

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)

**LAKE ODESSA HABITAT REHABILITATION
AND ENHANCEMENT PROJECT**



PUBLIC REVIEW DRAFT
JULY 2004



**US Army Corps
of Engineers** ®
Rock Island District

POOLS 17 AND 18
MISSISSIPPI RIVER
MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
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ACKNOWLEDGEMENT

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**US Army Corps
of Engineers** ®
Rock Island District

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TO SIGN
OUR WORK**

EXECUTIVE SUMMARY

The Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) is located 15 miles south of Muscatine, Iowa, on the right descending bank of the Mississippi River between river miles (RM) 434.5 and 441.5. The project lies in Louisa County, Iowa, and encompasses the federally owned lands between the Iowa River on the south and Michael Creek on the north. All project lands are in Federal ownership and are managed by the U.S. Fish and Wildlife Service (USFWS) as part of the Mark Twain National Wildlife Refuge Complex. The USFWS has granted management of the project's lower half to the Iowa Department of Natural Resources (IDNR) through a cooperative agreement.

The Lake Odessa area was originally leveed off for agricultural purposes in 1913. Active wildlife management began in the mid-1950's with efforts to manipulate water levels to promote vegetative growth and provide high quality resting and feeding areas for migratory waterfowl. Levee overtopping and generally inadequate water level management capabilities often compromised these efforts. While Lake Odessa has traditionally had high fall duck and geese populations and significant duck production, levee breaks have resulted in frequent losses of emergent aquatic vegetation and mast trees when flooding is prolonged. Sedimentation from the flood events has decreased deep aquatic habitat, which reduces circulation of oxygenated water and increases the possibility of fishkills.

The goals of the proposed project are to restore and protect wetland, terrestrial, and aquatic habitat. The objectives identified to meet these goals were: (1) reduce forest fragmentation; (2) increase bottomland hardwood diversity; (3) enhance migratory bird habitat; (4) restore sand prairie; (5) increase habitat for overwintering fish; (6) provide safe areas for developing fish; (7) protect habitat features; and (8) protect archeological sites. The following enhancement features and their associated plans were considered to achieve the project goals and objectives:

1. Moist Soil Unit (MSU) Enhancement
 - No action.
 - Enhance water level management capability at Field 4 & 5, Field 21, and MSU 20.
 - Enhance water level management capability at Unit 2.
 - Enhance water level management capability at Fox Pond.
 - Dredge access channels to Swarms and Bebee Ponds.
 - Enhance water level management capability at IDNR MSU.
2. Fisheries Enhancement
 - No action.
 - Dredge 1,490- by 751-foot area in Lake Odessa.
 - Dredge a 5,158-foot channel in Goose Pond.
 - Dredge a 6,040-foot channel between Yankee and Blackhawk Chutes.
 - Dredge access channels to Swarms and Bebee Ponds.
3. Mast tree planting
 - No action.
 - Restore and improve the bottomland hardwood forest by planting 27 acres of mast trees at Sites A and B.

- Restore and improve the bottomland hardwood forest by planting 26 acres of mast trees at Site C.
 - Restore and improve the bottomland hardwood forest by planting 40 acres of mast trees at Site D.
4. Levee Restoration
 - No action.
 - Restore perimeter levee crown and interior levee side slopes, construct a spillway and wing dam, and protect archeological sites.
 5. Sand Prairie Planting
 - No action.
 - Plant a 36-acre field with sand prairie grasses and forbs.
 6. Fish Nursery
 - No action.
 - Replace a water control structure to allow for fish passage.

Evaluation of the project enhancement features and construction options was accomplished using the Wildlife Habitat Appraisal Guide (WHAG) and annualization of outputs and costs. The WHAG evaluation methodology quantifies habitat output in the form of habitat units (HUs) that are used in conjunction with project cost data and functional life expectancy to compare the construction options of the proposed enhancement features. This incremental analysis identifies which combinations of enhancement features would be cost efficient and cost effective.

The recommended plan (shown on Figure ES-1) includes: (1) enhancing water level management capability at Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, and IDNR MSU, as well as dredging access to Swarms and Bebee Ponds; (2) fisheries enhancement dredging in Lake Odessa, Goose Pond, Yankee/Blackhawk Chutes, and Swarms and Bebee Ponds; (3) mast tree planting at Sites A through D; (4) levee restoration; (5) sand prairie planting; and (6) fish nursery construction.

Enhancing water level management capability will provide more moist soil habitat, greater vegetation diversity and growth, and reliable food supplies to migratory waterfowl. Fisheries enhancement dredging will create areas of deeper water and/or access to deeper water for overwintering fish. Mast tree planting will improve the quality and quantity of forest habitat by re-introducing mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Levee restoration will provide reliable flood damage protection, reduce flood damages and levee failures, and protect archeological sites from further erosion. The sand prairie planting will increase habitat complexity and provide feeding and nesting opportunities for a wide variety of wildlife. The fish nursery will allow fry to be reared to the fingerling stage in a predator free environment.

Implementation of the recommended plan will increase the quality and quantity of preferred habitats at this location. The project outputs meet site management goals and objectives and support the goals and objectives of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP), the North American Waterfowl Management Plan, and the Partners in Flight Program.

The U.S. Army Corps of Engineers would be responsible for the Federal share of any mutually agreed upon major rehabilitation of the project that exceeds the annual operation and maintenance

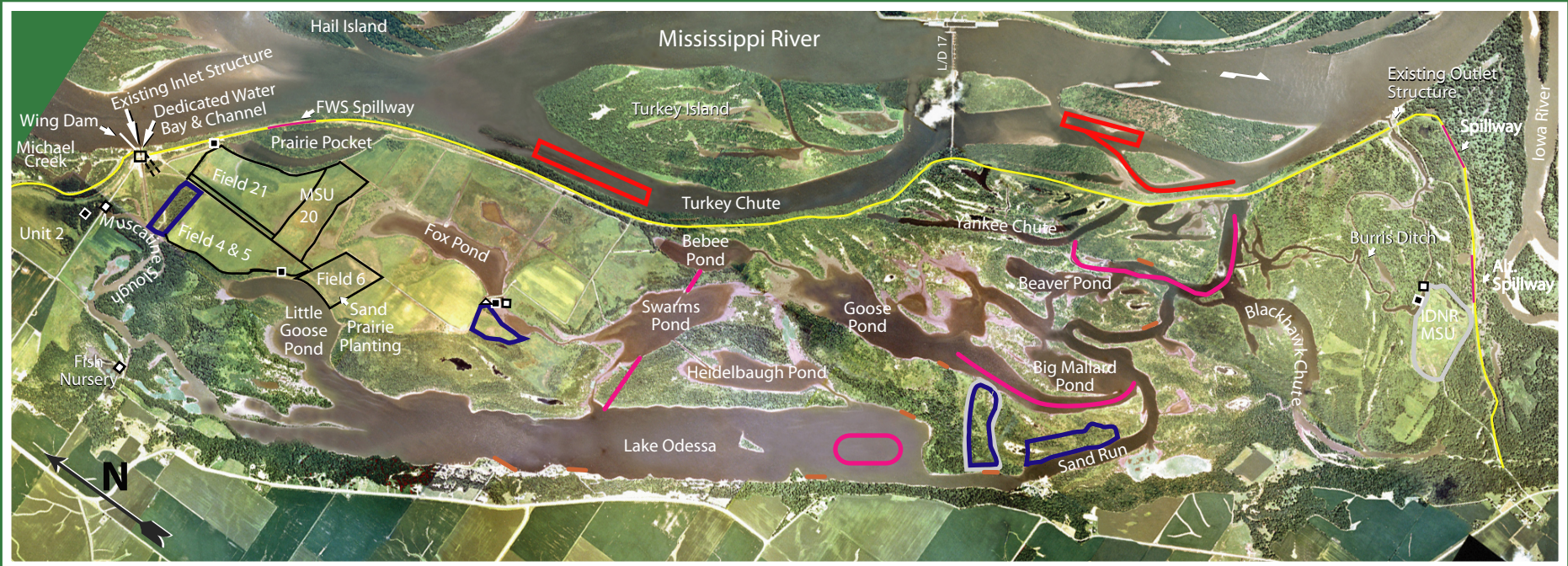
requirements identified in the final Definite Project Report (DPR) and that is needed as a result of specific storm or flood events. Major rehabilitation of the project is not included in the project cost estimate.

Section 906(e) of the 1986 Water Resources Development Act (WRDA) specifies that first cost funding for enhancement features “located on lands managed as a national wildlife refuge” will be 100% Federal. All Lake Odessa project features will be located on federally owned lands managed through a cooperative agreement with the U.S. Fish and Wildlife Service, the Federal project sponsor. Per Section 107(b) of the 1992 WRDA, the U.S. Fish and Wildlife Service will accomplish project operation and maintenance at an estimated average annual cost of \$63,176. The Iowa Department of Natural Resources is the non-Federal project sponsor.

The District Engineer has reviewed the project outputs and determined that implementation of the selected plan is justified and in the Federal interest. Therefore, the Rock Island District Engineer recommends construction approval for the Lake Odessa Habitat Rehabilitation and Enhancement Project at an estimated Federal expense of \$11,098,152. The total Federal cost estimate, including general design and construction management, is \$13,802,552.

UMRS EMP

Figure ES-1 LAKE ODESSA Project Location Map



LEGEND

— Restore Perimeter Levee

— Mast Tree Planting

— Dredged Material Placement Site

— Excavate Channel/Deep Holes

— Hydraulic Dredging Borrow Site

— Archeological Site Protection

■ Portable Pump and/or Pad

Replace / New Water Control Structure

▲ New Pump Station

0 1/2 mile 1 mile
Scale

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CONTENTS

Subject	Page
1. INTRODUCTION	1
a. Purpose	1
b. Resource Problems and Opportunities	1
c. Project Selection	1
d. Scope of Study	2
e. Format of Report	2
f. Authority	2
2. ASSESSMENT OF EXISTING RESOURCES	4
a. Resource History and Description of Existing Features	4
b. Water Resources and Flooding History	5
c. Land Use and Current Area Management Objectives	6
d. Aquatic Resources	8
e. Water Quality	8
f. Sedimentation	9
g. Vegetation	9
h. Fish and Wildlife	10
i. Endangered Species	10
j. Historic Properties	12
k. Hazardous, Toxic, and Radioactive Waste	13
3. PROJECT OBJECTIVES	16
a. Problem Identification	16
b. General Fish and Wildlife Management Goals	17
c. Project Goals, Objectives, and Potential Enhancement Features	18
d. Criteria for Potential Enhancement Features	19
4. POTENTIAL PROJECT FEATURES	21
a. Moist Soil Unit (MSU) Enhancement	21
b. Field 6 Sand Prairie Planting	22
c. Fish Nursery	22

CONTENTS (Cont'd)

Subject	Page
d. Potential Deep-Water Fisheries Enhancements.....	23
e. Mast Tree Planting	24
f. Green Tree Reservoir.....	24
g. Refuge Protection through Levee Restoration	25
h. Leave Levee Breached	25
i. Cross Dike	25
j. Yankee Chute Gatewell	26
 5. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES	 27
a. Environmental Output Evaluation	27
b. Feasible Project Features	28
c. Cost Estimates for Habitat Improvement Measures	33
d. Formulation and Evaluation of Alternative Plans	34
e. Summary	38
 6. RECOMMENDED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE CONSIDERATIONS	 40
a. General Description.....	40
b. Recommended Plan.....	40
c. Project Feature Summary.....	48
d. Construction Considerations.....	52
e. Operational Considerations.....	52
f. Maintenance Considerations.....	52
 7. SCHEDULE FOR DESIGN AND CONSTRUCTION	55
 8. COST ESTIMATES	56
 9. ENVIRONMENTAL EFFECTS	62
a. Summary of Effects.....	62
b. Economic and Social Impacts	62
c. Natural Resources Impacts.....	63
d. Historic Properties.....	68
e. Human Use	69
f. Cumulative Impacts	70
g. Adverse Impacts Which Cannot Be Avoided.....	70
h. Short-Term Versus Long-Term Productivity	73
i. Irreversible or Irretrievable Resource Commitments.....	73
j. Relationship of the Proposed Project to Land-Use Plans	74
k. Compliance with Environmental Quality Statutes	74
 10. PROJECT PERFORMANCE ASSESSMENT MONITORING	77

CONTENTS (Cont'd)

Subject	Page
11. REAL ESTATE REQUIREMENTS	84
12. IMPLEMENTATION RESPONSIBILITIES AND VIEWS	85
a. Corps of Engineers.....	85
b. U.S. Fish and Wildlife Service.....	85
c. Iowa Department of Natural Resources	85
13. COORDINATION, PUBLIC VIEWS, AND COMMENTS	86
a. Coordination Meetings	86
b. Coordination by Correspondence.....	87
14. CONCLUSIONS.....	91
15. RECOMMENDATIONS.....	92
16. FINDING OF NO SIGNIFICANT IMPACT	93
LITERATURE CITED	95

Tables

No.	Title	Page
3-1	Project Goals, Objectives, and Potential Enhancement Features	19
3-2	Potential Enhancement Features Development Criteria	20
5-1	Environmental Output and Costs of Each Feature	34
5-2	Moist Soil Unit Enhancement: Best Buy Combinations.....	36
5-3	Fisheries Deep-Water/Access Enhancement: Best Buy Combinations.....	38
6-1	Lake Odessa Project Feature Summary Table	48
6-2	Probable Construction Sequence	54
7-1	Project Implementation Schedule	55
8-1	Project Cost Summary	56
8-2	Detailed Project Cost Summary	57
8-3	Estimated Annual Operation and Maintenance Costs.....	61
8-4	Estimated Post-Construction Annual Monitoring Costs.....	61
9-1	Archeological Site Status as Documented by Phase II Testing	71
9-2	Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements	76
10-1	Monitoring and Performance Evaluation Matrix	78
10-2	Resource Monitoring and Data Collection Summary	79
10-3	Sedimentation Transect Project Objectives Evaluation	82
10-4	Post-Construction Evaluation Plan	83

CONTENTS (Cont'd)

Figures

No.	Title	Page
ES-1	Lake Odessa Project Location Map	ES-4
2-1	UMR, Pool Land Cover/Land Use.....	15
5-1	MSU Best Buy Plans	37
5-2	Fisheries Best Buy Plans	38
9-1	Potential Lake Odessa EMP Project Features	75

Plates

1	Location Plan, Index, and Vicinity Map	35	Muscatine Slough Water Control Structure
2	Orthophoto of Existing Features	36	Access Road Water Crossing for Dedicated Water Bay
3	Recommended Plan Upper End	37	Fox Pond Water Control Structure
4	Recommended Plan Lower End	38	Iowa DNR Moist Soil Unit Water Control Structure
5	Alternatives Evaluated Upper End	39	Portable Pumps and Pump Pads
6	Alternatives Evaluated Lower End	40	Fox Pond Pump Station Plan and Detail
7	Alternatives Not Evaluated Upper End	41	Mast Tree Planting Details
8	Alternatives Not Evaluated Lower End	42	Boring Locations Upper End
9	Perimeter Levee Plan	43	Boring Locations Lower End
10-30	Plan & Profiles	44-53	Boring Logs I-X
31	Typical Sections I	54	Pre-Construction Monitoring Plan
32	Typical Sections II	55	Future Monitoring Plan
33	Proposed Dedicated Water Bay		
34	Fish Nursery Stoplog Structures		

Appendices

A	Correspondence
B	Clean Water Act, Section 404(b)(1) Evaluation
C	Draft Memorandum of Agreement/Final Programmatic Agreement for Historic Properties
D	Habitat Evaluation and Quantification and Incremental Cost Analysis
E	Hazardous, Toxic, and Radioactive Waste Documentation Report
F	Water Quality
G	Geotechnical Considerations
H	Sedimentation
I	Hydrology and Hydraulics
J	Cost Estimate
K	Structural Analysis
L	Real Estate Plan
M	Distribution List

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1. INTRODUCTION

a. Purpose. The purpose of this report is to present a detailed proposal for the rehabilitation and enhancement of the Lake Odessa project area. This report provides planning, engineering, and sufficient construction details of the recommended plan to allow final design and construction to proceed subsequent to approval of this document.

b. Resource Problems and Opportunities. The northern portion of the Lake Odessa complex is part of the U.S. Fish and Wildlife Service (USFWS) Mark Twain National Wildlife Refuge Complex, Port Louisa National Wildlife Refuge, Louisa Division. The Iowa Department of Natural Resources (IDNR) through a cooperative agreement with the USFWS manages the southern portion of the area, the Odessa Wildlife Management Area. The project area is comprised of a large lake (Lake Odessa), several other backwater bodies of water, wooded land, and open fields.

Lake Odessa is highly susceptible to seepage, making it difficult to maintain wetlands that waterfowl populate. In addition, Lake Odessa has decreased in depth over the years, which is detrimental to overwintering fish. During multiple flood events, Lake Odessa's perimeter levee has been breached, causing severe damage to the habitat features of the refuge.

Significant opportunities are available for preserving, enhancing, and developing habitat for migratory birds, fish, and endangered species by enhancing and developing wetlands, planting mast trees, and creating deep holes/channels in the lake and backwater areas.

c. Project Selection. The USFWS nominated the Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) for inclusion in the Rock Island District's Environmental Management Program (EMP). The Fish and Wildlife Interagency Committee (FWIC) then ranked the project habitat benefits based on critical habitat needs along the Mississippi and Illinois Rivers. After considering resource needs and deficiencies pool by pool, the Lake Odessa HREP was recommended and supported by the FWIC and the River Resources Coordinating Team (RRCT) as providing significant aquatic, wetland, and terrestrial benefits with opportunities for habitat enhancement. Enhanced capability to manage the project area for migratory birds, fish, and wildlife use only would be achieved by implementing the proposed project enhancement features. Development of this report was actively coordinated with the project sponsors—the USFWS and the Iowa Department of Natural Resources. Coordination occurred during on-site visits to the project area, team meetings, and phone conversations (see Appendix A).

d. Scope of Study. The 6,788-acre Lake Odessa project area is located in Louisa County, Iowa, between River Miles (RM) 434.5 and 441.5 and is approximately 15 miles south of Muscatine, Iowa, in Pools 17 and 18. All project lands are in Federal ownership. Plate 1 provides vicinity and general location maps for Lake Odessa.

The study focuses on proposed project features that would improve aquatic, wetland, and terrestrial habitat and enhance overall resource values. The project is consistent with agency management goals and was planned for the benefit of resident and migratory birds and fish and other wildlife.

Field surveys, aerial photography, and habitat quantification procedures were completed to support the planning and assessment of proposed project alternatives. Hydrographic soundings were performed in developing sedimentation rates and estimating excavation quantities. Soil borings were taken to determine soil types and construction difficulty. Soil tests were performed to determine the characteristics of the material to be worked with. Baseline water quality monitoring was performed to define present water quality conditions/problems.

The USFWS and the IDNR have made wildlife and resident fish observations within the study area. These observations, along with future studies and monitoring, will assist in evaluating project performance.

e. Format of Report. The report is organized to follow a general problem-solving format. The purpose, problems, and project selection process are presented in Section 1. Section 2 establishes the baseline for existing resources. Section 3 provides the goals and objectives of the project. Sections 4 and 5 propose and evaluate project alternatives. Section 6 describes the recommended plan and lists general design and construction considerations. Section 7 describes the schedule for design and construction. Section 8 contains cost estimates for initial construction and annual operation and maintenance. Section 9 assesses the environmental effects of the recommended plan. Section 10 details the performance evaluation and monitoring plans. Section 11 describes real estate requirements. Sections 12 and 13 summarize implementation requirements and coordination. Sections 14 and 15 present the conclusions and recommendations. Section 16 contains a Finding of No Significant Impact statement. Drawings (plates) and appendices have been furnished to provide sufficient detail to allow review of the existing features and the recommended plan.

f. Authority. The Upper Mississippi River System - Environmental Management Program (UMRS-EMP) is currently a Federal-State partnership to (a) plan, construct, and evaluate measures for fish and wildlife habitat improvement through Habitat Rehabilitation and Enhancement Projects (HREP) and (b) monitor the natural resources of the river system through the Long Term Resource Monitoring Program (LTRMP). The Water Resources Development Act (WRDA) of 1986 (P.L. 99-662) states: "To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. Congress further recognizes that the system provides a diversity of opportunities and experiences. The system shall be administered and regulated in recognition of its several purposes" (Section 1103). The Environmental Management Program was originally comprised of five elements: HREP; LTRMP; Recreation Projects; Economic Impacts of Recreation; and Navigation Monitoring. Currently, EMP is only comprised of two elements—HREP and LTRMP. The other EMP elements either have been successfully completed or are now carried out under other authorities.

The original authorizing legislation has been amended three times since its enactment. The 1990 WRDA, Section 405, extended the original EMP authorization an additional 5 years to FY 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 habitat projects program and the long-term resource-monitoring program. WRDA 1992 also assigned sole responsibility for operation and maintenance of habitat projects to the agency that manages the lands on which the project is located. The 1999 WRDA, Section 509, reauthorized EMP as a continuing authority with Reports to Congress every 6 years and changed the cost sharing percentage from 25% to 35%. The Lake Odessa HREP has no cost-sharing requirement because all project features are located on federally owned land managed by the USFWS as a national wildlife refuge.

2. ASSESSMENT OF EXISTING RESOURCES

a. Resource History and Description of Existing Features (See Plate 1). The Lake Odessa complex is Corps of Engineers fee title land that is managed jointly by the USFWS and the IDNR. The entire complex is located in Louisa County, Iowa. The USFWS lands, known as the Louisa Division, are located in the northern portion of the complex and are part of the Mark Twain National Wildlife Refuge Complex, Port Louisa National Wildlife Refuge. This 2,609-acre area stretches from RM 438 to 441. The 48-acre Port Louisa Refuge headquarters area, located on the bluff, is the only USFWS fee title property. The IDNR lands, in the southern portion of the complex, comprise the 4,179-acre Odessa Wildlife Management Area, from RM 434 to 438. The total IDNR acreage contains 3,828 acres of Federal land under license and 351 acres of State-owned land. Both areas are protected by a levee system along the Mississippi River to the east and the Iowa River to the south. The total acreage for the complex is 6,788 acres. The Lake Odessa complex boundaries and vegetative cover types are shown on Figure 2-1 (page 15).

The Mississippi River corridor, also known as the Mississippi River Flyway, has historically been, and still is, the prime corridor for migratory waterfowl, neotropical migratory birds, and many other avian species. These birds utilize the flyway to migrate from breeding areas located in the northern United States and Canada and wintering areas in southern North America, Central America, and South America. The floodplain corridor, with its network of wetlands, bottomland forest, and grasslands, also provided habitat for a great variety of fish and wildlife species.

The Lake Odessa complex was formerly a part of the Muscatine-Louisa County Joint Drainage and Levee District Number 13. Construction of the levees originally began in 1913 for flood protection of agricultural land. Pumping plants were built in 1914 and 1920 to better drain the area inside the levee for farming. Because of seepage from the river through the levee and periodic flood events, pumping was necessary to allow farming of the area. Prior to completion of Lock and Dam 17, approximately 26% of the area was cultivated, though general crop production was poor. By 1937, control of water levels became too costly and all pumping operations ceased. Farming was reduced to a minimum, even 2 years before Lock and Dam 17 was placed in operation in 1939. Most of the Mississippi River floodplain was also leveed, drained, and farmed by that time. This cumulative change in land use, over time, influenced by agriculture, urbanization, flood control, and navigation, has led to a decline in both the quality and quantity of fish and wildlife habitat in the floodplain.

The Corps' involvement began in the late 1930's when the Odessa Bottoms were purchased in preparation for construction of the lock and dam system and the 9-foot navigation channel. In 1945, much of the land purchased by the Corps, but not needed for navigation purposes, was transferred to the USFWS for management. By the late 1940's, several of the Corps' General Plan units, managed by the USFWS, had been designated as individual National Wildlife Refuges, including the Louisa Refuge. The Mark Twain Refuge Complex, and the individual refuges within it, was officially established in 1958. The Lake Odessa area has been managed primarily in the interest of the national migratory bird management program.

The USFWS then partnered with the Iowa Conservation Commission (ICC) in 1946 to transfer management of a portion of the Louisa Refuge lands to the State for wildlife management through a Cooperative Agreement. In 1947, the State purchased the land at the present Schafer Access and later purchased more land at the present Snively Access. In 1954, the ICC installed the first inlet and outlet structures at the Lake Odessa complex. This gave the ICC the ability to regulate Lake Odessa's water level, primarily for waterfowl management. This water level management continues to be a joint venture with the USFWS.

In addition to the inlet and outlet structures and perimeter levee, interior features currently present in the Lake Odessa complex are numerous. On the USFWS-managed lands, Field 4 & 5, moist soil unit (MSU) 20, MSU 21, and Unit 2 are currently managed primarily for migrating waterfowl. Each of these areas has a low berm, a water control structure (stoplog), and water supply ditches. The current MSU water supply system, originating at the inlet structure, allows water entering the complex to flow into either the main lake or the water supply ditch, but not both. Portable pumps can be brought in to assist filling the MSUs in the fall. In addition, a pump at Fox Pond can be used to drain the area to promote wetland plant growth. The IDNR also has an MSU, although it can only be partially filled because of a sand lens or seam in the unit. In the past, access to Swarms and Bebee Ponds and Yankee Chute has been deepened. Siltation has reduced the depths of these ditches, stranding fish and reducing management options.

b. Water Resources and Flooding History. Lock and Dam 17 is located at RM 437.1 where it ties into Lake Odessa's perimeter levee. The normal water level upstream of the dam is 535.87 MSL, which corresponds to a flat pool stage of 9.3 feet. Water levels downstream of the dam are highly variable and range from a stage of 1.68 feet (1988) to 25.90 feet (1993). Flood stage is 14.0 feet.

Historically, the Lake Odessa complex was a braided side channel of the Mississippi River. The main lake was a flowing chute with smaller chutes throughout the area with interconnected backwater areas. The area was flooded during high water periods, primarily in the spring. During low water periods, usually in the summer, the water drained slowly from the area. This seasonal flooding and subsequent drying in the unrestricted floodplain created a diverse ecosystem.

The Lake Odessa complex has a long history of flooding, even after construction of the current levee system. The levee was breached in 1947, 1951, 1952, 1965, 1969, 1973, 1990, 1993, and 2001. The Corps, USFWS, and the IDNR have all participated in levee repairs. Some portions of the levee have been improved during repair operations, but other sections have never been improved, only maintained. This has resulted in a levee with numerous low spots and improper slopes.

The Flood of 1993, the worst for the complex, caused major impacts to the Lake Odessa complex. The levee was breached in two places, the inlet and outlet structures were rendered inoperable, large amounts of sediment were deposited inside the levee, and the entire area was flooded for 5 months, essentially the whole growing season. This prolonged flooding greatly impacted the seasonal vegetation and had long-term impacts on the bottomland hardwood forest. Tree mortality was increased, impacting mast-bearing trees such as oaks and pecans, while favoring more flood-tolerant species such as silver maple. The USFWS and IDNR, with assistance from the Corps and the NRCS, replaced the inlet and outlet structures and repaired damage to interior features.

The Flood of 2001 also caused major impacts to the Lake Odessa complex. In order to minimize the head differential between the river and the complex interior, water levels were raised inside the area to compensate for rising river levels. However, the inlet and outlet structures did not allow the interior of the complex to fill with water as fast as the rising river levels. The levee breached or was overtopped in seven places. On the USFWS managed land, approximately 1,800 feet of levee were lost, 2,000 feet of service roads and auto tour routes were damaged, 3 parking lots were scoured out, over 1,500 feet of ditches were filled in, and 2 inches to over 4 feet of sediment was deposited into the refuge wetland units. Wind-driven waves damaged the entire length of the Michael Creek and Mississippi River levees. Water control structures were damaged and the main pumping station and pump were disabled. The IDNR managed lands also suffered damage. Two

levee breaks occurred on the Mississippi River levee; 150 feet long near Beebe Pond and 177 feet long at the outlet works. The levee separating the Odessa complex from the Iowa River broke in two places—a 332-foot-long break near the Toolesboro access road (with 8-foot-deep scour hole) and a 228-foot-long break between the base of the bluff and the Toolesboro sub-impoundment (IDNR MSU) (with a 10- to 15-foot-deep scour hole). In addition, several hundred feet of levee along the Mississippi River and a short area along the Iowa River were damaged by erosion.

c. Land Use and Current Area Management Objectives. The Lake Odessa complex is probably best known for migratory waterfowl concentrations. Odessa's mixture of large shallow lakes, isolated ponds, marsh, and forest attract many fish and wildlife species. The abundance of wildlife makes the complex one of southeast Iowa's most popular destinations for outdoors enthusiasts. The current management and future goals of the USFWS and IDNR are similar, with some minor differences.

The USFWS has a main management strategy of managing for migratory birds with a secondary focus on wading birds, shorebirds, and other wetland-dependent wildlife species. With waterfowl as the main focus, the area is kept as open and treeless as possible with adequate feeding and resting areas for the birds. This succession setback is accomplished through farming (up to 330 acres), burning (1,042 acres), mechanical treatment, and water level management (800 acres). While Lake Odessa currently has a strong waterfowl population and migratory bird use, a future goal for the USFWS is to make the refuge water level management more reliable. Their objective is to accomplish this by creating a constant and reliable water source for existing MSUs, and a capability to shallowly flood a larger area with less labor-intensive maintenance. This portion of the complex is closed to all public access during the fall migration period, from mid-September to February 1st, thereby providing a valuable and protected resting and feeding area for migratory waterfowl.

The IDNR has similar management strategies, with the main emphasis on water level management of the entire complex. With water level management, the main objective is waterfowl management, but the total management strategy encompasses entire assemblages of species and the habitat complexes upon which they depend. For example, water level management at Lake Odessa benefits waterfowl, as well as wading birds, shorebirds, snakes, fish, etc. It is also aimed at maintaining a diverse bottomland forest, which is critical to a whole array of both migratory and resident songbirds and raptors. To enhance the current conditions, IDNR objectives are to create more reliable resting and feeding areas for migratory birds, improve the bottomland hardwood population through increased tree species diversity, create more deep-water fish habitat, and protect the refuge features by strengthening the main levee system.

Because the entire Lake Odessa complex is hydraulically connected, the USFWS and the IDNR work together to manipulate water levels within the levee. Water level management is accomplished by gravity flow through the inlet and outlet structures. River conditions permitting, the following illustrates the water level management goals for the main lake. Gage readings are taken at Schafer's Landing.

December 1 to April 1 – maintain at 534.5 MSL
April 1 to July 15 – slow drawdown to 532.5 MSL
July 15 to August 15 – maintain at 532.5 MSL
August 15 to September 15 – raise to 534.0 MSL
September 15 to October 15 – raise to 535.0 MSL
October 15 to November 1 – raise to 535.5 MSL
November 1 to December 1 – raise to 536.0 MSL

The current configuration of the inlet structure allows water to be directed either to the main lake or to the USFWS MSUs (4 & 5, 20, 21) supply ditches via a stoplog structure, but not both. During low-water years, water control reliability is lost, mainly at the expense of the MSUs. In addition, seepage through the perimeter levee, flooding, and levee breaches all contribute to make water level control more difficult.

Management techniques for MSUs can be passive or active. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires a dewatering (or drawdown) in the spring or early summer as an initial step. Gravity flow is the most common and most cost-effective method. The timing and rate of drawdown influence the plant germination and thus the usage by waterfowl and other wetland wildlife. MSUs are flooded gradually beginning in September, maximum water depths are maintained through early November, and slow drawdown begins after spring flooding. The current management scheme for the USFWS MSUs is as follows:

- Unit 2 – flood in spring, for migratory waterfowl and shorebirds
- Field 4 & 5 – flood in fall, but water availability limits depth (only 10 acres flood reliably)
- MSU 20 – flood in fall, but water availability limits depth
- MSU 21 – flood 25% of area in fall, but water availability limits depth
- Fox Pond – summer drawdown followed by fall flooding, pumping capabilities limit the area of drawdown and fall flooding

Pumps can be utilized at the MSUs and at Fox Pond to augment the gravity flow system or to dewater a unit, but are not always available.

The area designated at the fish nursery (plate 3) is an existing refuge wetland that is primarily managed for migratory birds; however, the existing water control structure is inoperable. Therefore, water control of this area is tied directly to water levels in the main lake.

In addition, the USFWS also has up to 330 acres in crop production to provide supplemental high-energy food sources to waterfowl and as a method of reducing tree invasion. Typical crops are corn, winter wheat, milo, buckwheat, and Japanese millet. Beginning in the 1970's, the number of acres under cultivation has been slowly reduced, with an increased emphasis on wetlands and MSUs to provide a healthy, diverse food source for migratory waterfowl and other wildlife. In 1980, over 1,000 acres were still cultivated. A further reduction in cultivation, but still higher than present, can be seen in Figure 2-1 (page 15), which shows Fields 4 & 5, 6, and 21, and Unit 2, as well as other areas, as agricultural fields. In 1985, a small, 25-acre sand prairie was established on the highest ridge of the refuge (portion of Field 6). Even though the 1993 flood heavily impacted this site, some warm season grasses and forbs survive. Prescribed burning of the unit helps maintain vegetation diversity.

The IDNR MSU (Toolesboro sub-impoundment) has water pumped into the unit during the fall but is otherwise left alone during the spring and summer. Because of seepage, the water level within the unit responds to interior lake levels to some degree. The unit can dry completely in the late summer. A suspected sand seam in the unit only allows one-third of the area to be flooded before the water escapes through seepage at a faster rate than pumping can maintain desired water levels.

The Corps' long-term forest management goal is to "manage project lands to provide a continuing public benefit from natural resources by perpetuating a diversity of ecological communities that are suitable for a variety of public purposes". The primary focus has been on restoration and

conservation of floodplain forests. Through participation in EMP projects, such as Lake Odessa, the Corps foresters have played an active role in regenerating mast-producing trees on higher sites in the floodplain. At Louisa Division, the Corps planted 5 acres of trees at the northern end of MSU 21 in 2001.

The Corps continues a forest management program on the IDNR-managed lands as well. Forest resources have been inventoried, and a thinning cut was recently completed in 2002 to enhance pin oak acorn production and pin oak tree regeneration. Additional timber stand improvement projects were finished to release sapling pin oaks from the heavy shade of overstory cottonwood and silver maple. Since the Flood of 1993, almost all mature oaks, hickories, sycamores, and hackberries have died and pecans have begun to decline. Regeneration is now dominated by silver maple.

In addition, the IDNR maintains some small fields, approximately 69 acres, in the southern portion of the complex. Crops of corn, grain sorghum, winter wheat, and legumes are rotated to provide a diversity of feeding options to deer, turkeys, quail, and songbirds. Waterfowl hunting is allowed on the IDNR-managed lands.

d. Aquatic Resources. The availability of overwintering habitat is critical to the survival of many species of fish, such as largemouth bass and bluegill. Those fish with low energy reserves in the spring will be less likely to have healthy and successful spawn, maturation of their eggs, and emergence of fry. Suitable overwintering habitat provides deeper, well-oxygenated water with little or no current velocity, ensures sufficient depth to prevent ice cover from blocking fish egress, and promotes dissolved oxygen ingress. These conditions are limited in the Lake Odessa complex. During the winter months, the current maximum water depth in the complex is at or about 6 feet, primarily in the main lake. Approximately 25% of the main lake is currently 5 to 6 feet deep, with less than 0.5% deeper than 6 feet. As late as 1952, the maximum depth was thought to be 15 feet, with an average depth of 4 feet.

Because the Lake Odessa complex was once connected to the main river, water flowed through the system more regularly, utilizing many different routes, and with higher velocities than current conditions allow. Construction of the main levee also isolated some former side channels from the river, such as Yankee Chute. Access channels to isolated waters, such as Bebee and Swarms Ponds, have lost depth over time due to siltation. This lack of free exchange of water and access at times led to reduced dissolved oxygen and fish kills.

e. Water Quality. Sedimentation in the Lake Odessa backwater complex has resulted in a preponderance of shallow water habitat that has negatively impacted water quality. The lake is highly susceptible to resuspension of bottom sediments from wind- and boat-induced waves. Circulation of oxygenated water has decreased in portions of the complex that have become isolated from the main flow path due to sedimentation. This is particularly true for Yankee Chute, where winter fish kills have been reported. No formal records have been kept; however, anecdotal evidence suggests that minor fish kills, notably for bluegills, occur almost every winter. Larger kills of several hundred fish occur every 3-4 years.

Baseline water quality monitoring was performed between 1990 and 1998 at four sites within the Lake Odessa complex (See Plate 54 for locations). Occasionally, dissolved oxygen concentrations below the state standard, and pH values above the state standard were measured. Most dissolved oxygen measurements less than 5 mg/l were observed during the summer months. Fewer low dissolved oxygen concentrations were observed during the winter months; however, winter fish kills reported prior to the initiation of baseline monitoring were presumably due to low dissolved oxygen concentrations. All pH values greater than 9 were most likely due to plant photosynthetic

activity. A detailed analysis of baseline water quality monitoring results can be found in Appendix F.

f. Sedimentation. The Lake Odessa Wildlife Refuge has experienced continual sedimentation from the time Lock and Dam 17 went into operation in 1939. Before this, the refuge area was in a braided portion of the Mississippi River side channel. The islands in the braided channel consisted of sand bar deposits that exist in the refuge today. Much of the coarse-grained sediment was stopped from entering the refuge by the construction of a perimeter levee and inlet and outlet structures. Heavy deposition can still occur during periodic flood events that overtop the perimeter levee. Barring levee breaching, typical sedimentation rates are from 1-3 centimeters per year. The rate of sediment accumulation entering Lake Odessa from the Mississippi River was estimated using the findings of the *Upper Mississippi River and Illinois Waterway Cumulative Effects Study*, which examined sedimentation rates in many backwater locations of the Upper Mississippi River.

g. Vegetation. Non-forested wetlands and bottomland hardwood forest are the two main vegetation types found at the Lake Odessa complex. Figure 2-1 uses 2000 data to show the various vegetative cover types and acreages within the project boundary. These cover types can be grouped into three broad categories: nonforested wetland (~1,700 acres), bottomland hardwood forest (~2,900 acres), and open water (~1,800 acres). The remaining 388 acres of the 6,788-acre project area are comprised of uplands, developed areas, or cultivated lands. All lands within the leveed area of the Lake Odessa complex, with the exception of the bluff area, are considered wetlands. Most of the agricultural lands shown on this figure have been allowed to return to native vegetation (non-forested wetland). Most of the non-forested wetlands are found on the USFWS-managed lands, many within the actively managed MSUs. Common wetland plants include smartweeds, sedges, rushes, cattails, bulrushes, millet, arrowhead, beggar ticks, and burreed. Migrating waterfowl find this combination of water and natural seed an irresistible place to feed and rest. Selected areas have also been planted to native grass and mixtures of alfalfa, clover, and grasses in order to provide nesting habitat for waterfowl and other resident wildlife. These areas of dense cover also provide valuable shelter for resident wildlife during the winter months.

