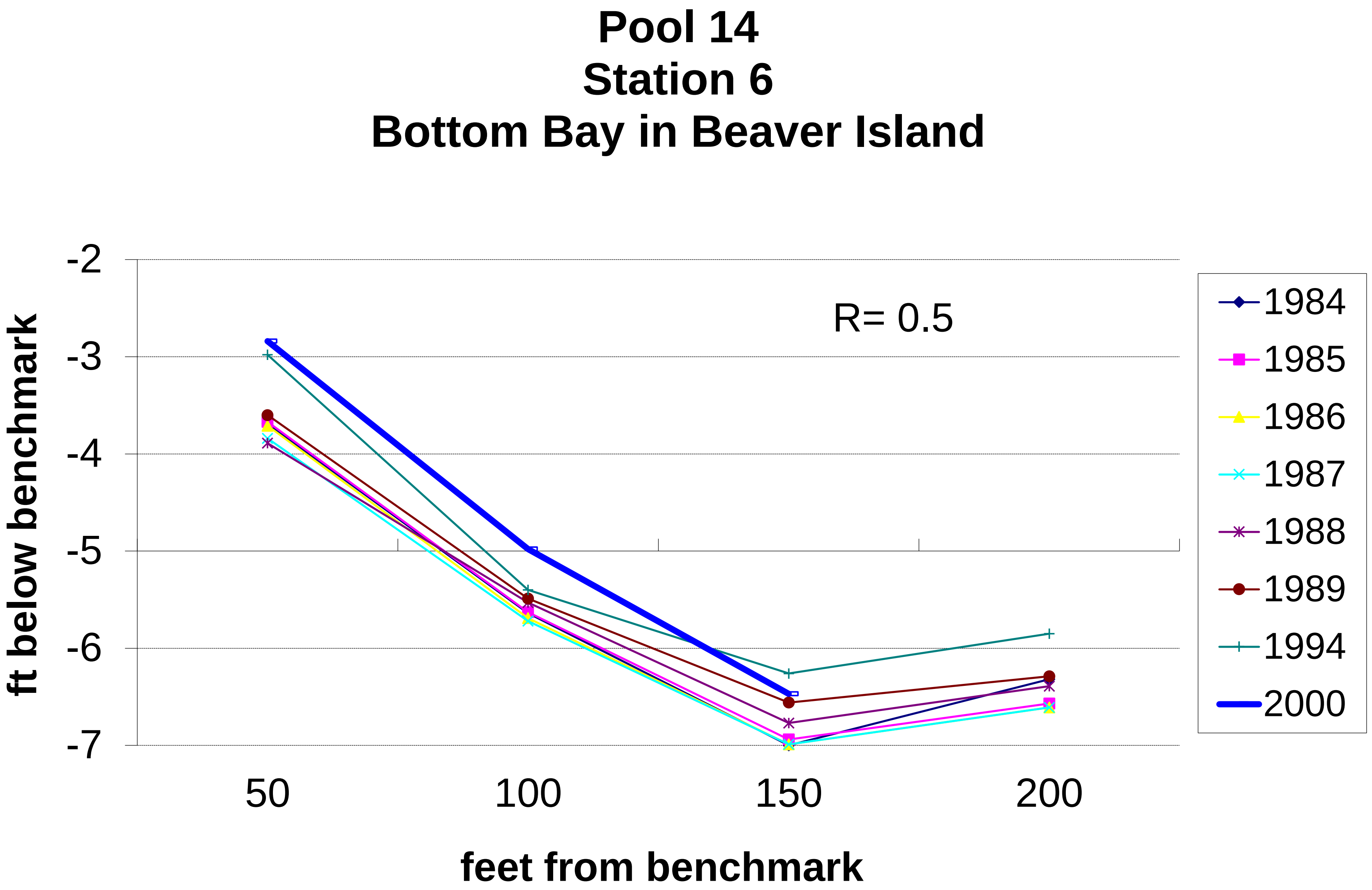

Pool 14
Station 5
Bay in Beaver Island
R= 0.8
0
-1
-2
-3
-4
-5
ft below benchmark
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989
1994
2000

Station 6				1984	2000		Rate
50	2.61	6.3	-3.69	-3.69	-2.84	0.6375	0.5
100	2.61	8.25	-5.64	-5.64	-4.98	0.495	
150	2.61	9.61	-7	-7	-6.47	0.3975	
200	2.61	8.93	-6.32	-6.32			
		8/19/1985					
50	2.83	6.5	-3.67				
100	2.83	8.46	-5.63				
150	2.83	9.77	-6.94				
200	2.83	9.4	-6.57				
		8/21/1986					
50	3.36	7.07	-3.71				
100	3.36	9.05	-5.69				
150	3.36	10.35	-6.99				
200	3.36	9.97	-6.61				
		6/11/1987					
50	2.56	6.4	-3.84				
100	2.56	8.28	-5.72				
150	2.56	9.55	-6.99				
200	2.56	9.17	-6.61				
		5/25/1988					
50	2.65	6.54	-3.89				
100	2.65	8.18	-5.53				
150	2.65	9.42	-6.77				
200	2.65	9.04	-6.39				
		6/28/1989					
50	2.74	6.34	-3.6				
100	2.74	8.23	-5.49				
150	2.74	9.3	-6.56				
200	2.74	9.03	-6.29				
		7/6/1994					
50	3.7	6.68	-2.98				
100	3.7	9.1	-5.4				
150	3.7	9.96	-6.26				
200	3.7	9.55	-5.85				
		8/2/2000					
50	3.49	6.33	-2.84				
100	3.49	8.47	-4.98				
150	3.49	9.96	-6.47				
200	3.49	no data					

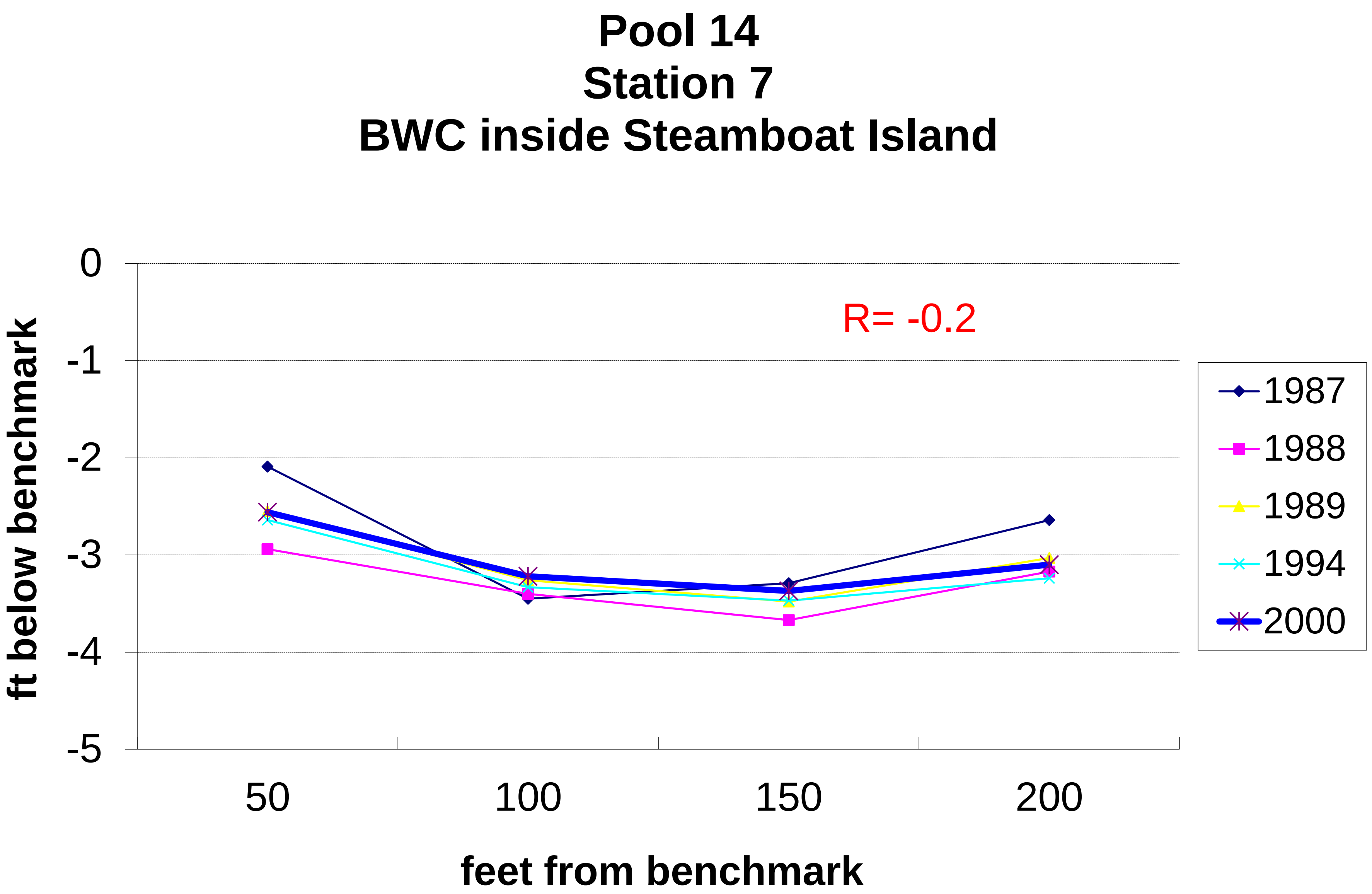

14-6/ 198


14-6 | 1989


14-6 200


Pool 14
Station 6
Bottom Bay in Beaver Island
R= 0.5
ft below benchmark
-2
-3
-4
-5
-6
-7
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989
1994
2000

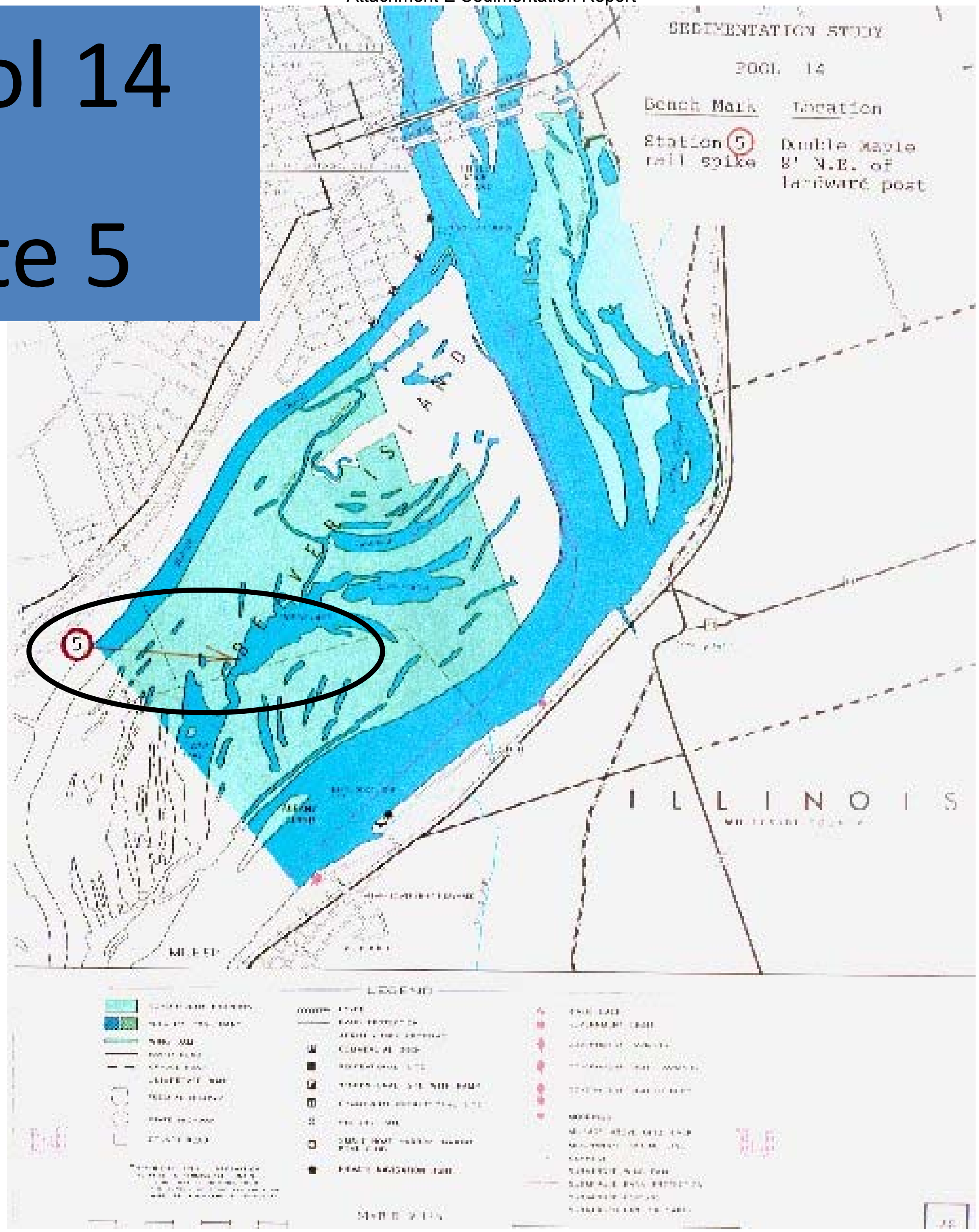
	Station 7	6/11/1987		1987	2000		Rate	
50	3.21	5.3	-2.09	-2.09	-2.56	-0.43385		-0.2
100	3.21	6.66	-3.45	-3.45	-3.22	0.212308		
150	3.21	6.5	-3.29	-3.29	-3.37	-0.07385		
200	3.21	5.85	-2.64	-2.64	-3.1	-0.42462		
		5/25/1988						
50	2.33	5.27	-2.94					
100	2.33	5.73	-3.4					
150	2.33	6	-3.67					
200	2.33	5.5	-3.17					
		6/28/1989						
50	2.97	5.52	-2.55					
100	2.97	6.23	-3.26					
150	2.97	6.45	-3.48					
200	2.97	6	-3.03					
		7/6/1989						
50	3.41	6.05	-2.64					
100	3.41	6.74	-3.33					
150	3.41	6.88	-3.47					
200	3.41	6.65	-3.24					
		8/2/2000						
50	2.96	5.52	-2.56					
100	2.96	6.18	-3.22					
150	2.96	6.33	-3.37					
200	2.96	6.06	-3.1					

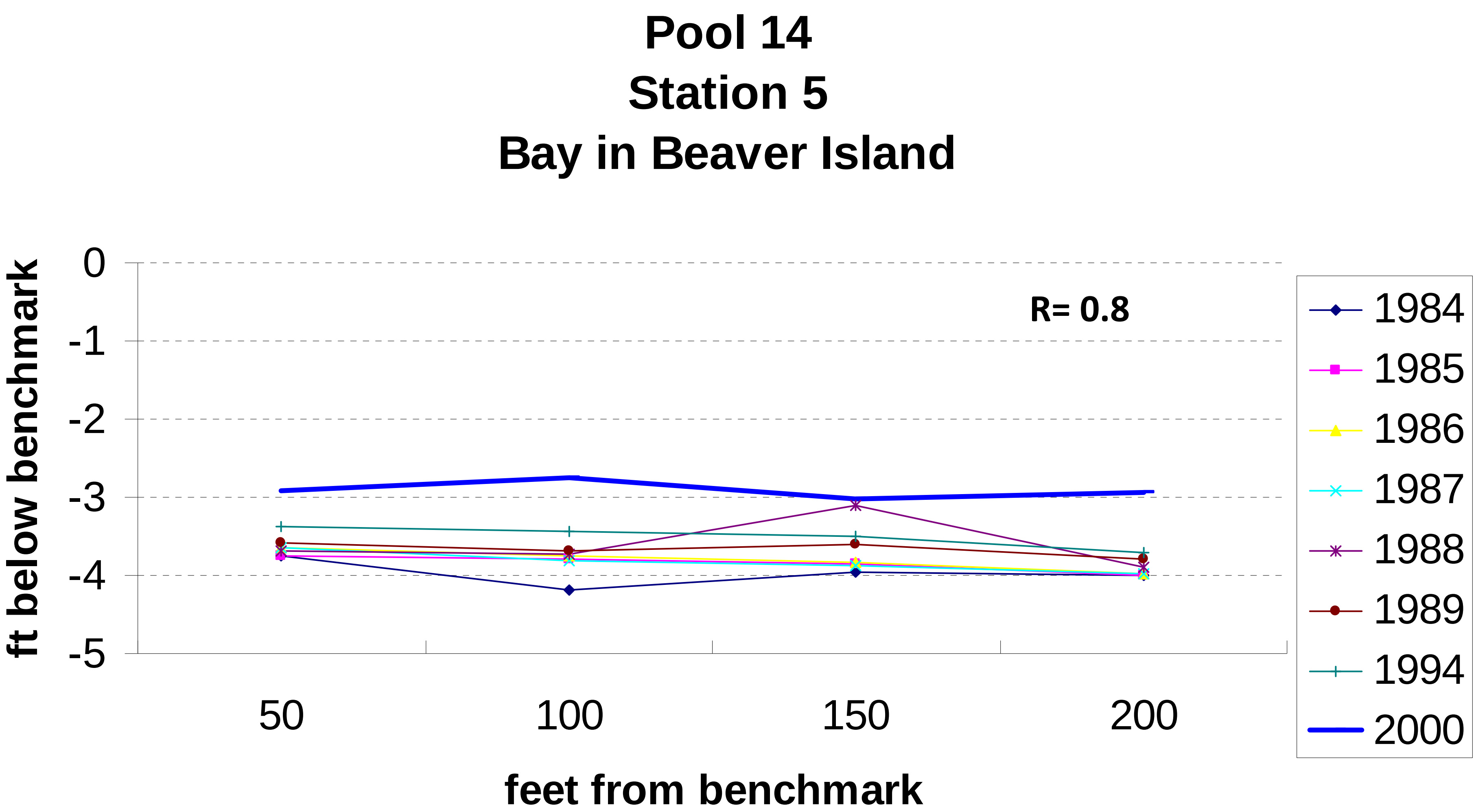

Pool 14
Station 7
BWC inside Steamboat Island
R= -0.2
ft below benchmark
0
-1
-2
-3
-4
-5
50
100
150
200
feet from benchmark
1987
1988
1989
1994
2000

UMRCC Talk
IA DNR

Pool 14

Site 5



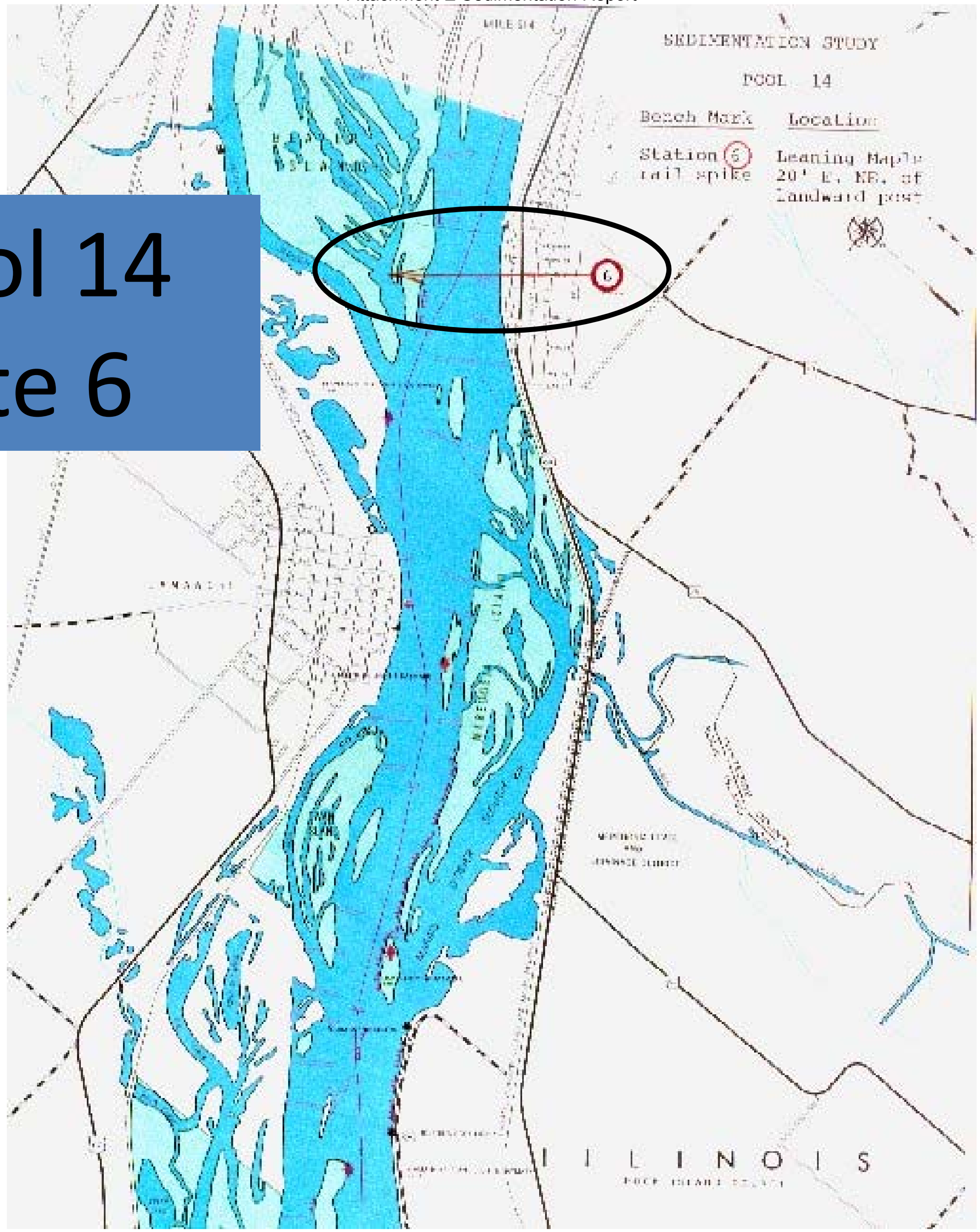

Pool 14
Station 5
Bay in Beaver Island
R= 0.8
0
-1
-2
-3
-4
-5
ft below benchmark
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989
1994
2000

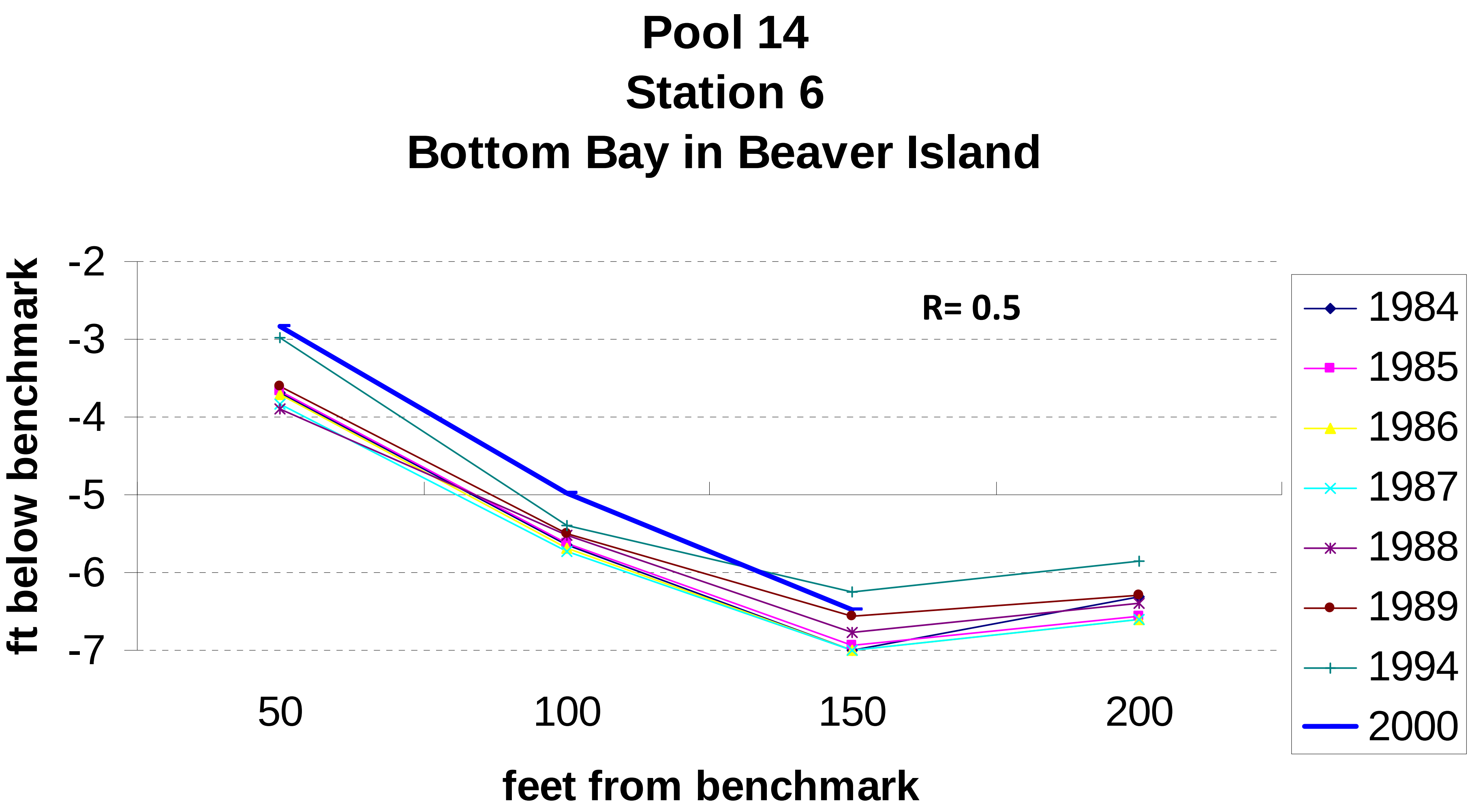

14-5


14-5


14-5

Pool 14
Site 6




Pool 14
Station 6
Bottom Bay in Beaver Island
R= 0.5
ft below benchmark
-2
-3
-4
-5
-6
-7
50
100
150
200
feet from benchmark
1984
1985
1986
1987
1988
1989
1994
2000