The majority of the bottomland hardwood forest is located on the IDNR-managed lands. This area displays typical silver maple association forest cover. Silver maple is the dominant species, which produces an edible seed in the spring but does not provide any hard or soft mast for wildlife consumption in the summer or fall months. Due to the agricultural clearing and changed hydrologic conditions, mast-producing tree species such as oak, hickory, pecan, and walnut have declined in the Rock Island District portion of the Upper Mississippi River. Mature, hard mast-producing species such as oak or pecan are present on the Lake Odessa complex. Soft mast-producing species such as hackberry, sugarberry, and sycamore have had their numbers severely reduced by mortality resulting from severe flooding in 1993. Young, vigorous stands of mast trees are not common and, as such, river biologists and foresters are concerned about the future availability of mast as a winter food source for wildlife in the floodplain forests in the region.

Few actively cultivated agricultural fields remain at the complex. Over time, there has been a shift away from agricultural row crops as the primary wildlife food source to more reliance on naturally occurring plants. MSUs can be manipulated to enhance species diversity to provide a healthy, diverse diet for waterfowl. Row crops are still planted, but at a reduced level, as a supplementary, high-energy food source. Ducks and geese use these fields during the prime migration times. Squirrels and deer utilize this food throughout the winter. In many years, the crop fields are not planted due to spring floodwaters. In these years, invasive plant species dominate the site.

Wildlife value derived at these sites during those years is variable, dependent on the plant species present.

h. Fish and Wildlife. Lake Odessa supports a diverse fishery in its complex of ponds, backwater sloughs, and in the main lake. The primary species are crappie, largemouth bass, bowfin, bluegills, carp, buffalo, and gizzard shad. The fish populations are relatively stable; however, this stability is disrupted by periodic flood events. In addition, fish kills have been documented in more isolated water bodies because of low dissolved oxygen concentrations.

Many different bird species use the Lake Odessa complex for all or part of their life cycle. The most common migratory waterfowl species are mallard, pintail, wigeon, blue-and green-winged teal, gadwall, black ducks, and Canada and snow geese. Common migrants include bald eagles, ospreys, and white pelicans. The Lake Odessa complex contains a mosaic of forest and shallow sloughs, and, in addition, has several actively managed moist soil units. In the sloughs, wood ducks forage for duckweed and invertebrates during the migration and brooding periods of the year. Prothonotary warblers, pileated woodpeckers, wood ducks, hooded mergansers, and red-shouldered hawks are known to nest in the area. Herons, egrets, rails, bitterns, and a wide variety of other shore and wading birds are commonly seen feeding in the complex wetlands during the summer. Less commonly observed bird species include wild turkeys, ring neck pheasants, and bobwhite quail.

Common wildlife species include white-tailed deer, small-mouthed salamanders, and yellow-bellied water snakes. Other wildlife species using the complex include raccoons, deer, frogs, muskrat, beaver, opossum, red fox, and coyote.

i. Endangered Species. The following is a list of federally threatened and endangered species potentially found in Louisa County, Iowa:

Status	Common Name	Scientific Name
E	Higgins' Eye Pearly Mussel	<i>Lampsilis higginsii</i>
E	Indiana Bat	<i>Myotis sodalis</i>
T	Bald Eagle	<i>Haliaeetus leucocephalus</i>
C	Eastern Massasauga Rattlesnake	<i>Sistrurus catenatus catenatus</i>

T = threatened
E = endangered
C = candidate

Higgins' eye pearly mussels usually inhabit coarse gravel, cobble substrate. Because of the dominance of sand and silty materials in the project area, these species are not likely to occur within the leveed area. Mussel beds are known to occur in the main channel of the Mississippi River in proximity to the Lake Odessa area. Dredging in Turkey Chute, as a source of material for the levee restoration, has been coordinated with the USFWS. No impacts to mussels are anticipated, and no mussel survey would be required prior to dredging in this area.

During the summer, Indiana bats frequent the corridors of streams with well-developed riparian woods, as well as mature upland forests in this part of Iowa and Illinois. They forage for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation, along the borders of croplands, along wooded fencerows, and over farm ponds and pastures. During the summer, the bats roost, rear their young beneath the loose bark of large dead or dying trees, and prefer standing dead trees with loose bark and enough space

to roost between the bark and the trunk. These roost trees are typically located within 1,600 feet of a stream or river. Indiana bats winter in caves or mines.

Bald eagles are regularly seen using the Mississippi River corridor area in and around the Lake Odessa complex during migration for resting and feeding, as well as a nesting area. The Lake Odessa complex contains many mature trees that are a key component for eagle habitat, both for roosting and nesting. Two nests in the complex are currently active. Though proposed for de-listing, the bald eagle would still be protected by the Migratory Bird Treaty Act and the Bald Eagle Protection Act.

The eastern massasauga rattlesnake is a candidate for listing under the Endangered Species Act. Massasaugas show a strong affinity for wetlands, but also use upland habitats during part of the year. Structural characteristics of a site are more important than vegetation type. Important components include both sunny and shady areas for thermoregulation, the presence of the water table near the surface for hibernations, and variable elevations between the lowland and upland areas. No known populations of massasaugas remain at Lake Odessa.

The following is a list of Iowa threatened and endangered species potentially found in Louisa County, Iowa. Some of these species may only be found in the rare sand prairie complex located north of the Lake Odessa complex and south of the city of Muscatine, Iowa. Those species most likely to occur in the project area are discussed in more detail below.

Status	Common Name	Scientific Name
E	Bald Eagle	<i>Haliaeetus leucocephalus</i>
E	Red-shouldered Hawk	<i>Buteo lineatus</i>
E	King Rail	<i>Rallus elegans</i>
E	Indiana Bat	<i>Myotis sodalis</i>
E	Higgins' Eye Pearly Mussel	<i>Lampsilis higginsii</i>
T	Butterfly Mussel	<i>Ellipsaria lineolata</i>
T	Squawfoot Mussel	<i>Strophitus undulatus</i>
E	Copperbelly Water Snake	<i>Nerodia erythrogaster neglecta</i>
E	Western Hognose Snake	<i>Heterodon nasicus</i>
T	Diamondback Water Snake	<i>Nerodia rhombifer</i>
E	Yellow Mud Turtle	<i>Kinostemon flavescens</i>
T	Blanding's Turtle	<i>Emydoidea blandingii</i>
T	Ornate Box Turtle	<i>Terrapene ornata</i>
T	Central Newt	<i>Notophthalmus viridescens</i>
T	Grass Pickerel	<i>Esox americanus</i>
T	Orangethroat Darter	<i>Etheostoma spectabile</i>
E	Dwarf Dandelion	<i>Krigia virginica</i>
E	Curved-pod Corydalis	<i>Corydalis curvisiliqua</i>
T	Flax-leaved Aster	<i>Aster linariifolius</i>
T	Slender Dayflower	<i>Commelina erecta</i>
T	Yellow Monkey Flower	<i>Mimulus glabratus</i>
T	Brittle Prickly Pear	<i>Opuntia fragilis</i>

T = threatened
E = endangered

Red-shouldered hawks (*Buteo lineatus*) are listed as a state endangered species in Iowa. This species requires large tracts of mature floodplain or riparian forest for nesting. These birds prefer a mature forest structure, with a well-developed canopy and an open sub-canopy for nesting sites. Forests on the edge of the river valley, adjacent to upland or valley slope forests, have the highest occupancy rate. A nesting pair has been observed at the south end of the complex in recent years.

King rails (*Rallus elegans*) are listed as a state endangered species in Iowa. This migratory species usually arrives in Iowa beginning around mid-May. This species can adapt to a wide variety of wetland habitat types as long as the terrain supports a reasonable amount of vegetation and is frequently wet. Optimal habitat is freshwater marshes with emergent vegetation (sedge, bulrush, or cattail). Muskrats enhance marshes by opening up a network of pathways, providing potential feeding and drinking places. Vegetation growing in tussocks is attractive to nesting rails. Decline of this species in the Midwest has been due to habitat destruction and drainage of wetlands.

The presence of the copperbelly water snake, a state endangered species, was recently confirmed at Lake Odessa. These snakes are frequently seen near the Toolessboro access road along the south end of the complex. Copperbelly habitat generally consists of wetlands and bottomland forests, although they sometimes hibernate in upland areas. They are often seen near shallow wetland edges in woodlands where buttonbush is the preferred vegetation type. This species is listed as a federally threatened species in Michigan, Indiana, and Ohio (northern range). It is not a federally listed species in Illinois and Kentucky (southern range) because of protections provided by a Conservation Agreement with the mining industry. At the time this agreement was established, the Iowa population had not been discovered.

Blanding's turtles, state threatened, are found in shallow and deep marshes, the shallow bays of lakes, slow-moving streams and rivers, and backwater sloughs. They prefer slow-moving, shallow water and a muddy bottom with abundant emergent vegetation, duckweed, and mosses. Open, sandy areas are preferred for nesting sites. If suitable nesting areas are not located, they may nest on the shoulders of roads, or wander a considerable distance from their marsh until a suitable area is found. The presence of this species has been confirmed at the Lake Odessa complex.

The diamondback water snake, a state threatened species, has been confirmed within the Lake Odessa complex. This large water snake is found only in southeastern Iowa near the Mississippi River. It inhabits rivers, sloughs, ponds, backwaters, and oxbows. It does not live in clear gravelly streams, and seems to avoid heavily wooded ponds. They feed on a wide variety of animals associated with water, including fish, amphibians, baby turtles, young snakes, insects, crayfish and small mammals.

The Lake Odessa complex is considered essential habitat for the river otter (*Lutra canadensis*), listed as threatened in Illinois. River otters are quite adaptable, utilizing a variety of habitat types. Although they frequent lakes and ponds, they typically live in marshes and along wooded rivers and streams with sloughs and backwater areas. Otters live in dens in the ground most of the year. Otters rarely dig dens themselves; instead, they utilize dens built by beavers, muskrats, or woodchucks. Brush piles, root areas under large trees, and similar sites are used as temporary homes. The presence of beavers in an area is important to otters, not only because of the dens they build, but also because the ponds created by beaver dams make ideal otter habitat.

j. Historic Properties. The Lake Odessa complex is one of the most archeologically rich areas in the Upper Mississippi River region. The first extensive occupation of the floodplain occurred during the Middle Archaic period. Early and Middle Woodland sites are distributed on almost every landform in the Lake Odessa bottoms. During the Mississippian period, the bottoms were occupied by the Oneota culture, with a principal village site on the bluff top at Toolessboro. The major historic site in the area is Burris City, dating from 1855-1859. This short-lived city, and National-Register-eligible site, was abandoned due to repeated flooding.

In his report on the Phase I cultural resources survey of the Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River Environmental Management Program (EMP), Benn

(1996:Table 2) documents a total of 64 recorded archeological sites from the Lake Odessa area. These sites are recorded in a “three-dimensional landscape context” based upon the Landform Sediment Assemblage (LSA) units from the geomorphological study by Benn and Anderson (1995). Benn (1996:50) states that:

The goal of archeological research to understand past human culture is sometimes lost in the managerial review and compliance process. In this sense, one of the principal goals of an archeological survey project which produces site locational information from the Lake Odessa EMP should be the reconstruction of human settlement patterns.

Benn (1996) approaches this task beginning with an analysis of the landform sediment assemblages to establish the depositional context for historic and prehistoric sites. This is followed by looking at site density data and forming a preliminary picture of the settlement patterns for use in making recommendations for site testing and data recovery.

Benn (1996:56) reports no Paleoindian or Early Archaic sites in the Lake Odessa project area. The first extensive occupation of the floodplain occurred during the Middle Archaic. A significant proportion of both Middle and Late Archaic sites probably remain deeply buried and undiscovered.

Early and Middle Woodland sites are generally on landforms close to the bluff line while Late Woodland sites show an abrupt change in settlement with sites distributed on almost every landform in the Lake Odessa bottoms (Benn 1996:56-60).

During the Mississippian period, people of the Oneota culture occupied the Lake Odessa bottoms. These sites all occur in the southern half of the bottoms, and considering that the “principal Oneota village in this area is...on the bluff top at Toolesboro, these small sites in the bottom appear to have functioned as temporary stations for collecting of seasonal resources” (Benn 1996:60).

The Corps obtained the February 2003 report entitled, *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, by David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc., (Benn and Isenberger 2003) in order to update the status of historic properties coordination for this project.

k. Hazardous, Toxic, and Radioactive Waste. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with ASTM Practices E 1527-00 and E 1528-00, ER 1165-2-132, and MVD DIVR 1165-2-9 for the Lake Odessa HREP (see Appendix E). Dense woodland, historical agricultural fields and low-lying backwaters of the Mississippi River characterize the Lake Odessa area.

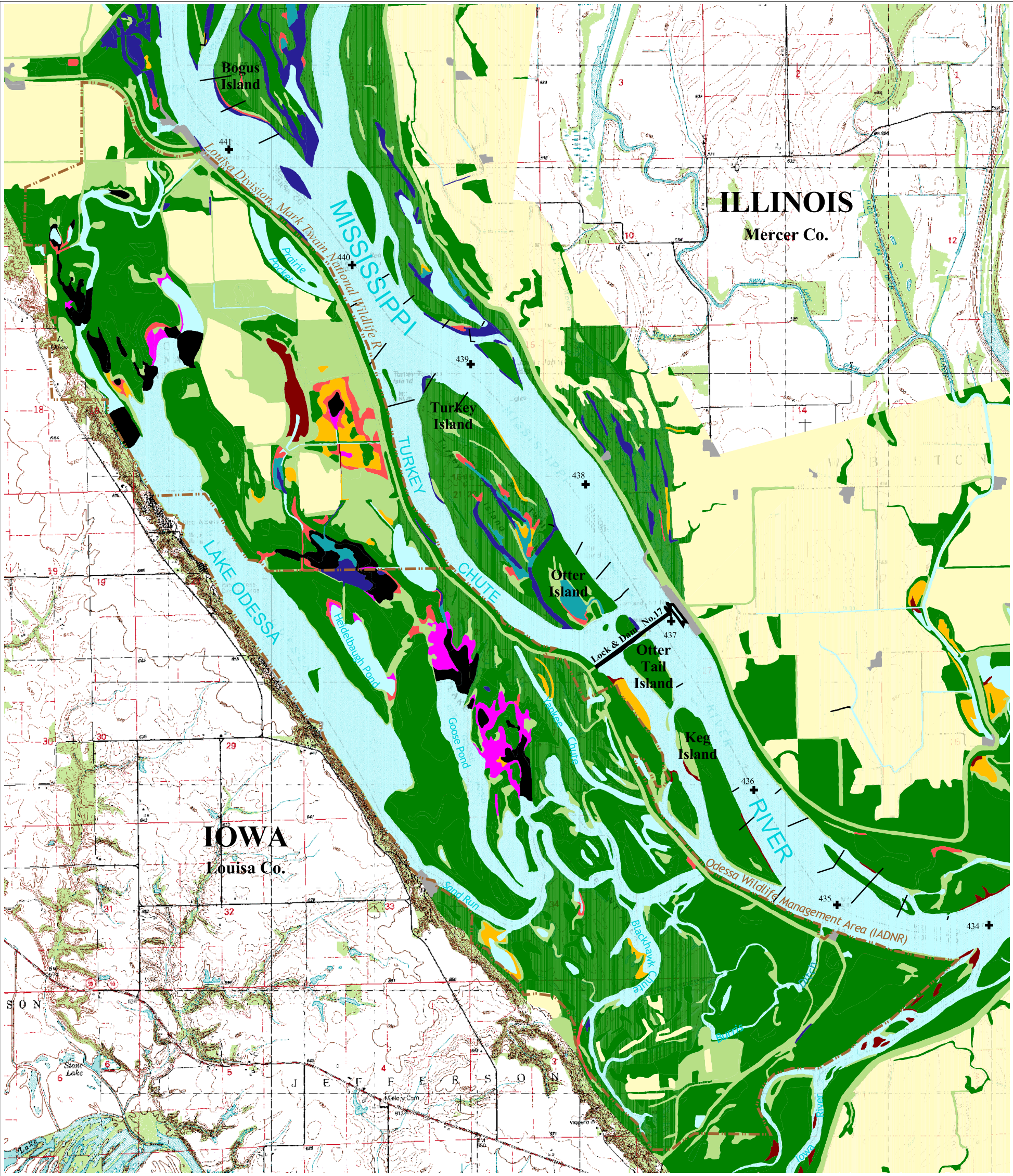
This assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the project features as long as the project features do not include any areas associated with a small weapons firing range. The range is located along the existing perimeter levee in the vicinity of levee station 180+00. Appendix E, Figure 2, identifies the general location of the small weapons firing range.

The recommended project features do not include levee restoration work in the vicinity of the firing range. If the levee enhancement project feature would be changed to include the section of levee that was used as the ammunition trap for the small weapons firing range, then the Lake Odessa HREP would need to devise construction activities and disposal plans for the surface soils

containing spent lead ball residue that are subject to Resource Conservation and Recovery Act (RCRA) statutory authority including sections 7002 and 7003.

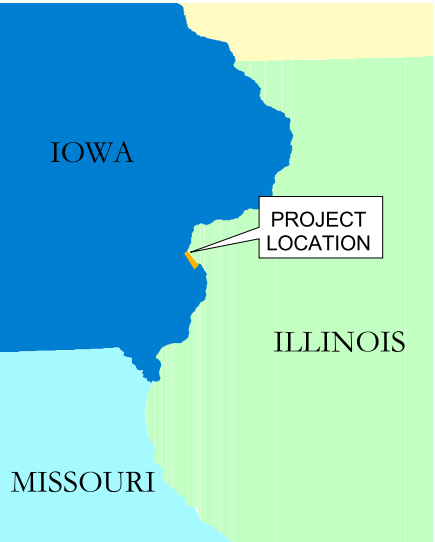
Military Munitions Rule 40 CFR Part 260 (source reference in Appendix E) has assisted with defining when fired munitions are considered solid waste and when they fall under the RCRA requirements. According to US EPA-Region 2, "Lead shot is not considered a hazardous waste subject to RCRA at the time it is discharged from a firearm because it is used for its intended purpose. However, spent lead shot (or bullets) is subject to the broader definition of solid waste written by Congress and contained in the statute itself. Spent shot and bullets are thus potentially subject to RCRA statutory authority including section 7002 and 7003. Construction activities may pose a problem since heavy equipment would likely disturb the surface soils and cause the spent lead shot to migrate and become a hazard to the environment. If these surface soils, that contain lead ball residue, are disturbed then prompt removal of surface soil layers for the levee modification would become necessary under RCRA regulation."

No further HTRW Assessment is recommended at this time.



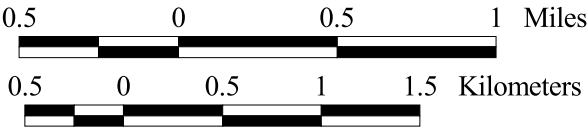
Lake Odessa
UMR Pools 17 and 18

1989 Land Cover

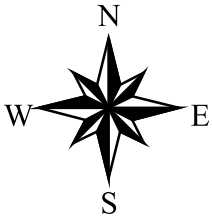


- Open Water
- Submergents
- Submergents and Rooted Floating Aquatics
- Submergents, Rooted Floating Aquatics and Emergents
- Rooted Floating Aquatics
- Rooted Floating Aquatics and Emergents
- Emergents

- Emergents and Grasses/Forbs
- Grasses/Forbs
- Woody Terrestrial
- Sand/Mud
- Agriculture
- Urban/Developed



- River Mile Marker
- Wing Dam
- Refuge/Wildlife Area Boundary



US Army Corps
of Engineers
Rock Island District

3. PROJECT OBJECTIVES

a. Problem Identification. The floodplain habitat at the Lake Odessa Complex has been greatly influenced by man's activities. Increased runoff within the basin has led to higher sediment loads carried by the Mississippi River. Construction of levees and the navigation system has altered the hydrologic regime of the floodplain by prohibiting floodwaters from slowly inundating the floodplain. Breaches of the existing levee have resulted in frequent losses of emergent aquatic vegetation used by migratory waterfowl. Prolonged flooding after levee breaches has increased the mortality of mast-producing trees. Sedimentation from frequent levee breaks and overtopping flood events has increased the extent of shallow water habitat and has reduced the amount of deeper water. Winter fish kills and reduced circulation of well-oxygenated water are being experienced as a result. The existing water control structures and pumps prevent optimal management of the moist soil units because the current configuration does not provide a reliable water supply or water level management capability. Frequent water level fluctuation has led to erosion of significant archeological sites located along the project's banklines. Significant opportunities are available for preserving, enhancing, and developing habitat for migratory birds, fish, and endangered species by enhancing and developing wetlands, planting mast trees, and creating deep holes/channels in the lake and backwater areas.

(1) Inadequate Water Level Management. Water level management is used primarily for waterfowl management, but benefits many other wetland species as well. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires dewatering wetland areas beginning in the spring. The areas are slowly drawn down, with maximum drawdown occurring in mid summer. In the fall months of the year, which is the migratory period for waterfowl, the objective is to shallowly flood the moist soil areas. These areas are gradually flooded beginning in September, with maximum water depths through early November. This flooding, along with vegetation growth, attracts migrating birds for both resting and feeding. The current configuration of the inlet structure allows water to be directed either to the main lake or to the USFWS MSU (4 & 5, 20, and 21) supply ditches, but not both. During low water years, water control reliability is lost, mainly at the expense of the MSUs. During these times, most of the water is directed toward the Main Lake, and not the MSUs. In addition, a limited number of Crisafulli pumps are available when needed to increase the water depths in the MSUs when gravity flow is insufficient or unavailable. This inadequate number of pumps limits the number of MSUs that can be filled and/or limits the desired water depth achieved via pumping from other sources. A suspected sand seam in the IDNR MSU limits flooding to one-third of the area before water escapes, at a rate faster than pumping can maintain. This unit also has no water control structure to facilitate draining the unit. In addition, seepage through the levee, flooding, and levee breaches all contribute to make water level control more difficult.

(2) Loss of Deep Aquatic Habitat. Due to sedimentation over the years, the refuge has experienced significant loss of deep-water habitat. Most of this sedimentation is believed to have come from the various flood events that have occurred over the years. At typical winter water elevations, Lake Odessa still has some deep habitat, with approximately 25% of the main lake 5 to 6 feet deep, but less than 0.5% marginally more than 6 feet deep. The typical sedimentation rate (assuming no levee breaches) is approximately 1 to 2 centimeters per year (see sedimentation considerations in Appendix H). Historical information from the 1950's stated that areas of the main lake had water as deep as 15 feet. In addition, siltation has reduced access to some water bodies, resulting in low concentrations of dissolved oxygen and isolating fish. Fish kills, primarily in the winter months, have been documented because of this isolation and/or lack of sufficient depth. Operation of the inlet and outlet works has been modified to alleviate this problem somewhat in the main lake and channel only.

Studies by the IDNR have illustrated the importance of deep aquatic habitat as overwintering areas for centrarchids. Species in this family include bluegill, largemouth bass, and white and black crappie. General characteristics of suitable overwintering sites include off-channel areas that do not freeze to the bottom and have suitable dissolved oxygen levels, slightly warmer waters (stratification), and protection from currents. Areas providing these types of habitat are presently minimal at the Lake Odessa complex, with depth as the limiting factor in most areas. In addition, Yankee Chute, Goose Pond, and Swarms and Bebee Ponds do not have reliable access to deep water.

(3) Decline of Mast-Producing Trees. Prolonged flooding, such as the Flood of 1993, is responsible for significant losses of bur oak, pin oak, hickory, sycamore, and hackberry. Flooding also indirectly favors more water-tolerant and less valuable species such as silver maple. This gradual change in species composition is detrimental to local wildlife populations, by limiting more appropriate food sources and reducing the number of older trees needed by cavity nesting species. River biologists and foresters are concerned about the future availability of mast as a winter food source for wildlife in the floodplain forests of the region.

(4) Damage of Interior Features Due to Flood Events. Over the years, Lake Odessa has experienced significant flood damage to its interior features. The floods of 1993 and 2001 reduced deep-water habitat due to sediment deposition. This flooding and sedimentation also increase the isolation of other waters inside the complex and reduce fish access to deeper water. Sediments left by flood events can also damage the MSUs, reducing vegetation in the short term and decreasing the depth in the MSUs themselves. Flooding has also damaged infrastructure in the Lake Odessa complex. The Flood of 1993 rendered both inlet and outlet structures inoperable. The Flood of 2001 breached the levee in seven places, washed out roads, isolated the inlet structure, and deposited massive amounts of silt and sediments in MSUs adjoining the levee.

(5) Erosion of Archeological Sites. The Lake Odessa complex is one of the most archeologically rich areas in the Upper Mississippi River region. The first extensive occupation of the floodplain occurred during the Middle Archaic period. Early and Middle Woodland sites are distributed on almost every landform in the Lake Odessa Bottoms. During the Mississippian period, the Bottoms were occupied by the Oneota culture, with a principal village site on the bluff top at Toolesboro. The major historic site in the area is Burris City, dating from 1855-1859. This short-lived village, a site eligible for inclusion in the National Register of Historic Places, was abandoned due to repeated flooding. Historic records and bankline measurements have shown that bankline erosion is a persistent problem at Lake Odessa that has caused the project's lakes and sloughs to widen. The rate of bankline retreat during the 1970s-1990s is 0.7-1.6 feet per year. Historic properties coordination and compliance activities have resulted in a Programmatic Agreement under Section 106 of the National Historic Preservation Act for historic properties preservation emphasizing riprap shoreline protection and site avoidance supplemented by data recovery excavations where avoidance or riprap is not feasible (also see Section 9d). This Programmatic Agreement is found in Appendix A, page A-185.

b. General Fish and Wildlife Management Goals. The Louisa Division, located in the northern portion of the Lake Odessa complex, is part of the Mark Twain National Wildlife Refuge Complex, one of more than 500 National Wildlife Refuges managed by the USFWS. The mission of the National Wildlife Refuge System is to preserve a national network of lands and waters for the conservation of fish, wildlife, and plant resources of the United States for the benefit of present and future generations. The Mark Twain National Wildlife Refuge Complex, Louisa Division, was established specifically for the protection of migratory birds, although refuge lands also provide

important habitat for many other species of resident and migratory wildlife. The Refuge has developed a Draft Comprehensive Conservation Plan to guide future management activities. Draft goals of the plan that relate to the problems described above include:

- Restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, and other wetland-dependent wildlife species.
- Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.
- Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.
- Identify and reduce the impacts of sedimentation and other water quality factors on fish and wildlife resources.

The southern portion of the Lake Odessa complex is the Odessa Wildlife Management Area, managed by the IDNR. The IDNR goals, as outlined in the 2000 Annual Management Report and 2001 Annual Management Plan, that relate to the problems described above are:

- Through water level manipulation, mimic the natural hydrologic cycle as the primary means of floodplain and ecosystem management, and ensure optimum migratory waterfowl habitat.
- Wood ducks, hooded mergansers, mallards, and Canada geese are known to nest in the area, with wood ducks predominating. Production of 2,000 wood duck on the area is desired, aided by forest management and installation of artificial nest boxes.

c. Project Goals, Objectives, and Potential Enhancement Features. Based on the identified problems and the fish and wildlife management goals of the cooperating agencies, the following goals, objectives, and potential enhancement features were considered by the interagency planning team during development of the DPR (Table 3-1).

TABLE 3-1. Project Goals, Objectives, and Potential Enhancement Features

Goals	Objectives	Potential Enhancement Features
Restore and Protect Wetland and Terrestrial Habitat	Reduce forest fragmentation Increase bottomland hardwood diversity Enhance migratory bird habitat Restore sand prairie	Establish hardwood trees on existing agricultural fields and forested areas Enhance MSUs with berm improvements Enhance MSUs water control with dedicated water supply, pumps, and/or control structures Plant native sand prairie species
Restore and Protect Aquatic Habitat	Increase habitat for overwintering fish Provide safe areas for developing fish Protect habitat features Protect archeological sites	Dredge deep holes/channels in main lake and backwater areas Construct fish nursery Restore existing perimeter levee Construct spillway Construct rock wing dam at inlet structure Protect shoreline using riprap

d. Criteria for Potential Enhancement Features. Table 3-2 presents general and specific criteria developed to assess potential enhancement features.

TABLE 3-2. Potential Enhancement Features Development Criteria

<u>Item</u>	<u>Purpose of Criteria</u>
A. General Criteria	
Locate and construct features consistent with EMP directives	Comply with program authorities
Construct features consistent with Federal, state, and local laws	Comply with environmental laws
Develop features that can be monitored (e.g., sedimentation, stability, water quality)	Provide baseline for project effects
Design features to facilitate operation and maintenance	Minimize operation and maintenance costs. Realize logistical difficulties in accessing the sites.
Locate and construct features consistent with best planning and engineering practices	Provide basis for project evaluation and alternative selection
Construct features which meet one or more of the project objectives	Meet project goals and objectives
B. Restore and Protect Wetland and Terrestrial Habitat	
Establish hardwood trees on existing agricultural fields and forested areas	Reduce forest fragmentation and increase species diversity
Locate plantings in existing forested areas	Increase bottomland hardwood species diversity and provide nesting and feeding habitat for wood ducks
Locate forest plantings on higher ground	Maximize tree survival rate and increase species diversity
Enhance MSUs with dedicated water supply, pumps, and control structures	Improve existing habitat suitability for migratory birds and other wetland-dependent species by improving water level control
Restore sand prairie	Increase size and diversity of an existing sand prairie site
C. Restore and Protect Aquatic Habitat	
Dredge deep holes/channels in main lake and backwater areas	Ensure fisheries access to the main lake throughout the year and ensure adequate dissolved oxygen and depths during winter and summer stress months, for centrarchids and associated species
Construct fish nursery	Create protected area for small fish (fry) to develop while reducing mortality from predatory fish
Restore main stem levee	Protect interior features of refuge from flooding by restoring the height and correcting the slope of the perimeter levee
Construct spillway	Limit damage to interior features by constructing a spillway to facilitate a controlled flooding situation in the event the perimeter levee is overtopped and to reduce potential levee failure
Construct rock wing dam at inlet structure	Reduce sedimentation in the inlet channel by placing a rock wing dam between the mouth of Michael Creek and the inlet channel for Lake Odessa
Protect archeological sites by placing riprap on the shoreline	Protect and preserve National Register eligible sites from erosion or wave-induced damage

4. POTENTIAL PROJECT FEATURES

This section describes and assesses a preliminary number of potential enhancement features that will meet the goals described in Section 3. Potential enhancement features were determined based on their contribution to the project goals and objectives, engineering considerations, and local restrictions or constraints. Features that were not considered feasible were not subject to further evaluation. These features are shown on plates 7 and 8, Alternatives Not Evaluated. Section 5 discusses the evaluation of the feasible project alternatives. These features are shown on plates 5 and 6, Alternatives Evaluated. For planning purposes, project life was established as the Corps' standard 50 years for all potential features.

a. Moist Soil Unit (MSU) Enhancement. As previously mentioned, the main management aspect of Lake Odessa is that of water level management. Currently, the sponsors (USFWS and IDNR) lack the control to efficiently manage water levels at certain times of the year. It is proposed that areas be developed to better aid in water level management for enhancement of vegetation growth in the summer months, and flooding for migratory birds in the fall migration season (See Plates 5 and 6). Proposed MSU enhancement is as follows.

(1) Field 4 & 5 (Fields 4 and 5 are one field). A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the area of water coverage would be approximately 83 acres. An additional 12.5 acres can be raised north of this field and mast tree-planting Site A by utilizing a proposed water control structure in the north perimeter berm to move water from Field 4 & 5. The 12.5-acre area was not pursued because management goals changed for this area.

(2) Field 21. Proposed details are similar to Field 4 & 5, except that no new water control structures are proposed. A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the approximate area of water coverage would be 83 acres.

(3) MSU 20. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). The typical depth of 1.5 feet would be obtained by gravity flow and by directing water pumped into Field 21 through an adjoining water control structure. When flooded to 538.5, the approximate area of water coverage would be 72 acres.

Note. A dedicated water bay would be included as an enhancement measure for the Field 4 & 5, Field 21, and MSU 20 features. The dedicated water bay would consist of extending the bay walls of the last downstream bay of the inlet structure with concrete and sheet piling, and excavating a new ditch to connect the bay to an existing ditch to empty water into the fields stated above. This dedicated water supply would allow gravity filling of the MSUs to approximately 536.0 feet MSL.

(4) Unit 2. A portable pump would be provided to augment existing control structures to furnish a consistent flow of water to the field. Existing berms around Unit 2 are assumed to be adequate to impound water up to elevation 538.5 feet MSL. At this elevation, water depths range from 0 to 2.7 feet (typically 1.5 feet). To assist in water level management, a new

water control structure is proposed to augment an existing water control structure under the adjacent road. When flooded to 538.5, the approximate area of water coverage would be 92 acres.

(5) Fox Pond. The Fox Pond option would consist of utilizing the region noted on plate 5. Currently, Fox Pond has a pump station that is dated and under-capacity to obtain desired water levels in the area. It is proposed that a new fixed pump station be constructed that has the capacity to raise water levels from 536.0 to 537.0 feet MSL, with 537.0 being maintained for approximately 2 months. Also at Fox Pond, a water control structure, along with a pump pad for a portable pump, is proposed to drain the area. One of the portable pumps from the above units would be utilized here because Fox Pond pumping would take place in the summer versus the fall for the other MSUs. The approximate area of water coverage would be 336 acres.

(6) Swarms/Bebee Ponds. This option would consist of dredging the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. This action would allow drawdown of these ponds to occur when the main lake is drawn down, thereby increasing the area and diversity of wetland vegetation growth. Conversely, in the fall, when lake levels are raised, this area would be inundated, providing access to food resources for migrating waterfowl. This action also provides fisheries benefits, described in the deep-water fisheries enhancement section that follows.

(7) IDNR MSU. This area has an existing berm that is adequate for the intended water levels in the unit. This unit also is proposed as a placement site for fine sediment dredged from the Blackhawk Chute/Yankee Chute feature which would act as a liner and enable the unit to better hold water. A portable pump, pump pad, and water control structure are proposed for construction to better facilitate water level management. The management plan for the unit is to raise the water level in the unit 4 feet in 14 days and then hold that water elevation for approximately 2.5 months through maintenance pumping. The approximate area of water coverage would be 49 acres.

(8) Sand Field MSU. This feature was proposed for the area noted on plate 7. This area was proposed to have a perimeter levee constructed, a pump installed to supply water to the unit, and an elevated ditch constructed to supply water to the MSU from the river. This feature was eliminated due to its relatively high elevation, cost, and potential seepage problems.

(9) Field Scraping. This feature was proposed for the area noted on plate 7. This proposed alternative consists of performing shallow scrapes in the depicted fields to create more diversity in topography. Through the scraping and sidecasting of material, deeper areas would be created for ponding water and the sidecast material would create elevated resting areas out of the ponds. This feature was not evaluated due to some of the fields being removed from consideration by the sponsors, and the remaining fields were reevaluated for MSUs by means of berm construction (Field 4 & 5 and Field 21). Other areas, closer to the levee, could be flooded with the Fox Pond improvements described above.

b. Field 6 Sand Prairie Planting. Restoring and increasing the size of the previously established sand prairie, which was damaged during the Flood of 1993, would increase plant diversity of this unique area. This feature would consist of planting this field with a predetermined seed mix, locally harvested, from a local supplier. See Plate 5 for location.

c. Fish Nurseries. The proposed fish nurseries would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are

greater. A nursery would allow the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake. A nursery would be managed for fish periodically, about one year in five, at the discretion of the refuge manager. During the other years, the nursery would continue to function as a wetland, providing habitat for migratory birds.

(1) Upper Fish Nursery. This feature would consist of utilizing an existing containment area to construct a fish nursery. The area currently has a stoplog control structure, which is damaged and would be replaced. The area, with the new structure, would be able to pond water, allowing the area to be stocked with fry in the spring that would be released into Lake Odessa later in the season. This would allow fish to reach a larger size in a more protected environment, resulting in decreased mortality. See Plate 5 for location.

(2) Lower Fish Nursery. This feature would be utilized in a similar manner to the upper fish nursery described above. A small bay off Sand Run would be screened off in the spring to allow stocked fry to grow in the absence of larger predatory fish. Proposed construction included a screen across the outlet and adding dredged material to the spit of land separating the bay from Sand Run. This nursery was eliminated from further consideration because it has a higher likelihood of drying up in the summer months and is currently providing good moist soil habitat. See Plate 8 for location.

(3) Little Goose Pond Fish Nursery. This nursery would also allow stocked fry to grow in absence of larger predatory fish within a bermed area of Little Goose Pond. This location was eliminated from further consideration because ponding water would be difficult without construction of a lengthy perimeter berm. See Plate 7 for location.

d. Potential Deep-Water Fisheries Enhancements. This feature would improve water quality and habitat for fish by means of hydraulic/mechanical dredging. Deep habitat would be created in the form of channels and deep holes. The deeper areas would provide oxygenated water as well as escape routes and habitat during the winter months (overwintering). All depths reflect the final water depth, not the amount of dredging. Proposed fisheries enhancements are as follows:

(1) Dredge Main Lake (Lake Odessa). This option would consist of dredging a deep hole in Lake Odessa that is approximately 1,490 feet long by 751 feet wide to a depth of 8 feet. The dredged material is mainly fine sediment, and would be hydraulically dredged into a 40-acre containment site (Site D) that would be constructed in the forested area between the Main Lake and Goose Pond. See Plate 6 for location.

Note. See Plates 7 and 8 for other variations that were considered for deep hole/channel dredging in Lake Odessa. Sponsors eliminated other locations. Access by equipment is major limiting factor, with limited placement sites. An 8-foot depth is based on sedimentation rate and 50-year project life.

(2) Dredge Goose Pond. This option would consist of dredging a deep channel to connect Goose Pond and Sand Run Chute. The approximate size of the channel is 5,158 feet long by 142 feet wide to a depth of 8 feet. The dredged material is mainly fine sediment and would be hydraulically dredged into a 40-acre containment site that would be constructed in the forested area between the Main Lake and Goose Pond. See Plate 6 for location.

(3) Dredge Blackhawk Chute/Yankee Chute Access. This option would consist of dredging a deep channel to connect Yankee Chute and Blackhawk Chute. The approximate size of the channel is 6,040 feet long by 95 feet wide to a depth of 8 feet. The dredged material is

mainly fine sediment, and would be hydraulically dredged into the IDNR MSU that was detailed above. See Plate 6 for location.

(4) Dredge Swarms/Beebe Access Channels. This option would consist of deepening the access channels connecting Lake Odessa to Swarms Pond and Beebe Pond. The approximate size of the dredge cuts would be 650 feet long by 126 feet wide by 1 foot deep between Beebe and Swarms, and 1,517 feet long by 118 feet wide by 1 foot deep between Swarms and Odessa. The dredged material is mainly fine sediment, and would be mechanically dredged and sidecast on the downstream embankment next to the channel. See Plate 5 for locations.

(5) Dredge Continuous Channel From Lake Odessa to Blackhawk Chute. This option would consist of dredging a deep channel that begins at Lake Odessa, runs up Sand Run Chute, and eventually ends in Blackhawk Chute, with a connector to Big Mallard Pond. This feature was not evaluated due to sponsor input, limited placement site capacity, and high preliminary cost estimate. See Plate 8 for layout of channel.

(6) Dredge Deep Holes in Blackhawk Chute. This option would consist of dredging deep holes in Blackhawk Chute. This feature was not evaluated due to sponsor input, placement site considerations, and preliminary cost estimates. See Plate 8 for layout of channel.

e. Mast Tree Planting. This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting would be to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree planting would restore some of the historic diversity of the bottomland forest community and reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. Mast tree species to be planted would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). Only those sites at higher elevations or on ridges were considered to maximize tree survival. See Plates 5 and 6 for locations.

(1) RPM Trees. This option would consist of planting Root Production Method™ (RPM) trees at a density of 30-50 trees per acre. These hardy containerized trees, grown from locally collected seed, are able to survive the dynamic nature of the floodplain and herbaceous competition, and require much less maintenance. In addition, they begin bearing acorns as soon as 18 months after planting, much earlier than trees produced through traditional methods.

(2) RPM Trees and Seedlings. This option would be the same as g. (1) along with the planting of seedlings. This option was eliminated from further evaluation because of higher tree mortality and increased maintenance with this option.

Note. Other mast tree planting sites were considered, but due to sponsor preference for location, the above sites were the only areas that were evaluated. See Plates 7 and 8 for other conceptual locations of mast tree planting sites.

f. Green Tree Reservoir. See Plate 8 for location. This feature would involve construction of a low perimeter berm and small pump station to shallowly flood a 50-acre area of pin oaks each fall to provide invertebrate food resources for waterfowl. This feature was

eliminated from further consideration because increased mast tree mortality may result from the periodic flooding proposed for this feature.

g. Refuge Protection through Levee Restoration. Various spots on the perimeter levee fall below the minimal level of protection, and a majority of the levee has slopes that are too steep on the interior side. This feature would restore the Lake Odessa Refuge perimeter levee by improving the crown and interior side slopes. Spillways would allow controlled filling of the interior from the downstream end, to prevent uncontrolled levee breaches during flood events. See Plates 5 and 6 for locations.

(1) Restore Perimeter Levee to 25-50 Year Level and Construct Spillway.

This option would establish a sloping levee profile starting at the 25-year level (downstream) and gradually rising to the 50-year level (upstream), while also flattening all slopes to 5 horizontal to 1 vertical to improve section reliability. Hydraulically dredging sand material from the Mississippi River and grading it into the existing levee section would accomplish this. In addition, two spillways are proposed to allow for a controlled flooding scenario of the refuge interior. One of the spillways would be located in the lower end of the refuge and is proposed to be 1,100 feet in length and built to the 10-year level of protection. The second spillway would be located in the upper end and is proposed to be 700 feet long and built to the 17-year level of protection.

(2) Restore Perimeter Levee to 20-Year Level and Construct Spillway. This option would raise the levee to a 20-year level of protection and improve interior side slopes to 5 horizontal to 1 vertical to improve section reliability. The spillway lengths for the 20-year levee would be longer, approximately 1,200 feet long at the 11.1-year level in the upper end, and 1,500 feet long at the 10-year level in the lower end. This feature was eliminated because the spillways for the 20-year level of protection would be longer than for the 25-year level of protection. This would result in higher costs and environmental impacts for a similar level of flood damage reduction and habitat protection.

Note: Both (1) and (2) above include constructing a rock wing dam between Michael Creek and the inlet structure in the upper end, to reduce sedimentation at or near the inlet structure. In addition, shoreline protection of National Register Eligible archeological sites in the interior of the complex by means of riprap placement was included in both of the items.

h. Leave Levee Breached. This feature would involve leaving the breaches in the perimeter levee caused by the 2001 flood event to maintain connectivity with the main channel. This connectivity would allow access to the Lake Odessa complex for a variety of fish species, which would utilize the shallow sloughs for spawning and fry habitat. However, the Lake Odessa complex still contains a mosaic of forest and shallow sloughs, resulting from its isolation from the Mississippi and Iowa Rivers. This feature was not pursued due to concerns over increased sedimentation and potential impacts to buttonbush habitat and other wetland habitats, which require water levels that are manipulated to resemble more natural levels than what is possible from connection to main channel flows. In addition, prolonged high water levels associated with flood events could adversely impact the bottomland forest tree health and regeneration that is provided within the more controlled leveed environment.

i. Cross Dike. This feature would involve constructing a dike between the USFWS and IDNR managed lands to provide independent water level management capability. This feature was eliminated from further consideration because hydraulic analysis determined that the dike would not pool enough water to allow the USFWS managed lands to operate independently of the IDNR

managed lands (majority of water would just flow around the western end of the cross dike). See Plate 7 for location.

j. Yankee Chute Gatewell. This feature would consist of constructing a gatewell structure in the perimeter levee at the head end of Yankee Chute to provide oxygenated water to this backwater. This feature was eliminated from further consideration because another project feature (channel dredging) would provide the same habitat benefit. See Plate 8 for location.

5. EVALUATION OF FEASIBLE PROJECT FEATURES AND FORMULATION OF ALTERNATIVES

This section describes the features that met the goals and objectives of this project. Each feature was evaluated to determine its potential for environmental restoration and enhancement. Costs also were derived for all feasible (practical, cost effective, and environmentally acceptable) project features. Feasible project features are those features determined to have positive benefits and no obvious reason for removal from consideration, such as not meeting the goals and objectives, high cost, or in the case of a dredging feature, no placement site.

a. Environmental Output Evaluation. Habitat evaluation models have been used to assist the decision-making process to determine what project features should be built based on habitat benefits (outputs) that meet the goals and objectives of the project. A habitat analysis was completed for the Lake Odessa project, with the goal of enhancing terrestrial, wetland, and aquatic habitat. This analysis employed a multi-agency team approach with representatives from the Corps of Engineers, the USFWS, and the IDNR.

Analysis of existing study area conditions, future conditions without the project, and impacts of several proposed features and alternatives was completed using the Wildlife Habitat Appraisal Guide (WHAG) procedures developed by the Missouri Department of Conservation and the Natural Resources Conservation Service. The WHAG is a numerical habitat appraisal methodology based on USFWS Habitat Evaluation Procedures (HEP) (1980). Though models can be effective tools to assist decision makers, they may not always capture all of the benefits of a proposed project feature.

The WHAG procedures evaluate the quality and quantity of particular habitats for preselected species communities, with each species representing a different guild. Different groups of species represent different habitats for that community. The WHAG team also selected target species from the list provided by the WHAG model. The qualitative component of the analysis is known as the Habitat Suitability Index (HSI) and is rated on a 0.1 to 1.0 scale. The quantitative component of the WHAG analysis is the measure of acres of habitat that are available for the selected evaluation species. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula ($HSI \times Acres = HUs$).

The WHAG team evaluated existing habitat conditions by using existing survey data, aerial photographs, vegetative cover maps, and first hand knowledge of the area. Projections of future with- and without-project conditions were based on predicted changes in the physical conditions of the project sites and professional judgment as to how these changed physical conditions would affect habitat components such as vegetation diversity and species composition.

Changes in the quality and/or quantity of HUs will occur as a habitat matures naturally or is influenced by development. To capture these changes, habitat conditions were estimated at selected target years for both with- and without-project conditions. The target years selected for this project were Year 0, 1, 25, and 50, with an estimated project life of 50 years. These changes influence the cumulative HU derived over the life of the project. Cumulative HUs are annualized and averaged. This determines what is known as Average Annual Habitat Units (AAHUs). AAHUs are used as an output measurement to compare all the features and project as a whole and to evaluate the difference between the environmental outcomes of with- and without-project conditions. This difference results in the net AAHUs for the project or project feature. For a more detailed description of the habitat analysis, refer to Appendix D of this report.

b. Feasible Project Features. Plates 5 and 6 show the locations of all feasible project features described below. Table 5-1 summarizes the outputs and costs associated with each management measure. Section 5(b) describes the environmental evaluation process for each feasible project feature. Detailed descriptions, by feature, of the environmental evaluation are provided in Appendix D, Habitat Evaluation and Quantification and Incremental Cost Analysis.

(A) Moist Soil Unit (MSU) Enhancement. Water level management is used primarily for waterfowl management but encompasses many other wetland species as well. The goal is to produce mudflat conditions that promote the germination of wetland plants from the existing seed bank. This requires dewatering wetland areas beginning in the spring. The areas are slowly drawn down, with maximum drawdown occurring in mid summer. In the fall months of the year, which is the migratory period for waterfowl, the objective is to shallowly flood the moist soil areas. These areas are gradually flooded beginning in September, with maximum water depths through early November. This flooding, along with vegetation growth, attracts migrating birds for both resting and feeding. Improvement at the following locations would lead to enhanced wetland vegetation diversity and growth during the summer months and provide better, more reliable food supplies to migratory waterfowl during fall migration times.

This management feature may be implemented at the following sites (32 possible combinations):

(1) No Action (M0, U0, F0, S0, D0). No action would result in no additional management efforts. No Average Annual Habitat Units (AAHUs) gain or loss would be realized other than what occurs under the current management objectives. Only portions of the existing MSUs could be flooded as desired under normal conditions. During low water years, water supply to flood the MSUs may be inadequate, leading to decreased value and use of the areas by migratory waterfowl and other wildlife species.

(2) Field 4 & 5, Field 21, MSU 20 (M1). This option consists of utilizing existing berms to allow water impoundment to elevation 538.5 MSL maximum, providing portable pumps and permanent pump pads (Field 4 & 5 and Field 21), and constructing a dedicated water bay at the inlet structure to provide a reliable water supply to all three MSUs and increase water level management control. Because these three areas are in very close proximity, contain similar habitat, and share a common water supply system, they will be considered as one site for evaluation purposes. This feature yields a net benefit of 83.2 AAHUs; 34.5 AAHUs for Field 4 & 5 and Field 21, and 14.2 AAHUs for MSU 20.

(3) Unit 2 (U1). This feature consists of adding one new water control structure and portable pump to increase water level management control. This feature yields a net benefit of 69.2 AAHUs.

(4) Fox Pond (F1). This option consists of constructing a new pump station for filling the area, replacing a water control structure, and providing a permanent pump pad for draining the area. A portable pump from another MSU area would be utilized here. These features would increase water level control and promote the growth of desirable vegetation. This feature yields a net benefit of 236.6 AAHUs.

(5) Swarms and Bebee Ponds (S1). This option consists of deepening the access channels to both Swarms and Bebee Ponds through mechanical dredging. The dredged material would be sidecast, adding to the topographic diversity. Dredging would hydraulically connect these ponds to the main lake during most water levels. Dredging also allows a drawdown of these ponds during the late spring and early summer, in conjunction with lowering the water levels in

Lake Odessa, to increase diversity and extent of wetland vegetation growth. Conversely, the main lake water levels are increased in the fall, which allows flooding of the wetland vegetation in these areas. Enhancing access to the main lake also provides fisheries benefits, described in the deep-water fish habitat section that follows (5.D). This feature yields a net benefit of 207.5 AAHUs for nonforested wetlands.

(6) IDNR MSU (D1). This option consists of clearing and grubbing the MSU's interior, then lining the existing MSU with a layer of fine, silty material generated from the Yankee/Blackhawk Chutes deep-water fisheries dredging feature (5.D.4). Portions of this MSU currently drain faster than pumping can raise them, which allows only partial flooding and limited use of the area. In addition, a water control structure, portable pump, and permanent pump pad would be provided. This feature yields a net benefit of 43.6 AAHUs.

(B) Sand Prairie Restoration. In 1985, the USFWS established a 25-acre sand prairie on one of the highest ridges within the floodplain (Field 6). This site was heavily impacted during the flood of 1993. Replanting and increasing the footprint of this area (36 acres) will provide feeding and nesting opportunities for a wide variety of wildlife.

(1) No Action (P0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally.

(2) Restore Sand Prairie (P1). This option consists of reseeding this unique area and expanding the area to 36 acres. Seed would come from a local source, produced under similar site conditions. This prairie contributes to the complexity of terrestrial habitats within the refuge. This feature yields a net benefit of 11.3 AAHUs.

(C) Fish Nursery Enhancement. The proposed upper fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake. This area would be managed for fish periodically, about one year in five, at the discretion of the refuge manager. During the other years, the area would continue to function as a wetland, providing habitat for migratory birds.

(1) No Action (N0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally. If no action would take place, stocked fry would experience increased mortality and low survival rates, or fingerlings that are more expensive would be stocked in an effort to reduce stocked fish mortality.

(2) Construct Upper Fish Nursery (N1). This option consists of replacing the damaged stoplog structure. With this option, a predator-free environment would be provided for rearing fish fry to the fingerling stage. Conserving fish stocking dollars through the ability to buy the less expensive fry while reducing their mortality would provide benefits. This feature, similar in function to a hatchery pond, yields a net benefit of -0.7 AAHUs. The decrease in benefits was expected because this habitat model is not designed to capture benefits of artificial features or unnatural functions. Model results were included for completeness, but the assumption was made that this feature would provide the intended nursery benefits, resulting in a savings in fish stocking expenses to the complex. The proposed 21-acre fish nursery is an existing USFWS wetland, managed primarily for migratory birds. The refuge has agreed to periodically, about one year in five; manage the unit to benefit native fish fry for stocking by the IDNR, at the discretion of the

refuge manger. Fish species for stocking will be limited to species native to the Upper Mississippi River.

(D) Deep-Water Fish Habitat. These features would improve water quality and habitat for fish. By means of hydraulic/mechanical dredging, deep habitat would be created in the form of channels and deep holes. The deeper areas would provide oxygenated water (during summer and winter) as well as escape routes and habitat during the winter months (overwintering). Dredging to improve access to areas of deeper water further decreases the risk of fish kills when fish populations in isolated water bodies are subjected to temperature extremes or low levels of dissolved oxygen, or both, by providing escape routes to areas that are more hospitable. All depths reflect the final water depth, not the amount of dredging.

This management feature may be implemented at the following sites (16 possible combinations):

(1) No Action (L0, G0, B0, S0). No action would result in no additional management efforts. If no action would take place, it is expected that sedimentation would continue to occur, resulting in increasingly shallow water. This may result in more frequent summer and winter fish kills due to low dissolved oxygen or insufficient refuge from freezing water conditions.

(2) Dredge Lake Odessa (Main Lake) (L1). This option consists of dredging a deep hole in the main lake, approximately 1,490 feet long, 751 feet wide, to a depth of 8 feet, based on an average winter water elevation of 534.5 MSL. This deep-water area would provide overwintering habitat for fish from the surrounding 776 acres of adjacent aquatic habitat. The dredged material, consisting of primarily fine sediment, would be placed in a nearby low area, currently dominated by flood-tolerant silver maple. Mast trees would be planted on the placement site after the dredged material has drained and consolidated (see 5.E.4). The increased elevation of the placement site would maximize mast tree survival by keeping the root systems from becoming saturated during high water or prolonged flood events, thereby promoting greater tree species diversity. This feature yields a net benefit of 418.6 AAHUs.

(3) Dredge Goose Pond (G1). This option consists of dredging a deep channel to connect Goose Pond to Sand Run, thereby providing better access to the main lake via Sand Run. The channel would be approximately 5,158 feet long, 142 feet wide, to a depth of 8 feet, providing deep-water overwintering habitat for fish from the surrounding 305 acres. The dredged material, consisting of primarily fine sediment, would be placed in a nearby low area; the same area as described above for the main lake dredging option, providing the same benefits to mast trees. This feature yields a net benefit of 67.8 AAHUs.

(4) Dredge Blackhawk Chute/Yankee Chute Access (B1). This option consists of two components—deepening the access to Yankee Chute and connecting with a dredged channel in Blackhawk Chute. The entire channel would be 6,040 feet long, 95 feet wide, to a depth of 8 feet. The dredged material, consisting of primarily fine sediment, would be placed in the IDNR MSU and would act as a liner for that unit, stopping the current leak and allowing for full use and flooding of that MSU (as described above). This feature yields a net benefit of 32.3 AAHUs for fisheries.

(5) Dredge Swarms/Bebbee Ponds Access Channels (S1). This option consists of deepening the access channels to both Swarms and Bebee Ponds through dredging. The size of the dredge cuts would be approximately 650 feet long, 126 feet wide between Bebee and Swarms, 1,517 feet long, 118 feet wide between Swarms and the main lake and 1 foot deeper than the

existing channel depth (to be equal to the pond depth). These ponds would then be hydraulically connected to the main lake during most water levels. The current channels can dry up during low-water conditions, isolating fish, increasing the potential for fish kills. This feature yields a net benefit of 5.9 AAHUs for fisheries.

(E) Mast Tree Planting. This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting would be to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree planting would restore some of the historic diversity of the bottomland forest community and reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. All options would consist of planting Root Production Method™ (RPM) trees at a density of 40 trees per acre and would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). RPM trees of the same species mix as above would be planted. Only those sites at higher elevations or on ridges were considered to maximize tree survival. This management feature may be implemented at the following sites:

(1) No Action (A0, C0, D0). No action would result in no additional management efforts. No AAHU gain or loss would be realized other than what may occur naturally. If no action takes place, it is anticipated that the habitat would not regenerate sufficient mast-bearing trees on its own. Species like silver maple and cottonwood would eventually dominate these areas, resulting in a gradual loss of habitat quality and species diversity.

(2) Plant Mast-Producing Trees on USFWS Sites A & B (A1). This option consists of planting mast trees on Site A - the northern portion of Field 4 & 5, adjacent to the existing pecan grove, and Site B - an old crop field near the outlet of Fox Pond, both areas with higher elevations. This would result in approximately 27 acres total of primarily old agricultural fields being planted. These areas are in close proximity, making it more cost effective to plant both areas rather than one or the other. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of 60.2 AAHUs.

(3) Plant Mast-Producing Trees on DNR Site C (C1). This option consists of interplanting mast trees over 26 acres adjacent to Sand Run, near the outlet of the main lake, in an area of slightly higher elevations. This site is currently dominated by silver maple with limited species diversity. Some hand clearing may be necessary around each proposed tree planting location, depending on the immediate area conditions. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of 1.3 AAHUs. The reintroduction of mast-producing tree species into an area of existing forest habitat is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another. In these circumstances, the results of the analysis may not reflect real life expectations; actual benefits are anticipated to be higher than calculated.

(4) Plant Mast-Producing Trees on DNR Site D (D1). This option consists of planting mast trees over the entire 40-acre dredged material placement site. This new site would be raised approximately 2-3 feet (final elevation) over the existing elevation, providing a slightly drier site that increases tree survival rates. The existing trees, primarily silver maple, would die off over a period of time from the added dredged material placed over the root systems. The proposed tree

planting species mixture would provide better habitat over time than the existing habitat does. RPM trees of the same species mix as above would be planted. This feature yields a net benefit of -24.0 AAHUs. This loss represents the significant disturbance of the existing floodplain forest by the construction of the containment berm and the dredged material placement. A temporary berm will be pushed up around the perimeter of the site, creating a containment area for the fine sediment from the dredging. A 100-foot wide area around the perimeter of the site, for the berm location and the borrow for construction; will require clearing and grubbing of the existing vegetation, impacting approximately 13 acres. However, the current forest is dominated by silver maple and cottonwood, more flood-tolerant species and less desirable for wildlife. The replacement of the existing soft mast-producing forest by primarily hard mast-producing tree species is a relatively subtle change in habitat quality. In addition, increasing the elevation of the site will greatly favor natural regeneration of hard mast-producing trees. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another. Long-term benefits, though subtle, are expected from this action. In addition, this site is the confined placement site for dredging for fisheries enhancements in the Main Lake, Goose Pond, or both.

(F) Restore Perimeter Levee. The objective of levee restoration is to reduce flood damages to the Lake Odessa complex and reduce incidences of levee failure. In addition, the inlet structure would be protected from excessive sediment accumulation and interior archeological sites would be protected from further erosion.

(1) No Action (R0). No action would result in no new work to the levee, although the USFWS would construct the upper spillway to the 17-year level of protection. Without the lower spillway proposed with this potential project feature, the upper spillway would still allow controlled entry of floodwaters, but the interior water levels of the complex could not be raised as planned to prevent flood damage and/or levee failure. If no action would take place, it is expected that the interior features would gradually lose their functions and increased sedimentation from flooding would further reduce water depths throughout the Lake Odessa complex. No action would result in a loss of habitat over time.

(2) Restore levee and construct spillway (R1). This will be accomplished by restoring all sections of the current perimeter levee system that fall below the 25-year level of protection to the 50 to 25-year level (upstream to downstream), while also flattening the interior slopes steeper than 5 horizontal to 1 vertical to improve section reliability. Sandy material, hydraulically dredged from Turkey Chute, a side channel of the Mississippi River, will be used for this repair.

Based on existing levee cross sections, it is estimated that approximately 44,396 feet of levee will require restoration to the new design grade and/or regrading of the interior slopes to 5:1. The approximate lengths of restoration are 22,496 feet upstream of Lock and Dam 17 and 21,900 feet downstream of the dam. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas, and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetland by construction activities. Details for the levee restoration can be found on Plates 10-31.

An additional fisheries benefit would result from dredging in Turkey Chute, below Lock and Dam 17. This dredge cut was planned to provide additional overwintering habitat in Pool 18. Overwintering habitat within 3-5 miles of the proposed dredge cut is limited to an area at Boston Bay, located near River Mile 434.5. River fisheries biologists believe that this additional deeper off-channel area would be beneficial to the overall fishery of Pool 18. Immediately below L/D 17 and adjacent to the Lake Odessa complex, the current water depths are relatively shallow, with the exception of three existing deep-water areas. These three areas currently provide excellent fisheries habitat and will be avoided as dredging areas. In this portion of Turkey Chute, the proposed dredging would increase both the deep-water areas as well as the total water area in the side channel complex. The amount of deep-water habitat, as a percentage of the total water area, was increased proportionately. The MOFISH side channel model lacked sufficient sensitivity to detect the benefits of this increase in deep-water habitat. However, the proposed dredge cut would ensure the continued presence of deep-water habitat in this area.

The proposed dredge cut upstream of Lock and Dam 17 is located in Turkey Chute, which currently has a large amount of deeper water. Dredging in this area will ensure that deep-water areas utilized by fish will persist; however, the WHAG model is not sensitive enough to document benefits for this action. More information for these dredge cuts can be found on plates 3, 4, and 32. As part of the levee restoration, two spillways will be added to the system.

Construction of the upper spillway (17-year level of protection) is a USFWS initiative; currently under construction, that was included under the 'with project conditions' of the habitat evaluation. The lower spillway, providing a 10-year level of protection, is part of this HREP. These spillways will allow the interior to flood in a more controlled manner, rather than by levee overtopping or breaching. This feature yields a total net benefit of 1671.5 AAHUs; 1030.6 AAHUs in nonforested wetlands, 209.5 AAHUs in bottomland hardwood forest, and 431.4 AAHUS in fisheries.

The second portion of the levee restoration includes construction of a wing dam between Michael Creek and the upper inlet structure in the Mississippi River. This wing dam will reduce sedimentation at or near the inlet structure that, if allowed to build up, interferes with water control capabilities of the inlet structure. No habitat evaluation was done for the wing dam feature.

The final component of the restoration involves archeological site protection. Shoreline protection of 9 archaeological sites will be accomplished with riprap. No habitat evaluation was done for this feature. However, any rock placed in the water will provide ancillary aquatic benefits, primarily for fish, to an area with little to no rocky structure.

c. Cost Estimates for Habitat Improvement Measures. Table 5-1 summarizes the outputs and costs associated with each management measure. This analysis was performed in 2002, using the cost estimate prepared at that time and using the 2002 interest rate of 6.25%.

TABLE 5-1. Environmental Output and Costs of Each Feature

Feature	Symbol	Output*	Cost**	Annualized Cost***
Moist Soil Unit (MSU) Enhancement				
No action	M0,U0,F0,S0,D0	0	0	0
Improve Field 4 & 5, Field 21, MSU 20 water control	M1	83.2	516.2	33.3
Improve Unit 2 water control	U1	69.2	110.0	7.1
Improve Fox Pond water control	F1	236.6	291.2	18.8
Improve Swarms & Bebee Pond access	S1	207.5	47.9	3.1
Improve IDNR MSU seepage and water control	D1	43.6	235.1	15.2
Sand Prairie Restoration				
No Action	P0	0	0	0
Seed 36 acres of Field 6 to prairie	P1	11.3	22.2	1.4
Fish Nursery Enhancement				
No Action	N0	0	0	0
Construct fish nursery	N1	-0.7	31.3	2.0
Deep-Water Fish Habitat Dredging				
No Action	L0,GO,B0,S0	0	0	0
Dredge Main Lake	L1	418.6	938.9	60.6
Dredge Goose Pond	G1	67.8	1038.1	67.0
Dredge Blackhawk Chute/Yankee Chute access	B1	32.3	731.4	47.2
Dredge Swarms/Beebe Pond access	S1	5.9	47.9	3.1
Containment berm for L1, G1, or L1+G1****			74.0	4.8
Mast Tree Planting				
No Action	A0, C0, D0	0	0	0
USFWS Sites A & B (old field)	A1	60.2	70.8	4.6
IDNR Site C (interplanting)	C1	1.3	68.3	4.4
IDNR Site D (dredged material placement site)	D1	-24.0	105.7	6.8
Main Stem Levee Restoration				
No Action	R0	0	0	0
Restore levee w/spillway	R1	1671.5	5216.7	326.0

* Outputs are calculated as Average Annual Habitat Units (AAHUs) for all species in WHAG model.

** All costs in \$1000s. Represents initial construction costs only.

*** Annualized cost is initial construction cost based on a 50-year project life, 6.25% interest rate.

**** The containment berm is not considered to be a feature and therefore has no code or out put. This area can be used for dredged material from Main Lake, Goose Pond, or both. See Section 5. d. (2) for more detailed description. The berm itself has no environmental outputs until the dredging is completed and this area becomes mast tree planting site D.

d. Formulation and Evaluation of Alternative Plans. For environmental planning, traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units. However, cost effectiveness and incremental cost analysis can provide decision makers with relative benefit-cost relationships of various enhancement or restoration solutions. While these analyses are not intended to lead to a single best solution, they do improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs.

(1) Methodology. The Corps of Engineers guidance requires incremental cost analysis for recommended environmental restoration plans. Two analytical techniques are conducted to meet these requirements. The Corps of Engineers Institute developed this methodology for Water Resources (Orth 1994). First, a cost-effective analysis is conducted to ensure that the least-cost solution is identified for each possible level of environmental output. Then, incremental cost analysis of the least-cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analyses are valuable tools to assist in decision-making.

Cost effectiveness and incremental analysis is basically a three-step procedure: (1) calculate the environmental outputs of each feature; (2) determine a cost estimate for each feature; and (3) combine the features to evaluate the best overall project alternative based on habitat benefits and cost. Only features that provided positive environmental outputs were considered for this analysis, beginning with the lowest cost increment. While cost and environmental output are necessary factors, other factors such as constructability and meeting the goals and objectives (Tables 3-1 and 3-2) of the sponsor are very important in deciding on the preferred alternative.

Several steps were taken to incrementally analyze this project. This project was evaluated using guidance prepared by the Corps of Engineers Institute for Water Resources. Each project feature's various alternatives were combined into two distinct groups for analysis—MSUs (nonforested wetlands) and fisheries enhancements. Different feature types were not combined in this analysis since the targeted species for these features were not directly comparable.

Environmental outputs were calculated as AAHUs. The annualized costs were calculated by applying a 6.25% interest rate to the construction costs over the 50-year life of the project. All costs are shown in dollars. The incremental analysis for each feature was accomplished using the Institute of Water Resources (IWR) Plan Decision Support Software. Further information on the analysis can be found in Appendix D of this report.

Incremental analysis is not necessary for features with only one possible or cost-effective alternative, other than no action, such as the fish nursery, sand prairie restoration, and levee restoration. Incremental analysis was also not performed for the mast tree planting alternatives. The mast tree-planting alternative has three potential features: USFWS Site A & B (evaluated as one site), Site C, and Site D. Habitat benefits can be clearly shown when one habitat type is converted to another, as is the case for Site A & B (idle field to forest). Interplanting, as proposed for Site C, is a relatively subtle change in land use. Lack of model sensitivity for this feature skews the habitat impacts and results of the analysis may not reflect real life expectations. Site D (dredged material placement site) was included as a potential mast tree site, but planting the containment area mitigates for the habitat loss of containment construction and use and is considered a fisheries dredging feature primarily, with secondary use as a mast tree-planting site. Though planting this site with mast trees incurs additional costs, this action offsets the habitat lost through containment site construction and use. In addition, replacing the existing soft mast-producing forest, dominated by cottonwood and silver maple, with a mix of hard mast-producing tree species is expected to give long-term habitat benefits to the area over existing conditions.

(2) Results. Combinations of features were grouped by function for incremental analysis; all MSU features were grouped together; all similar fisheries enhancements, except the fish nursery, were grouped together. Alternative increments of each group's features were then analyzed to identify the most cost-effective increments of each feature type included in the selected

plan. The same procedure was performed for the fisheries enhancements. The results for MSUs and fisheries dredging features are summarized below.

The incremental analysis for MSU enhancement evaluated alternatives M0, U0, F0, S0, D0, M1, U1, F1, S1, and D1. A total of 32 potential combinations may be formulated with the identified increments of feasible project features. Eight cost-effective plans resulted from the analysis, six of which were considered best buys. Table 5-2 and Figure 5-1 present the results of the incremental analysis and the best buy plans identified for the MSU features.

Although enhancing Swarms Pond, Fox Pond, and Unit 2 (S1+F1+U1) is also a best buy plan, this combination does not address improvements for the USFWS MSU complex (Fields 4&5, 21, MSU 20), considered to be the most important MSUs at the Lake Odessa complex. In addition, improvement to IDNR MSU provides a confined placement site for the dredged material from Blackhawk/Yankee Chutes fisheries enhancement feature, yielding 32.3 AAHUs for fish.

TABLE 5-2. Moist Soil Unit Enhancement: Best Buy Combinations

Feature Alternative	Output (AAHUs)	Annual Cost (\$1)	Average Cost (\$/AAHU)	Incremental Cost (\$1s)	Incremental Output (AAHUs)	Incremental Cost per Unit (\$/AAHU)
M0+U0+F0+S0+D0	0.0	0	0.0	0	0.0	0.0
M0+U0+F0+S1+D0	207.5	3,097	14.9	3,097	207.5	14.9
M0+U0+F1+S1+D0	444.1	21,893	49.3	18,786	236.6	79.4
M0+U1+F1+S1+D0	513.3	28,996	56.5	7,103	69.2	102.6
M0+U1+F1+S1+D1	556.9	44,169	79.3	15,173	43.6	348.0
M1+U1+F1+S1+D1	640.1	77,490	121.1	33,321	83.2	400.5

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25% interest, 50-yr project life. Initial construction costs only.

M0, U0, F0, S0, D0 - No Action

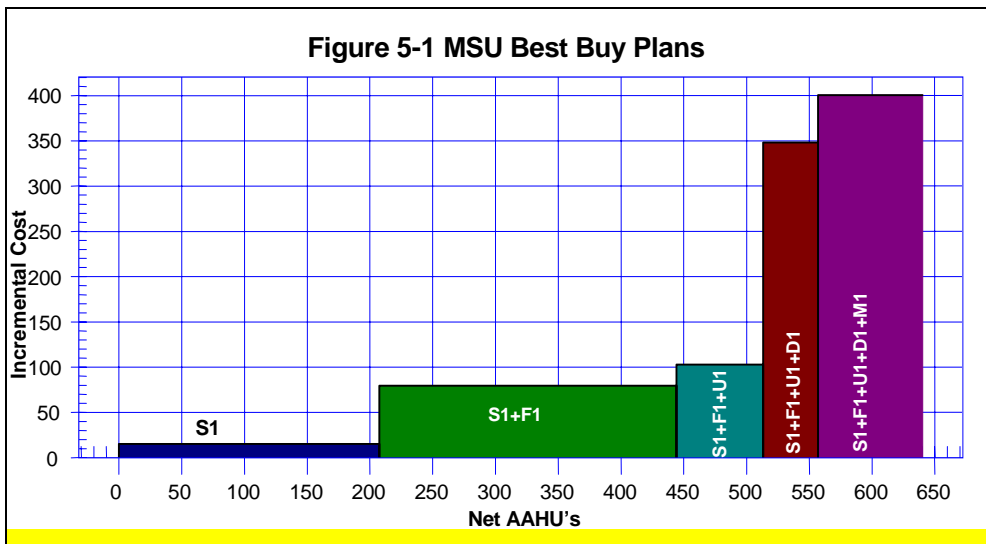
M1 - Enhance USFWS Complex (Field 4 & 5, Field 21, MSU 20)

U1 - Enhance Unit 2

F1 - Enhance Fox Pond

S1 - Enhance Swarms/Beebe Ponds

D1 - Enhance IDNR MSU



The incremental analysis for fisheries enhancement evaluated alternatives S0, L0, G0, B0, C0, S1, L1, G1, B1, and C1. A total of 32 potential combinations were possible, but due to non-combinable features, only 16 actual combinations were analyzed as the identified increments of feasible project features. Costs and AAHUs for dredging the Main Lake were combined with the containment costs for alternative L1. Costs and AAHUs for dredging Goose Pond were combined with the containment costs for alternative G1. Another alternative was added which included costs and AAHUs for dredging both the Main Lake and Goose Pond, and containment, alternative C1. This combined feature was therefore not combinable in the analysis with either the Main Lake or Goose Pond. Containment costs remained essentially unchanged regardless which of the three alternatives above was considered. Table 5-3 and Figure 5-2 present the results of the incremental analysis and the best buy plans identified for the fisheries, deep-water/access features.

This combination includes features that also have moist soil enhancement benefits, not included in the incremental analysis for fisheries features. Swarms/Bebee Pond dredging provides an additional 207.5 AAHUs and dredging Blackhawk/Yankee provides liner material for the IDNR MSU, providing 43.6 AAHUs.

TABLE 5-3. Fisheries Deep-Water/Access Enhancement: Best Buy Combinations

Feature Alternative	Output (AAHUs)	Annual Cost (\$)	Average Cost (\$/AAHU)	Incremental Cost (\$1s)	Incremental Output (AAHUs)	Incremental Cost per Unit (\$/AAHU)
S0+L0+G0+B0+C0	0.0	0	0.0	0	0.0	0.0
S0+L1+G0+B0+C0	418.6	65388	156.2	65388	418.6	156.2
S1+L1+G0+B0+C0	424.5	68485	161.3	3097	5.9	524.9
S1+L0+G0+B0+C1	492.3	135499	275.2	67014	67.8	988.4
S1+L0+G0+B1+C1	524.6	182714	348.3	47215	32.3	1461.8

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25% interest, 50-yr project life. Initial construction costs only.

S0, L0, G0, B0, C0 - No Action

S1 – Dredge Swarms/Beebe Ponds

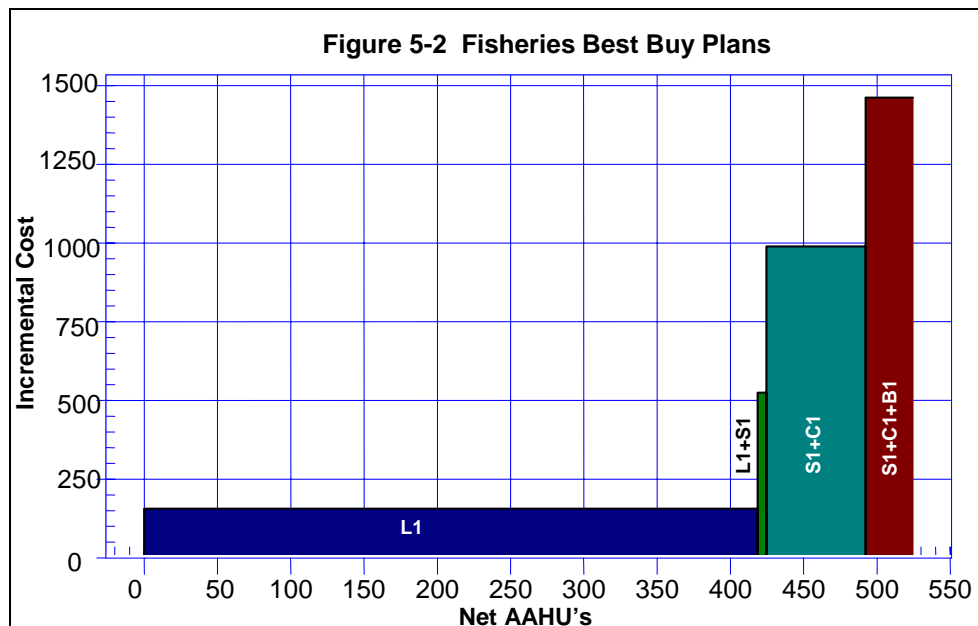
L1 – Dredge Main Lake+containment

G1 – Dredge Goose Pond+containment

B1 – Dredge Blackhawk/Yankee Chutes

C1 – Dredge Main Lake+Goose Pond+containment

The following features are not combinable: L+G, L+C, G+C (containment costs would be counted twice)



e. Summary. The proposed projects for the Lake Odessa complex involve four primary enhancement features: enhancing the current MSUs, primarily through increased water level control; increasing the amount of deep-water overwintering habitat for fish; planting mast-producing trees on higher elevations; and protecting the interior features with levee improvements and a spillway. Additional, but minor, features included reestablishing the sand prairie (terrestrial habitat enhancement) and constructing the fish nursery (fisheries enhancement).

The results of the WHAG analysis suggest that the Lake Odessa complex can be enhanced with the features proposed for this project. Results of the WHAG application were compared as increments to costs, where applicable, for the MSU and fisheries dredging features. No incremental analysis was performed where only one possible alternative, other than no action, was possible, such as for the fish nursery, sand prairie restoration, and levee restoration. Incremental analysis also was not performed for the mast tree planting alternatives. Lack of model sensitivity for these features skews the habitat impacts and the results of the analysis may not reflect real life expectations. However, all of these features will enhance the Lake Odessa complex and increase the species diversity of the area.

The results of the incremental analyses shown in this section were considered with other factors, including site topography, management objectives of the resource agencies, critical needs of the region, and ecosystem needs of the Upper Mississippi River System.

Based on the results of the MSU analyses presented above, the most cost-effective or “best buy” plan that would meet all project objectives for the MSU component would be enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Beebe Ponds + IDNR MSU (M1+U1+F1+S1+D1). Based on comments and input received from both the USFWS and the IDNR (project sponsors) during the alternative formulation process of the DPR, the best buy plan mentioned here is the sponsors’ preferred plan.

Based on the results of the dredging analyses presented above, the most cost-effective or “best buy” plan that would meet all project objectives for the fisheries enhancement (dredging) would be dredging Swarms/Beebe Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes (S1+L0+G0+B1+C1). Based on comments and input received from both the USFWS and the IDNR during the alternative formulation process of the DPR, the best buy plan mentioned here is the sponsors’ preferred plan.

In conclusion, the WHAG and incremental cost analyses indicate that enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Beebe Ponds + IDNR MSU; dredging Swarms/Beebe Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; mast tree planting at Sites A, B, C, and D and restoring the perimeter levee would provide the greatest outputs in a cost-effective manner. This combination would meet HREP goals and objectives, would add to habitat diversity as well as quality, and would best meet the overall management objectives for the site.