14-7


14-7


14-7
2000

Beaver Island HREP

Appendix M

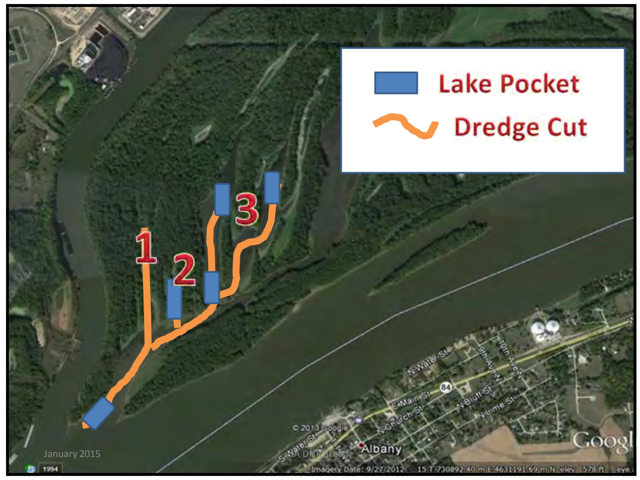
Design Engineering

Attachment F
Fish Habitat

IA DNR (Gritters)

- -----Original Message-----
- From: Gritters, Scott [DNR] [mailto:Scott.Gritters@dnr.iowa.gov]
- Sent: Tuesday, January 20, 2015 4:11 PM
- To: Savage, Monique E MVR
- Cc: Griffin, Michael [DNR]; Hansen, Kirk [DNR]; Richards, Nathan S MVR; Petersen, Joshua [DNR]; Baylor, Sharonne; Britton, Ed; Engelke, Russell (russell_engelke@fws.gov)
- Subject: [EXTERNAL] Beaver Island Dredge cuts
- Monique:
- I think you got the gist of a potential dredge cut pattern we would like to see in Beaver Island but I made a potential Cartoon for you to evaluate. I made it as a simple two page PowerPoint The Cartoon shows three different kinds of dredge cuts in it as I always like experimentation in the design of our projects.
- I am certainly open to dredging or designing habitat for overwintering in other areas such as Lower Lake but it will need to be created away from flowing water.
- Scott Gritters Fisheries Biologist
- cid:image001.jpg@01CE734D.8C8733F0
- Iowa Department of Natural Resources
- P 563-872-4976 | Scott.Gritters@dnr.iowa.gov
- 24143 Hwy 52 | Bellevue, IA 52031
- WWW.IOWADNR.GOV <http://www.iowadnr.gov>
- FB_16x16 <https://www.facebook.com/iowadnr>
- Tw_16x16 <https://twitter.com/iowadnr>
- Pin_16x16 <http://pinterest.com/iowadnr/>
- Leading Iowans in Caring for Our Natural Resources.

January 2015 IA DNR Sketch



Beaver Island Cartoon Features

1. Steward- use standard UMRR dredge cut (fill used to the berm on SW section of Beaver Island)
2. Small Lake- completely cup in this lake with berm and dredge out majority of the substrate. Placement of fish habitat within the lake including rock, wood and sand
3. Bluebell and Sand Burr dredge out a standard UMRR dredge cut but have open lake like pockets that are wider and deeper then the connecting dredge cuts. These “Lake Pockets- ” in the northern portions are to hold fish early in winter but pockets will created in Lower Bluebell and at the bottom end of Lower Cut to hold fish maybe late in the winter process as oxygen abates. All “Lake Pockets” will have rock, woody structure and sand habitat features in them to promote use.

January 2015 IA DNR Sketch

Document Recieved From IA DNR February 2016

Fish Habitat Enhancements

The Iowa DNR Fisheries staff has used several habitat enhancements on Iowa waters to improve catch rates for anglers. Some of the enhancements are constructed on the dry or frozen bottom while others can be placed from a boat in existing water. Each habitat enhancement brings its own limitations and benefits that are usually directed towards a specific species, season, or angling type. Some of the common enhancements are tree piles, rock reefs and mounds, spawning attracting areas, stake beds, benched jetties, bank hides, and other???? Material for small scale projects can be salvaged from other uses at little or no cost. Cement blocks, cable spools, old picnic tables, metal trash cans and broken concrete from construction sites as well as many other materials can be turned into excellent fish habitat. Volunteer labor can be utilized to minimize the time and effort to construct many types of enhancements.

Tree Piles

Description

Tree piles can provide cover for several species and are readily available near most water bodies. Some prey species use the cover for shelter from predators while others use the piles as possible ambush sights.

Site Selection

Placement locations can vary widely. All depths and locations can offer some benefits to many species during some period of the year. Site selection should be based on a combination of factors. Those might include the natural bottom contour, where angling activity would best occur to avoid conflicts with other activities, siltation, behavior patterns of the desired fish species, as well as any other concerns. Anglers can find submerged locations easier when some of the branches are left exposed. Deeper piles offer shelter during summer months and piles placed in the deepest areas can provide excellent cover for winter panfish.

Construction

Securing the trees to the bottom can be done by either staking with fence posts or weighting with heavy objects, commonly concrete blocks. Number 9 soft steel wire can be used to tie the trees to the anchoring devices and will last for 3 to 5 years. Copper or aluminum wire will last indefinitely but is more expensive. Polypropylene rope works well also but wave movement may cause abrasion. Screw-in fence anchors and steel cable have been used to secure large brush piles to the bottom of dry lake bottoms. Weighted trees can be placed in the ice and will likely sink in the general vicinity but may move when ice melts or cause hazards to other winter uses.

Placement

Placement of trees in open water requires a large boat or working platform. Trees can be weighted then either hauled or towed out to needed areas. This method is labor intensive and smaller trees are requires but four people can readily place up to 30 trees during a half days effort.

Considerations

Cedar trees are usually abundant on the surrounding public property or from neighboring road ditches. Trees that have grown alone usually have a bushier shape and provide more cover per tree. Trees grown in tight groups often lack the side branches that provide the shelter. Other tree species can be beneficial but have drawbacks. Hedge trees, (Osage Orange) are quite bushy and contain very long lasting branches but the thorns are difficult to work with and often puncture tires. Hardwoods such as oaks can also be a source of trees. They are usually more desirable as timber and therefore may have offer greater aesthetic benefits if left. Surplus Christmas trees do not offer long term habitat and their branches are thin and break down quickly.

Spawning Areas

Description

Male panfish make shallow depressions in the loose bottom material to create a site for the female to lay eggs. Usually many males frequent a small area. Sand, pea gravel, and limestone chips have been used to create areas in many Iowa lakes.

Site Selection

Water depths should be 18 to 42 inches depending on expected water clarity, near existing shoreline access areas when possible, and where sediments will not eventually cover the site. Areas with deeper water, submerged rock, and or flooded timber nearby can be even more productive because the additional sheltered areas offer places for pre-spawn fish to stage or other to safely retreat should danger arise. Excellent areas would be the corners on each side of an existing jetty where the jetty connects to the shoreline, areas near submerged road crossings, the sides of small steep side coves, or the corners of the dam.

Construction

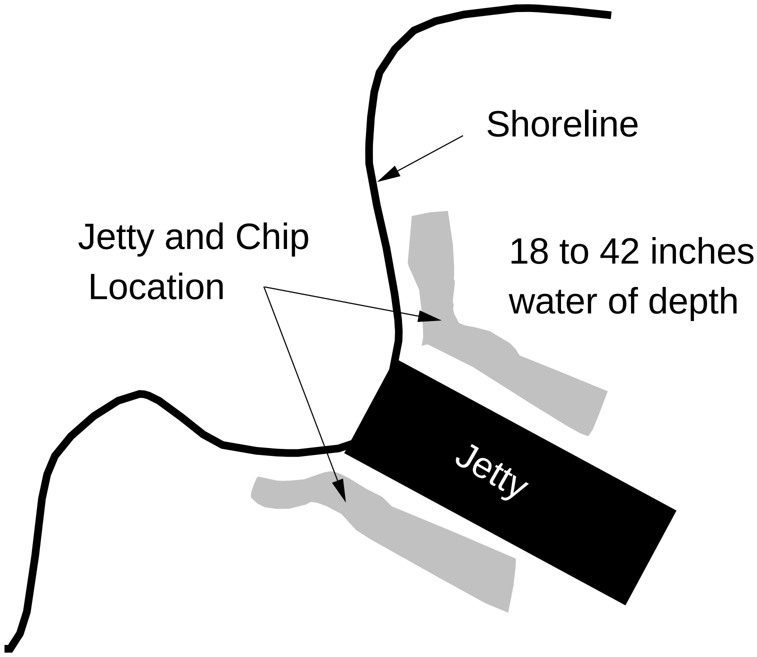
Limestone chips from local quarries work well for this purpose and are readily available near most locations. The chips are commonly used to resurface “Oil and Chip” roads. Pea gravel mined from river beds is best but delivery to remote areas may escalate the cost to above feasible limits. A typical dump truck load will cover an area approximately 30 feet by 60 feet approximately 6 inches thick. Length and width can vary but long, narrow areas that follow the bottom contour would offer greater angler access.

Placement

Spawning areas on dry or frozen bottoms are easy to construct. Very little site preparation is needed and many times the material is only dumped from a truck then shaped to the desired depth by a small tractor and blade. Placement in open water can be done by an excavator. The machine can reach several feet form shore and easily sprinkle and shape the material with the bucket. Material can be placed on the ice but movement during the thaw can occur.

Considerations

Material transportation can become a large portion of the final cost. Pea gravel provides excellent habitat characteristics but availability is usually dependant on local river mining. The limestone chips are common in many parts of the state. Quarries commonly crush them in early summer but usually make only quantities needed for local road projects. Therefore availability may be a problem during the off season. They are also available with or without fines. The material without fines would be less likely to pack and panfish may prefer this over the material with fines. Sand is readily available throughout the state but course sand is sometimes harder to find. The course sand particles will not pack together and will offer characteristics similar to that of pea gravel or limestone chips. The cost of each material type delivered to the site must be evaluated to create the largest benefits possible. An illustration of a typical location is shown below.



Shallow Rock Piles

Description

Shallow Rock Piles will hold many species of fish during all open water seasons. The rock surfaces attract many invertebrate species and the cavities provide shelter areas to fish.

Site Selection

Sites in clear water, away from possible silt sources, and adjacent to additional submerged rock flats work well. The face of the dam or areas along armored shoreline stretches can offer these characteristics and can be easily utilized by both boat and shore anglers.

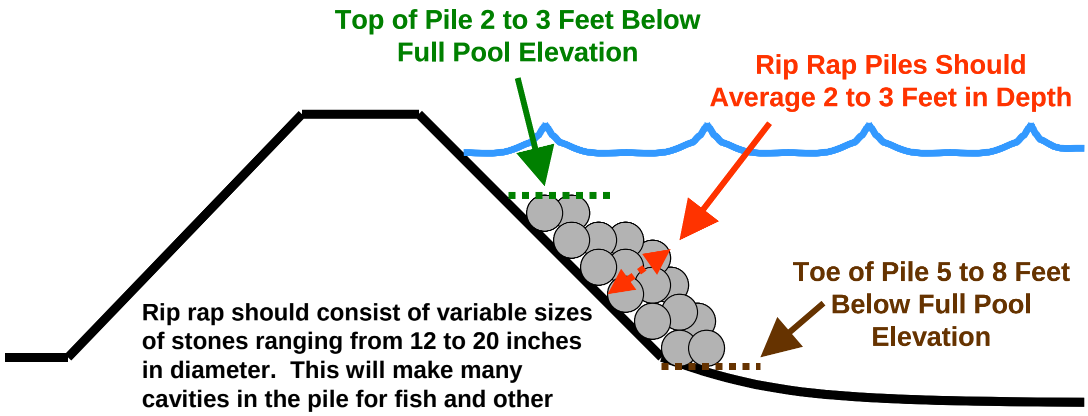
Construction

These piles usually consist of two to three typical dump truck loads of screened riprap or clean salvaged concrete.

Placement

Material placed to form a reef six feet wide perpendicular to shore starting in two feet and extending into eight feet of water works well. A long reaching excavator would easily reach both the unloading area and the outer edges of the reef. The top should be at least two feet under the normal pool level. Several piles can be placed along a given stretch of shoreline. An illustration of a Shallow Rock Pile is shown below.

Shallow Rock Piles



Rip rap should consist of variable sizes of stones ranging from 12 to 20 inches in diameter. This will make many cavities in the pile for fish and other aquatic organisms to utilize. Rip rap should be placed along dam face or in other approved and evaluated areas, like described above, ranging from 10 to 20 linier feet in shoreline length. Placing 2 to 5 of these piles in an impoundment will greatly enhance crappie, catfish, bluegill, and bass fishing of a system. Happy fishing!

Considerations

These piles should last many years if placed below the typical wave and ice line. Impacts to boating traffic should be minimal because they are very close to existing shoreline. Screened riprap is slightly more expensive but the extra cavities offered by the lack of fine material should attract more fish.

Rock Fields

Description

The face of a dam or a stretch of armored shoreline can attract many fish species throughout the year. The rock surfaces and cavities provide excellent attachment areas for invertebrates. These cavities provide sites for higher food chain members or fish to find shelter from even larger predators. Larger predators in turn, frequent these areas searching for prey. The areas thus become popular angling sites. The addition of rock covered areas to other parts of a water body should also attract fish.

Site Selection

The recommended characteristics of a possible area would be a location large and open enough to freely troll or drift across, with naturally occurring drop-offs nearby, and or gradually deepening water depths of four feet descending into eight or nine feet. These areas should also be located such that any deposited or suspended sediments would not cover the site.

Construction

The material can be dumped over a dry or frozen bottom or barges can be used when available to place material in open water. The rock used at these locations does not usually freeze so softer, less expensive rock could be purchased.

Placement

The rock should nearly completely cover the bottom but does not need to be excessively thick and in many cases spreading is minimal. Any irregularities left during placement would further accent the area. The material should not be packed into the bottom.

Considerations

Screened riprap, when available, might be a better choice than non-screened or pit run rock because of its ability to provide more cavities with fewer fines. The screening process would also remove any excessively large pieces whereby allowing the available tonnage to cover a larger area. Native field stone also works well when available. Rock Field locations are submerged and sometimes difficult to locate. Therefore, they should be as large as feasible.

Stake Beds

Description

Fish attracting areas made from individual oak stakes or fiberglass strips have been placed in many locations of several Iowa water bodies. These areas often contain from several hundred to a few thousand pieces. This type of configuration allows crankbaits to be pulled through the stake bed with minimal snagging or perpendicular bobber fishing to occur with ease. Panfish and largemouth bass commonly utilize these areas during early and mid summer months.

Site Selection

Stakes should be placed in areas with approximately eight feet of water depth. Potential stake bed sites with adequate water depths within casting distance of shore usually do not naturally occur. Excavation for fill material used in jetty construction often creates suitable areas. The stake bed can cover a varied water depth but shorter stakes should be used in shallower areas. A clearance of two feet over the top of the stakes at normal pool to avoid damage by boats should be targeted.

Construction

Two methods of construction have been used in the past. Individual pieces can be pressed into the bottom sufficiently as to not float away or fall over. Spacing should be approximately twelve inches. Individual stakes can also be nailed together into individual rows with shorter stakes serving as the cross links. Several constructed rows can be nailed together to form an eight foot cube. These cubes can then be weighted with cement blocks and sunk in open water.

Placement

Pressing individual stakes into the soft lake bottom is the fastest method of placement. Individual stakes can also be placed from a boat or while wading.
This method works well during a drawdown where the potential site is partially flooded. Cubes can be lowered into open water from a boat or placed on the ice. Both of these methods are more labor intensive and are only used when other methods are not an option.

Considerations

Oak stakes are readily available from the State Forest Sawmill but are heavy, may float out, and may need to be pointed before pressing in the bottom. Transportation can become a problem because of the weight of the stakes. Surplus fiberglass step ladder legs acquired from the manufacturer have been used in several southern Iowa lakes. The fiberglass stakes will last indefinitely, will not float, and should be less susceptible to hook snagging. Availability is unpredictable and transportation from the factory to the desired location can be expensive because of the distance.

Benched Jetty Modification

Description

Fishing jetties are popular access points for the shoreline angler. The riprap and deepened sides attract fish of several species. The addition of a bench or shelf below the water's surface for spawning panfish can further enhanced the jetty's fish attracting ability. This bench also helps stabilize some of the jetty's side erosion.

Site Selection

Benches are most beneficial on calm jetty sides with no siltation sources nearby. Natural or man-made deepened areas nearby also enhance the site. Water depths over the bench can vary and should be approximately equivalent to with the typical water clarity available during the panfish spawning season. Any deep flooded timber or trees nearby may further enhance the attracting ability of the area.

Construction

Benches can be part of the design of newly constructed jetties with little additional cost. Jetties constructed on dry bottoms are usually earthen fill from the immediate area and barrow areas can be specified that result with the formation of the bench. Benches at least ten feet wide can then be topped with limestone chips or pea gravel similar to that used when constructing spawning beds. The jetty sides and toe areas below the bench should be riprapped. Benches can be added to existing jetties either while dry or submerged. Dry construction is easiest because fill or excavation of the surrounding area is readily visible and accessible.

Placement

Placement usually requires heavy construction equipment and is part of a contract with a private construction contractor.

Considerations

Benches are an inexpensive addition to a newly constructed jetty that brings the fish to the angler's feet. Water clarity and siltation are two important factors that affect the life expectancy and attracting ability of the bench. When incorporated into the jetty's initial design, have little or no influence on the final cost. This combination of features adds a variety of high quality habitat to an area the angler frequents. An illustration of a typical benched jetty is shown below.

Benched Jetty

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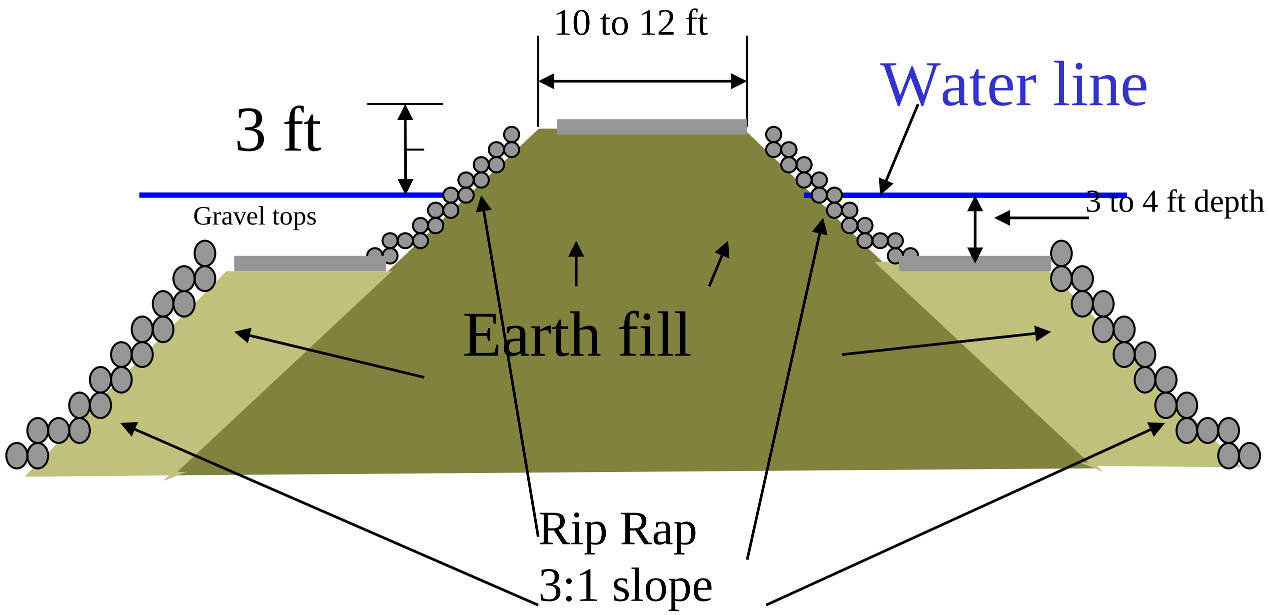

Catfish Hotels

Destription

Channel catfish are one of the most sought after fish species in Iowa. Channel catfish prefer hollow areas to rest and spawn. Enhancements of an area to attract them near angler access points can improve angling. Construction of this type of complex, (a Catfish Hotel), is easily done on a dry lake bottom with readily available materials. These Hotels would increase the number of catfish in an area and the drifting scent of baits would draw the catfish from their resting areas to the angler.

Site Selection

Areas near existing shoreline access areas with five to ten feet of water depths and possibly a creek channel meander nearby work well for this purpose. Boat anglers often prefer more secluded locations.

Construction

Salvaged sections of plastic field tile twelve to eighteen inches in diameter cut approximately 40 inches long then weighted with riprap serve this purpose quite well. Plastic field tile rolls when shipped are wound around a large diameter center tube. These plastic center tubes are often available as scrap at little or no cost from agconstruction companies. They are normally 7 feet long and when shortened to half length can become excellent catfish shelters. A tractor loader or skid-steer can be used to cover one end of the tube with riprap. Individual tubes can protrude from different sides of a common pile. A normal sized dump truck load of riprap may cover up to ten tubes

Placement

Placement on a dry bottom is a requirement. This would only be possible at newly constructed or temporarily drained locations. Riprap delivery to site is usually possible through local contractors. The local DNR Fisheries staff in conjunction with volunteers can readily select sites, operate needed equipment, and construct these Hotel complexes.

Considerations

Catfish are somewhat territorial and multiple tube openings near one another may be utilized by only one fish. Openings should be directed away from one another to minimize these conflicts and a common riprap pile may weight down as many as four or five tubes. Water depths over the top of the riprap should be such as to not create a boating hazard. The rock and plastic materials would last for many years if placed in areas of minimal sedimentation.

Pallet Structures

Destription

Cubes or other shaped structures made from scrap shipping pallets can be used to attract panfish and largemouth bass. Weights to hold the structure in place are usually the only purchased items needed.

Site Selection

These structures are usually placed in water depths of five to eight feet near shoreline access if possible. Shallower areas can be used but boating traffic could cause problems. Several individual structures when clumped together have a greater cumulative ability to attract fish. Creek channel edges or nearby rock piles ad additional features which further enhance the structure's ability to attract fish.

Construction

Pallets of similar dimensions can be quickly nailed together with an air powered nail gun to form shapes of various sizes. Some designs have been formed cubes while others have slots. Some have tops and others have no tops. Variety seems to be the key characteristic. Construction on the dry or frozen bottom is easiest but they can be built on shore and hauled to the final location with a boat. Either method requires some sort of weighting to hold the structure in place. Salvaged concrete blocks are the most common weight used but riprap can be hand placed in each structure and also works well.

Placement

Many structures are constructed at the final location and no addition placement is required. Structures constructed on shore and placed in open water from a boat may be quite heavy and could be difficult to handle. Some of these may bob when dumped overboard and may require additional weights.