In cooperation with the USFWS and IDNR, the Corps has planned and designed a project that serves the needs of the resources and the resource managers, while being cost conscious. The preferred alternative has an overall output of 2,884.3 AAHUs. The preferred alternative for this study includes all of the features evaluated in this section, which is listed above. This total consists of 640.1 AAHUs gained from moist soil unit enhancement, 11.3 AAHUs from the sand prairie, - 0.7 AAHUs from the fish nursery, 524.6 AAHUs from deep-water/access for fisheries, 37.5 AAHUs from mast tree planting, and 1,671.5 AAHUs gained from levee restoration. Table 5-1 gives a breakdown for the specific features within each of these categories.

A breakdown of costs for the recommended plan is outlined in Section 8 - Cost Estimates. The costs shown in Table 8-1 and 8-2 reflect further refinement of the project features of the recommended plan including updated costs and interest rates.

6. RECOMMENDED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE CONSIDERATIONS

a. General Description. The following preferred alternatives were developed by the planning team and supported by the project sponsors (USFWS and IDNR): moist soil unit (MSU) enhancement (includes Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, Swarms/Beebe Ponds, and IDNR MSU) (M1+U1+F1+S1+D1), fisheries enhancement through deep hole/access dredging (includes Main Lake, Goose Pond, Blackhawk/Yankee Chutes, Swarms/Beebe Ponds) (B1+S1+C1), enhancement of the perimeter levee by restoring the crown (includes enhancing slopes, a spillway, a wing dam, and archeological site protection) (R1), mast tree planting at four separate sites (A through D) (A1+C1+D1), construction of the upper fish nursery (N1), and reestablishment of the sand prairie (P1). Plates 3 and 4 show the recommended plan.

b. Recommended Plan.

(1) MSU Enhancement (M1+U1+F1+S1+D1). The recommended plan for this feature involves enhancing the MSU's water level management capability (Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, IDNR MSU, and Swarms/Beebe Ponds). Currently, the water supply/levels and area flooded are limiting factors in all the MSUs. The proposed improvements would increase water level control, reliability, and increase the flooded area; thereby providing moist soil habitat. Improvement at the following locations would lead to more moist soil habitat, enhanced wetland vegetation diversity and growth during the summer months, and provide better, more reliable food supplies to migratory waterfowl during fall migration. In general, fields are dewatered after spring floodwaters have receded using pumps or control structures (gravity). During the drier summer months, wetland vegetation flourishes in the MSUs. Beginning in September, water is gradually added to the units, attracting migrating waterfowl by providing feeding and resting opportunities.

(a) Field 4 & 5 (M1). Enhanced water level management capability will be accomplished by providing a portable pump and pump pad, and modifying the existing inlet structure to dedicate 1 of its 4 bays for filling this MSU as well as Field 21 and MSU 20. The dedicated water bay is described in 6.b.(1)(d). Perimeter berms that delineate and contain water in field 4 & 5 are already in place and are of acceptable condition. The existing berms will allow water impoundment to elevation 538.5 MSL. The dedicated water bay and a portable pump will be used to raise the water to this level (83 acres flooded at 538.5 MSL). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. A pump pad, located on Little Goose Pond, will be constructed using an articulated concrete mat and will include a permanent hose hookup to reduce operation costs (See Plate 39). This feature yields a net benefit of 34.5 AAHUs.

(b) Field 21 (M1). Enhanced water level management capability will be accomplished by providing a portable pump and pump pad, and modifying the existing inlet structure to dedicate 1 of its 4 bays for filling this MSU as well as Field 4 & 5 and MSU 20. The dedicated water bay is described in 6.b.(1)(d). Perimeter berms that delineate and contain water in field 21 are already in place and are of acceptable condition. The existing berms will allow water impoundment to elevation 538.5 MSL. The dedicated water bay and a portable pump will be used to raise the water to this level (83 acres flooded at 538.5 MSL). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. A pump pad, located near Prairie Pocket, will be constructed using an articulated concrete mat and include a permanent hose hookup to reduce operation costs (See Plate 39). This feature yields a net benefit of 34.5 AAHUs.

(c) MSU 20 (M1). Enhanced water level management capability will be accomplished by modifying the existing inlet structure to dedicate one of its four bays for filling this MSU as well as Field 21 and Field 4 & 5. The dedicated water bay is described in 6.b.(1)(d). The existing berm will allow water impoundment to elevation 538.5 MSL. The dedicated water bay will be used to gravity fill this MSU to elevation 536.0 MSL. Water levels may be raised to elevation 538.5 MSL by moving water from Field 4 & 5 and/or Field 21 through existing control structures (72 acres flooded at 538.5MSL). This feature yields a net benefit of 34.5 AAHUs.

(d) Dedicated Water Bay (M1). The dedicated water bay is needed to improve operation of the overall complex. Currently, water level management is dependent on raising and lowering a stoplog structure in the ditch leading from the inlet structure. The problem is that diverting water to the MSUs using the stoplog structure precludes water from filling the main lake and vice versa. A dedicated bay will allow filling of the MSUs and the main lake simultaneously. The dedicated water bay will divert flow from the downstream bay of the 4-bay inlet structure by extending the bay's concrete wall to meet a sheet pile wall (40 feet) that then leads to a newly excavated ditch (500 feet, 4,559 cubic yards), which then meets an existing ditch that leads to the MSUs (See Plate 33). Construction of the bay will allow gravity filling of Field 4 & 5, Field 21, and MSU 20 to an approximate elevation of 536.0 MSL. The new ditch section will also include a 64-inch by 43-inch pipe arch to provide access over the ditch (See Plate 36).

(e) Unit 2 (U1). Enhanced water level management capability will be accomplished by providing a portable pump and new water control structure. A portable pump will be used to raise interior water levels and flood 92 acres at 538.5 MSL. The portable pump (4,000 gpm) and power unit will be mounted on a trailer and stored at the USFWS Refuge Office when not in use. The existing berm is 2,800 feet long and requires no additional work (an existing roadbed and the project's perimeter levee are used as Unit 2's north and west berms). The new water control structure is a 36-inch CMP with slide gate that will be located next to the existing 24-inch stoplog structure under the road across Muscatine Slough (See Plate 35). This structure's purpose is to assure that an adequate supply of water from Muscatine Slough reaches the portable pump. This feature yields a net benefit of 69.2 AAHUs.

(f) Fox Pond (F1). Enhanced water level management capability will be accomplished by constructing a new pump station, water control structure, and pump pad. The pumping plan for this unit involves raising water levels from 536.0 MSL to 537.0 MSL in two 6-inch increments. Each increment will be pumped in over a 7-day period with the 537.0 MSL elevation maintained for approximately 2 months to maximize feeding opportunities for waterfowl (336 acres flooded at 537.0 MSL). The proposed new pump station will be a concrete-lined sheet pile sump housing a vertical pump. The pump will be a submersible 25,000 gpm vertical belt driven propeller pump powered by an external power unit (stored off site). Immediately adjacent to the pump, will be an 8-inch thick concrete pad to support the power unit. The pump station will pump water into Fox Pond via a steel pipe that will run through the berm (See Plate 40). The existing 14,000-gpm pump station will be left in place to facilitate draw down of Fox Pond.

A new 36-inch CMP water control structure with slide gate will replace the existing gatewell structure (See Plate 37). A portable pump pad located on the Fox Pond side of the embankment will also be constructed near the pump station to allow a near total dewatering of the unit in early summer using a portable pump. An additional portable pump is not needed for this MSU because one of the other portable pumps used at Field 4 & 5, Field 21, or Unit 2 can be used here in early summer and then moved back for early fall pumping at the other units. The pump pad will be constructed using articulated concrete matting and include a permanent hose hookup to reduce

operation costs (See Plate 39). This dewatering will promote vegetation growth desired as a food source by migrating waterfowl. This feature yields a net benefit of 236.6 AAHUs.

(g) IDNR MSU (D1). Enhanced water level management capability will be accomplished by providing a portable pump, constructing a new water control structure, and reducing the seepage rate. A portable pump will be used to raise interior water levels 4 feet over 14 days (541.0 MSL) and then maintain that level for approximately 2.5 months to maximize feeding opportunities for waterfowl (49 acres flooded at 541.0 MSL). The portable pump (10,000 gpm) and power unit will be mounted on a trailer and stored at the IDNR Refuge Office when not in use. A pump pad, located on Burris Ditch, will be constructed using articulated concrete matting, and include a permanent hose hookup to reduce operation costs (See Plate 39). The existing berm is 5,925 feet long, encompasses 49 acres, and requires no additional work. A new 36-inch CMP water control structure with slide gate will replace the existing gatewell structure (See Plate 38).

The seepage rate for portions of this MSU is greater than pumping can raise them, which limits successful management for waterfowl use. The seepage rate will be reduced by placing fine-grained material (63,531 cubic yards) hydraulically dredged from the Yankee/Blackhawk Chutes deep-water fisheries project feature (see 6.b.(2)(c)) into the MSU to act as a liner. Following placement, the dredged material will be incorporated into the existing material to a depth of ~1 foot to enable the MSU to better hold water. Prior to placement, the MSU interior will be cleared and grubbed to create a better seal between the new and existing materials. The cleared and grubbed material will be stockpiled outside the MSU in an adjacent field. In addition to the clearing and grubbing, a structure will be constructed prior to dredging to allow run off water to leave the area. Various options exist for the structure, and one will be chosen during design that ensures IDNR water quality requirements are met (See Plate 4). This feature yields a net benefit of 43.6 AAHUs.

(h) Swarms/Beebe Ponds (S1). This feature consists of mechanically dredging the access channels connecting Lake Odessa to Swarms Pond and Beebe Pond. The approximate size of the dredge cuts will be 650 feet long by 126 feet wide between Beebe and Swarms, and 1,517 feet long by 118 feet wide between Swarms and Lake Odessa. Both channels will be dredged 1 foot deeper than the existing pond depth. The side slopes of the channel will be 6H:1V and encompass ~2 acres between Beebe and Swarms and ~4 acres between Swarms and Lake Odessa. The excavated material is mainly fine-grained sediment that will be mechanically dredged and sidecast on the downstream embankment next to the channel. The channel dredging will allow both ponds to drain during drawdown periods, which will promote vegetation growth that when re-flooded, can be used by migratory waterfowl. Under existing conditions, vegetation is primarily found around the pond's edges because the trapped water does not allow germination of moist soil plants. This feature yields a net benefit of 207.5 AAHUs for moist soil species.

(2) Fisheries Enhancement (B1+S1+C1). The recommended plan for this feature includes dredging channels and/or deep holes in the main lake (Lake Odessa), Goose Pond, Blackhawk/Yankee Chute Access, and Swarms/Beebe Ponds. The dredging plant will need to be trucked to Lake Odessa and reassembled on site, as there is no navigable connection to the Mississippi River. The primary emphasis of fisheries enhancement is creating areas of deeper water and/or access to existing deeper water at the Lake Odessa complex. Sedimentation and flood damage have reduced deep-water habitat over time. Additionally, access channels to Swarms/Beebe Ponds and Yankee Chute have silted in, reducing the ability of fish to leave some areas if conditions would necessitate (low dissolved oxygen in the summer, escape from freezing water in the winter). Both of these problems can result in localized fish kills. Water depths in the Lake Odessa complex are currently no deeper than 6 feet deep. Water depths of 8 feet or more are considered ideal, primarily for overwintering habitat. For the deep-water dredging, a sedimentation

rate of 1-2 cm/yr was calculated. This rate assumes that the levee restoration will reduce flood damages and sediment deposition over existing conditions. The access channel dredging depths were adjusted to include the estimated 50 years of sedimentation. The deeper areas will provide oxygenated water (during summer and winter) as well as escape routes (all season) and overwintering habitat during the winter months.

(a) Dredge Main Lake (Lake Odessa) + Dredge Goose Pond (C1). In the Main Lake, an area approximately 1,490 feet long by 751 feet wide will be dredged hydraulically to a depth 2 feet deeper than the existing lakebed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 30-acre area at normal water elevations. A total of 81,555 cubic yards of fine-grained sediment will be placed on land in a 40-acre confined site dominated by silver maples (See Plate 4 for location). Dredging in the Main Lake yields a net benefit of 418.6 AAHUs.

In Goose Pond, this feature consists of dredging a deep channel to connect Goose Pond and Sand Run. An area approximately 5,158 feet long by 142 feet wide will be dredged hydraulically to a depth 4 feet deeper than the existing channel bed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 17-acre area at normal water elevations. A total of 90,170 cubic yards of fine-grained sediment will be placed on land in a 40-acre confined site. Dredging in Goose Pond yields a net benefit of 67.8 AAHUs.

The confined site used for these areas will require low-level berm work (5 feet high), using adjacent material, in advance of placement. Minimal tree clearing (100 feet) is needed where the low-level berm is constructed. Once dry, mast trees will be planted on the placement site at a rate of 40 per acre. The mast tree planting benefits are discussed under mast tree planting site D.

(b) Dredge Blackhawk Chute/Yankee Chute Access (B1). This feature consists of dredging a deep channel to connect Yankee Chute to Blackhawk Chute. The channel will be approximately 6,040 feet long by 95 feet wide and will be dredged hydraulically to a depth 4 feet deeper than the existing channel bed (~8 feet of water after dredging). The dredged area will have side slopes of 6H:1V and encompass a 13-acre area at normal water elevations. A total of 63,530 cubic yards of fine-grained sediment will be placed in the IDNR MSU to reduce seepage (see 6.b.(1)(f)). This feature yields a net benefit of 32.3 AAHUs.

(c) Dredge Swarms/Beebe Ponds (S1). This feature consists of mechanically dredging the access channels connecting Lake Odessa to Swarms Pond and Beebe Pond. The approximate size of the dredge cuts will be 650 feet long by 126 feet wide between Beebe and Swarms, and 1,517 feet long by 118 feet wide between Swarms and Lake Odessa. Both channels will be dredged 1 foot deeper than the existing channel bed to a depth equal to the adjacent ponds. The side slopes of the channel will be 6H:1V and encompass ~2 acres between Beebe and Swarms and ~4 acres between Swarms and Lake Odessa. The excavated material is mainly fine-grained sediment that will be mechanically dredged and sidecast on the downstream embankment next to the channel. These ponds would then be hydraulically connected to the main lake during most water levels. The current channels can dry up during low-water conditions, isolating fish, increasing the potential for fish kills. This feature yields a net benefit of 5.9 AAHUs.

(3) Mast Tree Planting (A1+C1+D1). This feature would improve wetland and terrestrial habitat by restoring or improving bottomland hardwood forests on portions of the Lake Odessa complex. The objective of tree planting is to improve the quality and quantity of forest habitat in the project area by re-introducing a component of mast-producing species to a forest community increasingly dominated by silver maple and cottonwood. Mast-producing tree plantings would restore some of the historic diversity of the bottomland forest community and

reduce forest fragmentation. Once mature, mast trees would provide food resources for multiple migratory and resident species and increase overall habitat diversity. Mast tree species to be planted would include northern pecan (*Carya illinoensis*), swamp white oak (*Quercus bicolor*), bur oak (*Q. macrocarpa*), pin oak (*Q. palustris*), sycamore (*Platanus occidentalis*), and shellbark hickory (*Carya laciniosa*). Only those sites at higher elevations or on ridges were considered to maximize tree survival. This feature would consist of planting Root Production Method™ (RPM) trees at a density of 40 trees per acre at all sites. These hardy containerized trees, grown from locally collected seed, are able to survive the dynamic nature of the floodplain and herbaceous competition, and require much less maintenance. In addition, they begin bearing acorns as soon as 18 months after planting, much earlier than trees produced through traditional methods.

(a) Mast Tree Planting Site A (A1). Site A is a 13-acre site just north of Field 4 & 5 that has mostly scrubby vegetation except for a small grove of pecan trees. The 530 trees planted on this site's higher elevations will avoid impacts to the existing pecan grove. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree, treating the area with herbicide, and mowing periodically. Mast tree planting Sites A and B were evaluated as one area in the habitat analysis. This combined feature yields a net benefit of 60.2 AAHUs.

(b) Mast Tree Planting Site B (A1). Site B is a 14-acre former crop field near the Fox Pond pump station that currently has mostly scrubby vegetation. The 560 trees will be planted on this site's higher elevations. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree, treating the area with herbicide, and mowing periodically. Mast tree planting Sites A and B were evaluated as one area in the habitat analysis. This combined feature yields a net benefit of 60.2 AAHUs.

(c) Mast Tree Planting Site C (C1). Site C is a 26-acre interplanting site bordering Sand Run that currently is dominated by silver maple and cottonwood trees. The 1,020 trees will be planted on this site's higher elevations. The recommended planting rate is 40 trees per acre. Some hand clearing may be necessary around each proposed tree planting location, depending on the immediate area conditions. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree and treating the area with herbicide. Mowing is not possible due to the site's remoteness (boat access only). This feature yields a net benefit of 1.3 AAHUs. The reintroduction of mast-producing tree species into an area of existing forest habitat is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another. In these circumstances, the results of the analysis may not reflect real life expectations; actual benefits are anticipated to be higher than calculated.

(d) Mast Tree Planting Site D (D1). Site D is a 40-acre site that is also being used as a placement site for fisheries enhancement dredging of the main lake (Lake Odessa) and Goose Pond (see 6.b.(2)(a)). After the dredged material has dried sufficiently, the 1,584 trees will be planted on this site's higher elevations. Once planted, the trees will be protected from weeds by placing a weed barrier mat around each tree and treating the area with herbicide. Mowing is not possible due to the site's remoteness (boat access only). Analysis of this feature resulted in a calculated loss of 24.0 AAHUs in habitat benefits. This loss represents the significant disturbance of the existing floodplain forest by the dredged material placement. However, the current forest is dominated by silver maple and cottonwood, more flood-tolerant species, and less desirable for wildlife. The replacement of the existing soft mast-producing forest by primarily hard mast-producing tree species is a relatively subtle change in habitat quality. In addition, increasing the elevation of the site will greatly favor natural regeneration of hard mast-producing trees. Existing habitat evaluation methodologies are generally less sensitive to such qualitative changes within habitat

types than to changes that are more drastic from one habitat type to another. Long-term benefits, though subtle, are expected from this action.

As noted in the above paragraph, site D will be elevated prior to planting the trees by placing dredged material in the area. Site D will have to be elevated approximately 2.7 feet to create proper growing conditions for the mast trees. To facilitate this, a temporary berm will be pushed up around the perimeter of the site, creating a containment area for the fine sediment from the dredging. A 100-foot wide area around the perimeter of the site, for the berm location and the borrow for construction, will require clearing and grubbing of the existing vegetation, impacting approximately 13 acres of existing low quality bottomland forest. This temporary berm will be approximately 5,800 feet in length, 5.0 feet high, have an 8 feet wide crown, 2.5 horizontal to 1 vertical side slopes, will require approximately 21,800 cubic yards of material to construct, and will provide approximately 40 acres of storage area. The containment area will provide approximately twice the volume required for the dredged material. This extra volume will provide the capacity required to allow the fine sediment to settle out from the dredging operations, which can be as much as 90% water. As a part of the containment berm, a structure will be constructed to allow run off water to leave the area. Various options exist for the structure, and one will be chosen during design that ensures IDNR water quality requirements are met (See Plates 4 and 32).

(4) Levee Restoration (R1). Restoration will be accomplished by raising low levee sections to a sloping profile, regrading interior levee slopes to 5H:1V, and constructing an overflow spillway. The sloping profile mentioned above is a design where the levee profile will slope up as you traverse upstream on the levee system (See Plates 9 through 31).

The perimeter levee is 9.5 miles long and is composed of a composite of material (sand, clay, and/or silt) with sand more common toward the upstream end. Approximately 8.4 miles of levee will require regrading, including crown enhancement to ~548.0-551.2 MSL, and/or slope enhancement to 5H:1V. Current levee heights range between the 10 and 500-year protection level with levee slopes generally between 2H:1V and 2.5H:1V.

Borrow for the restoration will be sand hydraulically dredged from Turkey Chute, a side channel of the Mississippi River (279, 987 cubic yards). Borrow will be dredged from an upper and lower site to reduce pumping lengths. The upper borrow site is the portion of Turkey Chute above the spillway of Lock and Dam 17, and will supply borrow for the levee work upstream of the dam. The lower borrow site is the portion of Turkey Chute below the dam, and will provide borrow for the levee work downstream of the dam. The dredge cuts in the lower portion of Turkey Chute will consist of channels that will be dredged deep enough to provide over-wintering habitat.

The dredged borrow material will be worked into the slope using bulldozer type equipment. The material will be spread and shaped to create the specified levee slope of 5H:1V. Some of the work areas will not have any material directly dredged to their location due to the minimal amount of work in those areas. For those areas, borrow will be brought from adjacent sites that will receive dredged material via a rubber tracked scraper that can traverse sand slopes causing minimal damage. The volume of material to be hauled to minimal work sites is approximately 10,200 cubic yards. Prior to dredging, the levee crown and interior slope will have the top 6 inches stripped to forge a better bond between the new borrow and the existing levee material. The stripped material will be placed at the new levee slope toe for use in containing the dredged material's return water. Due to levee slope repairs, 5,496 feet of the existing gravel road will have to be replaced or relocated. Of the 5,496 feet, 2,100 are upstream of the dam, and will need to be replaced. The remaining 3,396 feet is located in the tieback section of the levee downstream of the dam, with the

majority of it needing to be relocated. All areas needing relocating or replacement, will be 12 feet wide by 8 inches thick.

Based on existing levee cross sections, it is estimated that approximately 44,396 feet of levee will require restoration to the new design grade and/or regrading of the interior slopes to 5:1. The approximate lengths of restoration are 22,496 feet upstream of Lock and Dam 17 and 21,900 feet downstream of the dam. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland and open water areas within the levee system. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetlands by construction activities. Note, earthwork quantities were obtained from modeling software (INROADS), utilizing survey data obtained from aerial and ground surveys. Plates 10-31 provide additional details of the proposed levee restoration.

The total acreage of habitat protected by the levee restoration is 1,700 acres of non-forested wetland, 3,900 acres of bottomland hardwood forest, and 1,800 acres of open or deep water. The habitat benefits of this protection are described in more detail below. The amount of wetland or open water habitat adversely affected by the levee restoration is a very small percentage of the total habitat protected and would not be a noticeable factor in the WHAG evaluation.

Habitat benefits calculated for the levee restoration yielded a net total benefit of 1671.5 AAHUs (non-forested wetlands=1030.6 AAHUs, bottomland hardwood forest=209.5 AAHUs, fisheries=431.4 AAHUs). Restoration is important because past levee failures have resulted in losses of emergent aquatic vegetation used by migratory waterfowl. Prolonged flooding after levee breaches has also increased the mortality of mast-producing trees. Sedimentation from frequent levee breaks and overtopping flood events has increased the extent of shallow water habitat, which results in more frequent fish winterkills and reduced circulation of well-oxygenated water.

(a) Spillways. In conjunction with the levee slope and crown improvements, two spillways will be constructed. The 700-foot upper spillway will be at approximately the 17-year protection level (elevation 548.8 MSL), and will be constructed by the USFWS using design standards and parameters specified and approved by the Rock Island District. The lower spillway will be constructed as a part of this HREP (See Plate 31). The 1,100-foot lower spillway will be constructed by shaping the existing levee section and placing 87,300 square feet of concrete matting on the crown and landside slope, 3,245 tons of riprap on the riverside slope and 1,489 tons of riprap on the landside toe, 150,800 square feet of geo-textile fabric to be placed under the riprap and concrete mat collectively, and a 6 feet high reinforced concrete cutoff wall running the length of the spillway. The finished crown of the spillway will be at approximately the 10-year protection level (elevation 545.2 MSL). The riprap will be a 2 feet thick on the riverside, and 3 feet thick on the landside, both for the entire length of the spillway. The concrete cutoff wall will be located on the crown of the levee, and shall prevent water infiltrating through the levee at an elevation lower than the spillway crown elevation. The spillways are designed to work together to fill the interior in a controlled manner, minimizing damage to the levee and interior features by reducing head differential at time of overtopping (~1 foot). The upper spillway is required because the levee's length and river slope prevents the lower spillway from filling the upper end to the elevation needed to prevent damages. To construct the spillway, approximately 14,400 cubic yards of excavated material will have to be relocated. It is anticipated that this material will be placed on

Comment [KHH1]: Is this right? Check previous references to FWS spillway for agreement. Everywhere else in the document, the upper spillway is at the 11.1 year level of protection.

adjacent levee sections requiring work. An alternate spillway location was added to recommended plan plate 4 because of cultural resource concerns. The alternate location will be used if cultural clearance of the current location is not possible.

(b) Archeological Site Protection (R1). Shoreline protection of 9 known archeological sites will be accomplished through rock protection. The protection will have a 50-year project life. Due to the lack of slope at two of the sites, they will be protected with a breakwater structure. The breakwater structures shall be located immediately off shore from the sites, and shall be constructed of riprap having an 8 feet wide crown and 2H:1V side slopes. For the remaining seven sites, the protection shall be riprap placed directly on the shoreline that will extend 3 feet out from the bank and have a 2H:1V side slope (See Plate 32). The total amount of riprap required for the proposed archeological site protection is 8,619 tons. Shoreline protection of archeological sites is needed to protect known sites from further erosion caused by frequent water level fluctuation. Habitat benefits for the proposed protection for the archeological sites were not evaluated. However, any rock placed in the water will provide ancillary aquatic benefits, primarily for fish, to an area with little to no rocky structure.

(c) Michael Creek Wing Dam (R1). The Michael Creek wing dam will be located just upstream of the project's inlet structure. The wing dam will have 2H:1V side slopes, an 8-foot top width, extend 25 feet into the river (additional 10-feet inland), and stand 3 feet taller than the existing river bottom along its 25-foot length (See Plate 32). The total amount of riprap required for the proposed wing dam is 90 tons. The wing dam will be submerged to avoid impacts to navigation, but high enough to deflect heavy sediments from Michael Creek and the Mississippi River into faster currents that will transport the material downstream, away from the inlet structure. Habitat benefits for the wing dam itself were not evaluated.

(5) Sand Prairie Planting (P1). This feature consists of planting the 36-acre field with a commercial, predetermined bulk seed mix harvested from a local mesic to dry prairie. The mix will contain both grasses and forbs. Approximately 25 acres of this site were previously restored, but heavily damaged by the 1993 flood. The remaining 11 acres are currently row cropped to provide food resources for waterfowl and other wildlife. The planting will be done by the USFWS using a seed drill at a rate of 12-16 pounds of seed per acre. Prior to planting, the USFWS will prepare the site, as appropriate. This may include burning, disking, and/or other measures, as needed. This feature yields a net benefit of 11.3 AAHUs.

(6) Upper Fish Nursery (N1). The proposed fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake. The refuge manager would select which species to stock in the nursery each year. This feature consists of utilizing an existing containment area for use as a fish nursery that is approximately 21 acres in area. The area currently has a stoplog control structure, which is damaged and will be replaced. This existing structure will be replaced with a 36-inch reinforced concrete pipe (RCP) culvert and stop log water control structure in a 48-inch RCP riser (See Plate 34). With the new structure, the area will be able to pond water up to approximately 3 feet deep, allowing the stocking of fingerlings that will be released into Lake Odessa at a later date (See Plate 3). This feature yields a net benefit of -0.7 AAHU. This structure is an artificial feature and could not be properly evaluated with the habitat models available. Model results were included for completeness. This apparent lack of benefits reflects the MOFISH model's design to evaluate natural situations. The negative impacts reflect the isolation of this area from the main lake. The assumption was made,

using best professional judgment, that this feature would provide the intended nursery benefits. Post-construction monitoring will be implemented to document the results of this feature.

c. Project Feature Summary. Table 6-1 summarizes project data.

TABLE 6-1. Lake Odessa Project Feature Summary Table

Feature	Measurement	Unit of Measure
<i>Moist Soil Unit</i>		
<i>Field 4 & 5</i>		
Site Area	83	acres
Pump Pad	1	items
Portable Pump with Power Pack (10,000 gpm)	1	items
<i>Field 21</i>		
Site Area	83	acres
Pump Pad	1	items
Portable Pump with Power Pack (10,000 gpm)	1	items
<i>MSU 20</i>		
Site Area	72	acres
<i>Fox Pond</i>		
Site Area	336	acres
Pump Station (25,000 gpm)	1	items
Pump Pad	1	items
Slide Gate Control Structure (36-inch CMP)	1	items
<i>Dedicated Water Bay</i>		
Sheet Pile	40	feet
Concrete	2	cubic yards
64" by 43" CMP Pipe Arch	62.5	feet
Excavated Channel	500	feet
	3203	cubic yards
<i>Unit 2</i>		
Site Area	92	acres
Portable Pump with Power Pack (4,000 gpm)	1	items
Slide Gate Control Structure under Muscatine Slough road (36-inch CMP)	1	items
<i>IDNR MSU</i>		
Site Area	49	acres
Clear/Grub	49	acres
Pump Pad	1	Items
Portable Pump with Power Pack (10,000 gpm)	1	items
Slide Gate Control Structure (36-inch CMP)	1	items
<i>Sand Prairie Restoration</i>		
<i>Field 6 Sand Prairie Planting</i>		
Area	36	acres

TABLE 6-1 (Continued)

Feature	Measurement	Unit of Measure
Fisheries Enhancement		
<i>Fish Nursery</i>		
Area	21	acres
Stoplog Control Structure (36-inch RCP)	1	items
<i>Dredge Lake Odessa (Main Lake) (Hydraulic)</i>		
Length	1490	feet
Top Width	751	feet
Depth	2	feet
Dredged Material	81555	cubic yards
Channel Side Slopes	6:1	horizontal:vertical
<i>Dredge Goose Pond (Hydraulic)</i>		
Length	5158	feet
Top Width	142	feet
Depth	4	feet
Dredged Material	90170	cubic yards
Channel Side Slopes	6:1	horizontal:vertical
<i>Dredge Blackhawk Chute/Yankee Chute (Hydraulic)</i>		
Length	6040	feet
Top Width	95	feet
Depth	4	feet
Dredged Material	63530	cubic yards
Channel Side Slopes	6:1	horizontal:vertical
<i>Dredge Channel Between Swarms and Bebee Ponds (Mechanical)</i>		
Length	650	feet
Top Width	126	feet
Depth	1	feet
Dredged Material	2890	cubic yards
Channel Side Slopes	6:1	horizontal:vertical
<i>Dredge Channel Between Swarms Pond and Lake Odessa (Mechanical)</i>		
Length	1517	feet
Top Width	118	feet
Depth	1	feet
Dredged Material	6290	cubic yards
Channel Side Slopes	6:1	horizontal:vertical
Main Stem Levee Restoration		
<i>Levee</i>		
Crown Width	12	feet
Side Slopes (Interior Only)	5:1	horizontal:vertical
Levee Length (Pre-Construction)	50396	feet
Levee Length (Work Areas))	44396	feet
Crown Elevation: River Mile 441.1	551.0	feet
River Mile 437.2	549.3	
River Mile 437.2	549.0	
River Mile 434.8	548.0	
Borrow Volume (Sand)	279987	cubic yards
Strip Layer	6	inches

TABLE 6-1 (Continued)

Feature		Measurement	Unit of Measure
Gravel Road Relocation	Width	12	feet
	Length	5496	feet
	Thickness	8	inches
	Mass	2931	tons
<i>Spillway</i>			
Crown Width		12	feet
Side Slopes: Interior Exterior		5:1 4:1	horizontal:vertical
Crown Elevation (MSL)		545.2	feet
Length		1100	feet
Concrete Matting		87300	square feet
Geotextile Fabric		150800	square feet
Riprap Thickness: Land Side (key in) River Side		36 24	inches
Riprap Mass (400 lb)		3245	tons
Riprap Mass (700 lb)		1489	tons
Bedding Thickness: Under Concrete Mat Under Riprap		6 9	inches
Bedding Mass		4672	tons
concrete Cutoff Wall	Length	1100	feet
	Height	6	feet
Excavation (Spoil)		14400	cubic yards
<i>Michael Creek Wing Dam</i>			
Crown Width		8	feet
Side Slopes		2:1	horizontal:vertical
Height		3	feet
Length		35	feet
Riprap Mass		90	tons
<i>Archeological Site Shoreline Protection</i>			
Crown Width		3	feet
Side Slope		2:1	horizontal:vertical
Height (average)		4	feet
Length (Shoreline)		3410	feet
Riprap Mass		8619	tons
<i>Mast Tree Planting</i>			
<i>Site A</i>			
Mast Tree Plantings		13	acres
Northern Pecan		88	trees
Swamp White Oak		88	trees
Bur Oak		88	trees
Pin Oak		88	trees
Sycamore		89	trees
Shellbark Hickory		89	trees
Total Trees		530	trees
Weed Barrier Mats		530	mats
Herbicide		530	treatment sites
Red Top Grass		13	acres

TABLE 6-1 (Continued)

Feature	Measurement	Unit of Measure
Mast Tree Planting (continued)		
<i>Site B</i>		
Mast Tree Plantings	14	acres
Northern Pecan	93	trees
Swamp White Oak	93	trees
Bur Oak	93	trees
Pin Oak	93	trees
Sycamore	94	trees
Shellbark Hickory	94	trees
Total Trees	560	trees
Weed Barrier Mats	560	mats
Herbicide	560	treatment sites
Red Top Grass	14	acres
<i>Site C</i>		
Mast Tree Plantings	26	acres
Northern Pecan	170	trees
Swamp White Oak	170	trees
Bur Oak	170	trees
Pin Oak	170	trees
Sycamore	170	trees
Shellbark Hickory	170	trees
Total Trees	1020	trees
Weed Barrier Mats	1020	mats
Herbicide	1020	treatment sites
Red Top Grass	26	acres
<i>Site D</i>		
Mast Tree Plantings	40	acres
Northern Pecan	264	trees
Swamp White Oak	264	trees
Bur Oak	264	trees
Pin Oak	264	trees
Sycamore	264	trees
Shellbark Hickory	264	trees
Total Trees	1584	trees
Weed Barrier Mats	1584	mats
Herbicide	1584	treatment sites
Red Top Grass	40	acres
Containment Berm for placement site		
Length	5800	feet
Height (average)	5	feet
Containment Area	40	acres

d. Construction Considerations.

(1) Storm Water Pollution/Erosion Control. The potential for storm water pollution during construction is minimal for this project. Storm water runoff from nearly all construction activity would be contained within the confines of the project. Temporary stabilization measures would be employed on disturbed areas of the side channel until stabilization occurs. Stabilization practices may include mulching, temporary seeding, and/or the erection of silt fencing. Overall, the long-term storm water runoff characteristics of the site would not be expected to change. All disturbed areas would reseed through natural succession with similar vegetation types as before project conditions.

(2) Permits. A public notice, as required by Section 404 of the Clean Water Act, will be made prior to submission of this report for final approval. A Section 401 water quality certificate from the State of Iowa and a Section 404(b)(1) Evaluation will be included in the final submission of this report. Because all land disturbances associated with this project are addressed in the 404(b)(1) Evaluation, a National Pollutant Discharge Elimination System (NPDES or Section 402) permit for storm water discharges will not be required.

(3) Construction Sequence. The probable construction sequence is summarized in Table 6-2; however, no sequence will be required contractually.

e. Operational Considerations. A brief description of pump operation, water control structures, pumping stations, inlet and outlet structures, and the fish nursery is given here. A complete list of Lake Odessa operation needs will be published in an O&M manual after construction.

(1) Pumps. There are multiple pumps included with this project, a fixed in place pump station, and four mobile crisafulli type pumps with self contained powering units. The pumps will have to be operated with manpower to keep them fueled and running, and relocate the portable pumps as needed.

(2) Water Control Structures. Multiple water control structures are a part of the recommended plan. The control structures include a gated controlled water bay, stop log structure, and multiple gated culverts. The gate on the water bay will have to be raised and lowered as needed to supply water to the MSU's in the upper end of the refuge. The stop log structure, which acts as the water control for the fish nursery, will have to be operated via installing and removing logs from the structure. The slide gate controlled culverts will have to be operated by raising and lowering gates.

(3) Refuge Inlet and Outlet Structures. In addition, the refuges inlet and outlet structures will have to be opened during extreme high water events. This will work concurrently with the spillways that are to be constructed to create a controlled flooding scenario.

(4) Upper Fish Nursery. The proposed 21-acre fish nursery is an existing USFWS wetland, managed primarily for migratory birds. The refuge has agreed to periodically, about one year in five; manage the unit to benefit native fish fry for stocking by the IDNR, at the discretion of the refuge manager. Fish species for stocking will be limited to species native to the Upper Mississippi River.

f. Maintenance Considerations. The proposed features have been designed to ensure low annual maintenance requirements. Maintenance may include performing inspections, adding

riprap, performing routine tree planting maintenance activities, mowing sites, prairie burning, and performing routine maintenance on the portable pumps and pump station. A complete list of maintenance needs for Lake Odessa will be published in an O&M manual after construction. The estimated annual maintenance costs are presented in Table 8-2. These quantities and costs may change during final design.

TABLE 6-2. Probable Construction Sequence

Sequence	Construction Work Item	Instructions	Purpose
1	Restore perimeter levee	Dredge Turkey Chute upstream and downstream of the lock and dam. Avoid dredging during late-fall and winter months.	Dredging in Turkey Chute will eliminate the need to obstruct river traffic. Perimeter levee will be enhanced as first step to offer added protection to interior features.
2	Construct spillway in lower end of refuge	Construct before restoring levee or ensure that section will not be raised with levee restoration.	This will eliminate possibility of raising the section during levee restoration and then excavating it out again to construct spillway.
3	Construct Michael Creek wing dam.	Construct as detailed in report.	Wing dam needed to focus flow of river to main channel. This will help limit sediment transport into Lake Odessa.
4	Construct containment berm at mast tree Site D and clear/grub IDNR MSU	Construct as detailed in report.	Containment areas needed for placing dredged material from deep holes/channels.
5	Dredge deep holes/channels	Avoid dredging during late-fall and winter months for the Main Lake. Allow water to drain from placement sites, and disk material into IDNR site.	At Site D, the dredged material will provide a dry, elevated surface to perform mast tree planting. At the IDNR MSU, it will provide a sealed unit to contain water when desired. No winter dredging to avoid overwintering fish impacts in Main Lake. No dredging June-August for water quality reasons.
6	Place shoreline protection	Ensure that equipment and dredged material/riprap does not disturb the existing shoreline during placement.	Reduce possibility of causing damage to archeological features that are being protected.
7	Install/construct water control structures	Construct in manner that minimizes damage to existing berms and maintains access into refuge.	Will ensure access at all times and minimize damage to existing berms.
8	Plant mast trees	Plant mast trees once Site D has dried adequately, which will take approximately one year. ¹	Area will be dewatered to provide suitable conditions for planting.
9	Plant sand prairie	Plant during dormant season (Nov 5 - Mar 5).	Sowing seeds during dormant season allows incorporation of the seed into the soil through frost heaving.

¹ Sites A, B, and C could be planted prior to D, as they will be planted in areas that will require no dewatering. But, it is anticipated that all the sites will be planted at approximately the same time.

² Shoreline protection, water control structures, and Michael Creek wing dam could be done concurrently, and in general, at any time.

7. SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 7-1 presents the schedule for project completion steps.

TABLE 7-1. Project Implementation Schedule

Requirement	Scheduled Date
Distribute Draft DPR	Mar 03
Complete ITR and VE study	Sep 03
Submit DPR for public and agency review	Aug 04
Submit Final DPR to Mississippi Valley Division	Oct 04
Receive plans and specification funds	Oct 04
Independent Technical Review of plans and specifications	Feb 05
Approval of plans and specifications	Jun 05
Construction approval by HQUSACE	Jun 05
Advertise contract	Jun 05
Award contract	Sep 05
Complete construction	Dec 07

8. COST ESTIMATES

Table 8-1 compares costs for the fully funded estimate (FFE) and the current work estimate (CWE) (see Appendix J). The FFE was calculated based on the proposed construction schedule, expected escalation costs, and a contingency factor, and represents the money expected to be spent at the end of project construction. The CWE, with an approximate 20% contingency factor, is shown in a detailed estimate of project design and construction costs as presented in Table 8-2. A detailed estimate of operation, maintenance, and rehabilitation costs is presented in Table 8-3. Table 8-4 presents the annual monitoring costs. Quantities and costs may vary during final design. All cost estimates are calculated using present worth (May 2004) and do not include future inflation escalation.

**TABLE 8-1. Lake Odessa Habitat Rehabilitation and Enhancement
Project Cost Summary, May 2004 Price Level**

Account	Feature	Fully Funded Estimate (FFE) (\$)	Current Working Estimate (CWE) (\$)
01	Lands and Damages	0	0
02	Relocations	0	0
06	Fish and Wildlife Facilities	\$11,641,961	\$11,098,152
30	Planning, Engineering and Design	\$2,039,000	\$2,039,000
31	Construction Management	\$698,005	\$665,400
Total Project Costs ¹		\$14,378,966	\$13,802,552

¹ Project features are on Federal land and therefore 100% federally funded.

**TABLE 8-2. Lake Odessa Habitat Rehabilitation and Enhancement
Detailed Project Cost Summary, May 2004 Price Level**

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
01	LANDS AND DAMAGES						
	Real Estate	-	-	\$ -	\$ -	\$ -	0%
02	Relocation	-	-	\$ -	\$ -	\$ -	0%
06	FISH AND WILDLIFE FACILITIES						
06.10	MSUs						
	Field 4 & 5						
	Portable Pump with Power Source	1	lump sum	\$49,803	\$49,803	\$9,961	20%
	Pump Pad	1	lump sum	\$56,528	\$56,528	\$11,306	20%
	Field 21 MSU						
	Portable Pump with Power Source	1	lump sum	\$49,803	\$49,803	\$9,961	20%
	Pump Pad	1	lump sum	\$56,528	\$56,528	\$11,306	20%
	Fox Pond						
	Permanent Pump Station	1	lump sum	\$195,476	\$195,476	\$39,095	20%
	36" CMP with Slide Gate	1	lump sum	\$22,361	\$22,361	\$4,472	20%
	Pump Pad	1	lump sum	\$56,528	\$56,528	\$11,306	20%
	Dedicated Water Bay						
	Structure Construction	1	lump sum	\$26,849	\$26,849	\$5,370	20%
	Supply Ditch	3,203	cubic yards	\$15.75	\$50,447	\$10,089	20%
	64" x 43" CMP Pipe Arch	1	lump sum	\$15,833	\$15,833	\$3,167	20%
	Unit 2						
	Portable Pump with Power Source	1	lump sum	\$41,265	\$41,265	\$8,253	20%
	36" CMP with Slide Gate	1	lump sum	\$13,561	\$13,561	\$2,712	20%
	IDNR MSU						
	Portable Pump with Power Source	1	lump sum	\$49,803	\$49,803	\$9,961	20%
	36" CMP with Slide Gate	1	lump sum	\$23,551	\$23,551	\$4,710	20%
	Pump Pad	1	lump sum	\$56,528	\$56,528	\$11,306	20%
	Clearing/Grubbing	49	acres	\$2,288	\$112,098	\$22,420	20%
	TOTAL MSUs				\$876,962	\$175,395	
06.20	Sand Prairie Planting						
	Field 6						
	Seed	36	acres	\$682.75	\$24,579	\$4,916	20%
	TOTAL Sand Prairie Planting				\$24,579	\$4,916	

TABLE 8-2 (Continued)

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
06.30 Fish Nursery							
	Structure						
	36" RCP With Stop Log Structure	1	lump sum	\$36,957	\$36,957	\$7,391	20%
	TOTAL		Fish Nursery		\$36,957	\$7,391	
06.40 Fisheries Enhancement (Deep Hole/Channel Dredging)							
	Lake Odessa (Main Lake)	81,555	cubic yards	\$9.12	\$743,781	\$148,756	20%
	Goose Pond	90,170	cubic yards	\$9.12	\$822,350	\$164,470	20%
	Blackhawk Chute/Yankee Chute ¹	63,530	cubic yards	\$9.12	\$579,394	\$115,879	20%
	Swarms Pond/Beebe Pond ⁴	9,185	cubic yards	\$7.79	\$71,551	\$14,310	20%
	Hydraulic/Mechanical Mob/Demob ⁸	1	lump sum	\$22,606	\$22,606	\$4,521	20%
	Sonar Surveys	1	lump sum	\$30,881	\$30,881	\$6,176	20%
	Containment Berm ²						
	Clearing/Grubbing	13.3	acres	\$2,172	\$28,888	\$5,778	20%
	Berm Work	21,799	cubic yards	\$3.71	\$80,874	\$16,175	20%
	TOTAL		Fisheries Enhancement		\$2,380,325	\$476,065	
06.50 Mast Tree Planting							
	Site A						
	Northern Pecan	88	trees	\$22.90	\$2,015	\$403	20%
	Swamp White Oak	88	trees	\$22.90	\$2,015	\$403	20%
	Bur Oak	88	trees	\$22.90	\$2,015	\$403	20%
	Pin Oak	88	trees	\$22.90	\$2,015	\$403	20%
	Sycamore	89	trees	\$22.90	\$2,038	\$408	20%
	Shellbark Hickory	89	trees	\$22.90	\$2,038	\$408	20%
	Labor/Tools For Planting	1	lump sum	\$935	\$935	\$187	20%
	Weed Barrier Mat	530	mats	\$12.37	\$6,556	\$1,311	20%
	Herbicide	530	trees	\$3.18	\$1,685	\$337	20%
	Red Top Grass	13	acres	\$1,081	\$14,053	\$2,811	20%
	Site B						
	Northern Pecan	93	trees	\$22.90	\$2,130	\$426	20%
	Swamp White Oak	93	trees	\$22.90	\$2,130	\$426	20%
	Bur Oak	93	trees	\$22.90	\$2,130	\$426	20%
	Pin Oak	93	trees	\$22.90	\$2,130	\$426	20%
	Sycamore	94	trees	\$22.90	\$2,153	\$431	20%
	Shellbark Hickory	94	trees	\$22.90	\$2,153	\$431	20%
	Labor/Tools For Planting	1	lump sum	\$935	\$935	\$187	20%
	Weed Barrier Mat	560	mats	\$12.37	\$6,927	\$1,385	20%
	Herbicide	560	trees	\$ 3.18	\$1,781	\$356	20%
	Red Top Grass	14	acres	\$1,081	\$15,134	\$3,027	20%

TABLE 8-2 (Continued)

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
Site C							
	Northern Pecan	170	trees	\$22.90	\$3,893	\$779	20%
	Swamp White Oak	170	trees	\$22.90	\$3,893	\$779	20%
	Bur Oak	170	trees	\$22.90	\$3,893	\$779	20%
	Pin Oak	170	trees	\$22.90	\$3,893	\$779	20%
	Sycamore	170	trees	\$22.90	\$3,893	\$779	20%
	Shellbark Hickory	170	trees	\$22.90	\$3,893	\$779	20%
	Labor/Tools For Planting	1	lump sum	\$1,713	\$1,713	\$343	20%
	Weed Barrier Mat	1020	mats	\$12.37	\$12,617	\$2,523	20%
	Herbicide	1020	trees	\$ 3.18	\$3,244	\$649	20%
	Red Top Grass	26	acres	\$1,081	\$28,106	\$5,621	20%
	Site Access ⁶	1	lump sum	\$1,169	\$1,169	\$234	20%
Site D ³							
	Northern Pecan	264	trees	\$22.90	\$6,046	\$1,209	20%
	Swamp White Oak	264	trees	\$22.90	\$6,046	\$1,209	20%
	Bur Oak	264	trees	\$22.90	\$6,046	\$1,209	20%
	Pin Oak	264	trees	\$22.90	\$6,046	\$1,209	20%
	Sycamore	264	trees	\$22.90	\$6,046	\$1,209	20%
	Shellbark Hickory	264	trees	\$22.90	\$6,046	\$1,209	20%
	Labor/Tools For Planting	1	lump sum	\$2,650	\$2,650	\$530	20%
	Weed Barrier Mat	1584	mats	\$12.37	\$19,594	\$3,919	20%
	Herbicide	1584	trees	\$ 3.18	\$5,037	\$1,007	20%
	Red Top Grass	40	acres	\$1,081	\$43,240	\$8,648	20%
	Site Access ⁶	1	lump sum	\$1,815	\$1,815	\$363	20%
TOTAL		Mast Trees			\$251,787	\$50,360	
06.60 Main Stem Levee Restoration ¹⁰							
Levee crown and side slope improvements							
	Hydraulic Dredging/ Placement ⁵	279,987	cubic yards	\$11.73	\$3,284,248	\$656,850	20%
	Borrow Placement By Scraper ⁹	10,149	cubic yards	\$1.50	\$15,224	\$3,045	20%
	Clearing / Grubbing	75	acres	\$142	\$10,650	\$2,130	20%
	6" Surface Scrape	90,086	cubic yards	\$3.03	\$272,961	\$54,592	20%
	Survey	1	lump sum	\$59,843	\$59,843	\$11,969	20%
	Mob/Demob ⁸	1	lump sum	\$219,546	\$219,546	\$43,909	20%
Spillway							
	Earthwork	14,400	cubic yards	\$3.57	\$51,408	\$10,282	20%
	6" Surface Scrape	14,178	square feet	\$0.97	\$13,753	\$2,751	20%
	Concrete Matting	87,300	square feet	\$9.65	\$842,445	\$168,489	20%
	Geotextile Fabric	16,757	square yards	\$2.99	\$50,103	\$10,021	20%
	Riprap (400 lb)	3,465	tons	\$25.33	\$87,768	\$17,554	20%
	Riprap (700 lb)	1,567	tons	\$25.33	\$39,692	\$7,938	20%
	Riprap Placement	3,049	cubic yards	\$20.83	\$63,511	\$12,702	20%
	Bedding Stone	4,944	tons	\$21.28	\$105,208	\$21,042	20%
	Concrete Cutoff Wall	1,170	feet	\$95.77	\$112,051	\$22,410	20%
Michael Creek Wing Dam							
	Riprap	90	tons	\$27.11	\$2,440	\$488	20%
	Placement From Barge	55	cubic yards	24.32	\$1,338	\$268	20%
	Mob/Demob	1	lump sum	\$30,970	\$30,970	\$6,194	20%

TABLE 8-2 (Continued)

Acct Code	Item	Quantity	Unit	Unit Price	Amount	Contingency	Cont. %
	Archeological Site Protection						
	Riprap (400 lb)	8,619	tons	\$27.11	\$233,661	\$46,732	20%
	Placement From Barge	5,224	cubic yards	\$22.68	\$118,480	\$23,696	20%
	Mob/Demob	1	lump sum	\$62,544	\$62,544	\$12,509	20%
	TOTAL		Main Stem Levee		\$5,677,844	\$1,135,571	
	FISH AND WILDLIFE FACILITIES COST SUBTOTAL				\$9,248,454		
	Contingencies Subtotal					\$1,849,698	
	FISH AND WILDLIFE FACILITIES COST TOTAL				\$11,098,152		
30	PLANNING ENGINEERING AND DESIGN						
	Definite Project Report				\$1,809,000		
	Plans and Specifications				\$175,000		
	Engineering During Construction				\$55,000		
	SUBTOTAL				\$2,039,000		
31	CONSTRUCTION MANAGEMENT						
	Contract Administration				\$99,900		
	Shop Drawing Review				\$66,600		
	Inspection and Quality Assurance				\$498,900		
	SUBTOTAL				\$665,400		
	TOTAL PROJECT COST				\$13,802,552		
Notes:							
¹ Dredged material from Blackhawk Chute to Yankee Chute shall be placed in IDNR MSU.							
² Containment berm shall be constructed to act as a placement site for material dredged from Lake Odessa and Goose Pond.							
³ Mast tree Site D shall be planted when area is dry.							
⁴ Swarms and Bebee Ponds shall be mechanically dredged with amphibious backhoe, with the dredged material placed on the downstream bank.							
⁵ Cost includes dredging and placement of sand to establish levee section.							
⁶ Cost to access Sites C and D by water.							
⁷ Unit price for rock placement is high because it will require a crane mounted on a barge.							
⁸ Mob/Demob cost includes reconfiguration costs to move between the dredge sites. Cost also includes the costs to mobilize the hydraulic and mechanical dredges. Restoration of levee only entails hydraulic dredging.							
⁹ Borrow placement by scraper is item to place hydraulically dredged borrow material by hauling from one area to another area by a small floating type scraper.							
¹⁰ Overall cost of main stem levee includes cost to relocate gravel road as needed.							

TABLE 8-3. Estimated Annual Operation and Maintenance Costs
(April 2004 Price Level)

Operation				
Pump Operation ¹	2715	hrs	\$8.90	\$24,166
Maintenance				
Mowing/Disking of MSUs ³	132	acres	\$20.02	\$2,643
Mowing Main Stem Levee Annually	137	acres	\$8.50	\$1,165
Mowing Mast Tree Sites A and B	27	acres	\$17.00	\$459
Mowing/Burning of Sand Prairie (Field 6) ⁴	36	acres	\$17.86	\$643
Riprap	132	tons	\$17.80	\$2,515
Road Gravel ⁶	1,200	tons	\$15.00	\$18,000
Site Inspection ²	64	hrs	\$47.75	\$3,056
Rehabilitation ⁵			\$-	\$ -
			Subtotal:	\$52,647
Contingencies (20%)				\$10,529
			Total:	\$63,176

¹ Pump operation costs include fuel and upkeep costs for all pumps.

² Yearly cost to inspect all items.

³ Annually, the USFWS plans to mow 25% of Field 4 & 5, Field 21, MSU 20, and Unit 2 (82.5 acres) and the IADNR plans to mow all of their MSU (49 acres), which totals ~ 132 acres.

⁴ Represents an average cost over the first 5 years. Includes mowing four times the first year, two times the second year, and burning one time per year for years 3 through 5. After year 5, field will be burned off every 3 years at \$12 per acre.

⁵ Rehabilitation cannot be accurately measured. Rehabilitation is the reconstructive work that significantly exceeds the annual operation and maintenance requirements identified above and that is needed as a result of major storms or flood events.

⁶ One time cost to place additional gravel that may have been lost due to settlement, etc.

TABLE 8-4. Estimated Post-Construction Annual Monitoring Costs
(April 2004 Price Level)

Item	Annual Cost
Engineering Data	\$ 5,200
Natural Resource Data	<u>\$ 2,000</u>
Subtotal	\$ 7,200
Contingencies (20%)	<u>\$ 1,440</u>
Subtotal:	\$ 8,640
Planning, Engineering, Design ¹	<u>\$ 2,100</u>
Total:	\$ 10,740

¹ Includes cost of annual performance evaluation report.

9. ENVIRONMENTAL EFFECTS

a. Summary of Effects. The Lake Odessa complex is a large, complex site with a variety of terrestrial and aquatic habitats that vary in quantity and quality. Overall goals for the project area are to protect some of these resources from future reductions in quantity and quality and to increase the quantitative and qualitative values of other resources. Increasing the value of some habitat types usually occurs at the expense of other habitat types. In most cases, the trade-off for higher quality habitat is a loss of lower quality habitat. In other cases, habitats of similar quality may be altered in order to carry out management objectives for the site.

The primary goals for the Lake Odessa HREP are to restore and protect wetland, terrestrial, and aquatic habitat. The proposed project features for the Lake Odessa complex involve four primary enhancement features: enhancing the current MSUs, primarily through increased water level control; increasing the amount of deep-water overwintering habitat for fish; planting 93 acres of mast-producing trees on higher elevations; and protecting the interior features through levee restoration and a spillway. Additional features include restoring the sand prairie (terrestrial habitat enhancement) and constructing the upper fish nursery (fisheries enhancement).

Management measures selected to meet these objectives include enhancing the following MSUs; USFWS complex (Field 4 & 5, Field 21, MSU 20), Unit 2, Fox Pond, Swarms/Bebee Ponds, and IDNR MSU; dredging the following areas to enhance fisheries habitat; Swarms/Bebee Ponds, Main Lake, Goose Pond, and Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; mast tree planting at Sites A, B, C, and D; and restoring the perimeter levee. This combination would meet HREP goals and objectives, would add to habitat diversity and quality, and would best meet the overall management objectives for the site.

The management measures planned for this project are consistent with and support the goals of the North American Waterfowl Management Plan and the Partners in Flight Program.

b. Economic and Social Impacts.

(1) Community and Regional Growth. No impacts to the growth of the community or region would be realized as a result of the project. The project indirectly would improve recreation opportunities at the Lake Odessa complex by increasing the attractiveness of the area for fishing, hunting, wildlife observation, photography, recreational boating, birding, and swimming.

(2) Community Cohesion. The proposed environmental enhancement project would positively impact community cohesion by attracting visitors and recreationists from other communities to the wildlife area. The potential increase in recreation activities at the Lake would not adversely impact area property owners. No public opposition to the enhancement measures has been expressed, nor is any expected.

(3) Displacement of People. No residential displacements would be caused by the proposed habitat rehabilitation and enhancement project.

(4) Property Values and Tax Revenues. The Lake Odessa Wildlife Area is located on federally owned land managed by the IDNR and the USFWS. No change in property values or tax revenues would occur.

(5) Public Facilities and Services. The project site currently experiences annual visitations in excess of 140,000 for non-consumptive uses, plus 20,000 hunter days per year and

50,000 angler days per year. The proposed project would positively impact public facilities and services by increasing overall habitat diversity, resulting in heightened opportunities for recreational use of the Lake Odessa Wildlife Area.

Public boat ramps located at the upper and lower ends of the lake would not be affected by the proposed project.

(6) Life, Health and Safety. There would be no impacts to life, health, or safety.

(7) Business and Industrial Growth. Changes in business and industrial activities during project construction would be insignificant. Long-term impacts to business activity would be related to tourism and recreational activities. No business or industrial relocations would be required.

(8) Employment and Labor Force. Project construction would slightly increase short-term employment opportunities in the project area. The project would not directly affect the permanent employment or labor force in Louisa County, Iowa.

(9) Farm Displacement. No farms or farmsteads would be displaced. No prime and unique farmland would be impacted.

(10) Noise Levels. Heavy machinery would generate an increase in noise during project construction and temporarily disturb wildlife and recreationists in the area. Construction would be done in phases over the winter and summer months with the majority of work occurring during the summer when the water levels are the lowest. The project is located in an area with limited residential or other development, and no significant long-term noise impacts would result.

(11) Aesthetics. The clearing of some woody vegetation would occur because of construction activities. Following construction, the area would be reseeded and planted with mast trees. No permanent adverse impacts to area aesthetics are anticipated. The enhancement of habitat areas would make the wildlife area more aesthetically pleasing to visitors. There are approximately 200 seasonal and 5 permanent residences on the bluff overlooking the complex. The proposed project would not be expected to adversely impact the viewscape for these properties.

c. Natural Resources Impacts. Effects of the project on natural resources were evaluated using WHAG (Urich *et al.* 1984). This habitat evaluation method was used during project planning to evaluate various features in terms of increased benefits to wildlife resources. Optimization of benefits (expressed as habitat units, or HUs) in relation to project cost is considered to be the goal of feature selection. Results of the habitat evaluation are summarized in Table 5-1, with a more detailed analysis in Appendix D. Assessment of project impacts was based on sound management practices and the experience of USFWS, Iowa DNR, and Corps natural resource professionals.

(1) Wetland and Floodplain Terrestrial Habitat. The primary benefits to wetland and floodplain terrestrial habitat include: (1) enhancing existing MSUs with increased water level control and reliability, thereby increasing germination and growth of desired wetland plants, and use of these plants by waterfowl and wildlife; (2) reseeding the former sand prairie area with locally grown, native seed, restoring a unique habitat and increasing the diversity of the area; (3) increasing forest acreage and diversity, accomplished through a combination of active planting of mast-producing trees in former cropfields, interplanting in existing forest, and replanting the dredged material containment site to a more beneficial mixture of species; and (4) preserving

existing MSU, sand prairie, and bottomland hardwood forest acreage from future losses due to flooding and/or levee failure by levee restoration.

All MSU areas disturbed during construction would be replanted following construction or would be allowed to revegetate from the existing seed bank. Material removed for construction of the water supply ditch from the dedicated bay would be sidecast and the area would be reseeded after construction.

The proposed project would take place entirely within the Mississippi River floodplain and within the Lake Odessa complex levee. No measurable change in floodplain storage would occur as a result of the proposed project, and the project would not directly or indirectly induce additional development within the floodplain.

Additional benefits would be incurred through levee restoration, which protects interior features from degradation by flooding and/or levee failure. Construction of the proposed features would disrupt use of surrounding areas by wildlife, but the majority of disruption would only be temporary. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetlands by construction activities. There is no practicable alternative to such construction and the resulting wetlands impacts if the overall environmental benefit, including protection of other existing wetland acreages, is to be achieved.

(2) Aquatic Habitat. Construction activity would temporarily increase turbidity immediately downstream of the proposed dredge cuts in the Main Lake, Goose Pond, Blackhawk/Yankee Chutes, Swarms/Bebee Ponds, and the two locations in Turkey Chute. Material hydraulically dredged from the Main Lake and Goose Pond would be placed into the new containment area. Material hydraulically dredged from Blackhawk/Yankee Chutes would be used to line the IDNR MSU. Material mechanically dredged from Swarms/Bebee Ponds would be sidecast on the downstream embankment next to the channel. Material hydraulically dredged from Turkey Chute, a side channel of the Mississippi River, would be placed inside the levee to restore design heights and side slopes. Minor increases in turbidity during construction are not expected to have any long-term impacts on aquatic resources. Disruption and loss of some benthic organisms would occur at construction sites, but these areas should be re-colonized following project completion. However, levee restoration at open water areas would increase the existing levee footprint by up to 100 feet, impacting some open water areas.

Construction of the wing dam between Michael Creek and the inlet structure for the Lake Odessa complex would deflect heavy sediments away from the inlet structure. The structure itself may provide fisheries benefits by increasing substrate and water velocity diversity in the immediate area. Only minor, temporary increases in turbidity are expected from these actions.

Riprap placement on the archeological sites would provide protection from erosion of these areas, with only minor temporary increases in turbidity. The riprap may provide additional substrate diversity in the Main Lake.

None of these actions is believed to have detrimental impacts to the aquatic resources of the area. Instead, these actions will provide much needed deep-water, and access to such, for the areas' fisheries. These habitat benefits are described in the following section. Additional benefits would be incurred through levee restoration, which protects the interior features from degradation by flooding and/or levee failure.

(3) Fish. Fish use of the deeper water areas in the Main Lake, Goose Pond, and Yankee/Blackhawk Chutes is expected to increase as a result of the project, particularly during winter months. In addition, access and egress from Swarms and Bebee Ponds, and Yankee Chute will be improved with the proposed project features. Lack of deep-water overwintering areas is a limiting factor at Lake Odessa. These areas would also serve as summer refugia. For these reasons, the fisheries enhancement features are expected to increase the quality of existing deep-water habitat and help to ensure its future availability in the Lake Odessa complex.

Construction of the fish nursery feature would provide a protected environment for fry to reach a larger size, before release into the Main Lake. This would decrease mortality of the fry and such stocking efforts could augment existing fish populations, as needed.

Restoration of the levee would protect the deep-water habitats from increased sedimentation incurred during floods and/or levee failures. Dredging in Turkey Chute to provide material for the restoration would increase water depths and enhance habitat for fish in the side channels where the dredge cuts are proposed as well as providing additional, needed overwintering habitat for Pool 18.

Placement of rock shoreline protection on selected archeological sites is expected to benefit aquatic resources by increasing substrate diversity. Additional discussion of aquatic and water quality impacts is contained in Appendix B - Clean Water Act, Section 404(b)(1) Evaluation.

(4) Wildlife. Enhancement of the MSUs would primarily benefit migrating waterfowl. Increased water level control and reliability would increase the germination and growth of moist soil plants. This improved control would also allow fall flooding of the units, making the food resources more readily available to waterfowl, such as dabbling and diving ducks. These areas would also provide benefits to other wildlife species. Construction of the proposed features would disrupt use of these areas by wildlife, but that disruption would only be temporary.

Preparation and seeding of the sand prairie area would eliminate use of that area for row crops grown for wildlife use. However, restoration of this unique sandy area within the floodplain would contribute to the overall diversity of the complex.

Mast tree planting would increase tree species diversity within the Lake Odessa complex. Planting on higher areas would increase the expected amount of tree regeneration. This increase in diversity, and production of mast by these trees, would benefit such species as the wood duck, one of the target species for this proposed action. Disruption of the habitat during planting would be minor. Sites A and B would have periodic mowing during tree establishment in order to reduce weedy competition. Once the trees are well established, the maintenance procedure would no longer be necessary. Once Site D has dried sufficiently, it would be graded prior to planting to ensure proper rainfall and floodwater runoff. No significant impacts to the system are expected from these actions.

Additional benefits would be incurred through levee restoration, which protects interior features from degradation by flooding and/or levee failure. Construction of the proposed features would disrupt use of surrounding areas by wildlife, but that disruption would only be temporary. Levee

restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. However, the protection provided by the levee and the large acreage of wetlands within the leveed area offset any impacts to wetland by construction activities.

(5) Endangered Species. The following is a list of federally endangered or threatened species potentially found in Louisa County, Iowa:

Status	Common Name	Scientific Name
E	Higgins' Eye Pearly Mussel	<i>Lampsilis higginsii</i>
E	Indiana Bat	<i>Myotis sodalis</i>
T	Bald Eagle	<i>Haliaeetus leucocephalus</i>
C	Eastern Massasauga Rattlesnake	<i>Sistrurus catenatus catenatus</i>

T = threatened
 E = endangered
 C = candidate

Higgins' eye pearly mussels usually inhabit coarse gravel or cobble substrate. Because of the dominance of sand and silty materials in the project area, these species are not likely to occur within the leveed area. Mussel beds are known to occur in the main channel of the Mississippi River in proximity to the Lake Odessa area. Dredging areas in Turkey Chute for levee restoration would be located away from any mussel beds in the area. For this reason, the proposed action is not expected to impact these mussel species.

During the summer, Indiana bats frequent the corridors of streams with well-developed riparian woods, as well as mature upland forests in this part of Iowa and Illinois. They forage for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation, along the borders of croplands, along wooded fencerows, and over farm ponds and pastures. During the summer, the bats roost and rear their young beneath the loose bark of large dead or dying trees, and prefer standing dead trees with loose bark and enough space to roost between the bark and the trunk. These roost trees are typically located within 1,600 feet of a stream or river. Indiana bats winter in caves or mines. Tree clearing should not be conducted during the April 1-September 30 timeframe. Prohibiting clearing activity during this 6-month timeframe would avoid potential impacts to summer roosting Indiana bats.

Bald eagles are regularly seen using the Mississippi River corridor area in and around the Lake Odessa complex during migration for resting and feeding, as well as a nesting area in the past. The Lake Odessa complex contains many mature trees that are a key component for eagle habitat, both for roosting and nesting. Tree clearing for project construction would be limited to a zone approximately 65 feet wide for construction of the water supply ditch from the dedicated water bay at the inlet structure, and 100 feet wide for the dredged material containment berm. In addition, placement of the dredged material into the containment site will increase tree mortality within the area. The proposed levee restoration may increase the existing levee footprint by up to 65 feet on land (100 feet in open water areas). Any clearing of trees suitable for roosting would be avoided during times that eagles are present. No known eagle nests are located within the immediate levee restoration area. In addition, the Lake Odessa complex provides many wooded areas. The impacted areas are very small in comparison. Therefore, no significant impacts to bald eagles are expected.

The eastern massasauga rattlesnake shows a strong affinity for wetlands, but also uses upland habitats during part of the year. No known populations of massasaugas remain at Lake Odessa and the proposed construction is not expected to impact this species.

The following is a list of State of Iowa threatened and endangered species potentially found in Louisa County, Iowa. Some of these species may only be found in the rare sand prairie complex located north of the Lake Odessa complex and south of the city of Muscatine, Iowa, several miles upstream. Those species most likely to occur in the project area are discussed in more detail below.

Status	Common Name	Scientific Name
	Bald Eagle*	<i>Haliaeetus leucocephalus</i>
E	Red-shouldered Hawk*	<i>Buteo lineatus</i>
E	King Rail*	<i>Rallus elegans</i>
E	Indiana Bat*	<i>Myotis sodalis</i>
E	Higgins' Eye Pearly Mussel*	<i>Lampsilis higginsii</i>
T	Butterfly Mussel	<i>Ellipsaria lineolata</i>
T	Squawfoot Mussel	<i>Strophitus undulatus</i>
E	Copperbelly Water Snake*	<i>Nerodia erythrogaster neglecta</i>
E	Western Hognose Snake	<i>Heterodon nasicus</i>
T	Diamondback Water Snake	<i>Nerodia rhombifer</i>
E	Yellow Mud Turtle	<i>Kinosternon flavescens</i>
T	Blanding's Turtle*	<i>Emydoidea blandingii</i>
T	Ornate Box Turtle	<i>Terrapene ornata</i>
T	Central Newt	<i>Notophthalmus viridescens</i>
T	Grass Pickerel	<i>Esox americanus</i>
T	Orangethroat Darter	<i>Etheostoma spectabile</i>
E	Dwarf Dandelion	<i>Krigia virginica</i>
E	Curved-pod Corydalis	<i>Corydalis curvisiliqua</i>
T	Flax-leaved Aster	<i>Aster linariifolius</i>
T	Slender Dayflower	<i>Commelina erecta</i>
T	Yellow Monkey Flower	<i>Mimulus glabratus</i>
T	Brittle Prickly Pear	<i>Opuntia fragilis</i>

T = threatened
E = endangered

Red-shouldered hawks are listed as a state endangered species in Iowa. This species requires large tracts of mature floodplain or riparian forest for nesting. These birds prefer a mature forest structure, with a well-developed canopy and an open sub-canopy for nesting sites. Forests on the edge of the river valley, adjacent to upland or valley slope forests have the highest occupancy rate. No adverse impact to this species is anticipated.

The king rail (*Rallus elegans*) is listed as a state endangered species in Iowa. This migratory species usually arrives in Iowa beginning around mid-May. This species can adapt to a wide variety of wetland habitat types as long as the terrain supports a reasonable amount of vegetation and is frequently wet. Optimal habitat is freshwater marshes with emergent vegetation (sedge, bulrush or cattail). Decline of this species in the Midwest has been due to habitat destruction and drainage of wetlands. No adverse impact to this species is anticipated. Several of the proposed moist soil unit improvements will benefit this species.

The presence of the copperbelly water snake, a state endangered species, was recently confirmed at Lake Odessa. Copperbelly habitat generally consists of wetlands and bottomland forests, although

they sometimes hibernate in upland areas. They are often seen near shallow wetland edges in woodlands where buttonbush is the preferred vegetation type. The proposed construction is not expected to adversely impact these species.

Blanding's turtles, state threatened, are found in shallow and deep marshes, the shallow bays of lakes, slow-moving streams and rivers, and backwater sloughs. They prefer slow-moving, shallow water and a muddy bottom with abundant emergent vegetation, duckweed, and mosses. Open, sandy areas are preferred for nesting sites. If suitable nesting areas are not located, they may nest on the shoulders of roads or wander a considerable distance from their marsh until a suitable area is found. No adverse impact to this species is anticipated.

The diamondback water snake, a state threatened species, has been confirmed within the Lake Odessa complex. This large water snake is found only in southeastern Iowa near the Mississippi River. It inhabits rivers, sloughs, ponds, backwaters, and oxbows. It does not live in clear gravelly streams, and seems to avoid heavily wooded ponds. The IDNR believes that the proposed habitat restoration within the Lake Odessa complex should help protect their habitat. No adverse impacts to this species are anticipated.

The Lake Odessa complex is considered essential habitat for the river otter. The river otter, while not listed in Iowa, is listed as threatened in Illinois. River otters are quite adaptable, utilizing a variety of habitat types. Although they frequent lakes and ponds, they typically live in marshes and along wooded rivers and streams with sloughs and backwater areas. No adverse impact to this species is anticipated.

(6) Hazardous, Toxic, and Radioactive Waste. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with ASTM Practices E 1527-00 and E 1528-00, ER 1165-2-132, and MVD DIVR 1165-2-9 for the Lake Odessa HREP. Dense woodlands, historical agricultural fields, and low-lying backwaters of the Mississippi River characterize the Lake Odessa area. The assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the Lake Odessa project features. Found within the Lake Odessa study area was a small, minimally used firing range. This firing range is not in direct connection with any of the project features, and therefore was considered a *de minimus* environmental condition in association with this project. After a thorough review of all information, there were no indications of any environmental concerns. Under the current locations of project features, there are no recommendations to be made at this time. Work on the section of levee bordering the firing range should be avoided. If the decision is made to execute the levee restoration in the reach directly behind the firing range, further HTRW assessments will be required.

d. Historic Properties. The Corps' historic properties coordination letter dated March 28, 2003 (Appendix A, includes all enclosures), presented the current status of historic properties at the Lake Odessa EMP project and proposed a Programmatic Agreement (PA) under Section 106 of the National Historic Preservation Act to address the adverse effects to historic properties resulting from the project. Table 9-1, below, is the same as Enclosure 4 to that letter and derives from Benn and Isenberger (2000:Table 2).

Table 9-1 lists all known historic properties sites at Lake Odessa; states the sites' National Register of Historic Places (NRHP) Status (Eligible, Not Eligible, Unknown); determines whether the site is within the Area of Potential Effect (APE) for the Lake Odessa EMP Project (see discussion of APE, below); and lists the Mitigation Treatment Recommendations for the sites located within the APE, which have been determined eligible for the NRHP. Three sites recently added to the APE

(13LA288, 312, and 455) still require fieldwork to evaluate them for NRHP significance (13LA288 and 455) or to establish horizontal and vertical site boundaries (13LA312). Provisions for this work are included in the PA along with provisions for unanticipated discoveries, including human remains and items of cultural patrimony subject to Native American Graves Protection and Repatriation Act (NAGPRA) compliance.

At 36 CFR 800.16(d) the APE is defined as “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.”

The Lake Odessa APE currently includes the footprint of project features defined at Figure 9-1 and all of the shoreline of Lake Odessa because it is affected by the fluctuating water levels designed into the water control aspects of the project. The project features are in six basic categories: moist soil unit enhancements; fisheries enhancements; mast tree plantings; levee restoration; sand prairie planting; and a fish nursery. If the project features change from those in Figure 9-1 and as described in the Corps’ March 28, 2003, coordination letter (Appendix A), additional field investigations for historic properties may be required. The APE is all on Federal land; none is on tribal lands [36 CFR 800.4(a)(1)].

Figure 9-1 illustrates the Lake Odessa EMP project features that have received Phase I survey and Phase II archeological testing. The information in Table 9-1 is valid only in relation to the area of the project features found on Figure 9-1.

Responses to the Corps’ March 28th letter are all found at Appendix A. There were communications from the Peoria Tribe of Indians of Oklahoma (letter dated April 2, 2003), the Advisory Council on Historic Preservation (ACHP, letter dated April 3, 2003), the State Historical Society of Iowa/State Historic Preservation Officer (SHSI/SHPO, letter dated April 16, 2003), and the Ho-Chunk Heritage Preservation (facsimile dated May 5, 2003). The Corps responded to the ACHP by letter dated May 9, 2003, and to the SHSI/SHPO by letter dated June 18, 2003 (see Appendix A). The other communications required no responses.

The Mitigation Treatment Recommendations as set out in Table 9-1 have been concurred with by the State Historical Society of Iowa/State Historic Preservation Officer (SHSI/SHPO) in their letter of April 16, 2003, found in Appendix A. No other respondents had comments on these recommendations or on the proposed PA for historic properties contained in the March 28th letter. The SHSI/SHPO’s comments on the draft PA were addressed in the Corps’ response dated June 18, 2003 (Appendix A). The finalized PA takes into account the changes made as a result of the SHSI/SHPO comments and is found at Appendix C. The fully executed PA will be filed with all signatories and with the ACHP. Implementation of its terms will evidence Corps compliance with its responsibilities under Section 106 of the National Historic Preservation Act.

e. Human Use. No mining activity is present in the project area, and no use of mineral resources would be affected by this project. The proposed action will not result in the conversion of any prime, unique, or designated state or locally important farmland to nonagricultural uses. Construction activity may cause some temporary disruption of recreational use in the project area. No negative effects to navigation will result from the proposed actions. All work in the Mississippi River (construct wing dam, dredge for levee restoration) will be conducted outside the confines of the navigation channel.

f. Cumulative Impacts. Although short-term impacts are likely to occur to local and migratory animals during construction, no negative cumulative impacts to fish or wildlife are expected. The proposed habitat measures should have positive long-term benefits to fish and wildlife using the project area. This project, in concert with other EMP HREPs on the Upper Mississippi River, should counter some of the long-term adverse impacts to the river ecosystem such as sedimentation, pollution, and general declines in riverine and floodplain habitat. Currently, 41 HREPs have been completed, resulting in the restoration of approximately 71,000 acres. Planning is underway on 28 additional HREPs that will restore another 54,000 acres.

g. Adverse Impacts Which Cannot Be Avoided. Unavoidable adverse impacts will primarily result from the clearing of vegetation for supply ditch and dredged material containment construction. Clearing of vegetation will be limited to the minimum extent necessary for project construction. An increase in the existing levee footprint is anticipated because of the proposed levee restoration, affecting 39 acres of wetlands temporarily and converting approximately 17 acres to levee. The benefits of levee restoration, reducing flood damages to 1,700 acres of non-forested wetland, 2,900 acres of bottomland hardwood forest, and 1,800 acres of aquatic habitat, will offset the relatively minor losses in these areas.