Considerations

These structures will usually last up to five to eight years underwater. Other forms of artificial habitat usually last longer. Construction material costs are usually low but labor can be intensive. Often, community or sportsman groups will gladly volunteer to help build these structures. Many times they have access to pallets or any needed tools. Minimal guidance to select the best sites will result with a fish attracting structure that is highly valued by the local community.

IA DNR
Fish Habitat Examples

March 2016

Background

- The following photographs were emails from Scottie Gritters, IA DNR to Kara Mitvalsky, CEMVR-EC-DN for examples of fishery substrate

Fish Habitat: Bluegill Tree

Fish Habitat (Before inundation)

Rock and Gravel Sand Bench

Rock Pile

Rock Humps (Before Inundation)

Fish Habitat (Before inundation)

Rock substrate with gravel center

Rock with Culverts

Fish Habitat (Before inundation)

Rock Bench along shoreline

Rock with tree combo

Fish Habitat (Before inundation)

Top of Rock Bench

Triangular Rock Hump

Beaver Island HREP

Appendix M

Design Engineering

Attachment G
Herpetology Study


Beaver Island – Natural Herp Sites
April 15, 2015 Site Investigation


Numerous small wetlands are scattered throughout


Interconnected large and small wetlands

Natural Herp Sites at Beaver ISland

Beaver Island HREP

Appendix M

Design Engineering

Attachment H
Mussel Data

CEMVR-EC-DN 18 Feb 2015

MEMORANDUM FOR RECORD

SUBJECT: Beaver Island Mussel Habitat Design Criteria

1. Introduction:

This MFR was created in February 2015 to support the Beaver Island HREP Design Team in mussel habitat creation. It is a review of the Bertom McCartney HREP Mussel Habitat Enhancement Monitoring, Unionid Habitat Literature Review, and Beaver Island Meeting Minutes for October 31, 2014. It is an attempt to find a consensus for mussel habitat design criteria for the Upper Mississippi in order to design a successful mussel habitat at Beaver Island.

2. Design Criteria:

The following information is a consolidations of design critieria.

a. Depth:

- Min. 3ft – max 6 ft (Beaver Island Meeting Minutes)
- *A. plicata, F. flava, L. costata, and S. undulates* prefer depth near 4.9 ft and avoided depths < 2 ft. *Anodonta (Pyganodon) grandis* prefers deep waters (4.4 ft). (Hart)
- *P. grandis* prefer deep shelves (9.8 ft deep). *L. siliquoidea* prefer depth <4.9ft. *P. alatus* occur at a variety of depths, but only on flats. (Straka and Downing)
- Depth should be at least 6 ft (Jeff Janvrin of Wisconsin DNR, Pool 8 Island HREP)

Summary: 3ft-6ft depth. There are a few studies that suggest deeper waters than in this range. It is generally agreed that the depth needs to allow host fish access to the area.

b. Substrate:

- Prefer river washed rock and quarry gravel (Beaver Island Meeting Minutes)
- Prefer gravel substrates in areas with no in stream cover (Hart)
- Recommend using river washed or rounded rock with 50% <0.25 in, 30% 0.25 to 0.5 in, 15% 0.5 to 1 in, 5% > 2 in, with larger rock scattered for variation. (Jeff Janvrin of Wisconsin DNR, Pool 8 Island HREP)
- In one survey done on a bank stabilization project, mussels did not colonize the rip rap, but instead were more abundant in adjacent “natural substrates”. (Watters)

Summary: River washed or rounded rock. Some gravel or larger rocks dispersed is acceptable.

c. Velocity:

- Min. 0.2m/s – max 1m/s (Beaver Island Meeting Minutes)
- USFWS, Higgins Eye Pearly Mussel Recovery Plan, confirms that velocity should be less than 1m/s for Higgin’s Eye Habitat.

- *A. plicata, F. flava, L. costata, and S. undulates* preferred velocity at 0.80 m/s and avoided velocity <0.25m/s. *Anodonta (Pyganodon) grandis* prefers velocity < 0.1m/s (Hart)
- A gravel bar habitat on the Tombigee River was created with velocities of 0.46 m/sec and 0.3 m/sec. This gravel bar habitat was very successful in mussel habitat creation. (Miller)
- Mid-depth velocity 0.18 to 0.46 m/sec during "normal flow", mid-depth velocity ≥0.76 m/sec during bank full flow (Jeff Janvrin of Wisconsin DNR, Pool 8 Island HREP)

Summary: Velocity range 0.25m/s- 1m/s. Some studies suggest velocities below this range.

d. Zebra Mussel:

- Zebra mussel veliger take hold at less than 0.1m/s (Beaver Island Meeting Minutes)

Summary: Avoid velocity <0.1m/s

e. Shear stress

- In one study in the Cumberland River in Kentucky, for stream discharges between 0.03 and 2.18 m^3/s, shear stress and stream power were negatively correlated. The authors suggest limiting shear stress to 50 $dynes/cm^2$ over existing mussel beds. (Layzer and Madison)
- In a study done in Pool 8, the authors stated that most sites with mussels in their study (165 of 223) had shear stress (Q95) ≤ 0.18 $dynes/cm^2$; shear stress (Q50) > 0.48 $dynes/cm^2$; and shear stress (Q5) ≤7.80 $dynes/cm^2$ (Zigler, Newton, Steuer, Bartsch, and Sauer)
- Several studies mention that shear stress may be a limiting factor.

Summary: There is no consensus about a range for shear stress. However, the studies agree that shear stress may be a limiting factor.

f. Fish habitat

- In one study in Oklahoma, mussel species richness and fish species richness were positively associated. However, fish species richness seemed to be a limiting factor rather than a determining factor. (Vaughn and Taylor)
- In one study, the authors emphasized the importance of juvenile settlement in the development of a mussel bed. The authors suggest that a habitat should be created within 1 km of good fish habitat. (Daraio, Weber, Newton, and Nestler)

Summary: Many studies agree that the presence and richness of fish species is essential. However, most of the studies do not go into specific requirements for mussel habitat design. One study suggested that a mussel habitat should be created within 1 km of good fish habitat.

g. Dissolved Oxygen

- Juveniles need >2mg/L DO (Sparks and Strayer)

Summary: DO was only mentioned in a couple of studies. This is the only study that puts a parameter on DO.

h. Re* (Boundary Reynolds Number)

- The authors of one study in Texas suggests a minimum Re* is needed during low flow. In their study, highest occurrence of mussels was at Re* > 11.01. (Randklev, Kennedy, and Lundeen)
- Highest density of *A. plicata* at low flow was related to Re* > 2.1, depth <5.6 ft. *L. fragilis* at low flow was related to Re*>2.4. If Re* < 2.4 then depth >4.1. *F. flava* was related to high flow Re* >7.2. (Steuer, Newton, Zigler)

Summary: Several studies agree that a minimum Re* is required. However, the minimum Re* varies between studies.

i. Froude Number

- In one study in Kentucky, the authors found that Fr was negatively correlated with mussel density in all rivers sampled. (Layzer and Hardison)
- The authors of one study in Texas suggests a minimum Fr is needed during low flow. In their study, if Re* <11.01, then Fr no >0.1503 was most predictive of mussel presence. (Randklev, Kennedy, and Lundeen)
- In a study done in Pool 8, the authors found that in the sampled high density mussel sites, Fr >0.09. (Zigler, Newton, Steuer, Bartsch, and Sauer)

Summary: Several studies agree that the Froude Number is a factor in mussel presence. Several studies also agree that the Froude Number is connected with other parameters. However, a there is no consensus on specific Froude Number criteria.

j. Hydrologic variability of rivers

- *A. plicata*, *P. grandis*, *F. flava,* characterized event sites. *E. dilatata*, *L. costata* characterized stable sites. Stable and event sites were defined using Richards (1990). (Di Maio and Corkum)

Summary: This is the only study that differentiated between stable and event sites for different species. Most studies discuss how stable flow is important for mussel habitat.

3. Higgins Eye:

- "Lampsilis higginsii is characterized as a large river species occupying **stable substrates** that vary from sand to boulders, but not firmly packed clay, flocculent silt, organic material, bedrock, concrete or unstable sand. **Water velocities should be less than 1 m/second during periods of low discharge.** They are usually found in mussel beds that contain at least 15 other species at densities greater than 0.01 individual/m^2. In the Mississippi River, the density of all mussels in the bed typically exceeds 10/m^2. (Higgins Eye Pearlymussel Recovery Plan, USFWS, 2004)

4. Other Mussel Habitat Findings

- General consensus among articles and studies from the Literature Review is that mussel habitat characteristics vary among rivers, river reaches, and mussel species.
- General consensus among articles and studies from the Literature Review is that hydraulic parameters are limiting factors, not determining factors. Mussels do not occur above or below certain thresholds, but abundance and species richness are variable between these thresholds. The general consensus is also that some flow is necessary to provide food and DO. Many studies also discuss how stable flow is important for mussel habitat.
- One study done in Pool 18 showed the relationships of depth, Froude number, shear stress, velocity, and substrate and what combinations are more likely to have mussel beds. To best understand these relationships, read directly from the study- *Final Report: Development of Habitat Descriptors and Models of Mussel Distribution in Pool 18 of the Upper Mississippi River, 2010* (Zigler, Newton, and Olsen)

5. Study Comparison Chart

- Appendix A is a comparison chart that shows the habitat characteristics and mussel densities of Bertom McCartney, Capoli Slough, and Cordova mussel surveys. Unlike many studies, these three projects were able to survey mussel bed densities and collect habitat data from that location.
    - Bertom McCarntney was a mussel habitat creation project that divided the stream into 7 portions with distinct habitat differences. The project was completed in 1992. The first mussel survey took place in October 2014.
    - The Capoli Slough Pre-Project mussel survey was conducted in 2009 in order to collect information on mussel bed composition, density, species richness, and habitat. This information was used to develop a plan to ensure that the Capoli Slough EMP-HREP minimized negative impacts on mussel communities.
    - The purpose of the Cordova monitoring project was to monitor the health and status of Higgins Eye Mussels and two different locations. The survey took place in October 2014.

6. Summary:

Based on studies from the Bertom McCartney HREP Mussel Habitat Enhancement Monitoring, Unionid Habitat Literature Review, and Beaver Island Meeting Minutes for October 31, 2014, it is difficult to draw conclusions about specific design parameters for mussel habitat. Because the studies were carried out in different locations throughout the Upper Mississippi River and the United States, river environments that work for one study may not work for a different location. Several studies suggest that a good mussel habitat does not have a clear set of criteria that falls within a specific range, but rather that habitat characteristics are connected to each other. However, in general, the following parameters are suggested:

- 3ft-6ft depth
- River washed or rounded rock
- Velocity range 0.25m/s-0.76m/s
- Avoid velocity <0.1m/s to prevent Zebra Mussels
- Stable flow

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Kimberly Ferguson
CEMVR-EC

Kara N. Mitvalsky, P.E.
CEMVR-EC-DN

CF:

Beaver Island PDT

Appendix A

	Bertom McCartney HREP (Oct 2014)							Capoli Slough (2009) (Pre-Project Survey)		Cordova (Oct 2014)	
Section	**1**	**2 & 2a**	**3**	**4**	**5**	**6**	**7**	**Hot Zone Areas**	**Capoli Slough Proper**	**Cordova EHA**	**Buffalo EHA**
Pool Number	11	11	11	11	11	11	11	9	9	14	16
River Mile	602	602	602	602	602	602	602	658.3-656.8	658.3-656.8	505	470-471
Substrate Placed Rock Gradation	A	F	C	D	E1	E2	B	-	-	-	-
Substrate Diameter/Type	8-36" angular rip rap	Silt/Sand/ 3/8 - 2" crushed angular fragments	4-12" angular rip rap	4-6" angular rip rap	2-4" rounded river stone	2-4" 50% rounded river stone and 50% crushed angular gravel/rock	6-16" angular rip rap w/ pocket (eddy_ of 90% sand/10% empty zebra mussel shells	Sand, silt, and clay. Some sections had some boulder and cobble. No gravel	Silt, clay, and sand with vegetation	Sand, Silt, and 5% gravel	Mix of cobble, gravel, sand, silt, and clay
Water Depth (ft)	8	2-3	6	6-7	6-7	6-7	6-7	3.3-5.9	4.6 (0.66-12.5 range)	3.3 (0.5min-5.5 max)	3.7 (0.6min-5.8max)
Current Velocity (ft/s)	>3 ft/s	1-2 ft/s	>3 ft/s	>3 ft/s	>3 ft/s	>3 ft/s	1-2 ft/s	-	-	-	-
Notes								Emergent and floating vegetation were present. Not much diversity. Overall Higgins Eye density - 0.12/m^2	Overall Higgins Eye Density - 0.02/m^2	Zebra Mussels- 89% of unionids infested. Higgins Eye - 0 to 0.12/m2	Zebra Mussels- 50% of unionids infested. Only 2 Higgins Eye were collected
Mussel Density	**0 /m^2**	**0.8 /m^2**	**0 /m^2**	**0 /m^2**	**4.8 /m^2**	**4.0 /m^2**	**1.6 /m^2**	**3.4/m^2**	**2.5/m^2**	**10.6/m^2**	**17.12/m^2**

Beaver Island HREP

Appendix M

Design Engineering

Attachment I
Forest Data

No mats
intermixed btw #5
Plantra tree tubes

1) **Tree Planting Scope of Work: Beaver Island (#3 Containerized Trees)**

#3
108 trees/ac

- Tree and shrub species must have been grown and delivered in containerized pots that meet, at a minimum, 10 1/8 inch top diameter by 7 ½ inch depth dimensions. Bottomland tree species will vary some in vertical height depending on species of the plant but trees must exert at a minimum 3-5 feet in vertical height with a minimum 1/2" caliper reading at the root flair. Shrub species must also exert 3-6 feet in vertical height and meet the containerized dimensions, at a minimum, 10 1/8 inch top diameter by 7 ½ inch depth. Root flair is located on the tree where the main stem tissue transitions to fibrous root tissue system. Containerized tree and shrub roots are to remain moist upon delivery and continue to be moist until they are planted in the ground. Proper tree planting techniques must be utilized: dig the hole no deeper than the root system, find the root flare and make sure it is even with the existing soil elevation, remove all foreign materials (wires, tags, and container) from tree, and gently backfill the hole with removed soil filling in all air pockets around roots. Tree bark protectors need to be placed around the main stem of each tree and shrub at time of planting. Tree bark protectors must be 2 feet tall with a 2.75-inch diameter when coiled, and they must be constructed with a rigid, twin-walled structure made out of environmentally sensitive polyethylene blend which is designed to be U.V. resistant to provide tree protection for 5-7 years. Mixing of species prior to planting is required so that within any given area, there are several different tree and shrub species represented. Bottomland hardwood trees and shrubs shall be randomly planted on a minimum 20-foot spacing between trees (NOT IN ROWS) during the fall planting season. Shrubs can be interplanted amongst bottomland tree species provided they have 10-foot spacing in all direction from the planted bottomland trees and 20-foot spacing from planted shrubs. The fall planting period extends from October 25th to December 10th. High water may affect timing of planting.

2) **Tree Planting Scope of Work: Beaver Island (#5 Containerized Trees)**

#5
48/acre

- Tree species must have been grown and delivered in containerized pots that meet, at a minimum, 11 7/8 inch top diameter by 11 inch depth dimensions. Bottomland tree species will vary some in vertical height depending on species of the plant but trees must exert at a minimum 5 feet in vertical height with a minimum 5/8" caliper reading at the root flair. Root flair is located on the tree where the main stem tissue transitions to fibrous root tissue system. Containerized tree roots are to remain moist upon delivery and continue to be moist until they are planted in the ground. Proper tree planting techniques must be utilized: dig the hole no deeper than the root system, find the root flare and make sure it is even with the existing soil elevation, remove all foreign materials (wires, tags, and container) from tree, and gently backfill the hole with removed soil filling in all air pockets around roots. Tree bark protectors need to be placed around the main stem of each tree and shrub at time of planting. Tree bark protectors must be 3-4 feet tall with a 2.75-inch diameter when coiled, and they must be constructed with a rigid, twin-walled structure made out of environmentally sensitive polyethylene blend which is designed to be U.V. resistant to provide tree protection for 5-7 years. Mixing of species prior to planting is required so that within any given area, there are several different tree species represented. Bottomland hardwood trees shall be randomly planted on a minimum 30-foot spacing between trees (NOT IN ROWS) during the fall planting season. Shrubs can be interplanted amongst bottomland tree species provided they have 10-foot spacing in all direction from the planted bottomland trees and 20-foot spacing from planted shrubs. The fall planting period extends from October 25th to December 10th. High water may affect timing of planting.

3) **Tree Planting Scope of Work: Beaver Island (#15 Containerized Trees)**

#15
27 trees/acre

- Tree species must have been grown and delivered in containerized pots that meet, at a minimum, 18 3/8 inch top diameter by 12 1/8 inch depth dimensions. Bottomland tree species will vary some in vertical height depending on species of the plant but trees must exert at a minimum 6 feet in vertical height with a minimum 1inch caliper reading at the root flair. Root flair is located on the tree where the main stem tissue transitions to fibrous root tissue system. Containerized tree roots are to remain moist upon delivery and continue to be moist until they are planted in the ground. Proper tree planting techniques must be utilized: dig the hole no deeper than the root system, find the root flare and make sure it is even with the existing soil elevation, remove all foreign materials (wires, tags, and container) from tree, and gently backfill the hole with removed soil filling in all air pockets around roots. Tree bark protectors need to be placed around the main stem of each tree and shrub at time of planting. Tree bark protectors must be 4 feet tall with a 2.75-inch diameter when coiled, and they must be constructed with a rigid, twin-walled structure made out of environmentally sensitive polyethylene blend which is designed to be U.V. resistant to provide tree protection for 5-7 years. Mixing of species prior to planting is required so that within any given area, there are several different tree species represented. Bottomland hardwood trees shall be randomly planted on a minimum 40-foot spacing between trees (NOT IN ROWS) during the fall planting season. Shrubs can be interplanted amongst bottomland tree species provided they have 10-foot spacing in all direction from the planted bottomland trees and 20-foot spacing from planted shrubs. The fall planting period extends from October 25th to December 10th. High water may affect timing of planting.

4) Tree and Shrub Planting Density and Distribution: Beaver Island Tree Planting

- Bottomland hard mast trees (northern pecan, shellbark hickory, swamp white oak, overcup oak, bur oak, and pin oak) and soft mast trees (river birch, common hackberry, common persimmon, American sycamore, green hawthorn, Kentucky Coffeetree) shall be planted at a density of 120 containerized trees per acre. Floodplain forest shrubs (common buttonbush, silky dogwood, red-osier dogwood, Northern Spicebush, American elderberry, American bladdernut) shall be planted at a density of 60 containerized specimens per acre. No single tree or shrub species will comprise more than 20% of the total number of individuals planted. Species distribution following these guidelines will be documented as acceptable for planting purposes. Table 1: Bottomland Hardwood Tree and Shrub Planting categorizes species by hard mast, soft mast, and shrubs with associated common and scientific names;

rows / no rows

Bottomland Hardwood Tree and Shrub Planting		
	Common Name	Scientific Name
Hard Mast Trees	Northern Pecan	*Carya illinoinensis*
	Shellbark Hickory	*Carya laciniosa*
	Swamp White Oak	*Quercus bicolor*
	Overcup Oak	*Quercus lyrata*
	Bur Oak	*Quercus macrocarpa*
	Pin Oak	*Quercus palustris*
Soft Mast Trees	River Birch	*Betula* nigra
	Common Hackberry	*Celtis occidentalis*
	Common Persimmon	*Diospyros virginiana*
	American Sycamore	*Platanus occidentalis*
	Green Hawthorn	*Crataegus viridis*
	Kentucky Coffeetree	*Gymnocladus dioicus*
Floodplain Forest Shrubs	Common Buttonbush	*Cephalanthus occidentalis*
	Silky Dogwood	*Cornus amomum*
	Red-Osier Dogwood	*Cornus stolonifera*
	Northern Spicebush	*Lindera benzoin*
	American Elderberry	*Sambucus canadensis*
	American bladdernut	*Staphylea trifolia*

CEMVR-EC-DN 11 April 2016

Memorandum for Record

Subject: Beaver Island Reforestation Meeting (3/8/2016)

1. In attendance were Kara Mitvalsky, Nate Richards, Sara Schmuecker (via phone), Joe Lundh, Ed Britton, Russell Engelke, and Karla Sparks.
2. Tree sizes, species, and locations were agreed upon.
3. Reforestation sites will be divided into ½ acre plots, each which will be planted with one size of tree (#3, #5, #15).
4. Diversity in heights would be beneficial at some of the wider locations. +/- 1 foot in elevation to create "Swales". Narrower placement sites will be sloped to drain, potentially with a higher elevation in the middle.
5. Crop tree release, girdling and other measures will be discussed further at the forestry meeting scheduled for late March.
6. Temporary seeding needs to be outlined between placement and when we will actually be shaping.
7. Shrub species presented were fine.
8. Understory seed mixture presented was fine.
9. Buffer seeding presented was fine, however, may want to consider cuttings of black willow and cottonwood as opposed to seeds (500 each per acre).
10. Adaptive Management will be to see if these trees will survive better here at an elevation selected for climate change as compared to trees at other sites.
11. Studies also considered for monitoring survivability in the swales.
12. Please direct any questions to the undersigned.

Kara N. Mitvalsky, P.E.

CEMVR-EC-DN

CF: Beaver Island PDT

Beaver Island HREP

Appendix M

Design Engineering

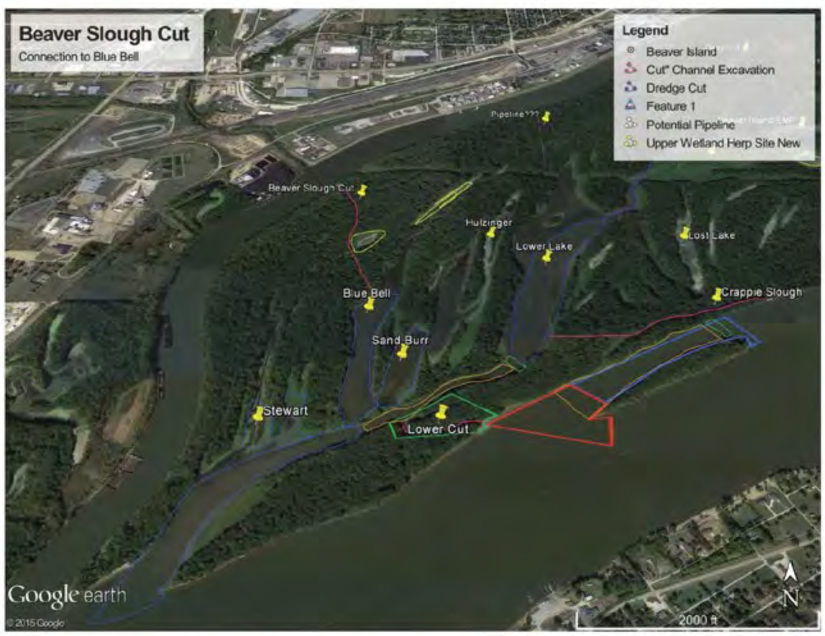
Attachment J
Beaver Cut

CEMVR-EC-DN
CEMVR-EC-HH 23 February 2015

Memorandum for Record

Subject: Stewart Lake Cut

1. The PDT had proposed cutting a channel between Beaver Slough and a constructed overwintering fish backwater area. By connecting to Beaver Slough, the PDT wanted to obtain a scouring velocity in the channel to keep the dredge cuts clean over time. The connection would require a closure structure with a gate, valve, structure that would have to be operated biennially. The USFWS has stated they will not perform any operation at this site. The IA DNR was willing to operate this structure.

2. Beaver Slough to Blue Bell Cut:
    a. This feature would connect Blue Bell to Beaver Slough as shown.
    b. 

    c. There was an existing lower topography area connecting Blue Bell to the backwater in Beaver Slough.
    d. The area would require a cut through higher elevations present along Beaver Slough (historic placement sites from Beaver Slough).
    e. The location of the proposed inlet is a shoaling location within Beaver Slough that would bring in additional sediment to the backwater area.
    f. There were significant concerns that once the Beaver Slough Cut entered Blue Bell, it would drop out sediment and fill in the constructed dredge cut.
    g. This feature was eliminated based on the above reasons.

3. Beaver Slough to Stewart Lake:
   a. This feature would connect Stewart Lake to Beaver Slough .

   b.
   c. This follows a lower topography area.
   d. This would require a cut through the higher elevations present along Beaver Slough (historic placement sites from Beaver Slough).
   e. The location of the inlet is near the Beaver Slough thalweg, making this a more suitable location to maximize energy from Beaver Slough and limit additional sediment.
   f. There were significant concerns that beyond the Stewart Lake Cut, sediment would drop out as it opened up into the Constructed dredge cut.
   g. This feature was eliminated based on the above reasons.