**Table 9-1. Historic Properties Site Status for the Lake Odessa (Iowa),*
Habitat Rehabilitation and Enhancement Project (HREP), Environmental Management Program (EMP),
as Documented by Phase II Testing (Benn 1998), a Corps Letter Dated 26 January 1998,
a State Historical Society of Iowa Letter Dated 20 April 1998,
a report by Benn and Isenberger (2003), and a 4 February 2003 Corps Meeting.
Lake Odessa Habitat Rehabilitation and Enhancement Project
Environmental Management Program - Upper Mississippi River System**

Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect (APE)	Mitigation Treatment and Other Recommendations for Sites Within the Area of Potential Effect	Length of Bank Protection (ft) [rounded to nearest 10 ft]	Comment
3	NE	No	N/A		This NR Status applies only to that small portion of site area in Federal ownership
13	NE	Yes	N/A		
27	E	Yes	Data Recovery & Riprap Bank Protection	200	Data Recovery Completed, but Bank Protection needed since erosion will be in undisturbed deposits before 50 years
30	E	Yes	Riprap Bank Protection & Prohibit Dredge Material Placement	1330	No Dredged Material Placement will be allowed on 13LA30
38	NE	Yes	N/A		Site has been mitigated through excavation.
47	NE	Yes	N/A		National Register status changed from E to NE due to destruction by recent bank erosion.
84	E	No			
97	NE	Yes	N/A		
98 & 99	E	Yes	Riprap Bank Protection	520	
100	NE	Yes	N/A		
104	E	No	N/A		
261	UNK	No	N/A		
288	UNK	Yes	To Be Determined (TBD)		Requires Phase II Testing
289	NE	Yes	N/A		
290	NE	Yes	N/A		
291	NE	Yes	N/A		
292	UNK	No	N/A		
293 b & f	NE	Yes	N/A		
293 a, c-e, g, & h	NE	Yes	N/A		National Register status changed from E to NE due to destruction by recent bank erosion.
296	UNK	No	N/A		
297	UNK	No	N/A		
298	UNK	No	N/A		
299	E	Yes	Riprap Bank Protection	250	
300	E	Yes	Riprap Bank Protection	400	
301	NE	Yes	N/A		
302	NE	Yes	N/A		
303	NE	Yes	N/A		
304	NE	Yes	N/A		
305	UNK	No	N/A		
308	UNK	No	N/A		
309	E	Yes	Data Recovery		Data Recovery Completed
312	E	Yes	Potential Mitigation (TBD) and/or Preserve by Avoidance (TBD)		Burris City in APE due to spillway in vicinity. Boundary establishment and Phase II testing to be accomplished in order to evaluate potential effects from spillway.

Table 9-1 (Continued)

Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect (APE)	Mitigation Treatment and Other Recommendations for Sites Within the Area of Potential Effect	Length of Bank Protection (ft) [rounded to nearest 10 ft]	Comment
318	UNK	No	N/A		
420	UNK	No	N/A		
421	UNK	No	N/A		
422	UNK	No	N/A		
423	E	Yes	Riprap Bank Protection	270	
424	E	Yes	Riprap Bank Protection	200	
425	NE	Yes	N/A		
426	NE	Yes	N/A		
427	UNK	No	N/A		
430	UNK	No	N/A		
431	NE	Yes	N/A		
432	NE	Yes	N/A		
433	UNK	No	N/A		
434	UNK	No	N/A		
435	UNK	No	N/A		
436	UNK	No	N/A		
437 North	NE	Yes	N/A		
437 South	E	Yes	Preserve by Avoidance		
438	E	Yes	Preserve by Avoidance		
439	NE	Yes	N/A		
440	NE	Yes	N/A		
441	UNK	No	N/A		
442	NE	Yes	N/A		
443	NE	Yes	N/A		
444	NE	Yes	N/A		
445	NE	Yes	N/A		
446	E	Yes	Bank Protection	240	
447	UNK	No	N/A		
448	UNK	No	N/A		
449	UNK	No	N/A		
450	NE	Yes	N/A		
451	NE	Yes	N/A		
455	UNK	Yes	To Be Determined (TBD)		Requires Phase II Testing
458	UNK	No	N/A		
459	UNK	No	N/A		
			Total Length of Bank Protection	3410	

Table 9-1 (Continued)

E: Eligible	
NE: Not Eligible	
UNK: Unknown	
N/A: Not Applicable	
*: This table summarizes the Corps' opinion following the reevaluation and recommendations in the Phase II final report dated April 1998 (BCA# 466) -- and the State Historical Society of Iowa letter dated 20 April 1998 (SHSI R&C#: 950558014) -- and the January 2003 draft report (Benn and Isenberger 2003) -- and a 4 February 2003 Corps in-house meeting on site mitigation methods (riprap chosen as the only feasible shoreline protection method).	
	Highlighting marks 14 sites which require mitigation of some type based on the Phase I Survey of Potential Lake Odessa EMP Project Features summarized in Benn (1998:Figure 5). (13LA27 and 13LA309 are marked in bold type and have data recovery completed.)
	Highlighting marks changes resulting from information in Benn and Isenberger (2003).
	Highlighting marks Corps mitigation methods chosen (or remaining to be determined) after a 4 February 2003 Corps in-house meeting on site mitigation methods.
References:	
Benn, David W.	
1998 <i>Phase II Archeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa</i> . Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 24, Modifications 1 and 2. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #466 - 2 volumes).	
Benn, David W., and Bill Isenberger	
2003 <i>Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa</i> . Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 37. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #1094, February 2003).	

h. Short-Term Versus Long-Term Productivity. Construction impacts (land clearing, dredging, equipment movement, etc.) will temporarily disrupt wildlife as well as human use. Conversion of the mast tree Sites A and B from idle crop field to bottomland hardwood forest with mast-producing tree species as a significant component would result in a short-term loss of some herbaceous food plants used by some species of migratory waterfowl. However, long-term productivity would be enhanced as woody vegetation develops and matures, providing higher quality food and cover for a more diverse group of wildlife species. Construction of the dredged material containment site will result in the loss of silver maple-cottonwood dominated forest but replanting to hard mast-producing trees will result in a higher quality forest than currently exists.

Protecting the complex interior with the levee restoration should preserve long-term productivity. Long-term productivity also should be enhanced by increases in bottomland hardwood habitat (particularly mast-bearing trees) and substrate diversity in aquatic habitats. Finally, long-term productivity of the MSU will be ensured through the proposed improvements.

i. Irreversible or Irretrievable Resource Commitments. The purchase of materials and the commitment of labor, fuel, and machinery to construct the project are considered irretrievable. Other than the aforementioned, none of the proposed actions is considered irreversible.

j. Relationship of the Proposed Project to Land-Use Plans. The proposed action is in agreement with the *Land Use Allocation Plan* (Corps 1989). The proposed project is not in conflict with any land-use plans currently being used for the site.

k. Compliance with Environmental Quality Statutes. Compliance with applicable environmental statutes is summarized in Table 9-2.

Figure 9-1. Potential Lake Odessa EMP Project Features

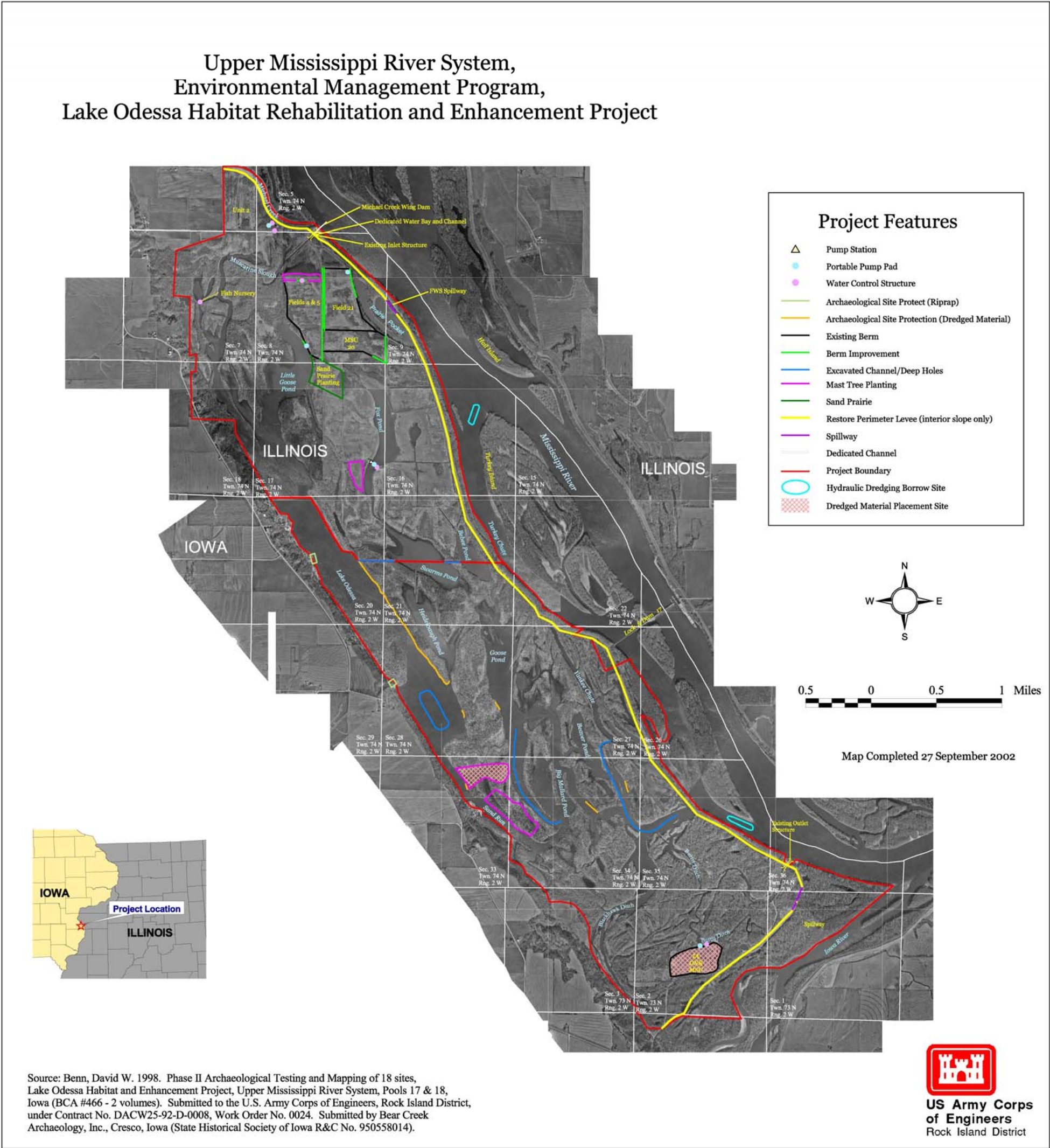


TABLE 9-2. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Federal Policies	Compliance
Archeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Full compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full compliance
Clean Water Act, 33 U.S.C. 1857h-7, et seq.	Full compliance
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full compliance
Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq.	Full compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Full compliance
Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Full compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Not applicable
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Full compliance
Flood Plain Management (Executive Order 11988)	Full compliance
Protection of Wetlands (Executive Order 11990)	Full compliance
Farmland Protection Act	Full compliance
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)	Full compliance

NOTES:

- a. Full compliance. Having met all requirements of the statute for the current stage of planning.
- b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning.
- c. Noncompliance. Violation of a requirement of the statute.
- d. Not applicable. No requirements for the statute required.

10. PROJECT PERFORMANCE ASSESSMENT MONITORING

This section summarizes the monitoring and data collection aspects of the project. The primary project objectives are discussed in Section 3 of this document, and the performance assessment is designed to gauge progress toward meeting these objectives.

Table 10-1 presents overall types, purposes, and responsibilities of monitoring and data collection.

Table 10-2 presents actual monitoring and data parameters grouped by project phase, as well as data collection intervals.

Table 10-3 presents sedimentation transect assignment to project objectives for post-construction monitoring.

Table 10-4 presents the post-construction evaluation plan, which displays the specific parameters and the levels of enhancement that the project hopes to achieve.

TABLE 10-1. Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluate planning assumptions.	USFWS	USGS (UMESC)	LTRM	--
	Pre-Project Monitoring	Identify and define problems at HREP site. Establish need of proposed project features.	Sponsor	Sponsor	Sponsor	--
	Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field Station or Sponsor through Cooperative Agreements or Corps	HREP/- Sponsor	See Table 10-2.
Design	Data Collection for Design	Include quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	See Table 10-2.
Construction	Construction Monitoring	Assess construction impacts; assures permit conditions are met.	Corps	Corps	HREP	See State Section 401 Stipulations.
Post-Construction	Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative) Sponsor (field observations)	Sponsor through O&M, or Corps	HREP/- Sponsor	See Table 10-4.

TABLE 10-2. Resource Monitoring and Data Collection Summary ¹

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Jun-Sep	Dec-Mar								
POINT MEASUREMENTS														
<u>Water Quality Stations</u> ²														
Turbidity	2W	M			2W	6W							Corps	
Secchi Disk Transparency	2W	M			2W	6W							Corps	
Suspended Solids	2W	M			2W	6W							Corps	
Dissolved Oxygen	2W	M			2W	6W							Corps	
Specific Conductance	2W	M			2W	6W							Corps	
Water Temperature	2W	M			2W	6W							Corps	
pH	2W	M			2W	6W							Corps	
Total Alkalinity	2W	M			2W	6W							Corps	
Chlorophyll	2W	M			2W	6W							Corps	
Velocity	-	M			-	6W							Corps	
Water Depth	2W	M			2W	6W							Corps	
Ice Thickness	-	M			-	6W							Corps	
Snow Depth	-	M			-	6W							Corps	
Wind Direction	2W	M			2W	6W							Corps	
Wind Velocity	2W	M			2W	6W							Corps	
Wave Height	2W	M			2W	6W							Corps	
Air Temperature	2W	M			2W	6W							Corps	
Percent Cloud Cover	2W	M			2W	6W							Corps	
Elutriate Analysis ³	1												Corps	
<u>Boring Stations</u> ⁴														
Geotechnical Borings							1						Corps	

TABLE 10-2 (Cont'd)

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
TRANSECT MEASUREMENTS														
<u>Sedimentation Transects</u> ⁵ Hydrographic Soundings							1	1	5Y				Corps	
<u>Vegetation Transects</u> ⁶ (sand prairie, mast trees) Visual Survey										1	1	Y	Corps, USFWS, IDNR	
POINT MEASUREMENTS														
<u>MSU Water Level Control</u> ⁷ Visual Survey										W	W	W	USFWS/IDNR	
AREA MEASUREMENTS														
<u>Waterfowl Survey</u> ⁸ Visual Survey										W	W	W	IDNR	
<u>Fish Nursery</u> ⁹ Visual survey												M	IDNR	
<u>Mapping</u> ¹⁰ Aerial Photography/ Remote Sensing										1			Corps	

LEGEND

W = Weekly

M = Monthly

Y = Yearly

nW = n-Week interval

nY = n-Yearly interval

1,2,3, --- = number of times data are collected within designated project phase

TABLE 10-2 (Cont'd)

¹ See plates 54 and 55 for monitoring sites.

² Water Quality Stations

Pre-Project
W-M439.4C, W-M438.6M, W-M436.3O, W-M435.3J

Post-Project
W-M437.5D, W-M436.3O

³ Elutriate Analysis

E-M438.8F, E-M437.5E

⁴ Corps of Engineers Geotechnical Borings

See plates 9-18 For Location and Boring Data

⁵ Sedimentation Transects

Post-Project Phase

SM441.2P-SM441.1P, SM439.0F-SM438.9E, SM438.5K-SM438.4J, SM437.4A-SM437.4F, SM436.3F-SM436.4G, SM436.0K-SM436.0L, SM435.6R-SM435.5R

⁶ Vegetation Transects (sand prairie, mast trees – species, survival, tree regeneration)

Pre and Post Project Phase

VM441.0I-VM439.8M, VM441.2M-VM440.9O, VM439.6H-VM439.5I, VM436.9D-VM436.3D, VM435.9C-VM435.8C

⁷ MSU Water Level Control Points

Post-Project Phase

Lowest points of Field 4&5, Field 21, MSU 20, Unit 2, Fox Pond, IDNR MSU, visual survey of water surface elevations DM440.7M, DM440.6N, DM440.5N, DM441.4L, DM439.5J, DM435.0G

⁸ Waterfowl Survey

Pre and Post Project Phase

Continue current waterfowl survey of MSU use (MSU 20, Field 21, Unit 2, Field 4&5, Fox Pond, IDNR MSU) on a weekly basis, September through mid-December

⁹ Fish Nursery

Post-Project Phase

Monitor fish growth and survival
Document release of fish into the main lake

¹⁰ Mapping (Pre-Construction Phase)

Date, type of mapping (aerial, etc.)

**TABLE 10-3. Lake Odessa Rehabilitation and Enhancement Project
Project Objectives Evaluation**

Project Objectives to Be Evaluated				
Transects / Points	Reduce Sedimentation	Increase Overwintering for Fish	Vegetation Growth	Water Level Control & Waterfowl
SM441.2P--SM441.1P	X			
SM439.0F--SM438.9E		X		
SM438.5K--SM438.4J		X		
SM437.4A--SM437.4F		X		
SM436.3F-- SM436.4G		X		
SM436.0K--SM436.0L		X		
SM435.6R— SM435.5R		X		
WM437.5D		X		
WM436.30		X		
VM441.0I—VM 439.8M			X	
VM441.2M— VM440.9O			X	
VM439.6H--VM439.5I			X	
VM436.9D-- VM436.3D			X	
VM 435.9C— VM435.8C			X	
DM440.7M				X
DM440.6N				X
DM440.5N				X
DM441.4L				X
DM439.5J				X
DM435.0G				X

TABLE 10-4. Post-Construction Evaluation Plan

Enhancement Potential									
Goal	Objective	Enhancement Feature	Unit	Year 0 Without Alternative	Year 1 With Alternative	Year 25 With Alternative	Year 50 Target With Alternative	Feature Measurement	Annual Field Observations by Site Manager
Enhance Wetland and Terrestrial Habitat	Increase bottomland hardwood diversity	Establish hardwood trees in existing areas, old fields, on dredge placement area	Mast tree survival and regeneration	NA	100%	100%	100%	Tree count/random sample	Estimate effective acreage and wildlife use, presence/absence of mast
	Enhance moist soil management units	Provide reliable water control	Acres of reliably flooded wetlands	199	380	380	380	Surveys/aerial photo interpretation / mapping	Effective water level control, waterfowl usage, Observe vegetation growth
	Restore sand prairie	Reseed 36 acres	% cover of native prairie species	10%	50%	100%	100%	Vegetation transects	Number of species; % cover with native plants
Enhance Aquatic Habitat	Increase habitat diversity	Fish nursery (operate 1 year in 5)	Fish nursery	0	20%	20%	NA	Visual survey	Survival and growth of fish, ease of release into main lake
		Deep hole/channel excavation	Acres with depth of 6' or greater	0	62	62	62	Sediment transects	Presence of fish, fishing activity; ; reports of kills
	Increase habitat for over-wintering fish	Deep hole/channel excavation	Acres with depth of 6' or greater	0	62	62	62		Fish presence or absence; reports of kills
	Improve water quality for Fish	Deep hole/channel excavation	D.O. (Mg/l)	< 5.0 during critical periods	> 5.0	> 5.0	> 5.0	Perform water quality measurements	Fish presence or absence; reports of kills
Enhance Wetland, Terrestrial, and Aquatic Habitat	Increase habitat protection	Restore perimeter levee height and slopes	Level of protection	10-year	25-year	25-year	25-year	Profile survey	Visual inspection to note defects (i.e., sloughs, rodent holes, etc.)
	Reduce flood damage to project features	Construct spillway	Spillway level of protection	NA	10-year	10-year	10-year	Profile survey	Visual inspection to note defects (i.e., loss of riprap, debris, etc.)

11. REAL ESTATE REQUIREMENTS

The Lake Odessa Habitat Rehabilitation and Enhancement Project is a part of the Upper Mississippi River System - Environmental Management Program authorized by Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended. The project is located on the Mississippi River in Pools 17 and 18 between RM 434.5 and 441.5.

The project is comprised of two different areas: Lake Odessa State Wildlife Management Area and the Mark Twain Refuge, both of which are located in Louisa County, Iowa. All of the project lands are on Government-owned property. A full description of the project area and Real Estate information is noted in Appendix L - Real Estate Plan.

The project sponsor is the U.S. Fish and Wildlife Service (USFWS). The project will be 100% Federal cost.

A draft Memorandum of Agreement (MOA) between the USFWS and the Corps of Engineers is included as Appendix C.

12. IMPLEMENTATION RESPONSIBILITIES AND VIEWS

a. Corps of Engineers. The U.S. Army Corps of Engineers, Rock Island District, is responsible for project management and coordination with the USFWS, the State of Iowa, and other affected agencies. The Rock Island District will submit the subject Definite Project Report (DPR); program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration. Section 906(e) of WRDA 1986 states that first cost funding for enhancement features will be 100% Federal cost because the project features will be located on federally owned land that is managed by the USFWS as a national wildlife refuge. Any mutually agreed upon major rehabilitation of the project that exceeds the identified annual operation and maintenance cost requirements will be the Corps of Engineers' responsibility. Major rehabilitation would be considered as a result of specific storm or flood events and is not included in the project cost estimate (Table 8-2).

b. U.S. Fish and Wildlife Service. The USFWS is the Federal project sponsor and will produce a Coordination Act Report (CAR) for this project. Operation and maintenance of the project, as described in Table 8-3, is the responsibility of the USFWS in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. The sponsors will further specify these functions in the Project Operation and Maintenance Manual to be provided by the U.S. Army Corps of Engineers prior to final acceptance of the project.

c. Iowa Department of Natural Resources. The IDNR, the non-Federal project sponsor, has provided technical and other advisory assistance during all phases of the project and will continue to provide assistance during project implementation.

13. COORDINATION, PUBLIC VIEWS, AND COMMENTS

Coordination has been made throughout the planning and design process with the following State and Federal agencies:

Iowa Department of Natural Resources
Natural Resources Conservation Service
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Iowa State Historic Preservation Agency

a. Coordination Meetings. Ongoing coordination with project cooperators was demonstrated by the following meetings:

- (1) May 29, 1990. Baseline monitoring meeting with the Corps, USFWS, and IDNR.
- (2) December 17, 1991. General scoping meeting with the USFWS and IDNR.
- (3) January 21, 1992. Planning meeting with the USFWS and IDNR.
- (4) January 22, 1992. Plan formulation meeting with the Corps, USFWS, and IDNR.
- (5) March 21, 1995. General scoping meeting with the Corps, USFWS, and IDNR.
- (6) August 15, 1996. Archeology site visit with the Corps, IDNR, Iowa SHPO, Bear Creek Archeology, UNI (Iowa), and Office of the State Archeologist.
- (7) September 24, 1997. Archeological meeting with the Corps, USFWS, IDNR, and Bear Creek Archeology.
- (8) July 17, 2000. On-site visit with the Corps, USFWS, and IDNR.
- (9) October 30, 2000. Baseline WHAG meeting with the Corps, USFWS, and IDNR.
- (10) February 12, 2001. General coordination meeting with the Corps, USFWS, and IDNR.
- (11) December 5, 2001. General coordination meeting with the Corps, USFWS, and IDNR.
- (12) January 31, 2002. Phone conference with the Corps, USFWS, and IDNR.
- (13) February 15, 2002. Phone conference with the Corps, USFWS, and IDNR regarding project features.
- (14) April 23, 2002. Spillway coordination meeting with the Corps, USFWS, IDNR, and FEMA.

- (15) May 7, 2002. Phone conference with the Corps, USFWS, and IDNR to review habitat analysis results.
- (16) January 28, 2003. Spillway coordination meeting with the Corps, USFWS, and IDNR.
- (17) February 11, 2004. Phone conference with the Corps, USFWS, and IDNR.

b. Coordination by Correspondence. The following letters are contained in Appendix A - Correspondence:

- (1) CENCR-PD-W Memorandum, dated June 1, 1990, subject: UMRS-EMP: On-Site Meeting for Lake Odessa, Iowa, Habitat Project.
- (2) CENCD-PE-PD-PL Memorandum, dated December 10, 1990, subject: Upper Mississippi River System Environmental Management Program.
- (3) Meeting Report, Lake Odessa HREP Interagency Meeting, Wapello, Iowa, December 17, 1991.
- (4) Meeting Report, Lake Odessa HREP Service/State Planning Meeting, Wapello, Iowa, January 21, 1992.
- (5) CENCR-PD-W Memorandum for Record, dated January 22, 1992, subject: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting.
- (6) CENCR-PD-W Memorandum for Record, dated March 23, 1995, subject: Environmental Management Program Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project Coordination Meeting.
- (7) Letter dated April 28, 1995, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding draft geomorphological investigation report by Bear Creek Archeology.
- (8) Letter dated May 5, 1995, from Ms. Kirsten Hoffman, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, commenting on report of geomorphological investigations for historic property contexts, Lake Odessa HREP.
- (9) Letter dated August 2, 1995, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding a final report by Bear Creek Archeology, Inc.
- (10) Letter dated January 23, 1996, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Beth Foster, State Historical Society of Iowa, regarding sites eligible for inclusion on National Register of Historic Properties.

- (11) Letter dated March 15, 1996, from Ms. Kathy Gourley, State Historical Society of Iowa, to Mr. Dudley Hanson, U.S. Army Corps of Engineers, Rock Island District, concerning National Register sites, Louisa County, Lake Odessa Project.
- (12) Letter dated April 30, 1996, from Mr. Ronald E. Pulcher, U.S. Army Corps of Engineers, Rock Island District, to Mr. David G. Stanley, Bear Creek Archeology, Inc., concerning review of draft Phase I cultural resources survey report.
- (13) Letter dated May 24, 1996, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding May 1966 final Phase I cultural resources survey report.
- (14) CENCR-PD-W Memorandum for Record, dated January 6, 1997, subject: UMRS-EMP Lake Odessa, Iowa, HREP Archeological Site Visit.
- (15) Letter dated March 24, 1997, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding draft Phase II archeological testing report.
- (16) Letter dated January 26, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding October 1997 draft Phase II archeological testing report.
- (17) Letter dated March 2, 1998, from Dr. Allen Farris, Iowa Department of Natural Resources, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, commenting on archeological site treatments for Lake Odessa HREP.
- (18) Letter dated April 2, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding Memorandum of Agreement for signature.
- (19) Letter from Ms. Kira E. Kaufmann, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, dated April 20, 1998, commenting on Phase II archeological testing of 14 sites at the Lake Odessa HREP
- (20) Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Fish and Wildlife Service, dated April 24, 1998, forwarding Memorandum of Agreement for signature
- (21) Letter dated May 19, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, forwarding Memorandum of Agreement for signature.

- (22) Letter dated May 22, 1998, from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding April 1998 final report of Phase II Archeological testing and mapping of 18 sites for Lake Odessa HREP.
- (23) Letter dated June 16, 1998, from Mr. Patrick T. Burke, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, forwarding fully executed Memorandum of Agreement for mitigation of adverse effects occurring at Horseshoe Site at Lake Odessa.
- (24) CEMVR-PM-R Memorandum for Record, dated February 9, 1999, subject: Lake Odessa EMP Historic Properties 50-Year Mitigation.
- (25) Letter dated April 16, 1999, from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding MOA for signature.
- (26) Letter dated April 16, 1999, from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Mr. Paul W. Johnson, Iowa Department of Natural Resources, forwarding MOA for signature.
- (27) Letter dated May 13, 1999, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Department of the Interior, forwarding MOA for signature.
- (28) Letter dated June 16, 1999, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, forwarding MOA for mitigation of adverse effects occurring at Cross Site.
- (29) Letter dated April 11, 2000, from Mr. Mike Griffin, Iowa Department of Natural Resources, to Ms. Barb Kimler, U.S. Army Corps of Engineers, Rock Island District, outlining information needs and project features for Lake Odessa HREP.
- (30) CEMVR-ED-DG Memorandum for Record, dated July 25, 2000, subject: 17 July 2000 on-site coordination meeting for Lake Odessa EMP DPR.
- (31) Letter dated August 3, 2000, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, requesting preliminary comments on proposed Lake Odessa project.
- (32) Letter dated October 25, 2000, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, forwarding for comment draft archeological report on Cross Site.
- (33) CEMVR-PM-AR Memorandum for Record, dated November 7, 2000, subject: Baseline WHAG Meeting Summary for Lake Odessa HREP.

- (34) CEMVR-ED-DG Memorandum for Record, dated December 6, 2001, subject: 5 December 2001 On-Site Coordination Meeting for the EMP Lake Odessa HREP DPR.
- (35) MFR of Phone Conversation, dated January 31, 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District.
- (36) MFR of Phone Conversation, dated February 15, 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District.
- (37) Draft Fish and Wildlife Coordination Act Report, dated September 30, 2002, prepared by the U.S. Fish and Wildlife Service, Rock Island Field Office.
- (38) Letter dated March 28, 2003, from Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, requesting comments and views from consulting parties on historic properties (with 5 enclosures).
- (39) Letter dated April 2, 2003, from Mr. John P. Froman, Chief, Peoria Tribe of Oklahoma, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, stating that the Tribe has no objection to the proposed project.
- (40) Letter dated April 3, 2003, from Mr. Don Klima, Director, Advisory Council on Historic Preservation, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, requesting additional information on Sites 13LA27 and 13LA309.
- (41) Letter dated April 16, 2003, from Mr. Daniel K. Higginbottom, Archaeologist, State Historical Society of Iowa, to Mr. Ron Pulcher, Archaeologist, U.S. Army Corps of Engineers, Rock Island District, providing comments and recommendations.
- (42) Letter dated May 2, 2003, from Mr. Mike Griffin, Iowa Department of Natural Resources, to Colonel William J. Bayles, District Engineer, U.S. Army Corps of Engineers, Rock Island District, concurring with draft DPR.
- (43) FAX dated May 5, 2003, from Ms. Emma Snowball, Ho-Chunk Heritage Preservation, to Mr. Ron Pulcher, U.S. Army Corps of Engineers, Rock Island District, forwarding Findings Summation.
- (44) Letter dated May 9, 2003, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, responding to Mr. Klima's letter of April 3, 2003.
- (45) Letter dated May 28, 2003, from Mr. Raymond V. Wallace, Advisory Council on Historic Preservation, to Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, stating their participation in consultation to resolve adverse effects is not needed.
- (46) Letter dated June 18, 2003, from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Lavon Grimes, State Historical Society of Iowa, responding to questions in her March 28, 2003, letter.

14. CONCLUSIONS

Full realization of the potential habitat value in the Lake Odessa project area has been hindered by repeated levee failure, flooding, sedimentation, and lack of water level management capability. Establishing areas containing reliable aquatic/wetland habitat will allow the project area to realize the highest benefit to migratory birds, wintering fish, and other local wildlife.

The recommended project enhancement features for Lake Odessa (moist soil unit enhancement, fisheries dredging, levee restoration, fish nursery, and mast tree/sand prairie plantings) are designed to meet the project's goals of restoring and protecting wetland, terrestrial, and aquatic habitat. These goals will be met by reducing forest fragmentation, increasing bottomland hardwood diversity, enhancing migratory bird habitat, restoring sand prairie habitat, increasing habitat for overwintering fish, providing safe areas for developing fish, and protecting habitat areas and archeological sites.

Assessment of the future with-project scenario shows definite increases in total habitat units over the 50-year project life for the target species, as well as a majority of other wetland and aquatic dwelling species considered. These increases represent quantification of the projected outputs: improved habitat quality and increased preferred habitat quality.

The project is consistent with and fully supports the overall goals and objectives of the Upper Mississippi River System-Environmental Management Program, the North American Waterfowl Management Plan, and the Partners in Flight Program.

15. RECOMMENDATIONS

I have weighed the outputs to be obtained from the full implementation of this habitat rehabilitation and enhancement project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. In my judgment, this project, as proposed, justifies expenditure of Federal funds. I recommend that the Secretary of the Army for Civil Works approve the proposed project to include enhancing water level management capability at moist soil units; dredging channels and deep holes for fisheries enhancement; planting mast trees; restoring the perimeter levee; planting a sand prairie; and constructing a fish nursery.

The current estimated Federal construction cost of this project is \$11,098,152. Total Federal estimated project cost, including general design and construction management, is \$13,802,552.

At this time, I further recommend that funds in the amount of \$175,000 be allocated for the preparation of plans and specifications.

(Date)

Duane P. Gapinski
Colonel, U.S. Army
District Engineer

**LAKE ODESSA HABITAT REHABILITATION
AND ENHANCEMENT PROJECT**

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

16. FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the information provided by this Environmental Assessment, along with data obtained from Federal and State agencies having jurisdiction by law or special expertise, and from the interested public. I find that the proposed habitat enhancement project at the Lake Odessa complex would not significantly affect the quality of the human environment. Therefore, it is my determination that an Environmental Impact Statement is not required. This determination may be reevaluated if warranted by further developments.

An array of management features and alternatives was considered for habitat enhancement. Features considered were:

- a. No Federal Action
- b. Moist Soil Unit Enhancement
- c. Sand Prairie Restoration
- d. Upper Fish Nursery Construction
- e. Creation of Deep-Water Fish Habitat
- f. Reforestation (Mast Tree Planting)
- g. Restoration of the Perimeter Levee

The preferred alternative consists of enhancing the following MSUs: USFWS complex (Field 4 & 5, Field 21, MSU 20), Unit 2, Fox Pond, Swarms/Beebe Ponds, and IDNR MSU; dredging the following areas to enhance fisheries habitat: Swarms/Beebe Ponds, Main Lake, Goose Pond, and Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; mast tree planting at Sites A, B, C, and D; and restoring the perimeter levee.

Factors considered in making a determination that an Environmental Impact Statement was not required were as follows:

- a. The project is anticipated to improve the value of the Lake Odessa complex for migratory and resident birds, fish, and wildlife species.
- b. Aside from temporary disturbance during construction periods, no long-term adverse effects to natural or cultural resources are anticipated. No State or Federal endangered or threatened species would be adversely affected by the proposed action.
- c. The project is in compliance with Sections 401 and 404 of the Clean Water Act. The project is in compliance with Section 106 of the National Historic Preservation Act (NHPA) based upon the fully executed "Programmatic Agreement Among the Rock Island District of the U.S. Army Corps of Engineers, the Iowa State Historic Preservation Officer, the State of Iowa Department of Natural Resources, and the United States Fish and Wildlife Service, Regarding Implementation of the Lake Odessa Habitat Rehabilitation and Enhancement Project, under the

Upper Mississippi System – Environmental Management Program” signed by the Corps on June 27, 2003, and filed with the Advisory Council on Historic Preservation as required under Chapter 36 of the Code of Federal Regulations, Part 800, the rules implementing Section 106 of the NHPA.

- d. No significant adverse impacts are expected to occur in the project area.

(Date)

Duane P. Gapinski
Colonel, U.S. Army
District Engineer

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APPENDIX A

CORRESPONDENCE

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-15PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX A
CORRESPONDENCE**

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**APPENDIX A
CORRESPONDENCE**

CONTENTS

Item	Page
CENCR-PD-W Memorandum, dated 1 June 1990, subject: UMRS-EMP: On-Site Meeting for Lake Odessa, Iowa, Habitat Project.....	A-1
CENCD-PE-PD-PL Memorandum, dated 10 December 1990, subject: Upper Mississippi River System Environmental Management Program	A-5
Meeting Report, Lake Odessa HREP Interagency Meeting, Wapello, Iowa, December 17, 1991	A-9
Meeting Report, Lake Odessa HREP Service/State Planning Meeting, Wapello, Iowa, January 21, 1992.....	A-13
CENCR-PD-W Memorandum for Record, dated 22 January 1992, subject: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting	A-19
CENCR-PD-W Memorandum for Record, dated 23 March 1995, subject: Environmental Management Program Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project Coordination Meeting	A-30
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated April 28, 1995, forwarding draft geomorphological investigation report by Bear Creek Archeology	A-34
Letter from Ms. Kirsten Hoffman, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, dated May 5, 1995, commenting on report of geomorphological investigations for historic property contexts, Lake Odessa HREP	A-37
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated August 2, 1995, forwarding a final report by Bear Creek Archeology, Inc.	A-39

Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Beth Foster, State Historical Society of Iowa, dated January 23, 1996, regarding sites eligible for inclusion on National Register of Historic Properties.....	A-43
Letter from Ms. Kathy Gourley, State Historical Society of Iowa, to Mr. Dudley Hanson, U.S. Army Corps of Engineers, Rock Island District, dated March 15, 1996, concerning National Register sites, Louisa County, Lake Odessa Project	A-46
Letter from Mr. Ronald E. Pulcher, U.S. Army Corps of Engineers, Rock Island District, to Mr. David G. Stanley, Bear Creek Archeology, Inc., dated April 30, 1996, concerning review of draft Phase I cultural resources survey report.....	A-48
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated May 24, 1996, forwarding May 1966 final Phase I cultural resources survey report	A-50
CENCR-PD-W Memorandum for Record, dated 6 January 1997, subject: UMRS-EMP Lake Odessa, Iowa, HREP Archeological Site Visit	A-55
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, dated March 24, 1997, forwarding draft Phase II archeological testing report	A-58
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, dated January 26, 1998, forwarding October 1997 draft Phase II archeological testing report	A-61
Letter from Dr. Allen Farris, Iowa Department of Natural Resources, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, dated March 2, 1998, commenting on archeological site treatments for Lake Odessa HREP.....	A-64
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, dated April 2, 1998, forwarding Memorandum of Agreement for signature.....	A-66
Letter from Ms. Kira E. Kaufmann, State Historical Society of Iowa, to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, dated April 20, 1998, commenting on Phase II archeological testing of 14 sites at the Lake Odessa HREP.....	A-68
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Fish and Wildlife Service, dated April 24, 1998, forwarding Memorandum of Agreement for signature.....	A-70
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, dated May 19, 1998, forwarding Memorandum of Agreement for signature.....	A-72
Letter from Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated May 22, 1998, forwarding April 1998 final report of Phase II Archeological testing and mapping of 18 sites for Lake Odessa HREP	A-74

Letter from Mr. Patrick T. Burke, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated June 16, 1998, forwarding fully executed Memorandum of Agreement for mitigation of adverse effects occurring at Horseshoe Site at Lake Odessa.....	A-77
CEMVR-PM-R Memorandum for Record, dated 9 February 1999, subject: Lake Odessa EMP Historic Properties 50-Year Mitigation	A-79
Letter from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, dated April 16, 1999, forwarding MOA for signature.....	A-80
Letter from Ms. Dorene A. Bollman, U.S. Army Corps of Engineers, Rock Island District, to Mr. Paul W. Johnson, Iowa Department of Natural Resources, dated April 16, 1999, forwarding MOA for signature	A-83
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. William Hartwig, Regional Director, Region III, U.S. Department of the Interior, dated May 13, 1999, forwarding MOA for signature	A-84
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, dated June 16, 1999, forwarding MOA for mitigation of adverse effects occurring at Cross Site	A-85
Letter from Mr. Mike Griffin, Iowa Department of Natural Resources, to Ms. Barb Kimler, U.S. Army Corps of Engineers, Rock Island District, dated April 11, 2000, outlining information needs and project features for Lake Odessa HREP	A-86
CEMVR-ED-DG Memorandum for Record, dated July 25, 2000, subject: 17 July 2000 on-site coordination meeting for Lake Odessa EMP DPR	A-88
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated August 3, 2000, requesting preliminary comments on proposed Lake Odessa project	A-90
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Maria Pandullo, State Historical Society of Iowa, dated October 25, 2000, forwarding for comment draft archeological report on Cross Site	A-94
CEMVR-PM-AR Memorandum for Record, dated 7 November 2000, subject: Baseline WHAG Meeting Summary for Lake Odessa HREP.....	A-96
CEMVR-ED-DG Memorandum for Record, dated 6 December 2001, subject: 5 December 2001 On-Site Coordination Meeting for the EMP Lake Odessa HREP DPR.....	A-117
MFR of Phone Conversation, 31 January 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District	A-124
MFR of Phone Conversation, 15 February 2002, prepared by K. Joe Dziuk, U.S. Army Corps of Engineers, Rock Island District	A-125

Letter from U.S. Fish and Wildlife Service to Colonel William J. Bayles, District Engineer, U.S. Army Corps of Engineers, Rock Island District, dated September 30, 2002, providing draft Fish and Wildlife Coordination Act Report	A-127
Letter from Bear Creek Archeology to Mr. Ron Pulcher, Engineers, Rock Island District, dated January 8, 2003, submitting invoice for investigation	A-141
CEMVR-PM-A Memorandum for Record, dated 4 February 2003, subject: Lake Odessa EMP Meeting on Historic Properties	A-142
Letter from Mr. Ron Pulcher, Archaeologist, U.S. Army Corps of Engineers, Rock Island District to Dr. David Benn of Bear Creek Archeology, dated 12 February 2003, requesting that the final report be updated	A-146
Letter from Bear Creek Archeology to Mr. Ron Pulcher, Engineers, Rock Island District, dated February 19, 2003, submitting Corporate Release Form	A-148
MFR of Phone Conversation, 24 February 2003, prepared by Ms. Karen Hagerty, U.S. Army Corps of Engineers, Rock Island District with Ms. Heidi Woeber, Rock Island Field Office of the FWS, discussing the need for mussel survey for the Lake Odessa HREP	A-149
Letter from Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, to Distribution List, dated March 28, 2003, requesting comments and views from consulting parties on historic properties (with 5 enclosures).....	A-151
Letter from Mr. John P. Froman, Chief, Peoria Tribe of Indians of Oklahoma, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, dated April 2, 2003, stating that the Tribe has no objection to the proposed project.....	A-160
Letter from Mr. Don Klima, Director, Advisory Council on Historic Preservation, to Mr. John P. Carr, U.S. Army Corps of Engineers, Rock Island District, dated April 3, 2003, requesting additional information on Sites 13LA 27 and 13LA309	A-161
Letter from Mr. Daniel K. Higginbottom, Archaeologist, State Historical Society of Iowa, to Mr. Ron Pulcher, Archaeologist, U.S. Army Corps of Engineers, Rock Island District, dated April 16, 2003, providing comments and recommendations	A-162
Letter from Mr. Mike Griffin, Iowa Department of Natural Resources, to Colonel William J. Bayles, District Engineer, U.S. Army Corps of Engineers, Rock Island District, dated May 2, 2003, concurring with draft DPR	A-166
FAX from Ms. Emma Snowball, Ho-Chunk Heritage Preservation to Mr. Ron Pulcher, U.S. Army Corps of Engineers, Rock Island District, dated May 5, 2003, forwarding Findings Summation	A-167
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, dated May 9, 2003, responding to Mr. Klima's letter of April 3, 2003	A-173

Letter from Mr. Raymond V. Wallace, Advisory Council on Historic Preservation, to Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, dated May 28, 2003, stating their participation in consultation to resolve adverse effects is not needed	A-175
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Lavon Grimes, State Historical Society of Iowa, dated June 18, 2003, responding to questions in her March 28, 2003, letter	A-176
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Jeffery Vonk, Director Iowa Department of Natural Resources, dated July 17,2003, forwarding the signed Programmatic Agreement.....	A-179
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Ms. Lavon Grimes, State Historical Society of Iowa, dated July 17,2003, forwarding the signed Programmatic Agreement.....	A-180
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Richard Steinbach, Complex Manager Mark Twain Refuge, dated August 15,2003, forwarding the signed Programmatic Agreement.....	A-181
Letter from Mr. Kenneth A. Barr, U.S. Army Corps of Engineers, Rock Island District, to Mr. Don Klima, Advisory Council on Historic Preservation, dated October 28,2003, forwarding the signed Programmatic Agreement.....	A-183
Final Programmatic Agreement.....	A-185

1 June 1990

MEMORANDUM FOR RECORD

SUBJECT: Upper Mississippi River System - Environmental Management Program (UMRS-EMP): On-Site Meeting for Lake Odessa, Iowa, Habitat Project

PURPOSE

A meeting was held at Lake Odessa, Iowa, on 29 May 1990 for the purpose of project scoping and baseline monitoring coordination. Persons attending are shown on enclosure No. 1.

DISCUSSION

1. There were two goals for the meeting: (1) baseline monitoring coordination, and (2) project scoping.
2. The upper end (north of the lateral ditch) of the project site is managed by the U.S. Fish and Wildlife Service (USFWS) for moist soil plants. The area south of the lateral ditch is managed by the Iowa Department of Natural Resources (IA DNR). Migratory waterfowl management is the primary objective for the entire area. A joint site management plan is in place.
3. After the 4th of July, lowering of the lake level is initiated in order to expose mud flats for purposes of vegetation germination (note: the entire lake is not lowered due to public pressure). *with 4-11-90*
4. The main problem at Lake Odessa is water control. This includes *water control* attaining sufficient depths when the Mississippi River is low, and releasing enough water through the gravity outlet when the Mississippi River is high. Water levels are successfully controlled in only 6 out of 10 years. Seepage and groundwater also "feed" the project area. *see enclosure 1*
5. Water control could be improved by modifying the existing inlet structure (3- 48" tubes, one of which is currently not functional) and the outlet structure (3- 48" tubes at the lower end of the project area below L&D 17), constructing a new inlet structure for the upper moist soil unit, and providing a pump station. The existing inlet and outlet structures were constructed in 1953.
6. Levee seepage is a problem at Lake Odessa. There are weak levee sections on the lake side (1:1 slopes) and areas of boils. The riverward side is in better condition.

CENCR-PD-W

SUBJECT: Upper Mississippi River System - Environmental Management Program (UMRS-EMP): On-Site Meeting for Lake Odessa, Iowa, Habitat Project

7. The typical fall problem (time of duck migration) is that water is too high. Seepage contributes to this problem. In addition, winter flow (circulation) is not sufficient (note: documented winter fish kills in the area). The fishkill problem appears to have been minimized by inducing flow thru the area during the winter (note: no winter fish kill in main lake since 1981-82).

8. There are significant pin oak populations on some areas of higher ground within the project area; however, high water levels are causing losses to occur.

9. The State maintains the existing levee by mowing, spraying, burning, and hand work. However, the lower section of the levee, from approximately L&D 17 down, needs improvement. There are some low spots in the levee, but height is not a primary concern (the lower levee is approximately 1 foot lower than the upper levee). There is no known recent survey of the levee. The levee system was built in the early 1900's for private purposes. There has been no significant levee improvements since the 1950's. The 1969 Iowa River flood caused breaching of the lower levee. The IA DNR has requested State funds for levee improvements (low priority; therefore, minimal chance of receiving funding).

10. There is an interest in dredging backwater areas in order to provide wintering fisheries habitat (improve connections and circulation).

11. The IA DNR has the plans for the original water control structures.

12. There are sandy soils in the Lake Odessa area.

13. The IA DNR has been monitoring monthly for the past 2 years water quality (PH, DO, turbidity) in Sand Run chute. This data will be useful for baseline monitoring.

14. There are known cultural resources in the Lake Odessa area.

15. Development and enhancement of "School Boy Pond" (Toolesboro sub-impoundment MSMU) is an additional project option. This would require shallow earthwork, island creation, and pumping capability.

16. Main lake enhancements would include: construction of jetties and islands; and selective dredging. Lake Odessa currently is approximately 6 feet deep at normal river stage.

CENCR-PD-W

SUBJECT: Upper Mississippi River System - Environmental Management Program (UMRS-EMP): On-Site Meeting for Lake Odessa, Iowa, Habitat Project

CONCLUSIONS/DECISIONS

Lake Odessa priorities are as follows:

- a. Increase capacity of water control structures;
- b. Improve levee (from L/D 17 downstream);
- c. Dredge (improve flows in backwater, i.e., Yankee Chute);
- d. Develop wetlands (create open water in Toolesboro sub-impoundment); and,
- e. Enhance main lake fishery (jetties, islands, dredging).

Encl

JERRY A. SKALAK
Rock Island District
Habitat Program Manager

Copies Furnished:

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Mr. Bill Ohde
Iowa Department of Natural Resources
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Wapello, Iowa 52653

Mr. Tom Bell
Mark Twain National Wildlife Refuge
R.R. 1, Box 75
Wapello, Iowa 52653

Mr. Chuck Davis
U.S. Fish and Wildlife Service
1830 2nd Avenue
Rock Island, Illinois 61201

ATTENDANCE LIST

29 May 1990 On-Site Meeting
UMRS-EMP Lake Odessa, Iowa, Habitat Project

<u>Name</u>	<u>Agency</u>	<u>Phone No.</u>
Jerry Skalak	COE	309/788-6361, x6605
Marv Martens	COE	309/788-6361, x6578
Bill Ohde	IDNR	319/523-8319
Bob Hoffman	COE	309/788-6361, x6623
Dan Holmes	COE	309/788-6361, x6480
Tom Bell	USFWS-Louisa/Mark Twain	319/523-6982
John Grettenberger	USFWS-Rock Island	309/793-5800
Gary Swenson	COE	309/788-6361, x6489
Jon Duyvejonck	COE	309/788-6361, x6308
Chuck Davis	USFWS-Rock Island	309/793-5800
Bill Aspelmeier	IDNR	319/263-5062
Don Pfeiffer	IDNR	319/694-2430
George Gitter	COE	309/788-6361, x6203
Clint VanFoggen	COE	309/788-6361, x6489
Don Kline	IDNR	319/694-2430



DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605

CENCD-PE-PD-PL (1105)

10 DEC 1990

MEMORANDUM FOR HQUSACE (CECW-P), WASH DC 20314-1000


SUBJECT: Upper Mississippi River System Environmental Management Program

1. Enclosed are three fact sheets of habitat rehabilitation and enhancement projects we are submitting for ASA(CW) approval of general design.
2. The two projects are, Peterson Lake, MN and North Lake, MN, located in the St. Paul District. The Lake Odessa, IA, project is located in Rock Island District.
3. The HQ, NCD, POC is Ms. Joan Havrilla, CENCD-PE-PD-PL, (312) 353-3140.

FOR THE COMMANDER:

3 Encls
as

CF (w/encls)
CENCS-PD


ALFRED P. BEHM
Chief, Planning Division

CECW-PC (CENCD-PE-PD-PL/10 Dec 90) (1105) 1st End Kennedy/28529
SUBJECT: Upper Mississippi River System Environmental Management
Program

HQ, US Army Corps of Engineers, Washington, DC 20314-1000 07 OCT 1991
FOR Commander, North Central Division, ATTN: CENCD-PE-PD-PL

1. The Peterson Lake, Minnesota, and Lake Odessa, Iowa, project fact sheets are approved as the basis for proceeding into general design (preparation of Detailed Project Report).
2. The North Lake, Minnesota, fact sheet is returned pending a decision by ASA(CW) on whether we will continue to participate in projects, such as this, which are fully or partly located on lands not managed as a national wildlife refuge and, therefore, would require Corps of Engineers participation in annual Operation and Maintenance. Based on the review just completed, we see no other obstacle to approving the fact sheet as the basis for proceeding into general design. If a non-Federal sponsor voluntarily agrees to assume the responsibility for O&M of the project, please resubmit the fact sheet for approval.

Encl
wd



JIMMY F. BATES
Chief, Policy and Planning Division
Directorate of Civil Works

CENCD-PE-PD-PL (CENCD-PE-PD-PL/10 Dec 90) (1105) 2d End
Ms. Havrilla/cld/(312) 353-1279
SUBJECT: Upper Mississippi River System Environmental Management
Program

Cdr, North Central Division, U.S. Army Corps of Engineers,
111 North Canal Street, Chicago, IL 60606-7205 23 OCT 1991

FOR

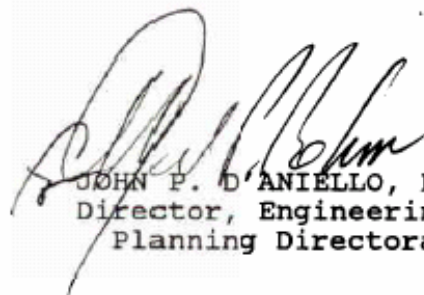
✓ Cdr, Rock Island District, ATTN: CENCR-PD
Cdr, St. Paul District, ATTN: CENCS-PD

1. The UMRS-EMP fact sheets for Peterson Lake, Minnesota, (NCS) and Lake Odessa, Iowa, (NCR) have been approved. The HQUSACE approved fact sheets, 6 December 1990, are enclosed. The approved fact sheet provides the basis for project development and indicates an order of cost that HQUSACE and ASA(CW) expect to see in the final definite project report (DPR). The approved fact sheet will also be used for publication in the UMRS-EMP Annual Addendums until a final DPR is completed.
2. The North Lake, Minnesota, fact sheet (NCS) is returned, for the reasons as stated.
3. The HQ, NCD, POC is Ms. Joan Havrilla, CENCD-PE-PD-PL, (312) 353-1279.

FOR THE COMMANDER:

3 Encls
nc

CF (w/encls):
CELMS-PD



JOHN P. D'ANIELLO, P.E.
Director, Engineering and
Planning Directorate

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM
FACT SHEETLAKE ODESSA
POOLS 17-18, UPPER MISSISSIPPI RIVER, IOWA

LOCATION: Lake Odessa is a 6,800-acre backwater complex of open lake, marsh, timbered islands, ponds, and chutes, separated from the Mississippi River by a levee. It is located roughly half above and half below Lock and Dam 17, approximately 15 miles south of Muscatine, Iowa. The site lies on lands within the Upper Mississippi River Wildlife and Fish Refuge and on lands administered by the State of Iowa under a cooperative agreement with the U.S. Fish and Wildlife Service.

RESOURCE PROBLEM: Existing water control structures limit water level management, and breaches of the low levee have resulted in frequent losses of emergent aquatic vegetation used by migratory waterfowl. Sedimentation from the frequent levee breaks and overtopping flood events has caused a preponderance of shallow water habitat, resulting in frequent fish winterkills and reducing the circulation of well-oxygenated water.

PROPOSED PROJECT: The proposed project would involve rehabilitating the southern boundary levee which connects to the federal levee at L/D 17. Existing inlet and outlet structures would be repaired and an additional inlet structure would be constructed to improve water control. Additional project features would involve the creation of islands; deep hole dredging and the placement of rock structures to enhance the fishery; and dredging and clearing to open up areas suffering from low winter flows of well-oxygenated water.

PROJECT OUTPUTS: The proposed project would reduce sedimentation in the entire backwater complex and provide improved water level management in the area benefitting both fish and waterfowl. Other habitat betterments resulting from implementation of this project would include improved flow of well oxygenated water and creation of new habitat for waterfowl and fish.

FINANCIAL DATA: The general design and construction costs are estimated to be \$295,000 and \$3,026,000, respectively. The project would be located on lands of the National Wildlife Refuge System and on certain lands acquired for the navigation project that were identified in a General Plan and made available to the States, through Cooperative Agreements between the Corps of Engineers and the Department of Interior (DOI), and between the DOI and each State. The Cooperative Agreements stipulate that the areas shall be maintained "in accordance with an annual management program...submitted to the Service." Under Section 906(e) of the 1986 Water Resources Development Act, the project area is "managed as a national wildlife refuge" and qualifies for 100 percent Federal funding of general design and construction. Costs for OM&R would be 75-percent Federal/25-percent non-Federal. The non-Federal sponsor would be the Iowa Department of Natural Resources.

Meeting Report
Lake Odessa HREP Interagency Meeting
Wapello, Iowa
December 17, 1991

On December 17, 1991, I attended an interagency planning meeting on the proposed Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP). This meeting followed a Service meeting the preceding day. Meeting attendees included Tom Bell, Refuge Manager (RM), Wapello District, Mark Twain National Wildlife Refuge (MTNWR), Jerry Olmsted, Fisheries Biologist, Brussels District, MTNWR, Joe Slater, Ecological Services, Rock Island Field Office, Bill Ohde, Iowa Department of Natural Resources (IDNR), and myself.

I began the meeting by recapping what I perceived as key issues central to the Lake Odessa HREP. I noted the refuge needed independent water level control from the adjacent state area; small-sized inlet and outlet structures limited the ability to conduct quick drawdowns and reflooding; levee breaks have disrupted the ability to effectively perform moist soil management; fisheries management is limited by shallow waters; mast trees are being lost and need restoration; dredge material disposal needs and locations must be identified; and well-designed structures are needed to reduce operation and maintenance costs.

We began discussion by talking about the proposed levee rehabilitation. It was noted the 9.3-mile levee is the lowest along this stretch of the Mississippi River, and has frequently been overtopped or breached. We agreed the levee needed to be raised in several areas, and a critical need exists for the levee to be widened to at least a 4:1 slope. A wider levee will facilitate vehicle access, which will allow a substantial increase in management activities.

We then discussed the need to address the seepage problem associated with the sandy soils in the project area. As described in the preceding day's meeting, we are very interested in the possibilities associated with the development of a lateral seepage ditch adjacent to the levee. A seepage ditch would be an additional wetland source; water could be diverted to a needed area; and it would appear to be utilizing natural forces rather than fighting them as another method might such as a pressure relief well. Ohde was interested in this approach, particularly with our suggestion that one direction of diversion could be to the Yankee Chute area, where typically there has been a shortage of oxygenated water.

Discussion then turned to the refuge proposal for a cross-dike along the southern boundary of the refuge, between the refuge and the IDNR area. We indicated we desired the ability to have independent water level management capabilities from the state area, and with the provision in the cross-dike of a pump station and Y-outlet structures, which could direct water onto the state area or into the river, if IDNR didn't want the water at the time of diversion, such independent water management abilities would be available. Ohde readily agreed with this conceptual design.

We then discussed the history of fish kills in the project area. Ohde stated he was unaware of any significant winter kills in the past 8-9 years. He was aware of one summer fish kill of northern pike during a very hot period. Olmsted asked

if the lake stratified with dissolved oxygen or temperature. Ohde stated he didn't think so because depths were quite shallow and uniform, generally not much deeper than 4 feet during summer pool.

Inlet structures were then discussed. Ohde stated there are currently three 48-inch tubes in place. Bell noted two at the north end don't work at the present time.

Discussion between Bell and Ohde clearly indicated the present condition was very inadequate in providing the necessary water to accomplish management objectives. We discussed the possibility that a separate inlet structure could be provided directly adjacent to Yankee Chute to provide oxygenated water.

I asked if IDNR needed pumps on their area. Ohde stated if the refuge were provided with additional inlet structures, he did not think they were needed on the main lake. He added that getting water off of the area was very problematic when the river was up, but the pumping costs might be prohibitive to considering this measure. We suggested the Corps of Engineers (COE) hydraulics branch investigate what pumping capacity would be required to remove water in the spring. Ohde pointed out that currently he can only get water off the refuge in about one-half of the years, and the state area is losing mast trees as a result. He pointed out he would need some pumping capability in the southern sector to manage the Toollesboro sub-impoundment and possibly for greentree management of a pin oak area.

We next discussed the proposed wetland development feature. Ohde noted in addition to the proposal to scrape and develop the 5-acre sub-impoundment at Toollesboro, two additional agricultural fields have been identified for possible wetland development, but Ohde did not think these fields were desirable for such development, and suggested this portion of this feature be eliminated. If that were the case, Bell pointed out, a Crisafulli portable pump would probably be adequate for the sub-impoundment area.

Discussion then turned to the main lake dredging component. It was noted dredging was called for between Sand Run and Schaffer's Point in selected spots. Bell and Olmsted pointed out the specified 14-16 foot depths could be too deep, and result in stratification with a dead zone near the bottom of the lake. Ohde questioned how this depth was arrived at, and it was agreed this needed to be a subject of further discussion with IDNR fisheries biologists.

Olmsted asked whether dredging of several holes in the southeast sector could instead be designed as a small channel which ran out to the river at the site of the old pump station. Ohde thought initially that access would be better at the south end, but Bell pointed out that with the wider levee, access would be available up to the site of the old pump station. Olmsted noted with the forested area in the southernmost sector, it would be more difficult for wintering fish movement there than in the slough which runs out to the old pump station. I added that dredging a channel in the slough would provide additional overwintering benefits for riverine fish. Ohde observed that Burris Ditch and Yankee Chute were the only deep waters in the project area.

I then raised the issue of what will be done with the dredge spoil, noting that the extremely sandy soils made revegetation difficult. Bell suggested some "top dressing" of more suitable silty soil could assist in establishing mast trees.

Olmsted asked if there were locations where IDNR could plant mast trees. Ohde noted IDNR is currently working with the COE on mast tree survival and restoration, especially at specific sites in the southern sector of the project area. Olmsted stated with likely project impacts to forested wetlands, mast tree planting could be highly desirable. Ohde stated most higher elevation sites on the state area are already occupied with mast trees. He pointed out the old agricultural field sites are almost entirely comprised of sandy soils. Olmsted suggested we could possibly "top dress" this area with silt. I questioned whether there would be enough organic matter in these locations to support mast trees.

Olmsted then suggested the jetties be relocated from the currently proposed shoreline location to a relocation offshore of the dredge spoil islands, pointing out there would be increased fisheries and wildlife benefits. Ohde agreed with this concept.

Discussion resumed about inlet structures. Ohde agreed Yankee Chute needs additional flowing water, either from an inlet structure or from lateral ditch diversion. Bell and Ohde then discussed the location of the levee inlet structure currently proposed just north of the cross-dike. Bell suggested a better location would be further north in the vicinity of Prairie Pocket. Placing the inlet structure in this location would provide additional water to substantially greater acres of refuge. Olmsted asked if this could be accomplished by placing the inlet at the very north end of the project area. Bell pointed out the current limitation centered on a reduced capacity to provide adequate water for refuge needs, and it was agreed COE hydraulics and engineering staff would have to study appropriate remedies.

I asked Ohde to verify that all of the IDNR project area was General Plan (GP) land, and he assured me that it was, with the exception of the bluff access roads.

Ohde then described an additional feature which he and Art Roseland, IDNR biologist, had discussed. This feature involves greentree management of a pin oak area of approximately 30-40 acres which they have identified in the southern sector. If this area were provided with a pump station and minor levee work, they could shallowly flood the pin oak forest and provide critical invertebrate food resources for breeding waterfowl. Ohde pointed out the area has a large, immediately adjacent water source for the pump station. Bell and I strongly concurred this would be a valuable project feature.

Ohde also noted Don Kline, IDNR fisheries biologist, had suggested some additional fish nursery areas in the southern sector on two old agricultural fields with scrub timber. Kline planned to flood these areas in the fall and keep them open.

Bell then discussed some of the issues surrounding the late drawdown dates currently used by IDNR. He noted if the federal government spent \$5-6 million,

we could only justify that kind of expense with sound habitat management. He stated if we began now to build a strong base of support with conservation groups and local constituents, by the time the project was built, he hoped IDNR would have the support they needed to begin earlier drawdowns. I also noted the Definite Project Report (DPR) would require a water management plan, which would have to meet COE criterion that demonstrated ample project benefits to justify the large expenditures which will be required. Slater observed mast trees are currently being threatened on the area. Ohde noted some of the tree losses could be attributed to the lack of ability to remove the water, which presumably would be addressed by project features.

I added there could be additional concerns with sediment contaminant issues, given the high density of lead shot which existed on the state area. Ohde concurred this was a legitimate concern, particularly since he had made an earlier projection of extremely high densities of lead shot on one portion of the state area which has historically been heavily hunted.

I noted current plans are for the first year of project construction to occur in FY 95. While project estimates have been in the neighborhood of \$3.5 million, with the changes and additions we are proposing the more realistic figure probably approaches \$6 million.

We agreed to have an additional meeting in January with all available appropriate IDNR personnel immediately prior to meeting with the COE.

Michael Bornstein / *sf*

Michael Bornstein,
EMP Coordinator,
Mark Twain National Wildlife Refuge

cc: Bell
Stratton
Gibbons
Olmsted
Slater
Milligan
Ohde
Tate
Pfeiffer
Kline
Roseland
Brown
✓ Skalak
Kimler

Meeting Report
Lake Odessa HREP Service/State Planning Meeting
Wapello, Iowa
January 21, 1992

On January 21, 1992, I attended a Fish and Wildlife Service (Service)/Iowa Department of Natural Resources (IDNR) planning meeting for the proposed Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP). This meeting was held immediately prior to the initial FY 92 interagency planning meeting with the Corps of Engineers (COE), Rock Island District. Meeting attendees included Bill Ohde, Art Roseland, Don Kline, Don Pfeiffer, and Stan Tate, IDNR, Joe Slater, Ecological Services Field Office, Service, and Tom Bell, Jim Mattsson, Jerry Olmsted, and myself, Mark Twain National Wildlife Refuge (MTNWR), Service.

I began the meeting by noting project features have been developed through three earlier planning meetings. Many features were developed in a funding request document for project planning, as well as through an interagency planning meeting held in May 1990. Planning meetings were recently held on December 16 and 17, 1991, to begin the FY92 planning phase of project development. The December meetings used the earlier meeting and funding request document as a basis for further development.

I then began discussion of specific project features. The 9.3-mile levee is to be rehabilitated. This levee is the lowest levee on this stretch of the Mississippi River, and has steep banks through most of its length. I noted a 4:1 slope would be highly desirable, as well as improving levee heights in selected areas.

I emphasized that after considerable discussion, the refuge has concluded it is very important to construct a cross-dike along the refuge/state boundary. With water control structures built into the cross-dike, the refuge would have significantly enhanced water level management capabilities. It was originally planned to dredge this area, and the cross-dike will provide a location for the placement of spoil material. I pointed out the cross-dike is not intended to extend across the main lake. Instead, it will cover the area from the easternmost boundary at the levee, westward to the east shore of the main lake, where it will turn north and tie in to existing high ground, perhaps at the road which exists at this location. I noted in earlier discussions the problems with the current inlet structures led us to conclude additional inlets were needed, and an outlet structure in the cross-dike would provide the opportunity to direct water either onto IDNR lands if it were desired, or directly into the river if IDNR did not want water at the time we were releasing it. In addition, a pump station built into the cross-dike would greatly increase the refuge's ability to dewater the area.

Discussion then turned to seepage issues. It has long been known by refuge and IDNR staff that the soils in the area are extremely sandy, and seepage through the levees has substantially hampered the ability to perform effective water level management. I said there were several options for addressing this problem, and the suggestion of a lateral seepage ditch at the toe of the levee by MTNWR Project Leader (PL) Stratton appeared among the most attractive. A lateral

seepage ditch would dissipate some of the natural energy of the system, would provide additional wetlands habitat, and the water could be directed to areas which needed it. Pfeiffer noted access across the ditch would be needed in several places to accommodate management needs such as timber stand improvement. Slater pointed out critical soil boring information was needed from the COE to more accurately predict seepage problems. Bell asked if IDNR was aware if there was as much seepage below the lock and dam as above it. Ohde responded that boils occurred quite often below the dam, and he felt seepage was also a problem in that area. Roseland perceived there would be some additional benefits to running a bermed ditch below Yankee Chute. He noted it would probably also require another water control structure. Ohde also pointed out a seepage ditch would enhance the ability to provide a faster rate of drawdown.

Milligan then inquired if there would be permit problems because of project impacts in non-forested wetlands. Slater replied this probably would not be a problem because there would be an overall net gain in non-forested wetlands.

Mattsson asked if the area's waters were interconnected or segregated in the winter. Kline stated some areas might be cut off, but the deeper areas remained connected, evidenced by the lack of any measurable numbers of dead fish found in the spring. Kline noted there have been virtually no measurable fish kills since the refuge began cracking the north inlet tubes in the winter, allowing oxygenated water to flow through the area. He said if there were an inlet in the Yankee Chute area, the additional flowing water would be a significant fisheries benefit. Slater asked if an inverted siphon could be placed in the levee, but Pfeiffer observed there would probably be a problem with it freezing.

Ohde stated the need for a pump in the main lake was contingent upon hydraulic information from the COE. I noted that if a pump would significantly enhance project objectives, we should seek its inclusion in the project.

Slater asked what the ideal water level would be in the main lake. Milligan further inquired what the IDNR's goal was for spring drawdown. Ohde replied that in spring, IDNR sought a level 1' below flat pool, and in the summer, sought an additional 2' below flat pool.

Ohde briefly described the dewatering scheme at the Toolesboro sub-impoundment. He noted IDNR is currently using a 12" Crisafulli pump to dewater the area, and he observed that getting a tractor onto the area was an intensive and difficult effort.

Ohde stated the agricultural field in the southern sector presents management problems, since it is generally too wet to use for farming, and too dry to develop for moist soil plants. Roseland suggested the material from the sub-impoundment scraping work could be used to develop the levee. Ohde thought the material could also be used in island creation. Ohde felt the two old agricultural fields were not suitable for development. Mattsson asked if the sub-impoundment area could be developed as a moist soil management unit. Roseland stated the access was difficult, pumping costs would be quite high, and the primary beneficiary would be hunters.

Roseland suggested it might be possible to develop 1/4 - 1/2 acre finger-shaped areas using pothole blasting or heavy equipment techniques. He noted the area was mostly occupied by river birch. Milligan asked what experience we have had with pothole blasting. I described our experience on the Big Timber HREP, and noted we would have less forest impacts with explosives than moving heavy equipment in. Tate pointed out benefits could be maximized by dredging the wet areas and using the material to provide additional mast tree sites. Milligan asked how much of the area would be dewatered. Ohde replied that essentially the area targeted was the main lake. Kline observed the public believes the drawdown is hurting the fishery. Milligan stated the timing of the drawdown is critical, since an early drawdown will wipe out the predators such as largemouth bass. Roseland noted the river will cause the same results, regardless.

Mattsson asked what the management objective was for the lake. Ohde stated that at the 533 elevation, a large area of mudflats was attained, in the neighborhood of 300-400 acres of valuable moist soil habitat. In addition, water was removed from standing on the trees. Roseland observed that historically, people wanted about 1' more water than was available for recreational purposes, and at the lowest level, about 20 years ago, the water was approximately 2' lower than the public desired.

Tate emphasized the valuable pin oak resource is currently being lost, primarily as a result of high water levels throughout the spring. He noted pin oaks could not be sustained in the shady areas, and mast tree recruitment was not occurring. He pointed out he was made aware of a problem with pin oak losses on the Lake Odessa area as long as 24 years ago!

At this point, Roseland clarified there were really two objectives with respect to drawdowns. The first objective involves an earlier drawdown and somewhat higher water level, which will result in drawing water off the mast trees. The second objective involves a further drawdown later in spring to develop moist soil plant habitat.

Discussion then turned to mast tree features. I asked if there was merit to considering "top dressing" dredge material with some silt in order to provide a more suitable environment to encourage the development of mast trees. Tate thought this had some promise. He also noted that simply by raising the land surface as little as 6" increased the opportunities for success with mast tree revegetation. He also thought some of the backwater areas might have siltier soils which would be more conducive to mast tree response. Tate thought we needed to identify specific areas where the plantings could take place. Ohde suggested one such area could be the old agricultural field sites which are now primarily dominated by river birch. Bell suggested containment levees could be constructed and silt could be pumped in to provide beneficial mast tree soils. Pfeiffer suggested we consider combining pothole development with mast tree planting by using the excavated pothole soils. Tate also made the observation that the majority of pin oaks on the area are even-aged, and 30 years down the road we are at risk of losing most of the mast tree component without significant revegetation efforts in the project.

Fisheries features were discussed next. I asked why dredging depths of 14 -16' were specified, stating this appeared to be substantial overdredging. Milligan noted in summer, depths greater than 8' were frequently anoxic. Olmsted and I pointed out that other HREP designs for fisheries usually involved depths of 8-10'. Kline thought the initial 14-16' depth may have been arrived at as a result of concerns with sloughing, and he agreed 8-10' depths would be sufficient. Milligan emphasized the importance of connecting deep holes to the deepest available water. Olmsted asked why the jetties were designed adjacent to the shore, pointing out the fisheries resource would benefit if they were located in a more disturbance-free area such as off of the islands. Kline thought there was merit in locating the jetties both off of the islands and offshore.

Pfeiffer noted there are significant cultural resource concerns throughout the project area, especially with respect to a known site in the southern sector. He suggested dredge spoil could be stacked around that area and protected with rip-rap.

Milligan asked if there would be benefits or losses associated with island creation which would result in a conversion of aquatic to terrestrial habitat. Kline pointed out there would be definite benefits, since the dredged material which would create the islands would also create deep holes for fish and provide critical additional habitat structure. Milligan perceived there could be a need to rip-rap the islands. I asked what the best fish design would be, and Kline and Milligan noted that connections to deep water and a convoluted design would be important considerations. Mattsson asked if there were water quality issues in the project area, and Ohde said essentially the water quality was good. Roseland noted the dredge cut could encourage speed boaters, and I stated that would be a good reason to stagger the dredge spoil islands. Roseland pointed out it might be wise to place the dredge cut near the west shore in the no-wake zone. The consensus was this was a good idea. Milligan stated it would be important to interconnect the dredge cuts in Yankee Chute, Lake Odessa, and Goose Pond to provide critical permanent water in late summer. I stated we also had earlier discussion about a dredge cut, rather than deep holes, in the Blackhawk Slough area. Olmsted asked if a cut could be designed with an outlet at the old pump station. Kline stated the outlet needed to be at the lowest (southernmost) end of the lake because of access considerations.

Roseland observed if a pump capability were provided, lower water levels could be achieved in the winter to the benefit of the forestry resource.

Olmsted asked if the inlets could be cracked more to provide greater lake overwintering access for river fish. Kline responded he did not want to do that. He prefers to protect the lake fish from the river fish population, especially rough fish. He noted that over the years, prior to the levee break, there has been a relatively stable lake fish population. Tate pointed out this was an additional reason for not wanting to move the outlet further north.

Discussion then turned to the possibility of developing a small pin oak-greentree type of area in the southern sector. Ohde noted there was a small area, estimated at 50-60 acres, which would require only a small amount of levee work to be manageable. In addition, a small pump with a portable power unit and a pipe would provide the ability to control water levels, especially because there

was a directly adjacent water source. I pointed out if this area were shallowly flooded in spring, there would be valuable invertebrate production which would directly benefit wood duck broods. Roseland noted we are not thinking of large levees--rather, this area would not require much work at all to construct low level berms. Mattsson, Bell, and I all concurred this feature would provide important additional waterfowl benefits.

Kline requested consideration be given to development of fish nursery areas which could be flooded most of the year. Tate said this would be acceptable provided the flooding was not on valuable pin oak habitat. Kline said the objective would be to grow fry and fingerlings in a protected area for as long as possible, and then flush them into deep water in the fall. He noted this had potential for bass and northern pike. This feature would require some additional berm construction, such as in an area of old fields. Bell suggested the nursery might be rotated between several small areas. Kline noted the IDNR has stopped stocking northern pike on Lake Odessa, and Bell asked if there were a need to stock fish on the project area. Kline said there was no such need at the current time, but more information was needed on impacts from the recent levee break. Olmsted asked if the nursery area might be located on the back side of Blackhawk Slough. Kline thought this had definite potential. He asked if the COE would provide 1' contour information which would help better identify suitable areas. I said this would soon follow as part of their early project planning efforts. Roseland stated it would be a good idea to locate these nursery areas on the highest ground, such as near the north inlet.

I noted we had discussed the potential for contaminant issues surfacing in the project area as a result of historically high levels of lead shot deposition from many years of waterfowl hunting. I said I had discussed this with COE staff, who told me that had also been a concern on the Potter's Marsh HREP, but sampling data at that site indicated even on a very heavily hunted area the amount of lead detected in samples was not significant.

Pfeiffer noted the COE might wish to straighten the levee in the southeast sector where there was an "eyebrow-shaped" segment.

Milligan asked if the refuge could enhance fisheries benefits on its portion of the project area. Bell noted there would be additional fisheries benefits as a result of project features which would provide the refuge with the ability to hold additional water into the fall. Kline also noted historically the refuge was quite shallow, with the exception of Prairie Pocket, since its elevation was higher than the state area.

Milligan thought the island construction would be better designed as irregular rock piles, and wave action could be reduced by incorporating the jetties.

Mattsson asked if the refuge would consider smaller moist soil management units on its area. Bell noted this was a possibility, but pointed out the smaller interior levees were never completed, and because of substantial seepage issues, unless seepage was addressed, it would not be practical to pursue smaller moist soil management units.

This concluded a rather lengthy planning session, which provided us with a well-developed set of features to present to the COE the following day.



Michael Bornstein
EMP Coordinator,
Mark Twain National Wildlife Refuge

cc: Bell
Stratton/Mattsson
Gibbons
Olmsted
Milligan
Slater
Ohde
Kline
Pfeiffer
Roseland
Kimler
✓ Skalak

22 January 1992

MEMORANDUM FOR RECORD

SUBJECT: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting

1. The subject meeting was held on 22 January 1992 at 0930 hours in the Rock Island District's Emergency Management Conference Room. The following representatives from the Rock Island District of the U.S. Army Corps of Engineers (CENCR), the U.S. Fish and Wildlife Service (USFWS), and the Iowa Department of Natural Resources (IADNR) were in attendance:

Jerry Skalak	CENCR-PD-W	Michael Bornstein	USFWS
Darron Niles	CENCR-PD-W	Jim Mattsson	USFWS
Ken Barr	CENCR-PD-E	Jerry Olmsted	USFWS
Steve Peacock	CENCR-PD-E	Joe Slater	USFWS
Barb Kimler	CENCR-ED-DG	Thomas Bell	USFWS
Marvin Martens	CENCR-ED-HW	Jim Milligan	USFWS
Clint Beckert	CENCR-ED-HQ	Bill Ohde	IADNR
Sibte Zaidi	CENCR-ED-G	Don Kline	IADNR
Gary Swenson	CENCR-OD-RM	Don Pfeiffer	IADNR
Jon Klingman	CENCR-OD-RM		

2. Lake Odessa is a 6,800-acre backwater complex of open lake, marsh, timbered islands, ponds, and chutes, separated from the Mississippi River by a levee. It is located half above and half below Lock and Dam (L/D) 17, approximately 15 miles south of Muscatine, Iowa.

3. The purpose of the meeting was to identify project goals and objectives and discuss potential project features. The following items pertaining to the Lake Odessa complex were discussed (see enclosure 1):

a. The Lake Odessa complex is located entirely on Federal Lands and is part of the Mark Twain National Wildlife Refuge. The southern portion of the complex is managed by the IADNR through a cooperative agreement with the USFWS.

b. The primary management objective for the Lake Odessa complex is improving migratory waterfowl habitat by providing reliable water control capability and improving present hardwood management efforts. Any aquatic habitat improvements must be compatible with the primary management objectives.

c. The main management problem identified by the USFWS and the IADNR is the inability to independently operate and control water levels in the northern and southern portions of the complex. Absence of a direct water source in the southern portion and excessive underseepage have caused this problem. Under current conditions, the water needs of the two management areas are incompatible during certain times of the year.