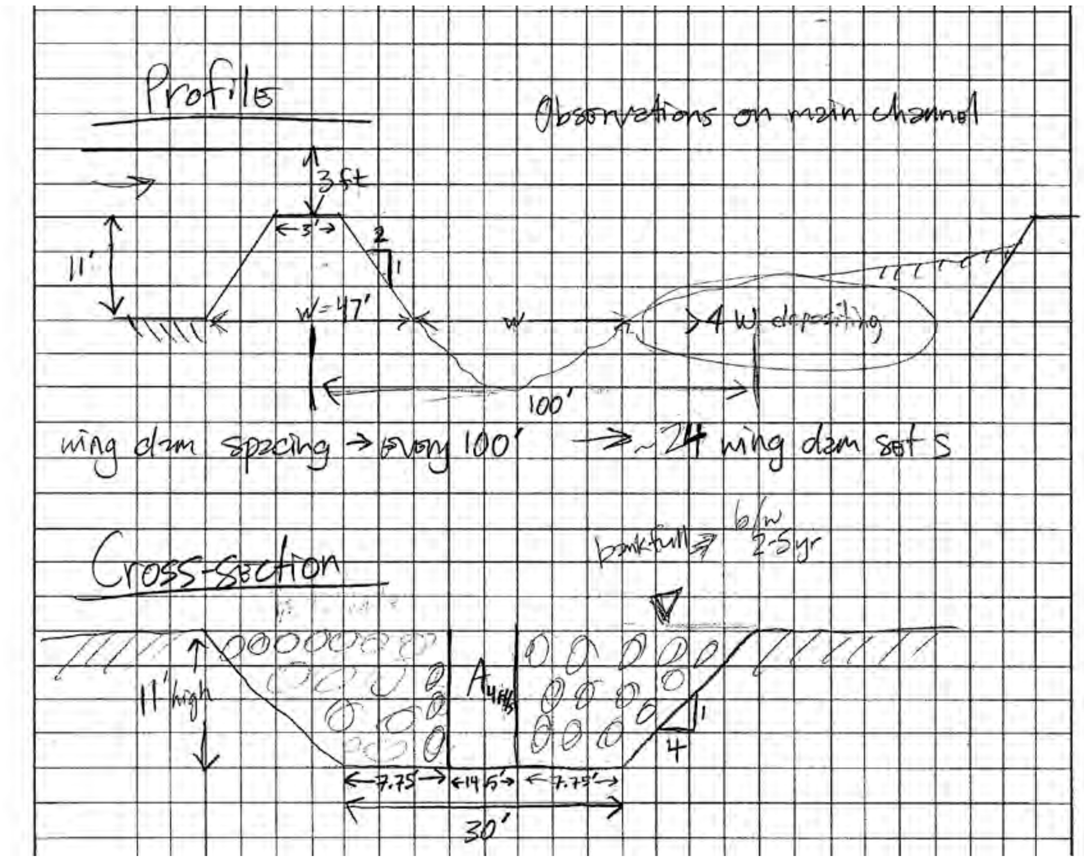
4. Beaver Slough to Lower Dredge Cut.
    a. This feature would connect Lower Dredge Cut to Beaver Slough as shown.

    b.
    c. This does not follow a lower topography area.
    d. This would require a cut through the higher elevations present along Beaver Slough (historic placement sites from Beaver Slough).
    e. This enters the project through an area which is not depositing sediment in Beaver Slough.
    f. There were significant concerns that once the Beaver Slough Cut entered Stewart Lake, it would drop out sediment and fill in the Constructed dredge cut.
    g. This feature was eliminated based on the above reasons.

5. Beaver Slough to Beaver Slough
   a. This feature would connect Beaver Slough to Beaver Slough.
   b. 

   c. This does not follow a lower topography area.
   d. This would require a cut through the higher elevations present along Beaver Slough (historic placement sites from Beaver Slough).
   e. This cut enters and exits at locations along Beaver Slough where the thalweg is near the cut; thereby maximizing the energy from Beaver Slough and minimizing the likelihood of sediment depositing at the cut location.
   f. A preliminary hydraulic analysis for this feature was performed. The following assumptions were made: (1) a gate at the inlet of the cut would be closed during winter to allow for centrarchid overwintering and would be opened during the spring to flush sediments that deposit during low water and flood conditions (2) the material that would be deposited is alluvial silt, non-colloidal (with a permissible velocity of 3.5ft/s (Chow, 1959)), therefore velocities of 4 ft/s would be required to “flush these sediments” (3) Channel bottom -30’ (4) Side slopes 4H:1V (5) Dredge depth is 6’below flat pool (11’deep) (6) Maximum in-channel velocities would occur under bankfull conditions, approximated as 2-yr discharge.

      The fall of the river (under 2-5yr Q) along the 2,400’ length of the proposed cut (~RM 531.6 to RM 531.1) is closer to 0.2’, however 0.4’ was used for slope calculation to be generous. The average channel velocity was calculated under bankfull conditions for this channel using mannings eqn. = 1.8 ft/s and the resulting Q =736 cfs. Based on this discharge, the cross-sectional area required to achieve the 4 ft/s velocity to flush sediments was determined as 184 ft^2. This reduced cross-sectional area would be achieved by placing wing-dam pairs with approximately one wing-dam length spacing (see profile drawing below). The height of the wing dams will match the top of bank (11'tall), the rock size will be ~400lb stone, 2H:1V side slopes and the top width will be 3'. The wing dams will extend 7.75' along the channel bottom into the center of the channel. The overall footprint (US & DS) of the wingdams will be 47', therefore the spacing between wing-dams along the length of the channel is ~100' to prevent sedimentation downstream of the wingdam sets. This results in ~24 wing dam sets.



g. Excavation quantities would be approximately 97,000 CY ($1.6M). Adding the 24 rock structures would be about $6.8M.
h. Habitat benefits for overwintering fish would be observed over approximately 1.8 acres (habitat below 4 ft).

6. Contacts for this MFR are the undersigned.

Kara N. Mitvalsky, P.E.
CEMVR-EC-DN

Lucie Sawyer, P.E.
CEMVR-EC-H

RPEDN 03-05-2015

Memorandum for Record: Beaver Island Meeting Minutes for March 04, 2015

1. The following personnel, indicated by an “x” were present at the meeting:

Name	Office	Present
Jon Duyvejonck	FWS	X
Ed Briton	FWS	X
Russ Engelke	FWS	X
Sharonne Baylor	FWS	
Scott Gritters	IADNR	
Mike Griffin	IADNR	X
Josh Peterson	IADNR	
Kara Mitvalsky	EC-DN (Project Engineer)	X
Lucie Sawyer	EC-H (H&H)	X
Nate Richards	PD-P (Biologist)	X
Elizabeth Bruns	EC-H (Water Quality)	X
Jon Schulz	OD-T (Forester)	
Darron Niles	PD-F (Study Manager)	X
Monique Savage	PD-F (Study Manager)	X
Dennis Johnson	PD-E	
Brandon Stevens	PM-M	X
Chris De Pooter	EC-T	X
Dan Arends/Eric	EC-G	X
Rachel Perrine	OD-P	X
Karla Sparks	PM-M	X
Mike Siadak	PM-M	X

2. Agenda for this meeting was to review and make recommendations on the remaining project features, discuss the path forward, and what the schedule looks like
    a. Stewart Slough Cut elimination because the lack of slope, sustainability, and cost – Engineers are not confident that if this 8M feature would work for the 1 acre of increase habitat. DNR, FWS Refuge, and FWS RIFO concurred with the Corps assessment
    b. Upper Cuts – Similar analysis will be used when discussing the upper cuts in throughout Beaver Island - DNR, FWS Refuge, and FWS RIFO concurred with the Corps assessment
        i. Rough cost is 2.5-3M
        ii. There are no overwintering habitat if the flows are not decreased so we will have two increment of this feature w/ and w/o closure structure
        iii. This feature will not be screened out to ensure we are doing our due diligence for all concerned stakeholders
    c. Albany Island – Albany Island is eroding
        i. Greatest concern is to prevent erosion
        ii. Growing island is positive and no one is adverse to island increase but erosion prevention is the critical factor

iii. Velocity - a further analysis of the potential velocity increase with chevron will be done once H&H has outputs – IA DNR and RIFO concur with path forward-Refuge defers to RIFO expertise in mussel habitat needs
    1. Moderate increase in flow at local area would be good – don't want to impact downstream mussel bed
    2. Eddy created at the end of rock placement – may need to place revetment downstream of opening
    3. Substrate doesn't exist now because hydrodynamics don't exist, it will sediment over if we don't change hydrodynamics
    4. Adaptive management may not be possible since by the time it was known there was an issue the impacts to the mussel bed would be done
    5. Reviewed Oqwaka (both scour/deposit) and Garner - lowest elevation for design of chevron and potential adaptive management to build higher if necessary
    6. Boulder to cobble mixture in optimal hydrodynamic areas

d. Tree height design based off of EFM results for the minimally tolerant trees 578
    1. Not going from flat pool since Pool 14 is hardly ever at flat pool – using 70% annual duration
    2. ROUGHLY 5 feet higher than existing
    3. Kara is working on placement sites
        a. Adjacent land placement
        b. Lower lake water placement
    4. A meeting will be scheduled to discuss potential tree clearing and placement sites. Based on schedules this meeting will not occur until the beginning of April.

e. Ephemeral Wetlands - DNR, and FWS RIFO concurred with the Corps assessment
    1. Based off of bullfrog and expert opinion would like the berms built to ten year
    2. Depth between the 2-3 foot range to keep fish out
    3. Use Odessa as example
    4. Kara trying to build berm with minimal impact to trees at upper and lower Herp site
    5. Potential to do perched wetlands at placement sites/tree plantings
    6. Eliminated Grass Slough and Buffalo because of large water area and difficulty cutting off connectivity to decrease fish access.
    7. Will have a meeting to discuss results of analysis
    8. The FWS Refuge does not concur with the Corps assessment at this time. Until the Refuge staff can visit the site, it is not prudent for them to make any decisions on the design, placement, or necessity for these features.

3. Ed will send out Herp Survey from Cathy Henry/Lucie will send out results of climate change

4. POC for this MFR is Monique Savage at 309-794-5342.

Monique Savage
RPEDN

CF via email:
Beaver Island PDT

400 0 400 800 1200

Scale 1" = 400'

Single Transducer Survey with 100 Foot Interval Coverage

Peripheral Contour Color Fill Legend

-10' - -1' | 0' - 8' | 9' - 19' | 20' - 29' | 30' - 50'

2 FT MINOR:
5 FT MAJOR:

Hydrographic Survey of the **Mississippi River** Ortho photography flown 1995

Horizontal Projection: State Plane, NAD1983, Illinois West - 1202 U.S. Survey Feet
Vertical Datum: MSL 1912 U.S. Survey Feet. All soundings adjusted to Flat Pool: 572.0
Water Surface at time of survey: 572.6 / Water Stage: +0.6 Feet

Survey Vessel: Launch Coot
Conducted by: Jesse Corgan and Lee Schweiger
Processed in AutoCAD Civil 3D 2012 by Bob Adams on 13 Nov 2012
File Name: UMR_14_5125-5176_12A.dwg

US ARMY CORPS OF ENGINEERS
MVR - ROCK ISLAND DISTRICT
OPERATIONS DIVISION - TECH SUPPORT BRANCH

Beaver Island Slough

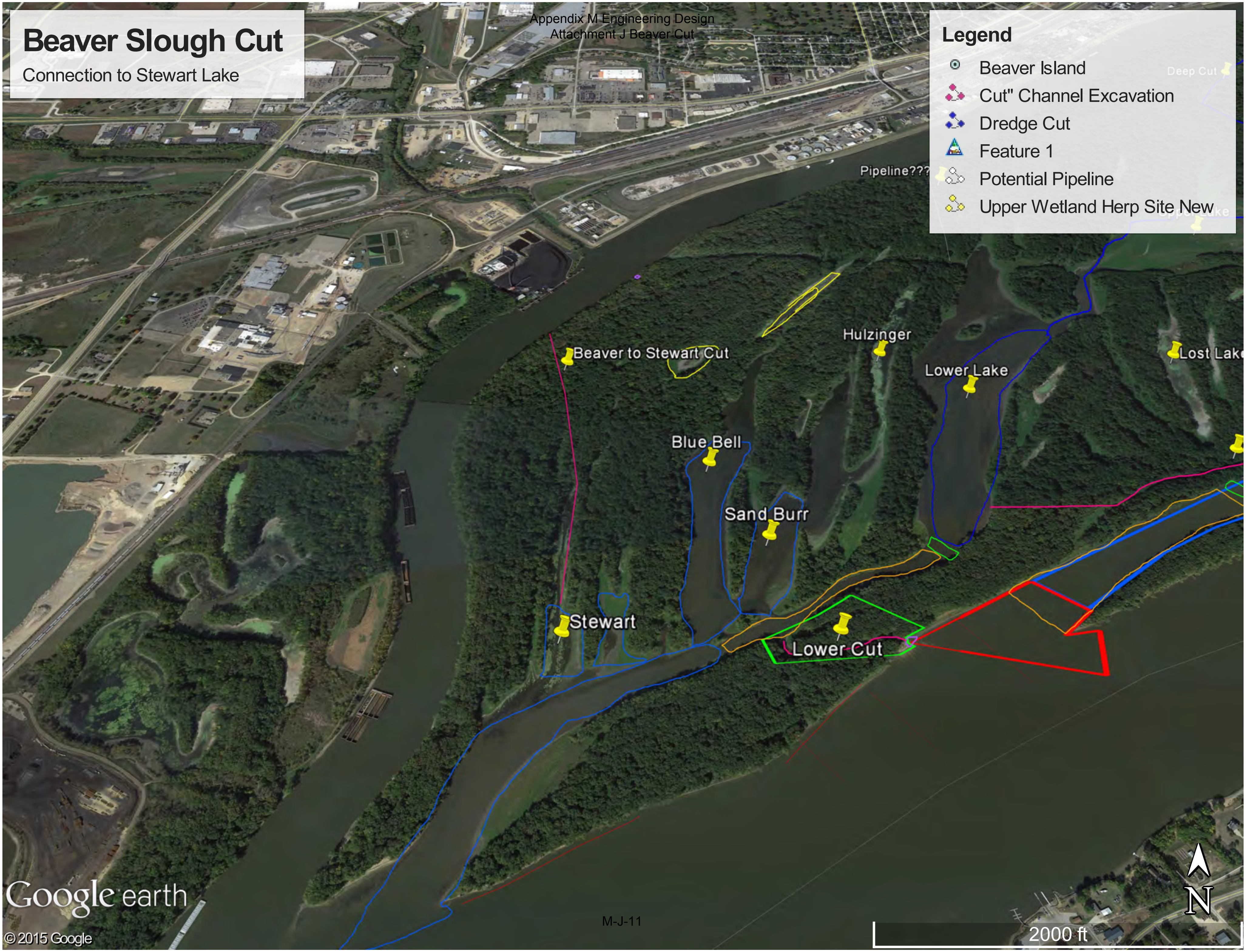
Survey Date: 8 Nov 2012

UMR / Pool 14 - Reach River Miles: 512.5 - 517.6

M/1-


Beaver Slough Cut
Connection to Beaver Slough
Legend
Beaver Island
Cut" Channel Excavation
Dredge Cut
Feature 1
Potential Pipeline
Upper Wetland Herp Site New
Beaver to Beaver
Blue Bell
Sand Burr
Stewart
Lower Cut
Google earth
© 2015 Google
3000 ft
N


Beaver Slough Cut
Connection to Lower Dredge Cut
Legend
Beaver Island
Cut" Channel Excavation
Dredge Cut
Feature 1
Potential Pipeline
Upper Wetland Herp Site New
Deep Cut
Upper Lake
Pipeline???
Beaver Slough to Lower Dredge Cut
Hulzinger
Lower Lake
Lost Lake
Crappie Slough
Blue Bell
Sand Burr
Stewart
Lower Cut
Google earth
© 2015 Google
2000 ft
N


Beaver Slough Cut
Connection to Stewart Lake
Legend
Beaver Island
Cut" Channel Excavation
Dredge Cut
Feature 1
Potential Pipeline
Upper Wetland Herp Site New
Deep Cut
Pipeline???
Beaver to Stewart Cut
Hulzinger
Lower Lake
Lost Lak
Blue Bell
Sand Burr
Stewart
Lower Cut
Google earth
© 2015 Google
2000 ft
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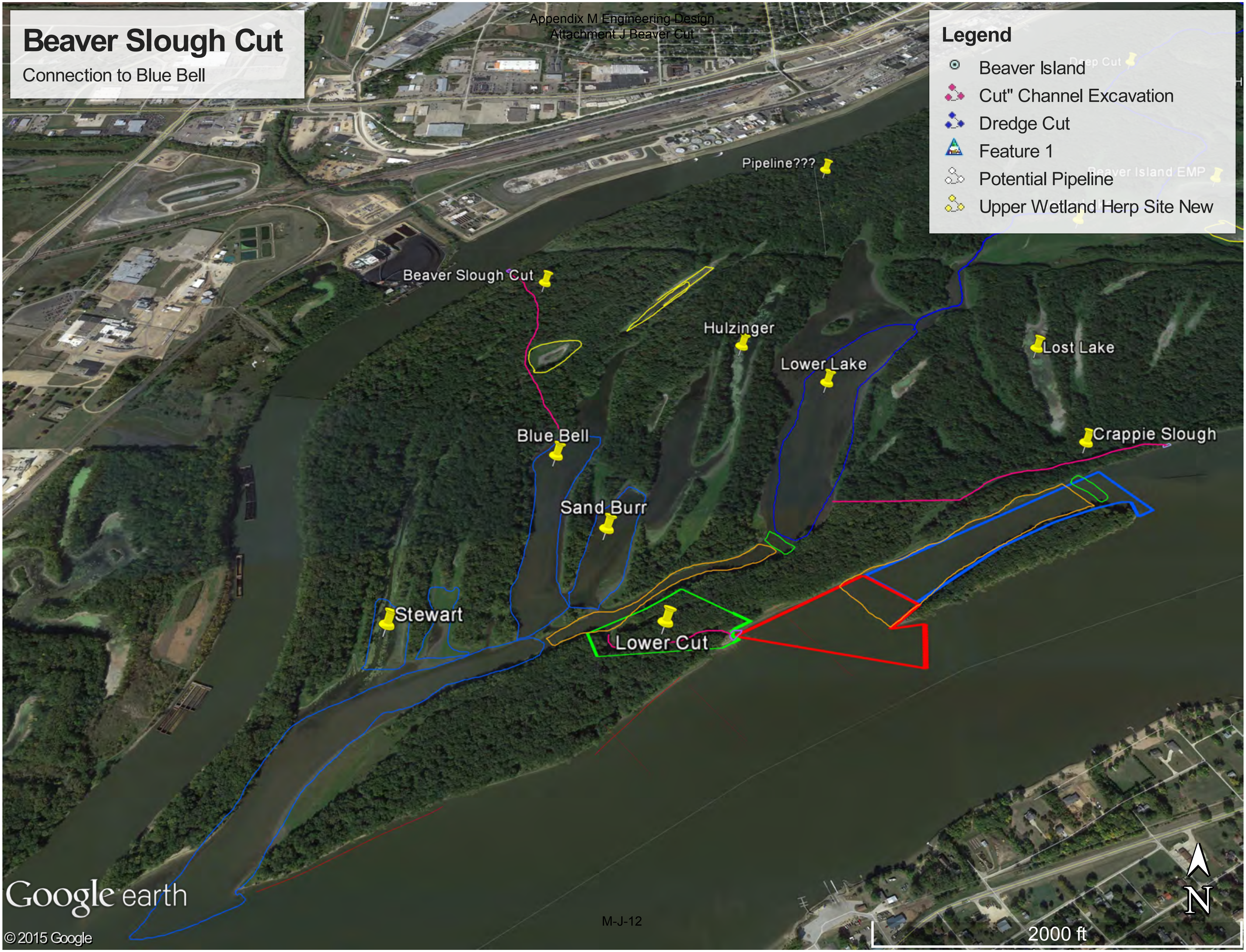
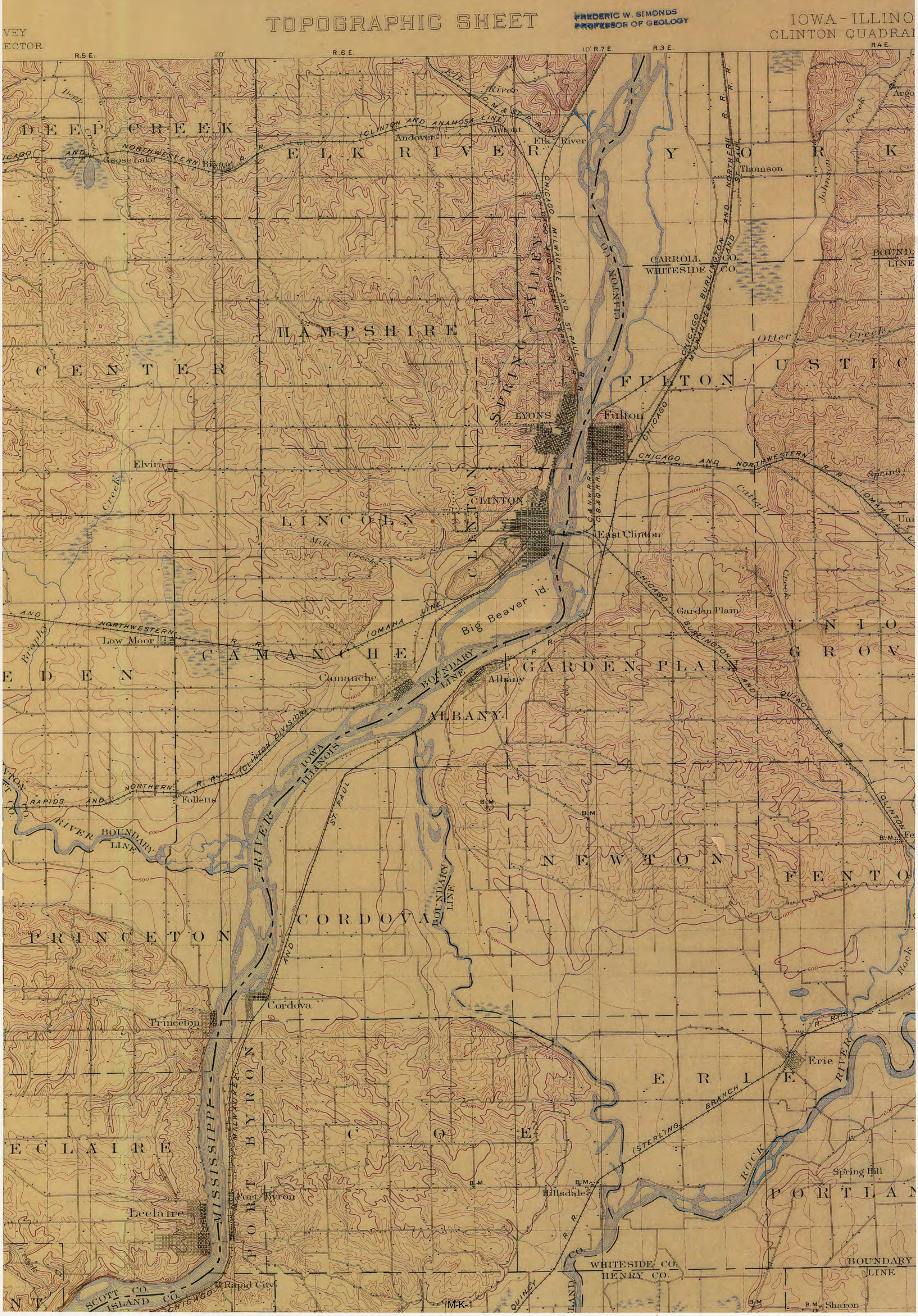

Beaver Slough Cut
Connection to Blue Bell
Legend
Beaver Island
Cut" Channel Excavation
Dredge Cut
Feature 1
Potential Pipeline
Upper Wetland Herp Site New
Pipeline???
Beaver Slough Cut
Hulzinger
Lower Lake
Lost Lake
Blue Bell
Crappie Slough
Sand Burr
Stewart
Lower Cut
Google earth
© 2015 Google
2000 ft
N

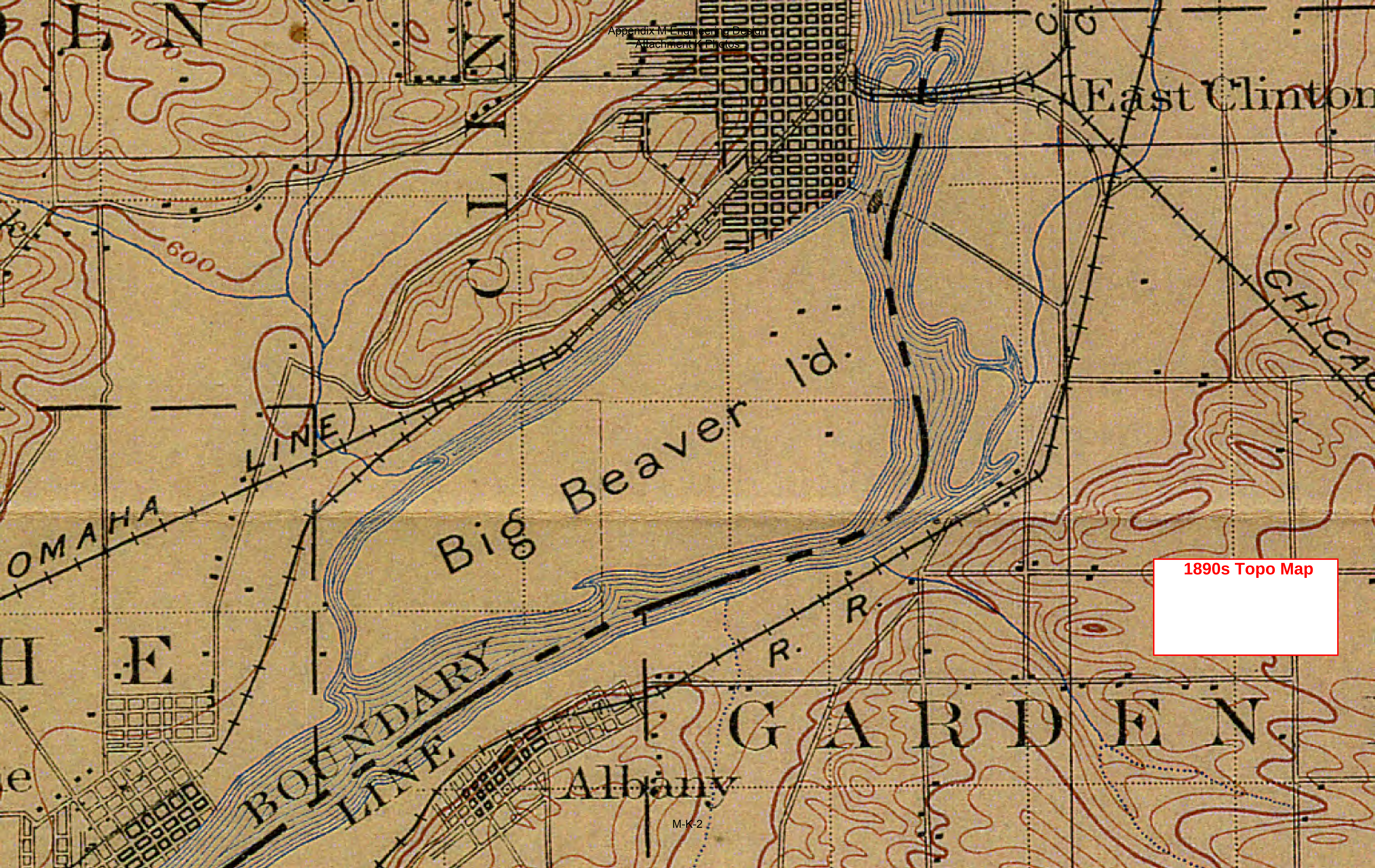
Beaver Island HREP

Appendix M

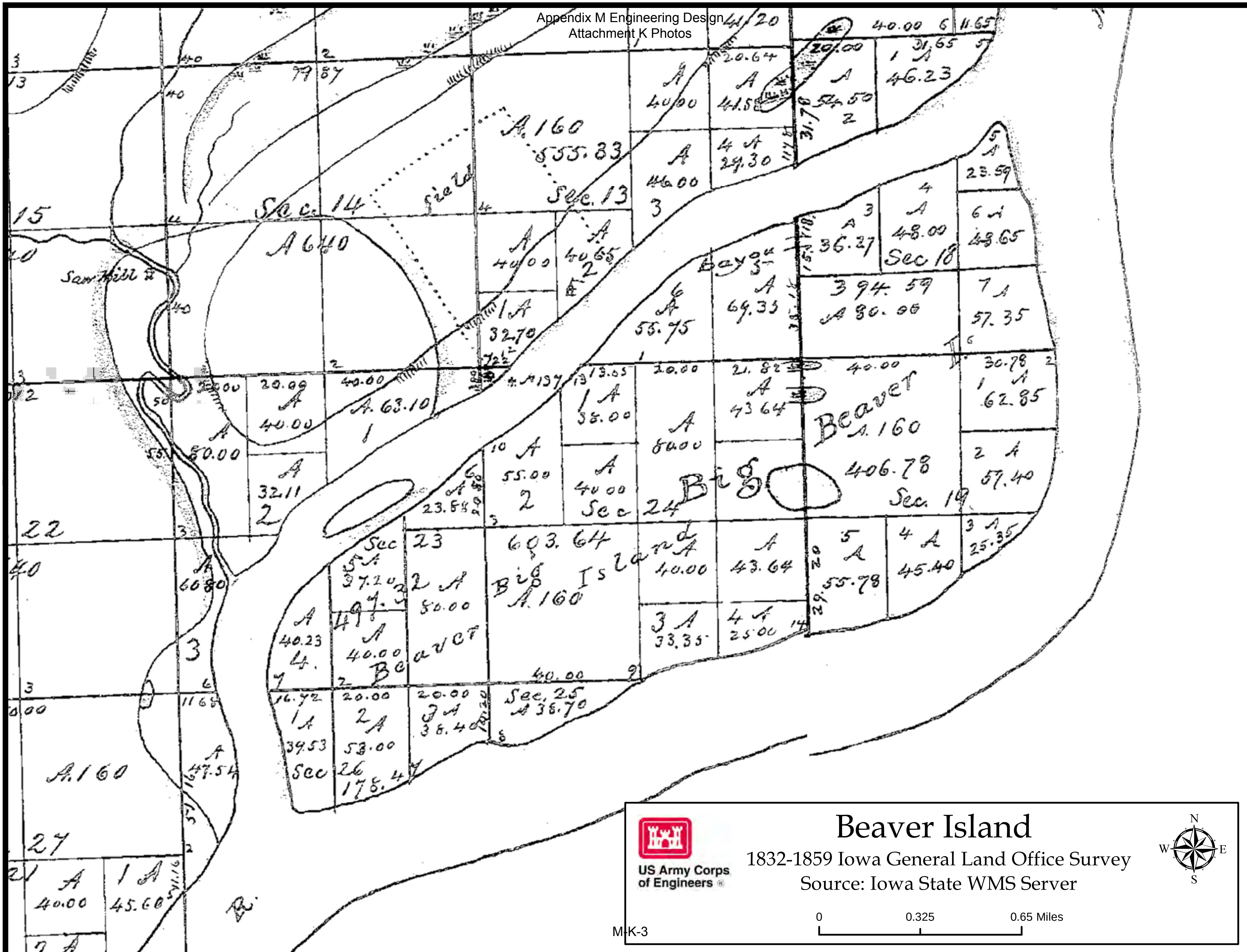
Design Engineering

Attachment K
Photos


TOPOGRAPHIC SHEET
FREDERIC W. SIMONDS
PROFESSOR OF GEOLOGY
IOWA - ILLINO
CLINTON QUADRA
R.5 E.
R.6 E.
R.7 E.
R.3 E.
R.4 E.
DEEP CREEK
ELK RIVER
YORK
Andover
Almont
Elk River
Goose Lake
Thomson
CLINTON AND ANAMOSA LINE
CHICAGO AND NORTHWESTERN R.R.
CARROLL CO.
WHITESIDE CO.
HAMPSHIRE
CENTER
FULTON
LYONS
Fulton
Elvira
CLINTON
LINCOLN
East Clinton
Mill Creek
Big Beaver Id.
Garden Plain
Low Moor
CAMANCHE
EDEN
Camanche
Albany
GARDEN PLAIN
UNION GROVE
ALBANY
BOUNDARY LINE
IOWA
ILLINOIS
Folletts
NEWTON
FENTON
PRINCETON
CORDOVA
Cordova
Princeton
ERIE
Erie
ROCK RIVER
COE
LECLAIRE
Leclaire
FORT BYRON
Port Byron
Hillsdale
PORTLAND
Spring Hill
MISSISSIPPI
WHITESIDE CO.
HENRY CO.
BOUNDARY LINE
Sharon
SCOTT CO.
Rapid City



1890s Topo Map

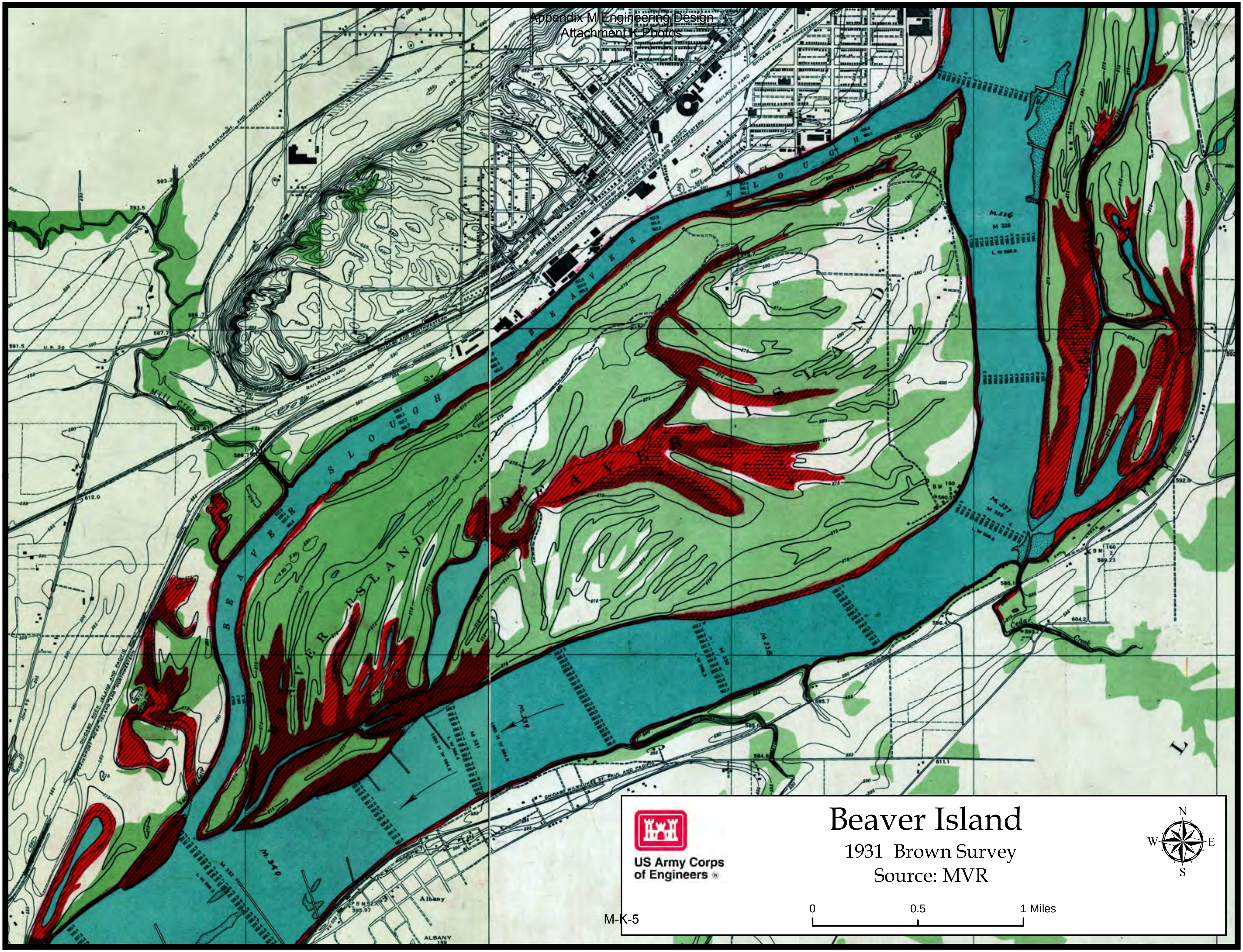


Beaver Island

1832-1859 Iowa General Land Office Survey

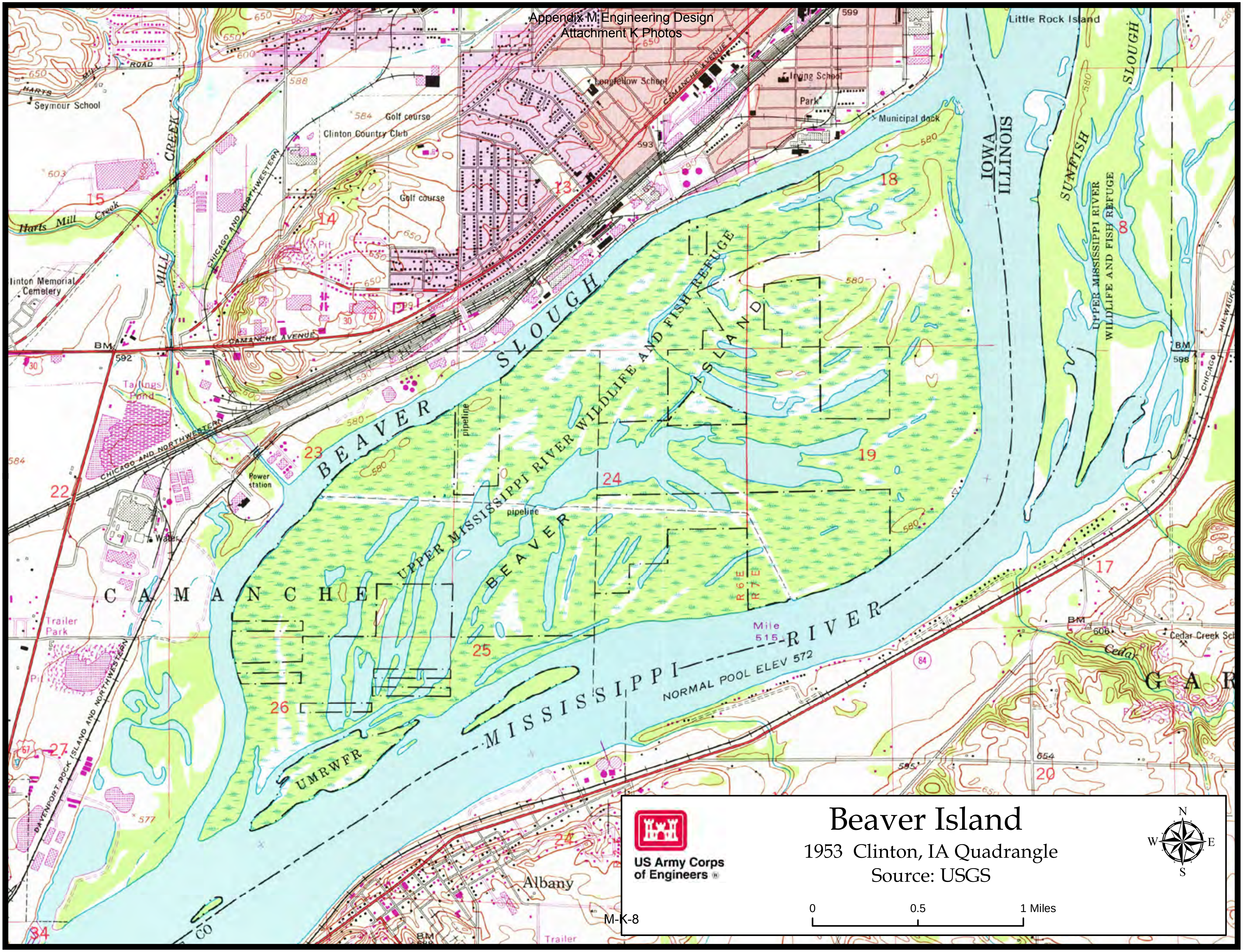
Source: Iowa State WMS Server


Beaver Island
1930s UMR Mosaic Dataset
Source: IA DNR & Ill. State Geological Survey
US Army Corps of Engineers
N
S
E
W
0
0.5
1 Miles


Beaver Island
1931 Brown Survey
Source: MVR
US Army Corps of Engineers
0
0.5
1 Miles
N
W
E
S
BEAVER SLOUGH
BEAVER ISLAND
Albany
ALBANY
RAILROAD YARD
Mill Creek
Cedar Creek


Beaver Island
1937 Orthophoto
Source: IADNR
US Army Corps of Engineers
N
W
E
S
0
0.5
1 Miles


Beaver Island
1951 Orthophoto
Source: IADNR
US Army Corps of Engineers
N
W
E
S
0
0.5
1 Miles


Beaver Island
1953 Clinton, IA Quadrangle
Source: USGS
US Army Corps of Engineers
0
0.5
1 Miles
N
S
E
W
BEAVER SLOUGH
BEAVER ISLAND
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
MISSISSIPPI RIVER
NORMAL POOL ELEV 572
Mile 515
CAMANCHE
Albany
Little Rock Island
SUNFISH SLOUGH
IOWA
ILLINOIS
UMRWFR
Power station
Golf course
Clinton Country Club
Seymour School
Longfellow School
Irving School
Park
Municipal dock
Trailer Park
Tailings Pond
CHICAGO AND NORTHWESTERN
DAVENPORT ROCK ISLAND AND NORTHWESTERN
CAMANCHE AVENUE
Harts Mill Creek
MILL CREEK
Cedar Creek Sch
pipeline


1-28-63
SZ-1DD-30
28-63
SZ-1DD-28
US Army Corps of Engineers
Beaver Island
1963 Orthophoto
Source: IADNR
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0.5
1 Miles


Beaver Island
1969 Orthophoto
Source: IADNR (1967-1974)
US Army Corps of Engineers
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1 Miles


Beaver Island
1969 Orthophoto
Source: IADNR (1967-1974)
US Army Corps of Engineers
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1 Miles
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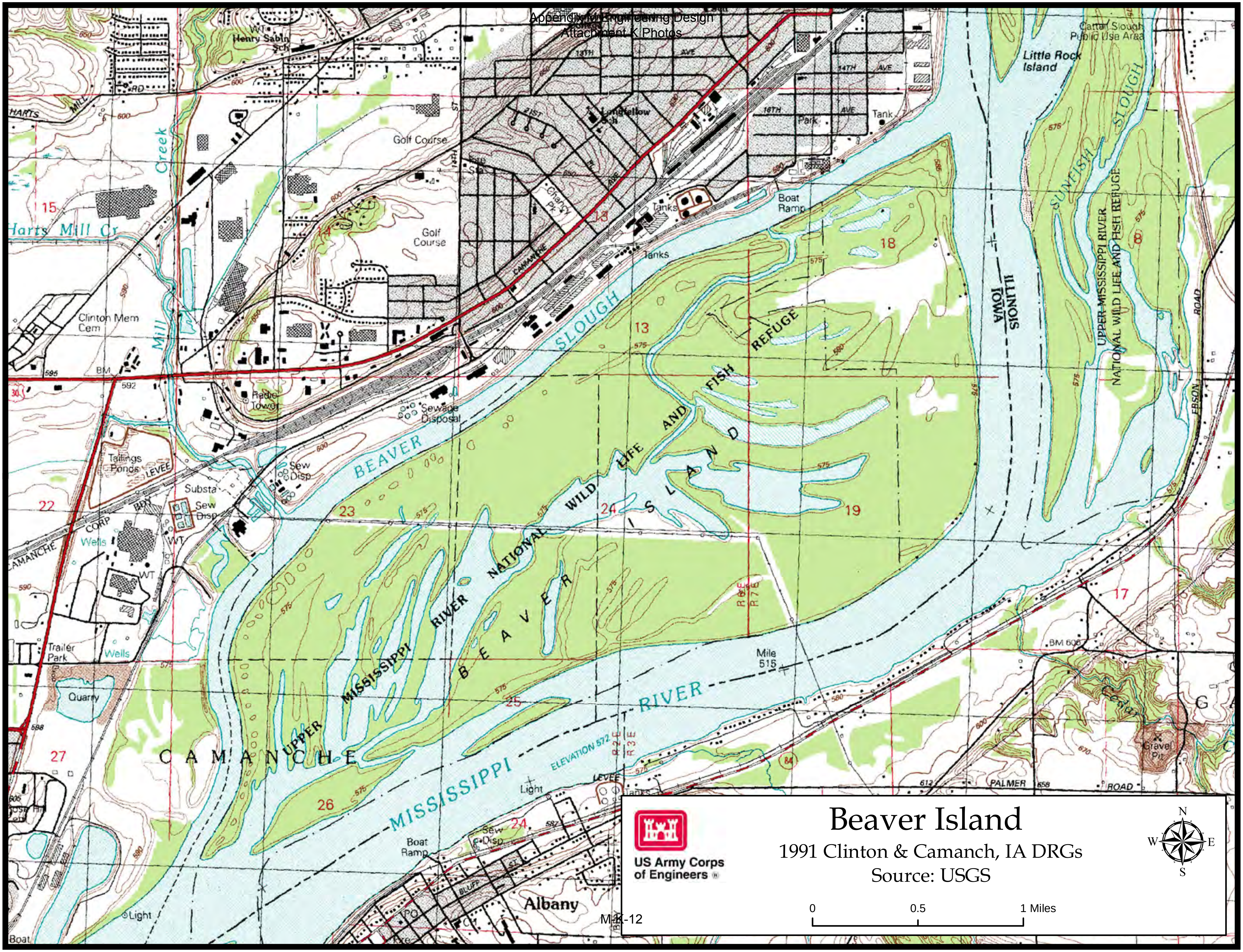
Beaver Island
1991 Clinton & Camanch, IA DRGs
Source: USGS
US Army Corps of Engineers
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0.5
1 Miles
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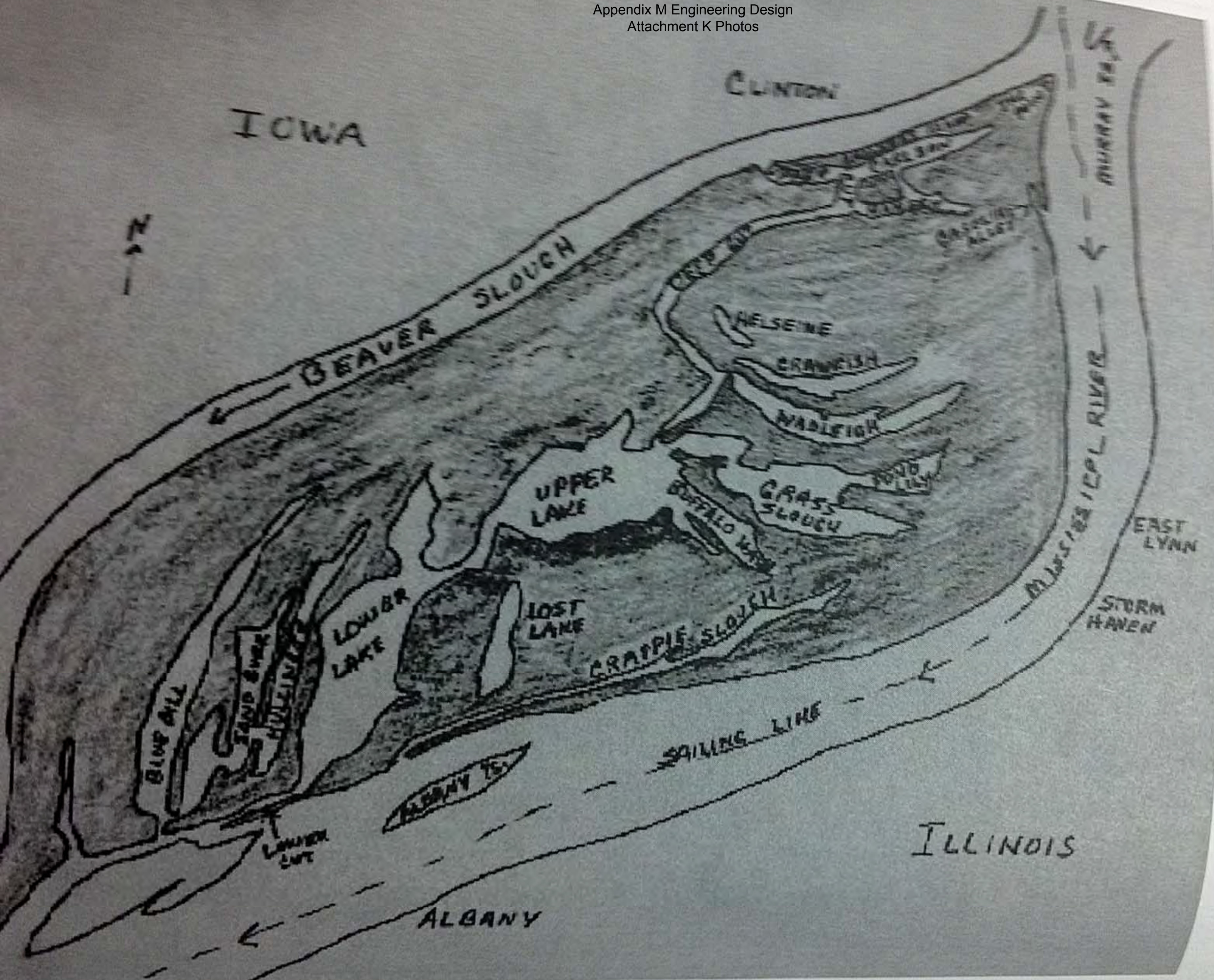
BEAVER ISLAND
UPPER MISSISSIPPI RIVER NATIONAL WILD LIFE AND FISH REFUGE
BEAVER SLOUGH
MISSISSIPPI RIVER
ELEVATION 572
CAMANCHE
Albany
Little Rock Island
SUNFISH SLOUGH
ILLINOIS
IOWA
Mile 515
Golf Course
Clinton Mem Cem
Harts Mill Cr
Mill Creek
Sewage Disposal
Tailings Ponds
Quarry
Trailer Park
Boat Ramp
Gravel Pit
Cattail Slough Public Use Area
Radio Tower
Tanks
Wells



Source: Back to Beaver Island, Flippo, 2001


Beaver Island
1995-96 UMR Orthos
Source: MVR
US Army Corps of Engineers
N
S
E
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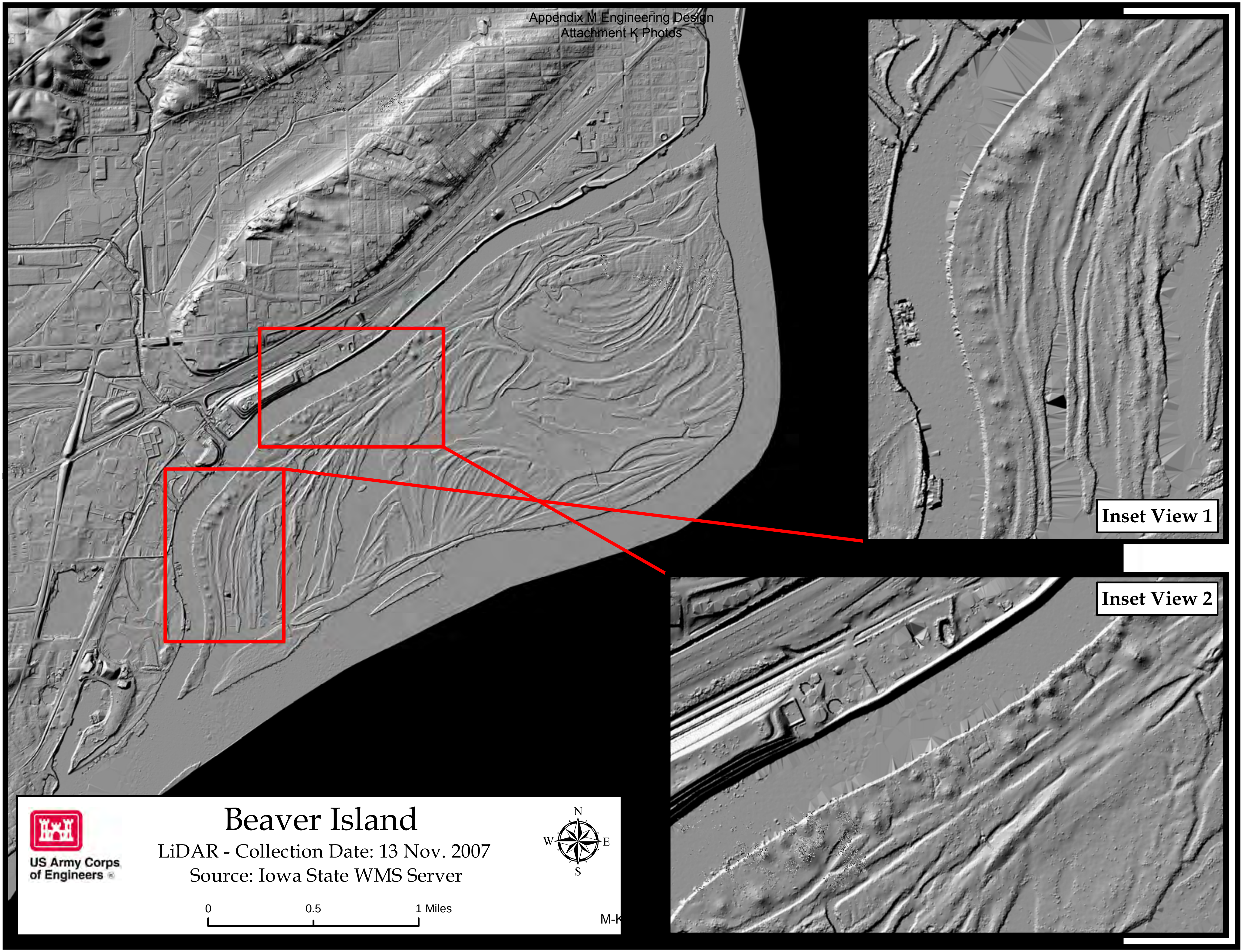
0.5
1 Miles


Inset View 1
Inset View 2
US Army Corps of Engineers
Beaver Island
LiDAR - Collection Date: 13 Nov. 2007
Source: Iowa State WMS Server
N
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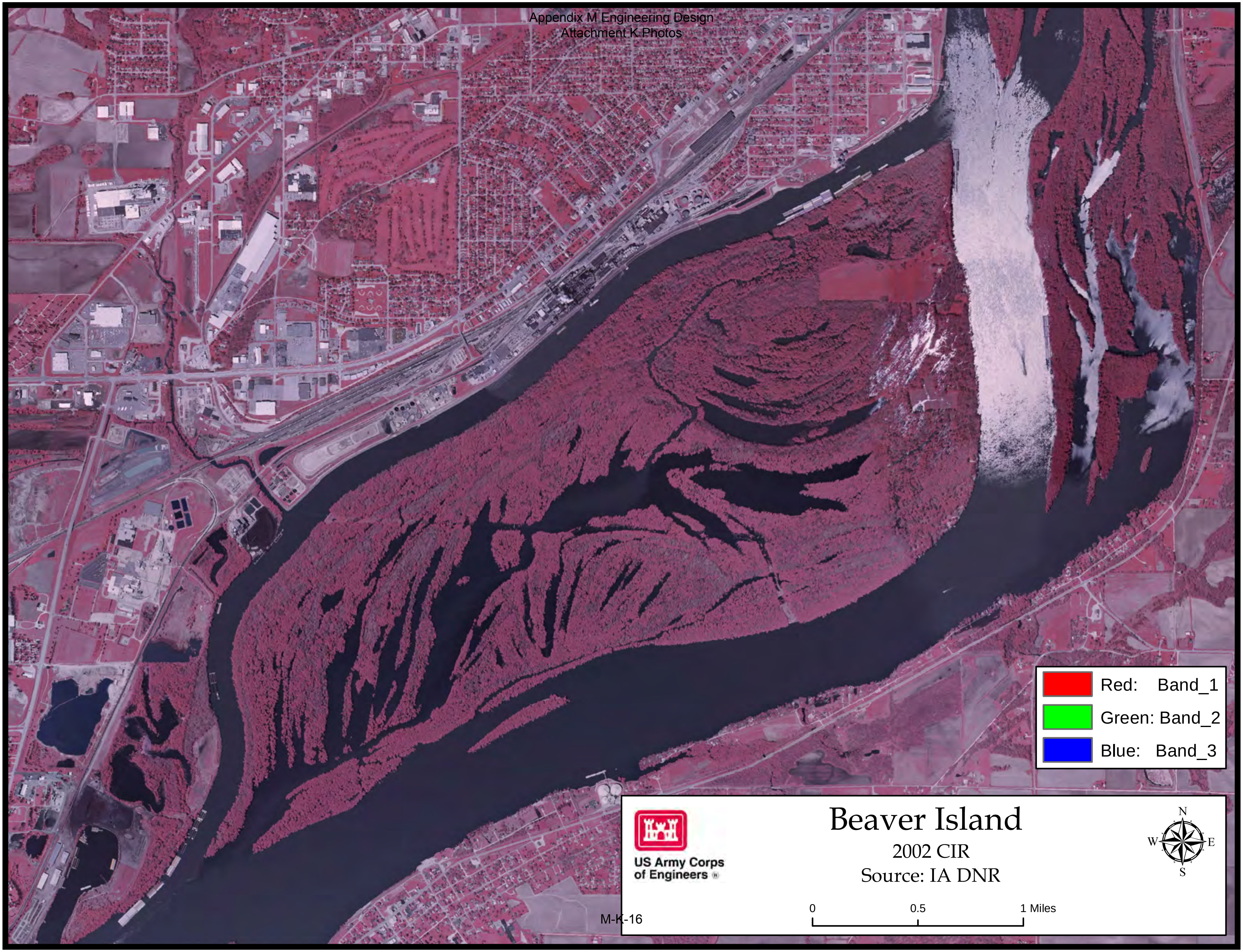
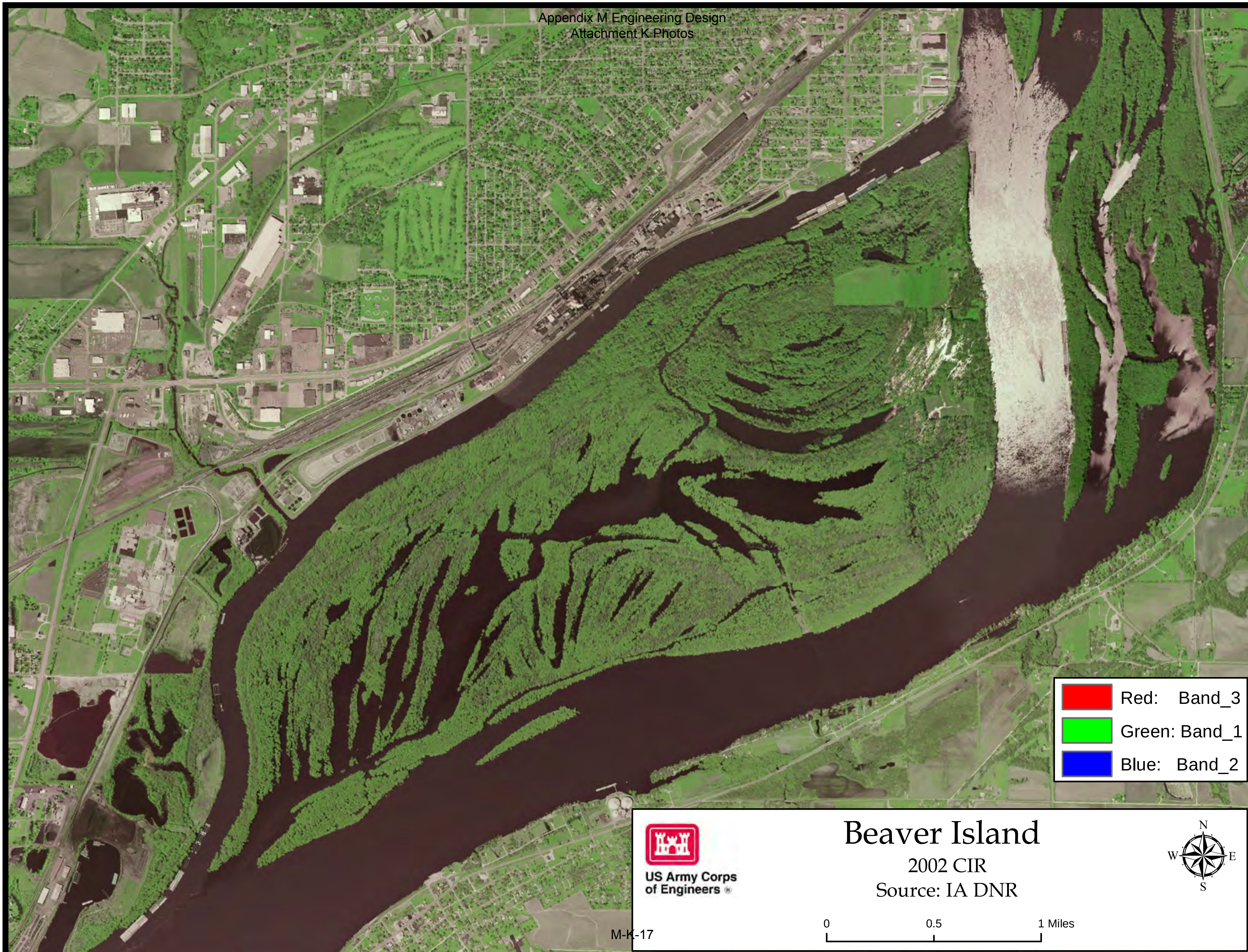
0
0.5
1 Miles
M-K


Red: Band_1
Green: Band_2
Blue: Band_3
Beaver Island
2002 CIR
Source: IA DNR
US Army Corps
of Engineers
0
0.5
1 Miles
N
S
E
W


Red: Band_3
Green: Band_1
Blue: Band_2
US Army Corps of Engineers
Beaver Island
2002 CIR
Source: IA DNR
N
W
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S
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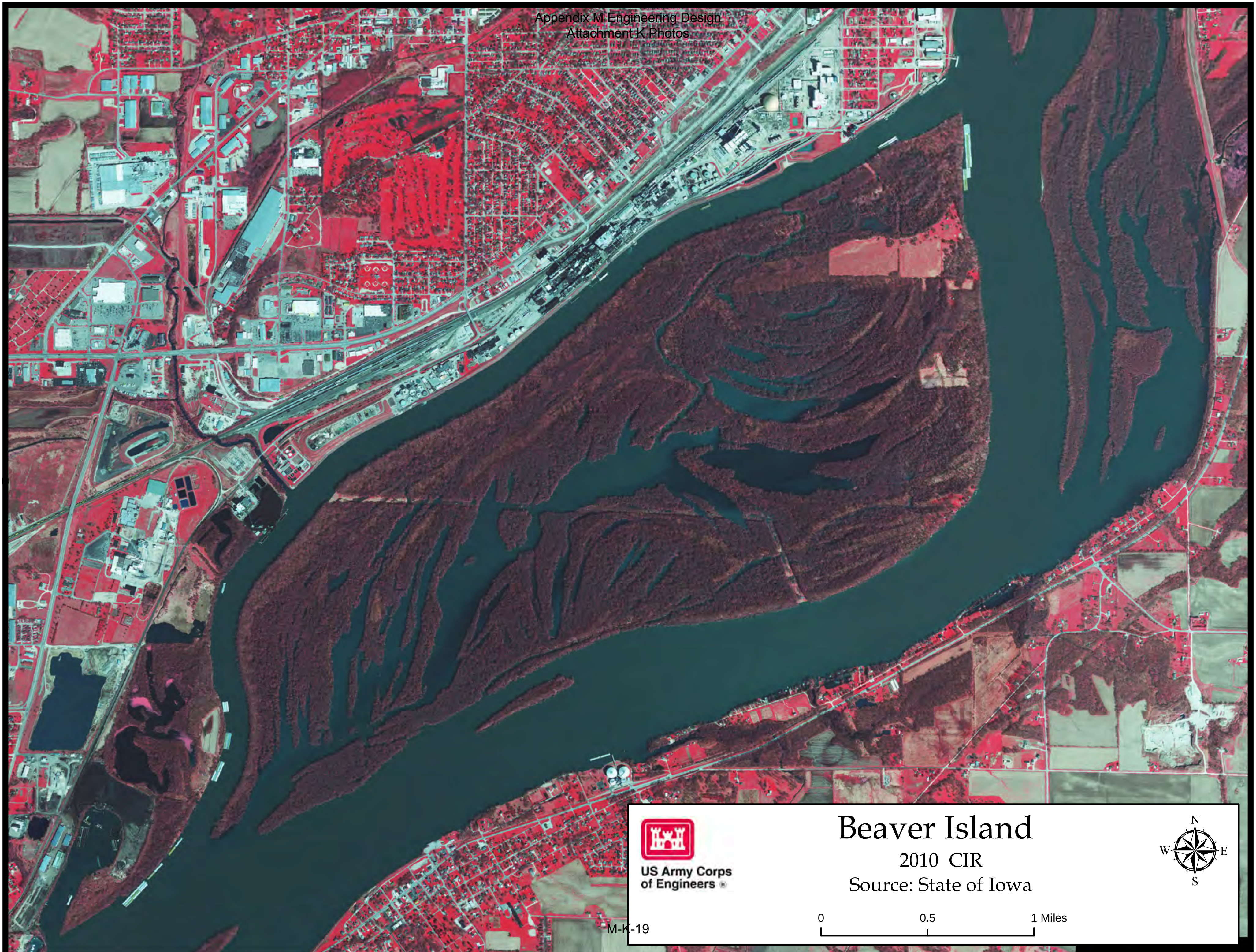
0.5
1 Miles


Beaver Island
2010 Orthophoto
Source: State of Iowa
US Army Corps of Engineers
N
W
E
S
0
0.5
1 Miles


Beaver Island
2010 CIR
Source: State of Iowa
US Army Corps of Engineers
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1 Miles
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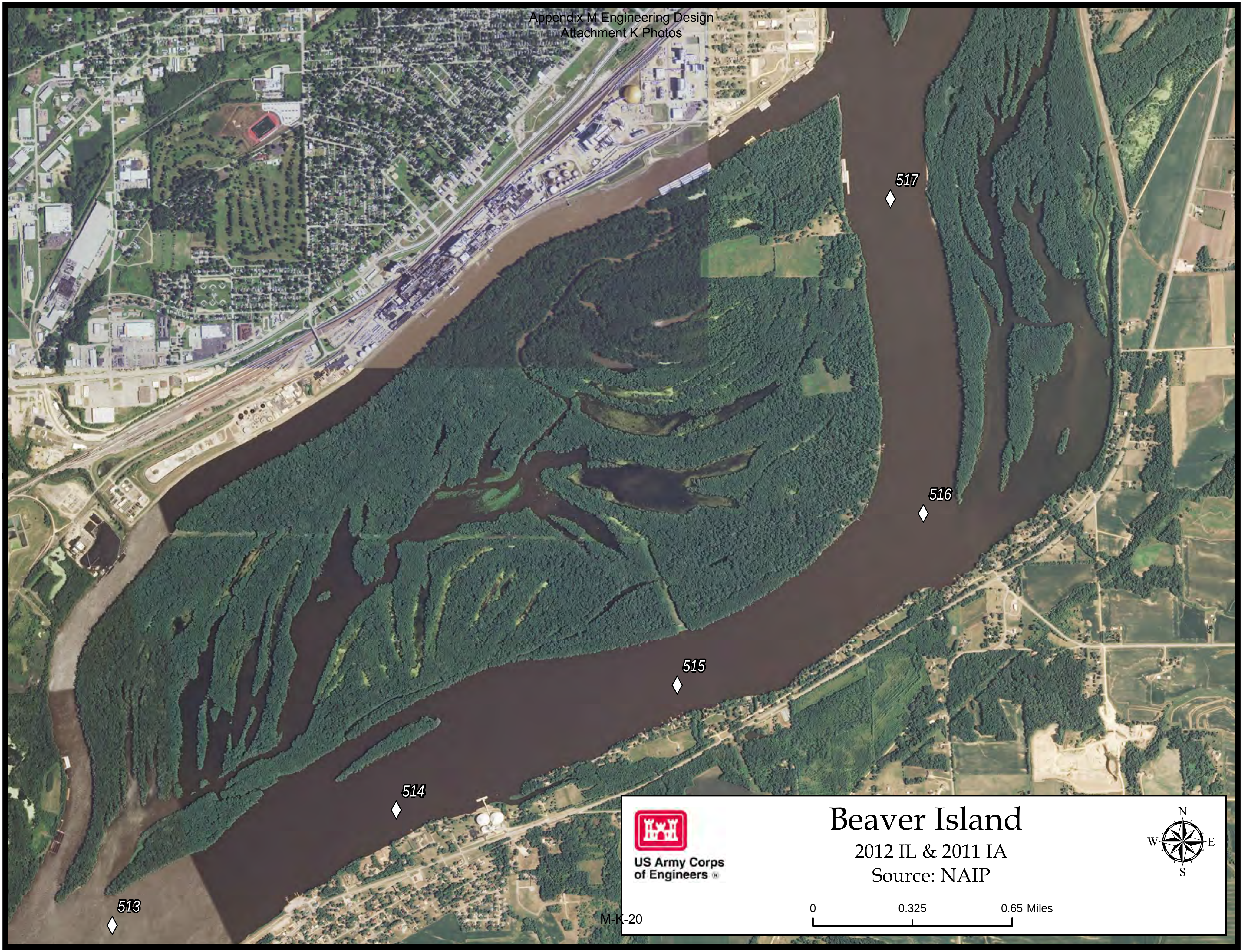
517
516
515
514
513
Beaver Island
2012 IL & 2011 IA
Source: NAIP
US Army Corps
of Engineers
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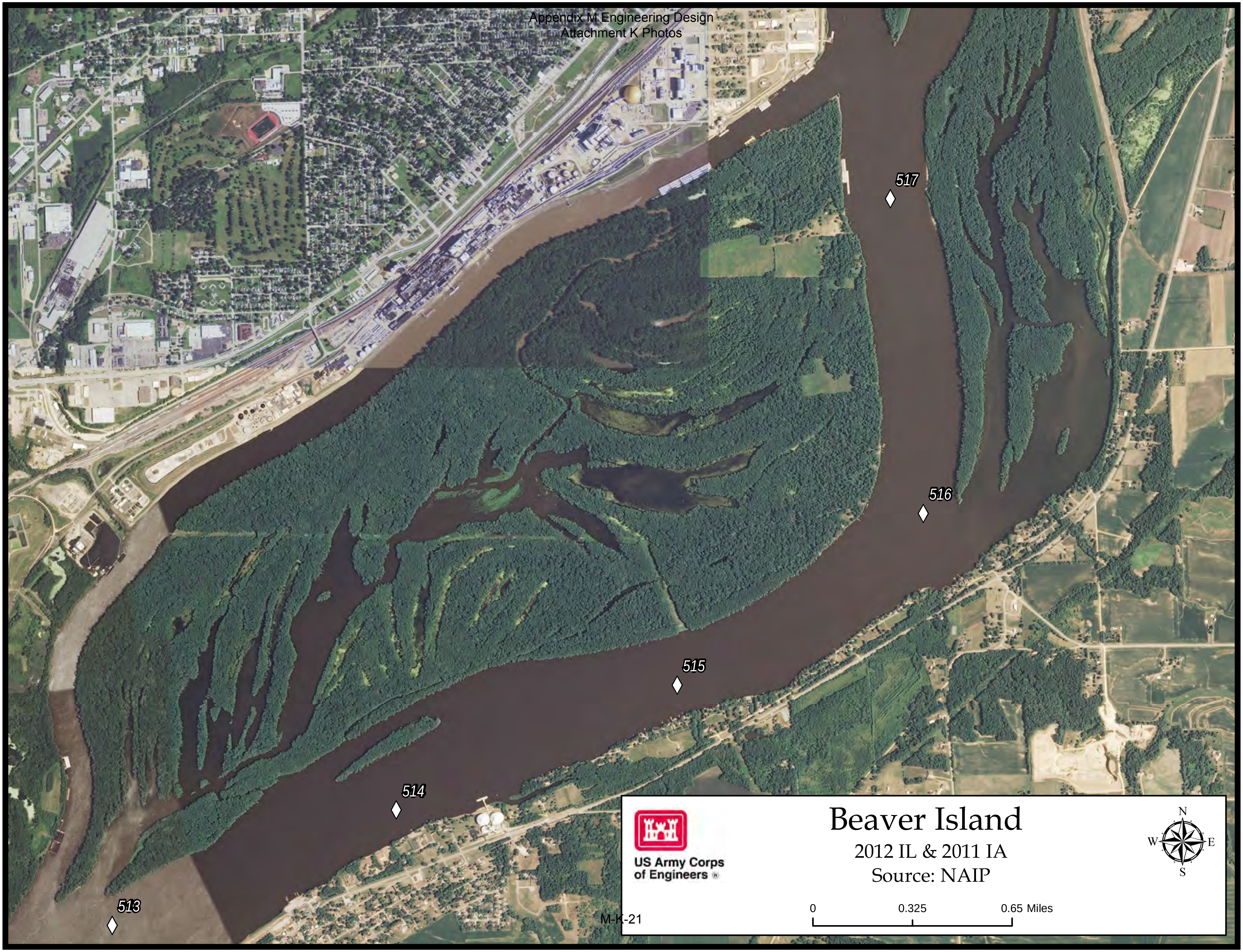
0.325
0.65 Miles


517
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US Army Corps
of Engineers
Beaver Island
2012 IL & 2011 IA
Source: NAIP
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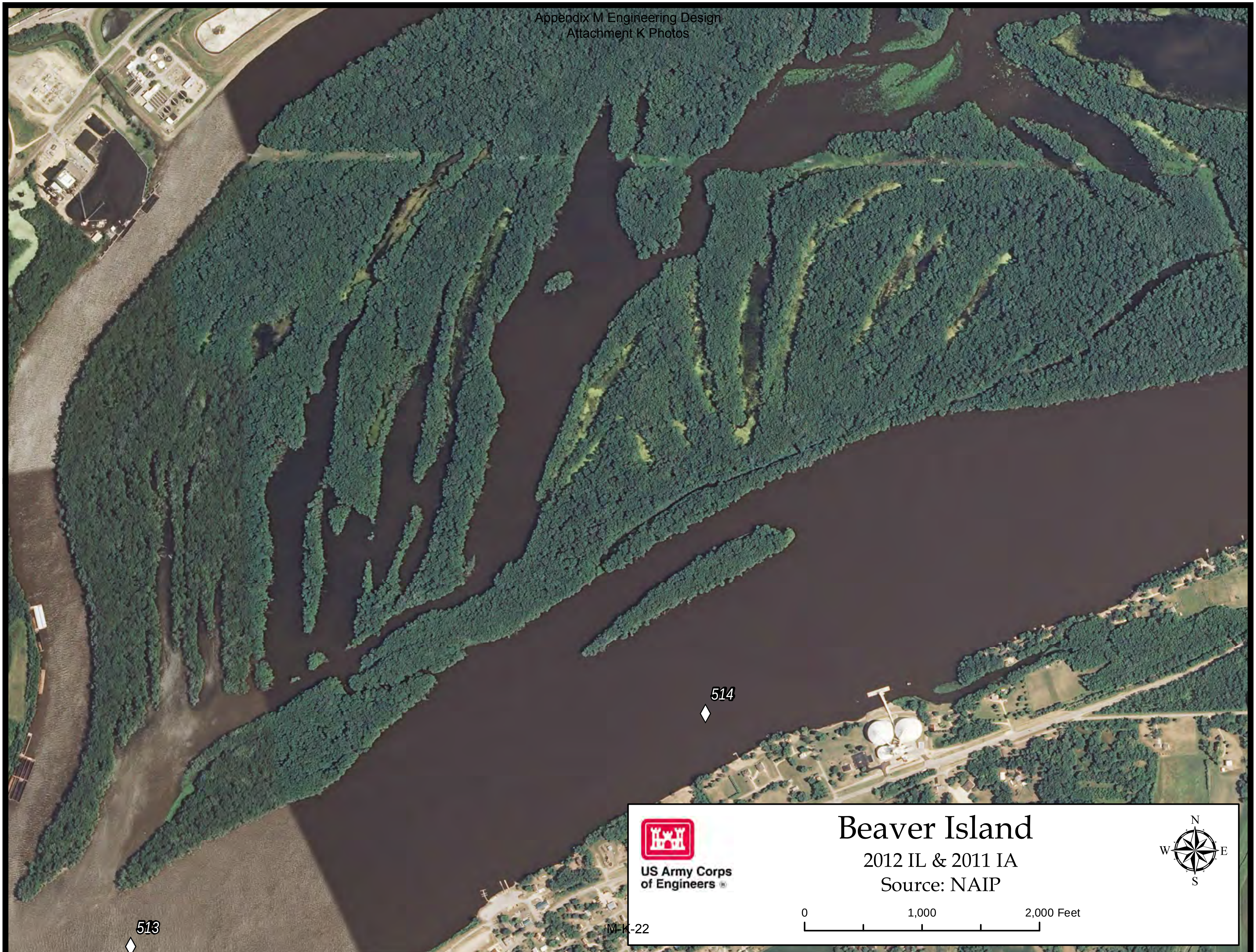
514
513
Beaver Island
2012 IL & 2011 IA
Source: NAIP
US Army Corps of Engineers
0
1,000
2,000 Feet
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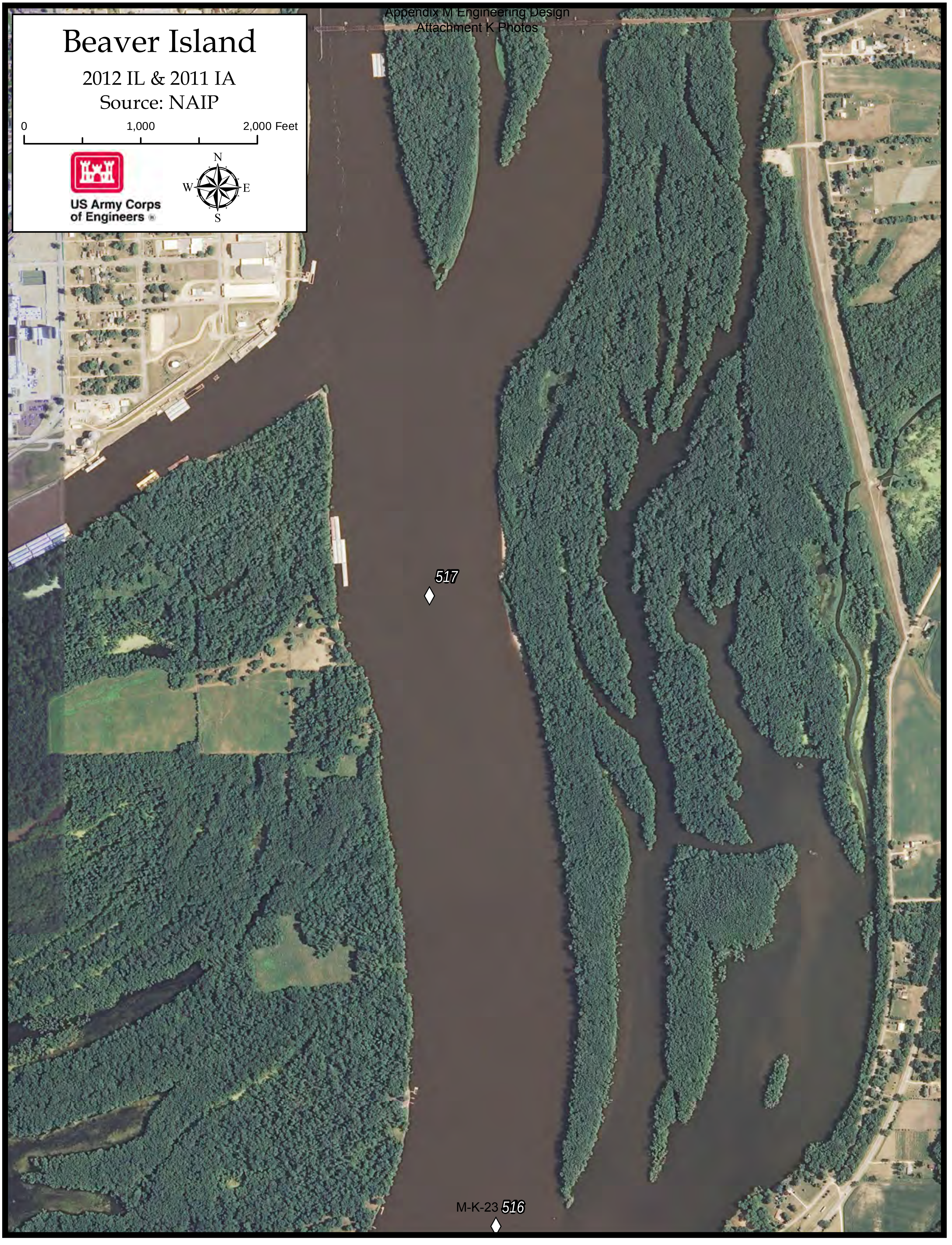
Beaver Island
2012 IL & 2011 IA
Source: NAIP
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2,000 Feet
US Army Corps of Engineers
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517
M-K-23
516

2011

US Army Corps
of Engineers ®
Mississippi Valley
Division

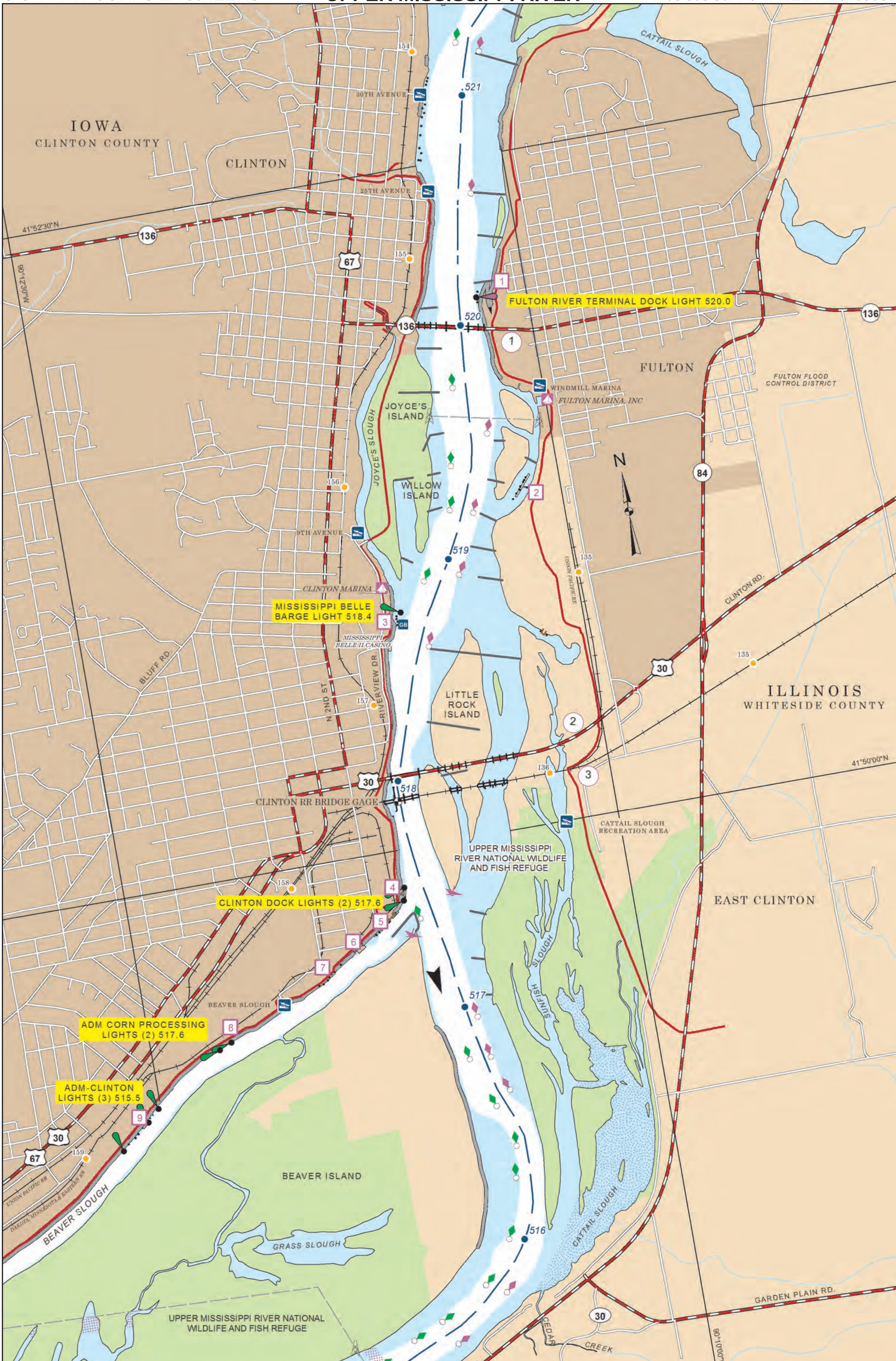
Upper Mississippi River Navigation Charts

Minneapolis, MN to Cairo, IL
Upper Mississippi River Miles 866 to 0
Minnesota and St. Croix Rivers

U.S. ARMY CORPS ENGINEERS

UPPER MISSISSIPPI RIVER

MISSISSIPPI VALLEY DIVISION



2011
UPDATED: Nov 2012

BUOY POSITIONS ON CHARTS ARE APPROXIMATE, SEE NOTICE IN LEGEND

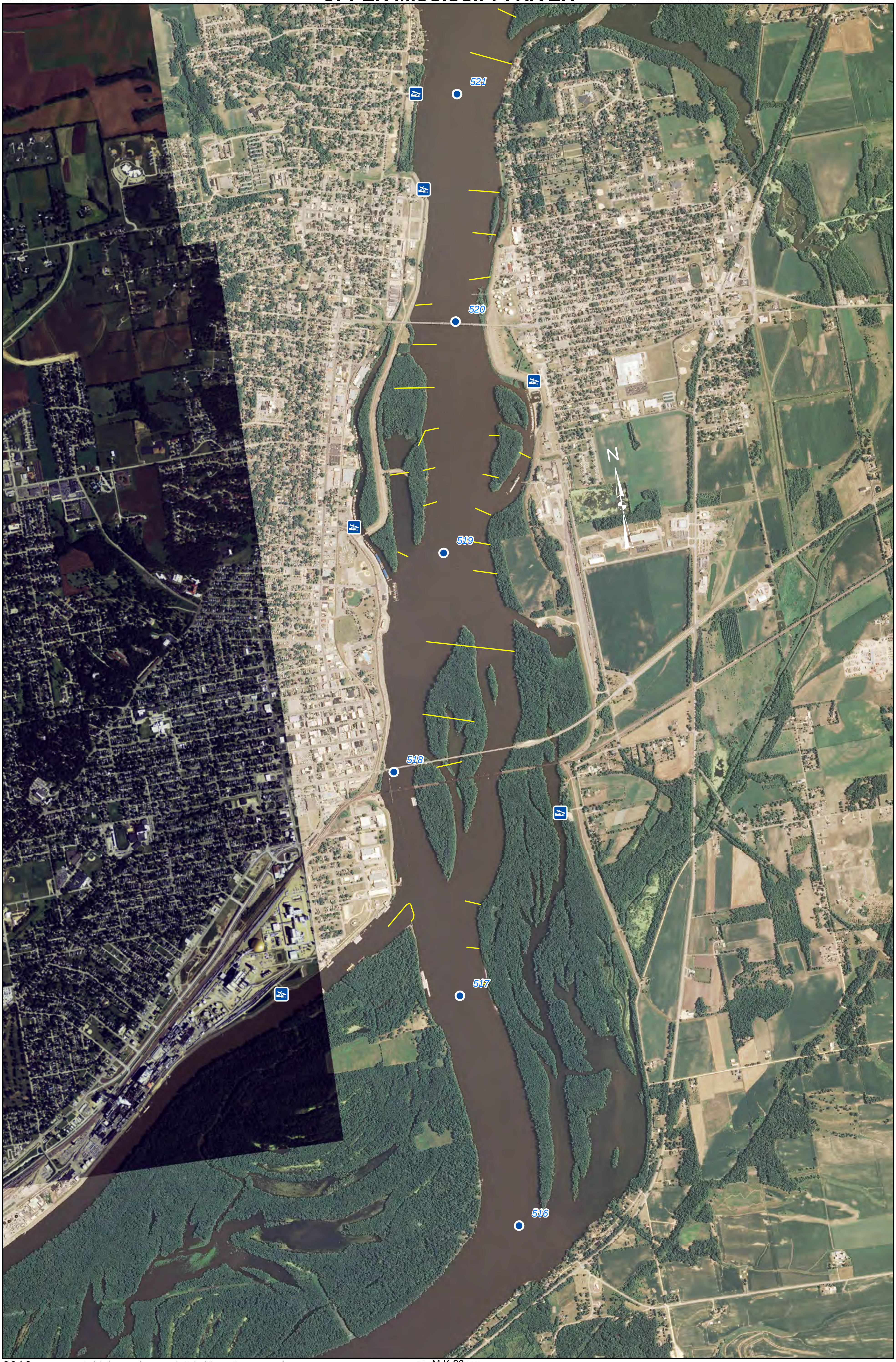
SCALE 1" = 2000'
0 2,000 4,000 6,000 Feet

CHART NO. 70
RIVER MILE 516 TO 521

U.S. ARMY CORPS ENGINEERS

UPPER MISSISSIPPI RIVER

MISSISSIPPI VALLEY DIVISION



2012

Aerial photography source is United States Department of Agriculture, National Agriculture Imagery Program (NAIP). Imagery captured 2012, Pool 11 captured 2010.

SCALE 1" = 2000'

0 2,000 4,000 6,000 Feet

CHART NO. 70

RIVER MILE 516 TO 521

U.S. ARMY CORPS ENGINEERS

UPPER MISSISSIPPI RIVER

MISSISSIPPI VALLEY DIVISION

2011

UPDATED: Nov 2012

BUOY POSITIONS ON CHARTS ARE APPROXIMATE, SEE NOTICE IN LEGEND

SCALE 1"=2000'

0 2,000 4,000 6,000 Feet

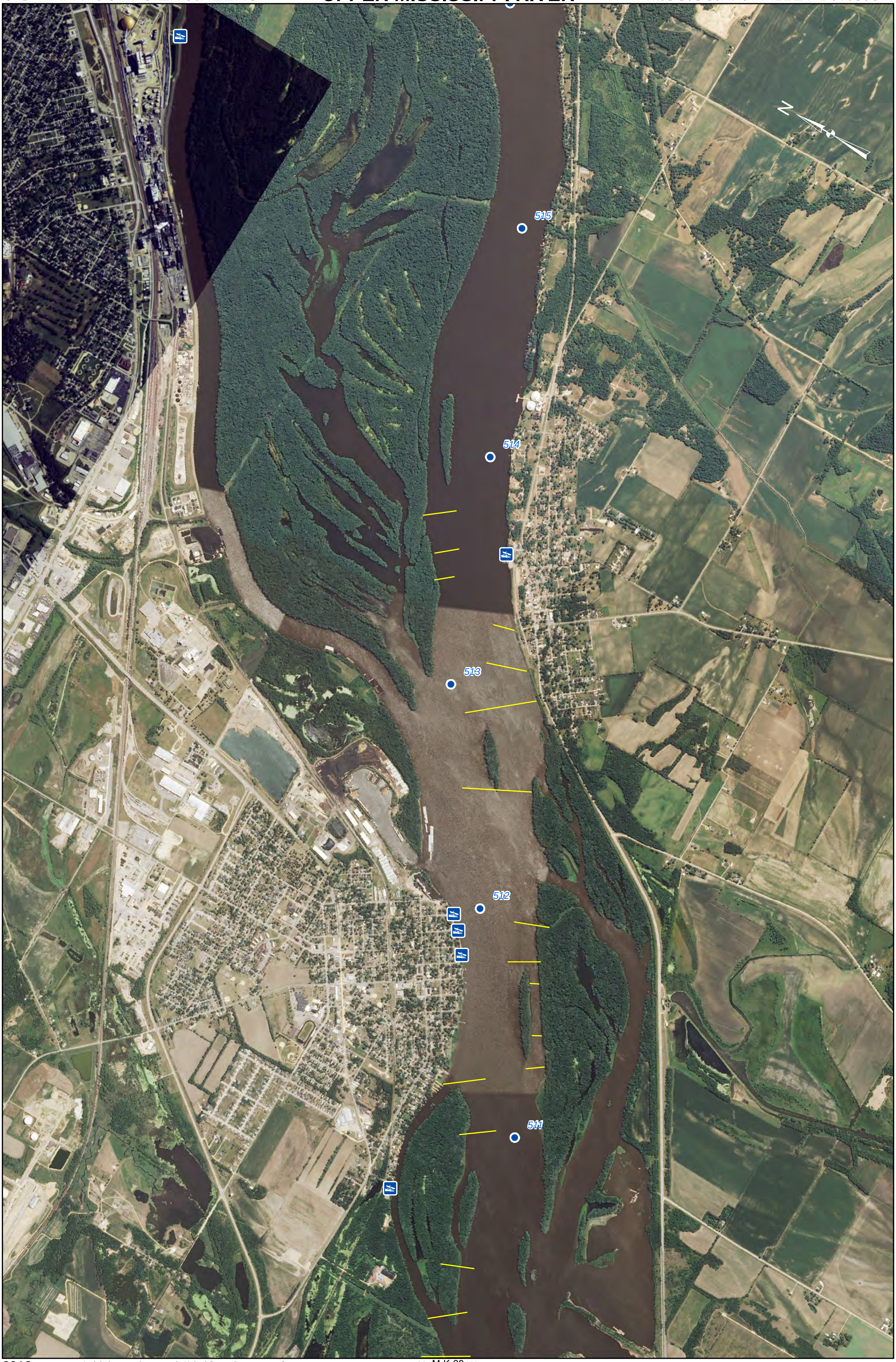
CHART NO. 71

RIVER MILE 511 TO 515

U.S. ARMY CORPS ENGINEERS

UPPER MISSISSIPPI RIVER

MISSISSIPPI VALLEY DIVISION



2012

Aerial photography source is United States Department of Agriculture, National Agriculture Imagery Program (NAIP). Imagery captured 2012, Pool 11 captured 2010.

SCALE 1" = 2000'

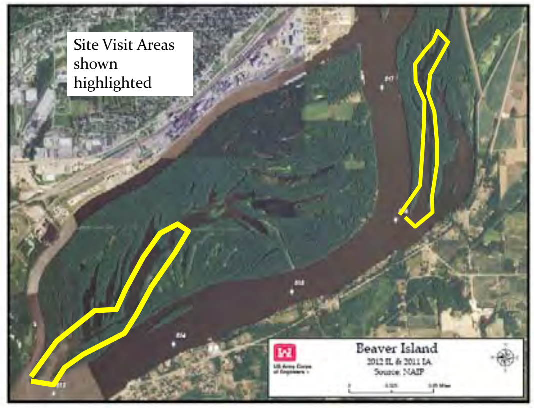
0 2,000 4,000 6,000 Feet

CHART NO. 71

RIVER MILE 511 TO 515

Beaver Island Site Visit

August 26, 2013



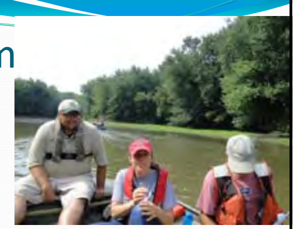
Beaver Island from Albany, IL

Multi-agency Team

USACE:
Dave Bierl (water quality)
Andy Leichty (programs)
Kara Mitvalsky (engineer)
Kacie Norton (intern)
Nate Richards (biologist)
Monique Savage (planner)
Jon Schulz (forester)
Brant Vollman (archeologist)

USFWS:
Sharonne Baylor
Ed Britton

IA DNR:
Mike Griffin
Scott Gritters



Boat Landing

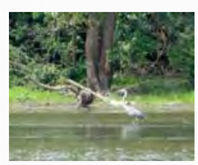
Lower Entrance

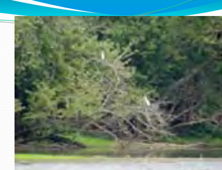
- Sandy area with one maple tree recently cut down.
- Uncertain about why sand has been deposited here (dredged material)?

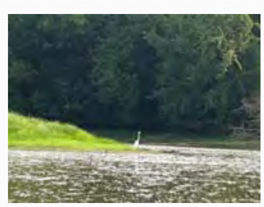
Mussels

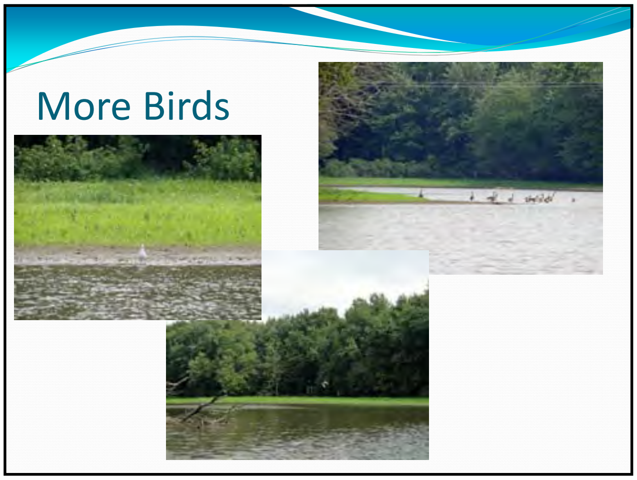
- Several discarded clam shells were noted within the interior shores of Beaver Island.

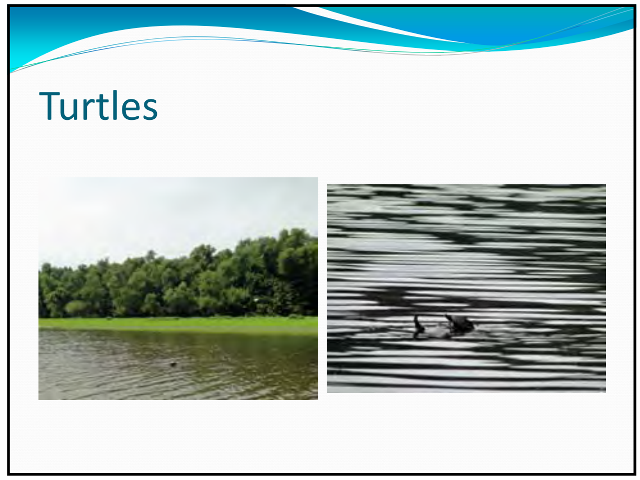
Birds



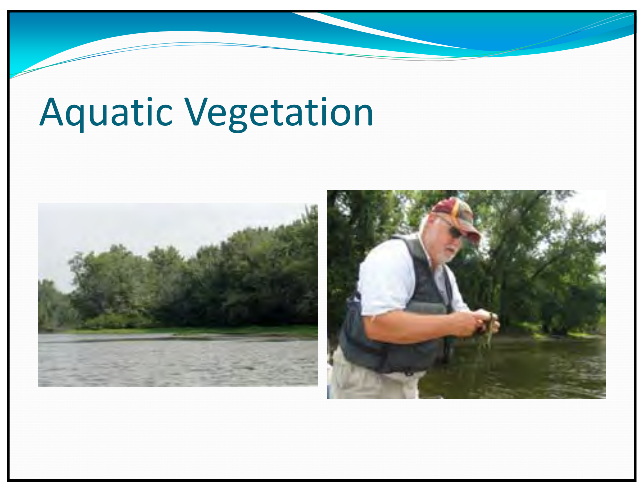





More Birds


Turtles

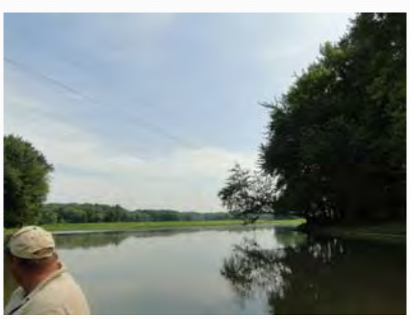

Fish


Aquatic Vegetation

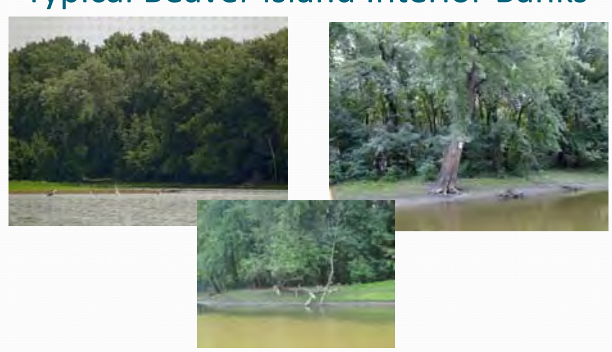
Trees

Lower Lake

Upper Lake



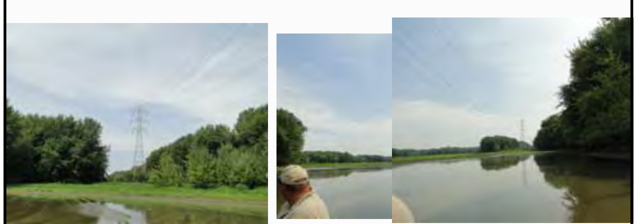
Typical Beaver Island Interior Banks



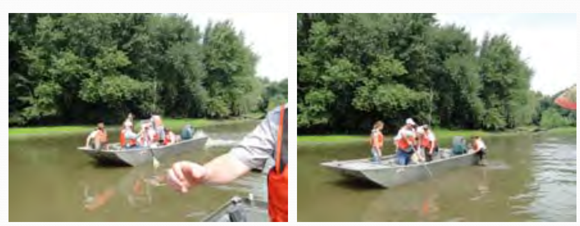
Beaver Island Interior Inlets or Finger Sloughs

Beaver Island Main Slough/Lower Inlet

Bisecting Power Line

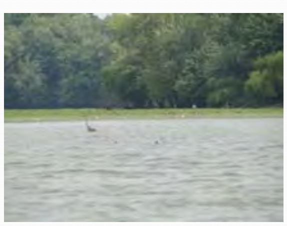


Shallow Water/Saved by Sharonne



Entering Cattail Slough

Cattail Slough



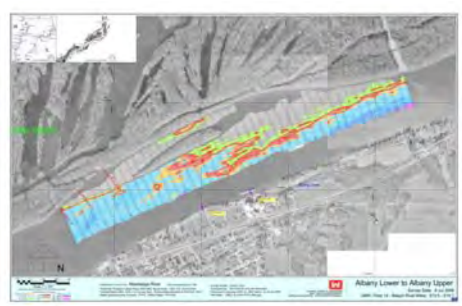
Attendees

- USACE, MVR
  - Nate Richards, Project Biologist
  - Kara Mitvalsky, Project Design Engineer
  - Lucie Sawyer, Hydraulic Engineer
  - Elizabeth Bruns, Water Quality
  - Jason Appel, Real Estate
  - Emily Johnson, Engineering Technician
- IA DNR
  - Scott Gritters
  - Charlie Jordan
  - Paul Sleeper
  - Eric Chapman
- USGS
  - Steve Zigler
  - Teresa Newton
- US FWS
  - Jon Duyvenjonck
- Exelon
  - Jeremiah Haas
- Retired Illinois DNR
  - Bob Shanzle

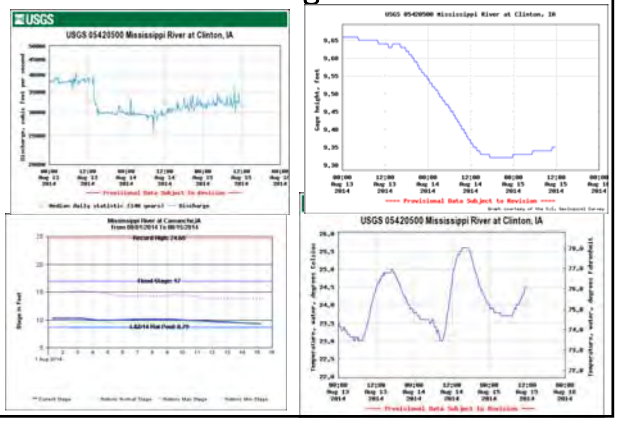
Site Visit Purpose

- Mussel Survey
- Site Recon

Orthosurvey for mussel areas (2009)

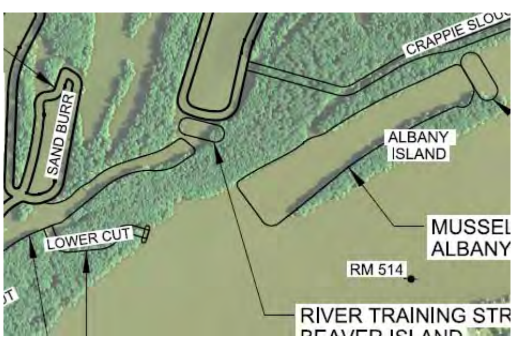


River during site visit



Potential Features

Areas visited



Blue = morning survey
Red = afternoon survey
Green = Site Reconnaissance

Mussel Surveys



Site Survey
One diver
Several individuals using hand and feet.
Once mussels were located, time was noted, mussels were placed into a bag, and later sorted, identified and sized.

Mussel Surveys

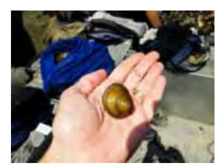



Mussel Sorting




Mussels

Pimpleback



Hickory Nut

Hickory Nut (left) and Higgins Eye

Pimpleback

More Mussels

Yellow Sand Shell

Higgins eye

Lower Cut

Dry inlet upstream of Lower Cut

Lower Cut

“Navigation side” entrance to Lower Cut

Lower Cut

Typical Cut conditions (high banks, shallow water, log/tree jams)

Lower Cut



Inlet area of lower cut into Beaver Island (lower lake)

Lower Cut

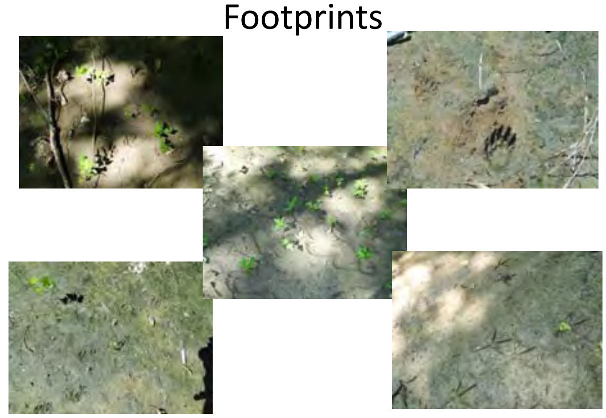


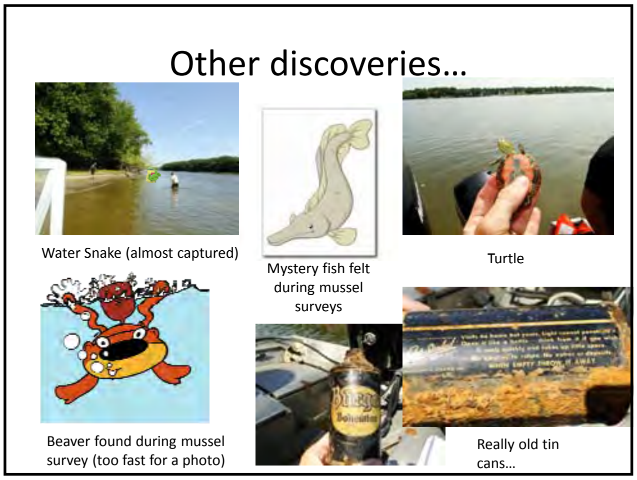
Low, unforested section at outlet of lower cut into Beaver Island

Lower Cut

Typical forest and understory in lower cut area

Footprints




Other discoveries…
Water Snake (almost captured)
Mystery fish felt during mussel surveys
Turtle
Beaver found during mussel survey (too fast for a photo)
Really old tin cans…

Beaver Island HREP

Appendix M

Design Engineering

Attachment L
Features Over Time

Beaver Island HREP

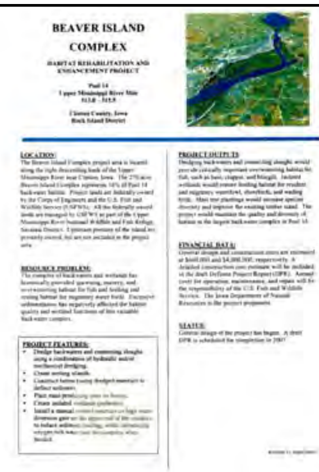
Definite Project Report
Feature/Alternative
Selection and Development

Slough Names

April 2002 DNR Fact Sheet

The project entails reestablishment of depth for fishes while using the silt to promote topographic diversity. The total project consists of 38 acres of aquatic work. Twenty-nine acres (10%) of shallow backwaters and connecting sloughs will be deepened to provide deep-water fisheries habitat. Nine acres of shallow isolated wetlands will be deepened (pothole formation). The dredged material will be placed in berms along the outside of the interior of the island to keep silt laden waters from entering the area from upstream and promote the entry of water to the area with relatively clean water from downstream connections. The berms will provide areas of high ground to be colonized by tree species and plants that need higher relief from repeated inundation and thus creating a much more diverse habitat though increased topographic, and species (both plant, tree and animal) diversity

April 2006 Fact Sheet


BEAVER ISLAND
COMPLEX
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

LOCATION:

RESOURCE PROBLEM:

PROJECT FEATURES:

PROJECT OUTPUTS:

FINANCIAL DATA:

STATUS:

August 2013: Kick Off

USACE:
Dave Bierl (water quality)
Andy Leichty (programs)
Kara Mitvalsky (engineer)
Kacie Norton (intern)
Nate Richards (biologist)
Monique Savage (planner)
Jon Schulz (forester)
Brant Vollman (archeologist)

USFWS:
Sharonne Baylor
Ed Britton

IA DNR:
Mike Griffin
Scott Gritters




Early Meetings

- October 2013:
  – Data needs and problem overview
- November 2013:
  – Identified data needs
- December 2013
  – Problems and Opportunities
- January 2014
  – Eliminated Cattail Slough

February 2014

- Public Meeting Planning
- Risk Register
- Update on data acquisition
- Limiting Factors

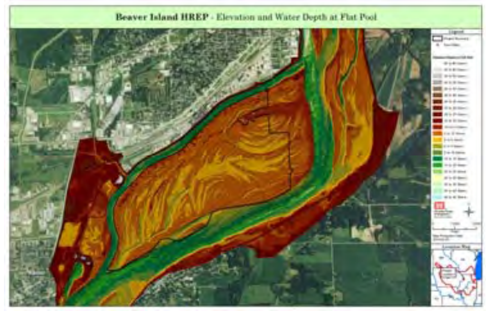
March 2014

- Scoping Meeting
  – Sedimentation
  – Management (limit to actively manage, closed area for hunting, top objective migratory waterfowl)
    - Habitat
    - Birds (bald eagle nest, rookery, shorebirds)
    - Forestry (old data, one generation after settlement)
    - Soil analysis
    - Vegetation Survey (2011)
    - Herps and use on site
    - Fish (overwintering rarest habitat)
    - Mussels
  – Continued existing condition aquisition

Beaver Island as a restoration project because….

- Largest island
- High public demand
- High density of diverse habitat
- It's the central park of Clinton
- Steam boat days
- Natural resting spot for migratory waterfowl instead of using Clinton
- Overwintering is gone
- Forestry in decline

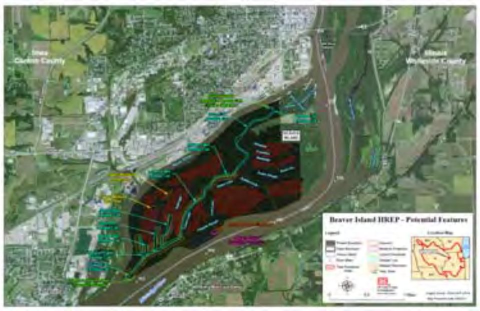
March 26, 2014 Public Meeting



6/12/14 PDT Meeting and Brainstorming

June 2014: Brainstorm

6/4/2014



6/17/14

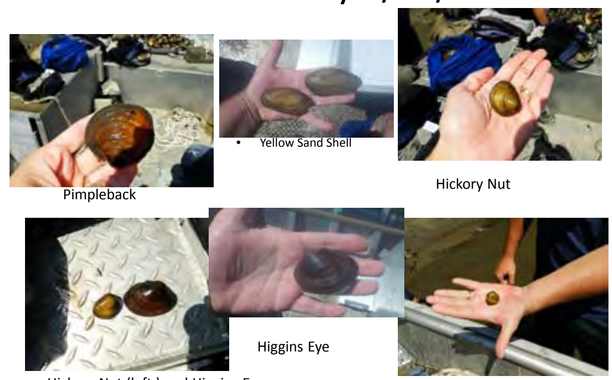
7/29/14

August 2014

- Shared drawings with sites located (7/29/14).
- Discussed wetlands, EFM, plantings.
- Discussed mussel habtiat and plan for a mussel dive
- Real estate showed all work on government land

Mussel Surveys (8.14.14)

Mussel Survey 8/14/14



Later August Meeting

- Starting to develop design criteria.
- Archeological Survey underway.
- Beaver Island Cut discussed (cut through to Blue Bell or Stewart or other lake).

October 2014

- Began to look into Albany Slough erosion (Albany Island helps the Slough maintain its depths).
- Mussel habitat paramters began to be developed. Determined that interior mussle habitat was not achievable based on flows.
- Paramters for herp habtiat established

December 2014

MEASURE	AREA'S INCLUDED	SYMBOL	SCALES	OBJECTIVE
Lower Dredging	Sand Burr, Bluebell, Small, Stewart and Lower Dredge Cut	L	2-Lake or channel dredge cuts	Fish, Trees
Lake Dredging	Lower Lake and Upper Lake Dredge Cut	D	2- Lake or channel dredge cuts	Fish, Trees
Upper Dredging	Upper and Deep Dredge Cuts	U	1	Connectivity to Beaver Slough, Trees
Stewart Channel Cut	Beaver Slough Cut and water control structure	S	2-With or without vanes	Connectivity to Beaver Slough, Sustainability, Fish, Trees
Albany Island Protection	Head of Albany Island	A	2-Chevron or Rock Protection	Mussel, Potential Fish
Albany Substrate	Albany Slough – dependent on Albany Island protection	R	1	Mussel
Wetlands	Lower, Upper, and TBD perched Sites	W	2-Isolated and Perched	Herps

January

- Multiple survey meetings

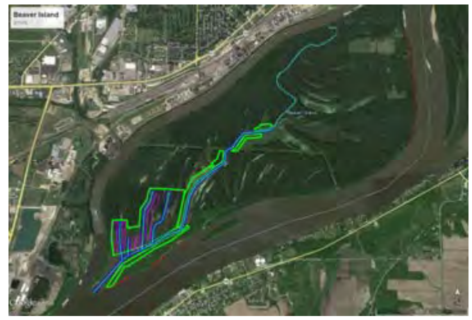
January 2015 (IA DNR)

March 2015

- Determined need for closure structure on upstream end to make sure that flow is low enough for overwintering habitat.
- Albany Island protection essential for mussels.
- Tree height design determined.
- Ephemeral wetlands, eliminated Grass and Buffalo sloughs due to size and multiple connectivity's.

March 2015

3/11/15



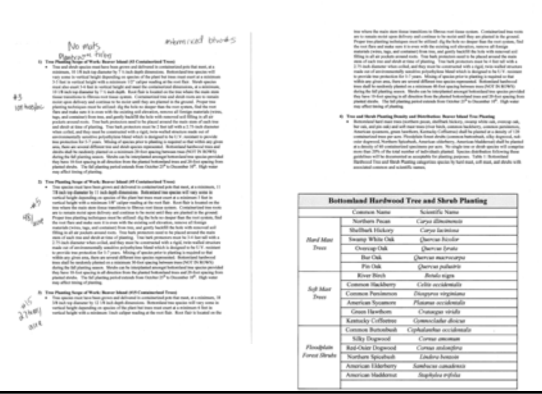
3/27/15

April 2015

- Reviewed objectives
- Lower Dredge Cut, consider diversion structure on lower end of island.
- Forest Sites: Make more natural
- Ephemeral wetlands: Existing wetlands are good, consider removing from site. Consider perched wetlands on placement sites.

April 2015

May 2015: Tree Planting Criteria



6) Tree and Shrub Planting Density and Distribution: Beaver Island Tree Planting

Bottomland Hardwood Tree and Shrub Planting		
	Common Name	Scientific Name
Hard Mast Trees	Northern Pecan	*Carya illinoinensis*
	Shellbark Hickory	*Carya laciniosa*
	Swamp White Oak	*Quercus bicolor*
	Overcup Oak	*Quercus lyrata*
	Bur Oak	*Quercus macrocarpa*
	Pin Oak	*Quercus palustris*
Soft Mast Trees	River Birch	*Betula nigra*
	Common Hackberry	*Celtis occidentalis*
	Common Persimmon	*Diospyros virginiana*
	American Sycamore	*Platanus occidentalis*
	Green Hawthorn	*Crataegus viridis*
	Kentucky Coffeetree	*Gymnocladus dioicus*
Floodplain Forest Shrubs	Common Buttonbush	*Cephalanthus occidentalis*
	Silky Dogwood	*Cornus amomum*
	Red-Osier Dogwood	*Cornus stolonifera*
	Northern Spicebush	*Lindera benzoin*
	American Elderberry	*Sambucus canadensis*
	American Bladdernut	*Staphylea trifolia*

5/18/15

Changes for Beaver Island based on some tree stuff.

1. Stewart RS Placement (need to make a 300 foot bottom.)
2. Stewart LS Placement (need to make shorter and move downstream. Look at new shape...)
3. Blue Bell Dredge Cut. End Cut where it gets wide at the top end.
4. Blue Bell LDB Placement site, end at new ending of dredge cut. (new site)
5. Sand Burr RB Placement Site. Add at upper end of dredge cut.
6. Sand Burr LB end before you reach the upper island.

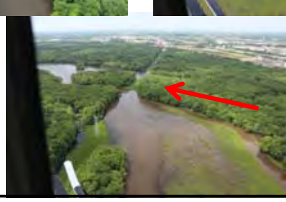
Sites with no markups can remain unchanged.

5/21/15

6/1/2015

June 2015

6/9/15 Helicopter Tour
Sediment flow from Upper Cut/Deep Cut to Upper Lake



June 2015

- Added rock to protect downstream end of Albany Island (previously had just been on upstream end near chevron).
- Need for closure structure emphasized following helicopter tour
- Diversion structure at bottom of Beaver Island eliminated

6/4/15 (for ICA)

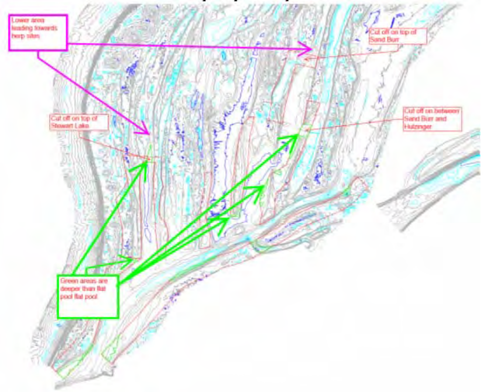
7/20/15

- Chevron design clarified
- Mussel criteria discussed
- Mussel surveys by IA DNR (update sent in December 2015)
- Forest criteria clarified
  - Smaller pockets with trees around then (RIFO/DNR)
  - Follow contours (FWS)
  - Tie into high ground (IADNR)
  - Raise areas needing more diversity (FWS)
  - Avoid long narrow runs (FWS)
- Request to close off head of lakes by IA DNR
- Avoid placement in water

8/27/2015 Meeting

9/4/15: Proposed changes resulting from July and August meetings

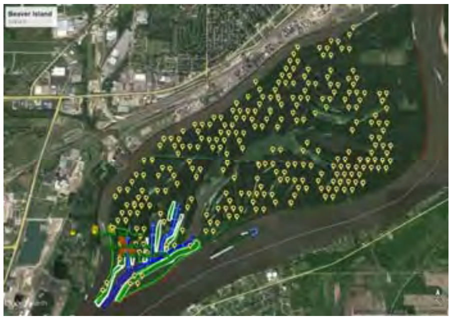
9/21/15 (after receiving comments on 9/4/15)



10/27/15 incorporating comments from 9/21 version

11/3/15

11/3/15



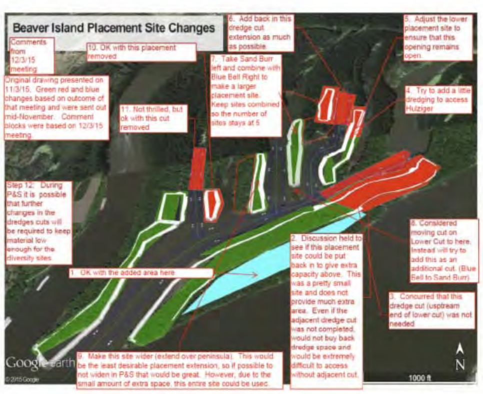
11/20/15

Changes Recommended At 11/3 meeting

11/23/15 (Cleaned up view of 11/20)

12/3/15

Changes recommended at 12/3 meeting



12/7/15

12/7/15

Beaver Island TSP (December 2015)