CENCR-PD-W(1165-2-26a)

SUBJECT: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting

Presently, water inflow is through three 48-inch gated tubes at the complex's north end (two of which are currently non-functional) and outflow is through three 48-inch gated tubes at the complex's south end.

d. The entire complex is encompassed by an existing low level sand/clay core levee. The levee north of L/D 17 was upgraded at some time by CENCR. The levee south of L/D 17 and along the Iowa River has not been upgraded or maintained since initial construction, with the exception of breach repairs. The levee adjacent to the Mississippi River has overtopped (and breached) in 1967 and 1965. The Iowa River levee breached in 1973 and 1990. Sand boils appear on the levee downstream of L/D 17 during high water periods.

e. Water control management in the complex's southern portion is currently influenced by recreational interests of boaters and adjacent cabin owners (approximately 100 privately owned cabins are located on Lake Odessa's west bank). Although the IADNR would prefer to begin drawdown in the area in May, they have agreed to maintain a water elevation of 534.5 to 535.0 until after the 4th of July weekend. This adversely affects mast tree regeneration. The majority of the mast trees are currently 30 years old or older. The IADNR plans to start drawdown earlier in the year as part of project implementation. This is not expected to be popular with recreationists. Maximum desired water surface elevations during spring and fall is 535.5 to 536.0.

f. Recreational usage has been relatively stable over the past several years (based upon general observations by site management staff).

g. The USFWS and IADNR recognize the need to build a strong conservation community foundation for this project to offset reduced recreational opportunities that will result from optimizing site management for migrating birds.

h. The complex's northern portion is closed to hunting in the fall and also contains contract farming operations.

i. Timber management activities have taken place in the complex. Stand mapping has been conducted by CENCR.

j. Bald eagles roost in the complex, but no eagle nests are located within the complex.

SUBJECT: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting

k. The Lake Odessa complex has a history of fish kills. The most recent fish kill was a summer occurrence involving northern pike. Since they began opening the water control structures during the winter months, no significant winter fish kills have occurred in the past 9 years.

4. The following potential project features were discussed:

a. Upgrade of the levee will provide a uniform level of flood protection. The upgrade will also provide side slopes no steeper than 4H:1V and a drivable top width. Pull off ramps and/or turnarounds will be provided to accommodate O&M activities.

b. The feasibility of constructing a landside seepage interception ditch will be investigated. This ditch may also serve as a water conveyance to recharge Yankee Chute in the south area.

c. Development of a moist soil management unit(s) (MSMU's) in the complex's northern unit will be investigated for improving migratory bird habitat by providing reliable feeding and resting areas. This feature will require contour mapping, as well as, subsurface investigations to determine the extent of under-seepage. The feasibility and optimization of sub-impoundments will be determined after this data is available.

d. Installation of a permanent pump is required for filling the MSMU's, drawdown will be accomplished through gravity flow. It is desired that the pump have the capability to fill the MSMU's in 10 to 14 days.

e. The IADNR would like to develop a green tree reservoir between the old pump station and the outflow structure. Reportedly, the area has an existing 2- to 3-foot berm surrounding it. Successful management of this area would require the ability to dewater the area in the spring and early summer and to retain 18 inches of water in the area in the fall (target elevation 533.0).

f. To further enhance mast tree growth, the possibility of small areas of cut and fill will be investigated. This would involve placing as little as 6 to 8 inches of fill on selected areas of existing mast trees and planting additional mast trees. The areas would be 1/4 to 1/2 acre. The fill could come from existing lower areas which support willows and river birch and also from channel cuts to interconnect isolated pond areas.

CENCR-PD-W(1165-2-26a)

SUBJECT: Lake Odessa, Iowa, Habitat Project Plan Formulation Meeting

g. To improve fisheries, dredging in the main lake of Lake Odessa as well as the access channel into Lake Odessa is proposed. Target dredging depth is 8 to 10 feet. There is concern about prop wash erosion on the west bank of Lake Odessa. The possibility of constructing groin type structures with dredged material and/or establishing an enforced no-wake area will be investigated as solutions to prop wash erosion. Also, if the dredged material is suitable, there is a possibility for beach nourishment along the west bank. Consideration will also be given to using dredged material to protect significant west bank archeological deposits.

h. The IADNR would also like to build a fish nursery area as part of this project. Optimally, the area would have 18 inches of water in the spring. In the summer, the area would need approximately 3 feet of water to "flush" the fish out of the nursery and into the main Lake Odessa complex. The IADNR would actively stock the nursery each spring. A suitable site might be found in one of the non-flowing side channels.

5. A Project Appraisal Report has been prepared by CENCR-ED-DG and is included as enclosure 2.

DARRON NILES
Waterway Systems Branch

Copies Furnished: (See Distribution List)

Lake Odessa, IA Distribution List

Mr. Bill Donels
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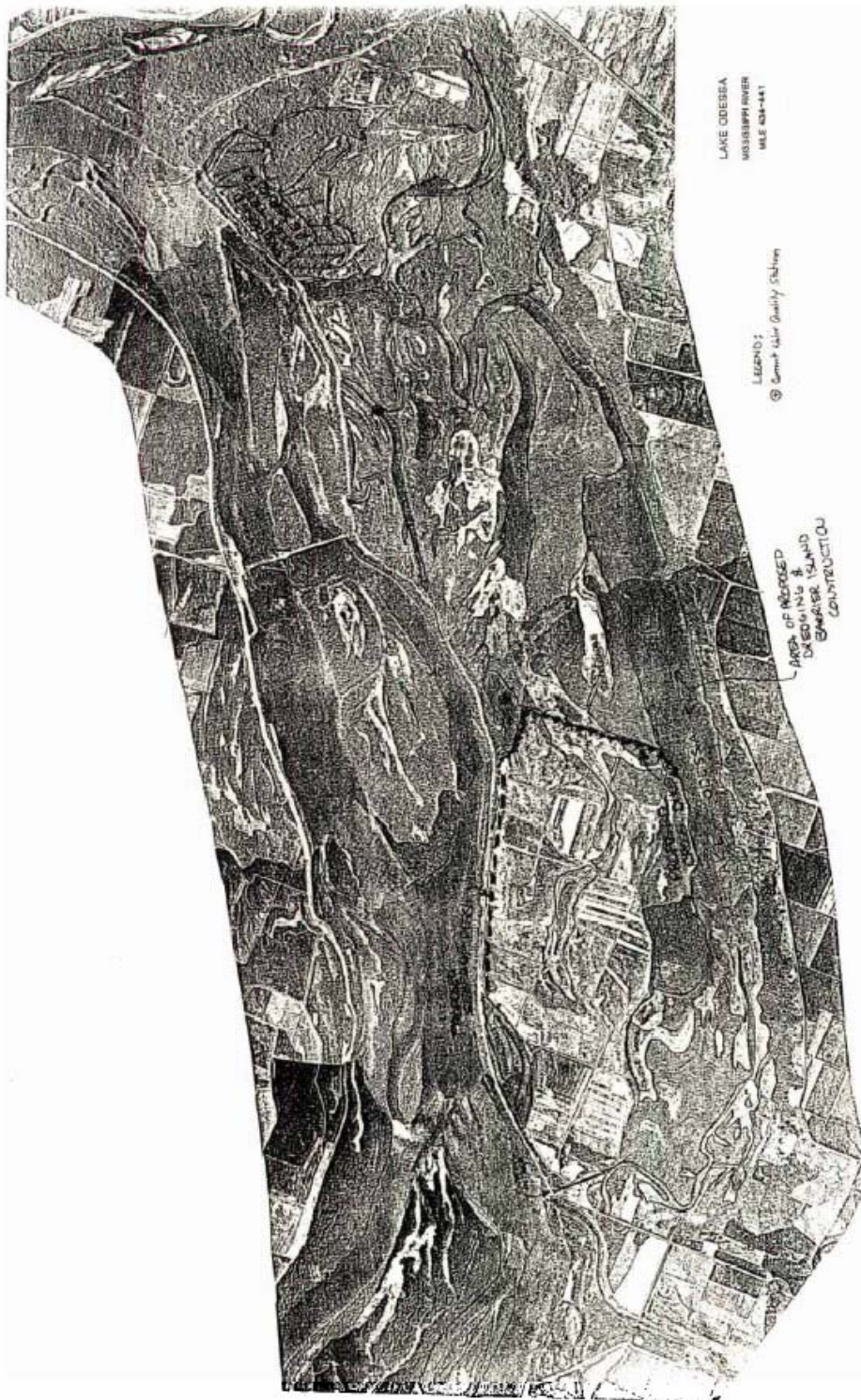
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ENCLOSURE I

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
PROJECT APPRAISAL REPORT

LAKE ODESSA

POOLS 17-18, RIVER MILES 434.6 THROUGH 441.7
LOUISA COUNTY, IOWA

MARCH 1992

ENCLOSURE 2

TABLE 1

Project Goals, Objectives, and Potential Enhancement Features

<u>Goal</u>	<u>Objective</u>	<u>Potential Enhancement Feature</u>
Restore Wetland Habitat	Increase potential for reliable food production for migratory birds	* Water Control * Levee Restoration * Crossdike * Ditches * Green Tree Reservoir.
	Increase Mast Tree Dominance	* Marsh Excavation & Selective Fill * Mast Tree Planting * Pothole Blasting * Barrier Islands
Restore Fisheries Habitat	Improve water quality	* Water Intake Structure * Dredging * Fish Nursery
	Improve wintering depth and velocity Increase fish spawning area	

Lake Odessa

Table 2

MONITORING AND PERFORMANCE EVALUATION MATRIX

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions.	USFWS	USFWS (EMTC)	LTRM	--
	Pre-project Monitoring	Identifies and defines problems at HREP site. Establish need of proposed project features.	Sponsor	Sponsor	Sponsor	--
	Baseline Monitoring	Establishes baselines for performance evaluation.	Corps	Field station or sponsor thru Cooperative Agreements or Corps.	Corps	See Table 3.
Design	Data Collection for Design	Includes quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	See Table 3.
Construction	Construction Monitoring	Assess construction impacts; assures permit conditions are met.	Corps	Corps	HREP	See State Section 401 stipulations.
Post-Construction	Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative) sponsor (field Observations).	Field station or sponsor thru Cooperative Agreement, sponsor thru O&M, or Corps.	LTRM	See Table 3.
	Biological Response Monitoring	Evaluate predictions and assumptions of habitat unit analysis. Studies beyond scope of performance evaluation.	Corps	Corps	LTRM	--

TABLE 3

Resource Monitoring and Data Collection Summary¹

Type Measurement	WATER QUALITY DATA			ENGINEERING DATA			NATURAL RESOURCE DATA		
	Pre- Project Phase	Design Phase	Post- Const. Phase	Pre- Project Phase	Design Phase	Post- Const. Phase	Pre- Project Phase	Design Phase	Post- Const. Phase
POINT MEASUREMENTS									
Water Quality Stations									
Turbidity	2W	M	2W	M					
Secchi Disk Transparency	2W	M	2W	M					
Dissolved Oxygen	2W	M	2W	M					
Specific Conductance	2W	M	2W	M					
Water Temperature	2W	M	2W	M					
Velocity	2W	M	2W	M					
Water Depth	2W	M	2W	M					
Water Elevation	2W	M	2W	M					
Percent Ice Cover	-	M	-	M					
Ice Depth	-	M	-	M					
Percent Snow Cover	-	M	-	M					
Snow Depth	-	M	-	M					
pH	2W	M	2W	M					
Chlorophyll	2W	M	2W	M					
Suspended Solids	2W	M	2W	M					
Wind Direction	2W	M	2W	M					
Wind Velocity	2W	M	2W	M					
Wave Height	2W	M	2W	M					
							Sampling Agency		Remarks
							COE		

TABLE 3 (continued)
Resource Monitoring and Data Collection Summary ¹

	WATER QUALITY DATA			ENGINEERING DATA			NATURAL RESOURCE DATA		
	Pre- Project Phase	Design Phase	Post- Const. Phase	Pre- Project Phase	Design Phase	Post- Const. Phase	Pre- Project Phase	Design Phase	Post- Const. Phase
Type Measurement	APR- SEP	OCT- MAR	APR- SEP	OCT- MAR					Sampling Agency Remarks
<u>Boring Stations</u> Geotechnical Borings					1				COE
<u>Column Settling Stations</u> Column Settling Analysis					1				COE
<u>Elutriate</u>				1					COE
<u>TRANSECT MEASUREMENTS</u> <u>Sedimentation Transsects</u> Hydrographic Soundings					1				COE
<u>Vegetation Transects</u> Vegetation Survey								1	
<u>AREA MEASUREMENTS</u> <u>Mapping</u> Aerial Photography (1:15,000) Topographic Mapping					1			1	COE COE

Legend

W = Weekly

M = Monthly

Y = Yearly

NW = n-Week Interval

NY = n-Year Interval

1,2,3 = Number of times data is collected within
designated project phase

COE = Corps of Engineers, Rock Island District

1. See Monitoring Plan for Active Monitoring Location.

23 March 1995

MEMORANDUM FOR RECORD

SUBJECT: Environmental Management Program (EMP) Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project (HREP) Coordination Meeting

1. The subject meeting was held on 21 March 1995 at 1000 hours at the U.S. Fish and Wildlife Services' (USFWS) Louisa Division Refuge Office near Wapello, Iowa. The following representatives from the Rock Island District (CENCR), USFWS, and Iowa Department of Natural Resources (IDNR) were in attendance.

Barb Kimler	CENCR-ED-DN	Tom Bell	USFWS
Darron Niles	CENCR-PD-W	Michael Bornstein	USFWS
Kevin Griggs	CENCR-PD-E	Amy Sprunger-Allworth	USFWS
Gary Swenson	CENCR-OD-RM	Mike Griffin	IDNR
Joe Slater	USFWS	Bill Ohde	IDNR

2. The purpose of the meeting was to review the flood repair status, project goals and objectives, and discuss potential project features since the last coordination meeting in January 1992.

3. Lake Odessa is a 6,800-acre backwater complex of open water, marsh, timbered islands, ponds, and chutes, separated from the Mississippi River by a levee. The project is located entirely on Federal lands half above and half below Lock and Dam (L/D) 17, approximately 15 miles south of Muscatine, Iowa. Management of the complex is split between the USFWS (north of L/D 17) and the IDNR (south of L/D 17).

4. The following proposed project schedule was reviewed.

Draft Definite Project Report (DPR)	November 1996
Public Review Draft DPR	February 1997
Final DPR to CENCR	April 1997
Construction approval	December 1997
Complete plans and specs	February 1998
Contract award	May 1998
Complete construction	September 2000

Since this HREP is a priority project of the IDNR every effort will be taken to expedite this schedule to allow for the earliest possible contract award date.

5. Flood repair status.

a. The Dredge THOMPSON was utilized in the Fall of 1994 to fill the upper levee break, including the future inlet structure location, with dredged sand from the navigation channel.

b. The USFWS used bulldozers to repair the remaining small breaks and minor overtopping damage on the upper levee.

c. The USFWS is conducting a pre-bid conference for the new inlet and outlet structures contract on 4 April 1995 at 0900 hours in Wapello, Iowa. The USFWS plans to initiate construction in the Summer of 1995. B. Kimler briefed the attendees on CENCR's value engineering evaluation of this

SUBJECT: Environmental Management Program (EMP) Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project (HREP) Coordination Meeting

construction, which recommended that the inlet structure elevation be reduced 6" to 1' because more flow would be achieved for the same amount of opening.

d. The IDNR has repaired the two main breaks on the Iowa River levee. The major break on the lower levee will be repaired in conjunction with installation of the outlet structure by the USFWS. The IDNR has minor crown grading to complete on the lower and Iowa River levee sections.

6. The project goals and objectives and the monitoring plan contained in the March 1992 Project Appraisal Report were reviewed (see enclosure (1)). Following this review, minor verbiage changes in the objectives description and the addition of water quality sampling sites in Prairie Pocket, Lake Odessa, and Blackhawk Chute were recommended.

7. B. Kimler summarized water quality data obtained from sampling sites in Beebe Lake and Yankee Chute (see enclosure (2)). Beebe Lake had low dissolved oxygen levels during the summer, while Yankee Chute had low concentrations in the winter and summer.

8. The following potential project features were discussed (see enclosure (3)).

a. Construction of a 36-inch gatewell structure will be investigated as a solution to the low dissolved oxygen levels experienced in Yankee Chute during the summer and winter months.

B. Two possible fish nursery sites were identified in the USFWS' project area. One site is just off Little Goose Pond and the other site is adjacent to Muscatine slough. A soils assessment is critical for the final site determination because the nursery's water levels would be highest while the rest of the projects' would be lowest. The nursery site will require a silt or clay material in order to maintain the needed water elevation (18-inches in spring; 3-feet in summer). The IDNR would actively stock the nursery each spring. A shallow well or crissofulli pump are possible water sources.

c. Moist soil management areas (MSMA) are proposed in the USFWS and IDNR managed areas. The USFWS MSMA is an existing 1,000+ acre area that currently has water level control problems caused by excessive seepage. A seepage ditch paralleling the levee has been proposed as a solution. CENCR will place piezometers in the MSMA to assess the seepage ditch's viability. If the ditch is viable, the MSMA may be enhanced through development of sub-impoundments within existing areas. The USFWS believes the sandy nature of MSMA will not be conducive to management at different elevations. The IDNR MSMA has existing bermed areas that will require installation of a small electric pump and stoplog structure to allow for water control capability. An adjacent water source is available that is generally free of pump choking vegetation.

d. CENCR will assess construction of a cross dike to increase the possible area of the upper MSMA and also to create hydraulically separate areas to meet the different management goals of the USFWS and IDNR managed areas. Adjacent borrow or material from the dredged channels project feature would be utilized in constructing the cross dike.

e. Development of a green tree reservoir between the old pump station and the new outlet structure was proposed for the IDNR managed area. An existing 2- to 3-foot berm would require additional fill for approximately 3 low areas

SUBJECT: Environmental Management Program (EMP) Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project (HREP) Coordination Meeting

along Burris Ditch to allow for water control capability. The ability to retain 6- to 12-inches of water in the fall will be achieved by installing a combination small electric pump station and stoplog structure near the downstream end of the reservoir. An adjacent interior water source or the Mississippi River are available for this feature.

f. Mast tree plantings in the small agricultural fields near the proposed green tree reservoir and IDNR MSMA will be pursued. Less than a foot of fill is required for the plantings, which would come from nearby lower areas that currently support willows and river birch. Deepening the existing low areas would benefit waterfowl by providing isolated brood habitat.

g. A controlled overtopping spillway will be investigated by CENCR to reduce flood related damages. The spillway would be constructed on the Iowa River levee and sized to allow overtopping without riprap protection, similar to the Bay Island, Missouri, HREP. Proper operation of existing and proposed structures along the levee should assure a minimal head difference when the levee is overtopped.

h. Channel and deep hole hydraulic dredging in Lake Odessa, Blackhawk Chute, and Muscatine slough has been proposed to improve fisheries. Target dredging depth is 8 to 10 feet. Dredged material would be used to create small barrier islands in Lake Odessa by utilizing geotubes, if practical. Dredged material may also be used for construction of the cross dike feature, protection of west bank archeological sites, or capping sandy areas of the USFWS MSMA. The IDNR and USFWS will provide a configuration for the dredged channels. *East*

i. Mechanical dredging in Prairie Pocket will be assessed for improving fisheries. The dredged material would be placed on the riverside of the levee or used to cap sandy areas of the USFWS' MSMA. A diversion structure will also be required in Muscatine Slough to assure that adequate water levels and dissolved oxygen concentrations are maintained in Prairie Pocket.

j. Pothole blasting to create secluded open water areas for migratory waterfowl will be investigated for both the USFWS and IDNR managed areas.

9. Required CENCR work items.

a. Additional cross sections will be obtained to assess changes since the flood of 1993. A base map with 2-foot contours was produced before the flood.

b. A WHAG analysis for with and without project features is needed. The baseline WHAG analysis was completed in September 1992.

c. A geotechnical evaluation is needed to assess the condition of the perimeter levee and to determine the material present in the proposed dredging channels and both MSMA's.

d. CENCR-ED-DN will acquire water quality sampling data for Sandy Run Chute from the IDNR.

e. After reviewing the preliminary cultural resources survey report, it appears that a large amount of the project area will require Phase II testing.

SUBJECT: Environmental Management Program (EMP) Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project (HREP) Coordination Meeting

10. A revised Project Appraisal Report and detailed cost and quantity estimates will be prepared before the next coordination meeting, tentatively scheduled for September 1995.

/s/

DARRON NILES
Waterway Systems Branch

Encls



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 28, 1995

Planning Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding the Bear Creek Archeology, Inc., draft report dated February, 1995, and entitled Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17-18, Iowa (BCA #342). The report was written by David W. Benn and Jeffrey D. Anderson and prepared under Corps Contract No. DACW25-92-D-0008, Work Order No. 11.

We request that you review and comment on this draft report. Please submit all comments within 30 days from the date of this letter.

If you have questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or you may write to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

DISTRIBUTION LIST

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R&C Coordinator
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Dr. David W. Benn
Principal Investigator
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State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

May 5, 1995

In reply please refer to:
RC#: 950558014

Mr. Dudley M. Hanson
Chief, Planning Division
Rock Island District, Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE -

Dear Mr. Hanson:

We have received and reviewed the information you submitted to our office concerning the above referenced project including the report entitled Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, upper Mississippian River System, Pools 17-18, Iowa, prepared by Bear Creek Archeology, Inc. Based on a review of this report and a review of our records and maps, we make the following comments and recommendations.

We concur with the recommendations of the consultant that archeological sites 13LA104, 13LA420, 13LA421, and 13LA427 are currently not being affected by management of the Odessa EMP project. The National Register eligibility of these sites has not been assessed. If any project activities are proposed for the vicinity of these four sites, archeological investigation to assess that site's potential National Register eligibility will be recommended.

Fourteen additional sites (13LA3, 13LA288, 13LA289, 13LA291, 13LA292, 13LA296, 13LA297, 13LA298, 13LA300, 13LA301, 13LA302, 13LA304, 13LA305, and 13LA308) have not had their potential National Register eligibility assessed. Phase II archeological assessment will be recommended for any of these sites that is in the impact area of a proposed project activity. There is presently not enough information available on these sites to determine them ineligible for the National Register.

We concur with the consultant that five archeological sites (13LA13, 13LA97, 13LA422, 13LA424, and 13LA425) are not eligible for nomination to the National Register. No further archeological work is recommended for these five sites. 13LA38 has been excavated and impacts to this site have been mitigated. No further work is recommended for this site.

We concur with the consultant's recommendation that eleven sites (13LA30, 13LA47, 13LA84, 13LA290, 13LA293, 13LA299, 13LA303, 13LA309, 13LA312, 13LA423, and 13LA426) should be designated for test excavations in order to assess their potential National

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Box 372
Clermont, Iowa 52135-0372
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Register eligibility. Some of these sites are currently being impacted by erosion and other factors. The assessment of these sites and the subsequent recommendations for appropriate mitigation measures should be a high priority.

13LA27 has been recommended for Phase III excavation. Excavation of this National Register eligible site should be a priority activity as well, depending on the degree of impact the site is currently experiencing due to erosion and other factors. Efforts should be made to protect this site id archeological excavation is not possible at the present time. Archeological sites 13LA98 and 13LA99 should be preserved. Any future project activities should avoid any impacts to these sites.

Any project activities proposed for areas of the site designated as having moderate or high potential for cultural resources, as depicted on Figure 17 of the report, should be preceded by archeological survey in order to locate any previously unrecorded archeological resources that might be present.

Should you have any questions or if this office can be of further assistance, please contact me at the phone number listed below.

Sincerely,



Kirsten Hoffman, Archeologist
Community Programs Bureau
(515) 281-4358

cc: Mr. Ron Pulcher, Rock Island COE



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

August 2, 1995

Planning Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a July 1995 final report entitled Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17-18, Iowa (BCA #342) authored by David W. Benn and Jeffrey D. Anderson.

Bear Creek Archeology, Inc., Cresco, Iowa, submitted the report under Corps Contract No. DACW25-92-D-0008, Work Order No. 0011. Please reference State Historical Society of Iowa R&C No. 950558014.

If you have questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

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REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

January 23, 1996

Planning Division (1165-2-26a)

Ms. Beth Foster
R&C Coordinator
State Historical
Society of Iowa
600 East Locust
Des Moines, Iowa 50319-0290

Dear Ms. Foster:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a draft report (Enclosure 1) entitled Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa, (BCA #405). It was authored by David W. Benn, Principal Investigator, and submitted by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 18. All work was conducted on Corps fee title lands.

Please note that we previously forwarded a related final report with our letter of August 2, 1995. The report, entitled Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17-18, Iowa (BCA #342), was authored by David W. Benn and Jeffrey D. Anderson. It summarized geomorphological investigations conducted in support of the current Phase I survey.

The Corps concurs with the Phase I report (page 114) that 12 archaeological sites (13LA13, 97, 100, 425, 431, 432, 440, 442, 443, 444, 445, and 451) are not eligible for inclusion in the National Register of Historic Places (NRHP). The Corps also concurs that one additional site (13LA38) has been sufficiently mitigated through excavation and is no longer eligible for the NRHP (page 116).

The Corps finds that sufficient data exists to determine three sites (13LA27, 98, and 99) eligible for inclusion in the NRHP. Benn recommends preservation for 13LA98 and 99 and data recovery for 13LA27; the Corps concurs. This will be addressed in the eventual plans for historic properties mitigation and/or data recovery for this project.

A fourth site (13LA104) may be eligible for the NRHP depending on whether or not a small rise is determined to be a burial mound. This site is not affected by the current project; however, the Corps proposes to verify this possible mound in consultation with the Iowa Burials Program and then remove it and the remainder of 13LA104 from cultivation. This work will be funded separately from this Environmental Management Program (EMP) project and is scheduled for 1996.

The Corps concurs that 15 sites (13LA30, 47, 290, 293, 299, 303, 309, 312 (historic town site of Burris City), 423, 426, 437, 438, 439, 446, and 450) are potentially eligible for inclusion in the NRHP and should receive Phase II testing (page 115). However, after a careful review of Benn's report and the project proposals, the Corps finds that the project will have No Effect on Burris City (13LA312). The fluctuating Lake Odessa water levels that are impacting all of the other 14 sites recommended for testing by Benn are not affecting this site. No other proposed project actions will impact Burris City; however, it is exposed at the Mississippi River shore line -- an impact unrelated to this project.

The Corps concurs that an additional 16 sites (13LA3, 288, 289, 291, 292, 296, 297, 298, 300, 301, 302, 304, 305, 308, 424, and 455) are potentially eligible for the NRHP and would normally receive Phase II testing. However, we also concur with Benn's proposal on pages 111-114 that no testing be conducted on these sites.

The Corps concurs with the report (page 113) in finding that this Lake Odessa EMP project will have No Effect on 16 sites (13LA84, 261, 318, 420, 421, 422, 427, 430, 433, 434, 435, 436, 441, 447, 448, and 449) -- plus a seventeenth site, Burris City (see discussion, above). The actual continued existence of 13LA84 (Poison Ivy Site) is in question. If parts of it remain, it would be eligible for inclusion in the NRHP. None of these 16 sites will be evaluated for the NRHP during the course of this project.

The Corps proposes to undertake Phase II testing on 14 of the 15 sites recommended by Benn; this excludes Burris City (13LA312). This work is scheduled for completion in 1996. Following this testing, a complete historic properties mitigation plan will be proposed for this project.

We request your comments on this matter within 30 days from the date of this letter. If we do not hear from you within this time, we will proceed as indicated.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
1133 North 17th Street
Manitowoc, Wisconsin 54220 (wo/enclosure)

Mr. David G. Stanley
Director
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (wo/enclosure)

Mr. H. John Dobrovolsky
Historic Preservation Officer
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111 (wo/enclosure)



State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

March 15, 1996

In reply refer to:
RC# 950558014

Mr. Dudley Hanson, Chief
Planning Division
Rock Island District, Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: COE - LOUISA COUNTY - LAKE ODESSA HABITAT REHABILITATION AND
ENHANCEMENT PROJECT - UPPER MISSISSIPPI RIVER SYSTEM - POOLS 17
AND 18 - CORPS CONTRACT DACW25-92-008, WORK ORDER NO. 18

Dear Mr. Hanson:

We have reviewed the information you submitted regarding the above-referenced project. We concur that 12 archaeological sites (13LA13, 97, 100, 425, 431, 432, 440, 442, 443, 444, 445, and 451) are not eligible for the National Register of Historic Places. No further work is needed on them. We also concur that site 13LA38 has been sufficiently mitigated through archeological excavation and is no longer eligible for the National Register.

We agree that three sites -- 13LA27, 13LA98, and 13LA99 -- are eligible for the National Register, and we agree with the consultant's recommendation that 13LA98 and 13LA99 should be preserved, while a data recovery plan should be developed and implemented for 13LA27.

We concur with the Corps' plan to consult with the Iowa Burials Program regarding the possible prehistoric mound at 13LA104. Please keep us informed about the results of that work.

Your letter states that the Corps considers 15 sites (13LA30, 47, 290, 293, 299, 303, 309, 312, 423, 426, 437, 438, 439, 446, and 450) potentially eligible for the National Register, and that the Corps plans to undertake Phase II testing on all of these except 13LA312. No testing of Site 13LA312 is planned at this time, because the site is outside the Area of Potential Effect of the proposed project. We agree with the Corps' plan to test thirteen of these sites. According to our records, site 13LA30 does not need to be tested to determine its eligibility because the Keeper of the National Register made a Determination of Eligibility (DOE) on this site in 1986. Additional testing of the site may be necessary in order to develop a data recovery plan, however.

☐ 402 Iowa Avenue
Iowa City, Iowa 52240-1806
(319) 335-3916

☒ 600 E. Locust
Des Moines, Iowa 50319-0290
(515) 281-6412

☐ Montauk
Box 372
Clermont, Iowa 52135-0372
(319) 423-7173

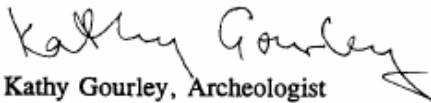
Mr. Dudley Hanson
March 15, 1996
Page 2

We understand that Phase II testing on the thirteen sites listed above will be undertaken in 1996. Please let us know if testing will be undertaken on 13LA30.

Your letter states that the Corps concurs with the consultant that an additional 16 sites (13LA3, 288, 289, 291, 292, 296, 297, 298, 300, 301, 302, 304, 305, 308, 424, and 455) are potentially eligible for the National Register, but that no additional work is proposed on them. Our office is not ready to concur with this proposal at this time, although we may be willing to consider developing a formal Memorandum of Agreement regarding treatment of these 16 sites. We request that the Corps seek the views of the Advisory Council on Historic Preservation in this matter.

If you have any questions, please do not hesitate to contact me at 515-281-8744.

Sincerely,



Kathy Gourley, Archeologist
Community Programs Bureau

cc: Ron Pulcher, Archeologist, Rock Island District Corps of Engineers
John Dobrovolny, Regional Preservation Officer, U.S. Fish & Wildlife Service
David Benn, Principal Investigator, Bear Creek Archeology



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 30, 1996

Planning Division

Mr. David G. Stanley
Director
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136

Dear Mr. Stanley:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) has reviewed your draft report entitled Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 and 18, Iowa, dated February 1996 (BCA #405). The report was authored by David W. Benn, Principal Investigator, and submitted by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 18.

Please prepare the final reports and include this letter; the Corps letter of January 23, 1996; the State Historical Society of Iowa letter dated March 15, 1996; and the Bear Creek letter dated April 3, 1996, in your final report.

Also, please add the following statement to the report cover: **This volume contains site locational information. NOT FOR PUBLIC DISTRIBUTION.**

Exhibit 1 must be included with the Scope of Work (SOW) in the report.

Figure 10 is confusing. Does this figure include all the areas surveyed by this work order? If so, it should clearly state this on the figure. If not, the survey coverage under this work order must be clearly illustrated. If survey coverage does not include the areas found on Exhibit 1 of the SOW, the report must clearly state why these areas were not included (particularly the Moist Soil Management Areas).

If you have any questions regarding this matter,
please call me at 309/794-5384, or you may write to
our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Ronald E. Pulcher
Authorized Representative
of the Contracting Officer

Copy Furnished:

Dr. David W. Benn
Research Coordinator
Bear Creek Archeology, Inc.
1133 North 17th Street
Manitowoc, Wisconsin 54220



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

May 24, 1996

Planning Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a May 1996 final report entitled Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #405) authored by David W. Benn, Principal Investigator.

Bear Creek Archeology, Inc., Cresco, Iowa, submitted the report under Corps Contract No. DACW25-92-D-0008, Work Order No. 0018. Please reference State Historical Society of Iowa R&C No. 950558014.

If you have questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division.

Sincerely,

[Signature]
Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

Mr. David G. Stanley
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P.O. Box 347
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Research Coordinator
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DISTRIBUTION LIST

Reports with Appendix E

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Reports without Appendix E

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Mr. R. Peter Winham
Archaeology Lab
2032 S. Grange
Sioux Falls, South Dakota 57105

6 January 1997

MEMORANDUM FOR RECORD

SUBJECT: Upper Mississippi River System-Environmental Management Program (UMRS-EMP) Lake Odessa, Iowa, Habitat Rehabilitation and Enhancement Project (HREP) Archeological Site Visit

1. The subject meeting was held on 15 August 1996 at the Lake Odessa project. The following representatives from the Rock Island District (CENCR), Iowa Department of Natural Resources (IADNR), State Historical Society of Iowa (SHPO), Office of the State Archaeologist (OSA), University of Northern Iowa (UNI), and Bear Creek Archeology, Inc. were in attendance.

Ron Pulcher	CENCR-PD-E	Joe Artz	OSA
Jim Ross	CENCR-PD-E	Mike Perry	OSA
Kevin Griggs	CENCR-PD-E	John Hedden	OSA
Darron Niles	CENCR-PD-W	Dave May	UNI
Mike Griffin	IADNR	Dave Benn	Bear Creek
Kathy Gourley	SHPO	Dave Stanley	Bear Creek

2. The purpose of the meeting was to inspect ongoing Phase II archeological excavations. The contractor was scheduled to survey 15 of the 30 sites identified during the Phase I investigation. The remaining 15 sites were not surveyed because representative sites were included in the 15 surveyed sites (will require SHPO concurrence).

3. Meeting participants visited sites 13LA446, 30, 47, 293, 299, and 423 (see attached). Open excavations showed each site's stratigraphy and often revealed extensive cultural deposits in surface or buried contexts. D. Benn explained the geomorphological and cultural context at each site.

4. M. Griffin questioned the application of Section 106 of the National Historic Preservation Act (NHPA) to this project. R. Pulcher responded that Section 106 requires Federal agencies to account for the effects of their undertakings on historic/cultural properties. It was also noted that just because Lake Odessa may be managed similarly before and after project construction, does not relieve the appropriate Federal agency from its responsibilities under Section 106. R. Pulcher further related that many of the shoreline erosion problem areas were of long standing and also are addressed under Section 110 of the NHPA. Section 110 requires agencies to manage and protect properties in their ownership, but lacks the mandatory requirements associated with Section 106. R. Pulcher explained that the impacts of concern are those involving direct earth moving in undisturbed soils and those associated with shoreline erosion (management of lake water levels and depth). Mitigation for sites eligible for inclusion in the National Register of Historic Places would range from data recovery by excavation to shoreline protection.

5. Post meeting developments:

a. The Phase II archeological survey contract was modified to allow completion of work this Fall because unusually high water levels prevented excavation at 3 of the 15 sites. The remaining excavations were completed the week of 9 December 1996. A draft report on the survey findings is expected by February 1997.

SUBJECT: Environmental Management Program (EMP) ~~Pool 11 Islands, Wisconsin,~~
Habitat Rehabilitation and Enhancement Project (HREP) Coordination Meeting

b. Survey results and mitigation requirements will be coordinated with the project sponsors (USFWS and IADNR) to assure that they still support project development. An estimate of mitigation costs should be available by the end of March 1997.

6. The current project schedule calls for draft Definite Project Report (DPR) preparation in November 1997, public review draft DPR in February 1998, and final DPR in April 1998.



DARRON NILES
Waterway Systems Branch

Encls

Lake Odessa, IA Distribution List

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Ms. Sue Julison
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Mr. Gale Hutton
U.S. Environmental Protection Agency
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Mr. Rick Nelson
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Iowa Department of Natural Resources
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Messrs. Don Pfeiffer & Don Kline
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Ms. Kathy Gourley
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Mr. David Benn
Bear Creek Archeology, Inc.
1133 North 17th Street
Manitowoc, WI 54220

Mr. David Stanley
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, IA 52136



DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF:

March 24, 1997

Planning Division (1165-2-26a)

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Pandullo:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a draft report (Enclosure 1) entitled Phase II Archaeological Testing of 14 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa, (BCA #466). It was authored by Dr. David W. Benn, Principal Investigator, and submitted by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 24. Please reference your R&C# 950558014.

Our letter of May 24, 1996, forwarded the final report entitled Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa, (BCA #405). It was authored by David W. Benn, Principal Investigator, and submitted by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 18. This report was prepared after receipt of the State Historical Society of Iowa letter dated March 15, 1996 (R&C# 950558014).

Enclosure 2, a table entitled "Archaeological Site Status Following Phase I Survey....," summarizes the Corps' opinion and the State Historical Society of Iowa (SHSI) position as of the end of the Phase I survey process. The SHSI did not concur that the 16 sites marked "X-NC" on Enclosure 2 should be omitted from the sample of sites for Phase II testing. The SHSI did agree with the status of the other sites as found on Enclosure 2.

Enclosure 3, a table entitled "Archaeological Site Status Following 1996 Phase II Testing....," summarizes the Corps' opinion following the 1996 Phase II testing work and follows Dr. David W. Benn's recommendations in the draft report at Enclosure 1. The 16 sites previously identified as being omitted from Phase II testing (marked X-NC on Enclosure 2) have been reevaluated by Dr. Benn following the Phase II work (this draft report, pages 153-154) with the following recommendations:

- five sites (13LA289, 291, 301, 302, and 304) are not eligible for the National Register of Historic Places (NRHP);
- nine sites (13LA3, 288, 292, 296, 297, 298, 305, 308, and 455) are in the area of No Effect;
- one site (13LA424) is eligible for the NRHP; and,
- one site (13LA300) should receive Phase II testing.

In 1997, field work will continue with testing of sites from the 1996 schedule: 13LA30, 423, and 438 (minor deep testing, water permitting); 13LA293a-h (horizontal and deep testing); and 13LA450 (was at water table in 1996). Phase II work will also take place on one new site, 13LA300. The 1997 work may result in modifications to the recommendations of the current draft report; therefore, the Corps intends to keep this report in draft until 1997 field results can be prepared. At that time any new or revised recommendations will be forwarded to you as an addendum to this report.

The Corps concurs with the draft report data recovery and/or preservation plans and recommendations presented for each of the NRHP-eligible sites (see the report text and the summary recommendations in Tables 2 and 13).

The data recovery and preservation recommended in this Phase II draft report are designed to mitigate the Adverse Effects of the Corps' undertaking at the Lake Odessa Habitat Rehabilitation and Enhancement Project during its projected life of 50 years (additional recommendations from the 1997 field work will be forwarded to you when complete).

When this draft report is finalized after the 1997 field work, and after receiving your comments on this February 1997 version and any addendum prepared after the 1997 work, the Corps intends to prepare a Memorandum of Agreement formalizing the mitigation measures agreed upon for the Lake Odessa project.

We request your comments on this draft report, realizing there is some minor amount of additional work planned. Please comment within 30 days of the date of this letter.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosures

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
1133 North 17th Street
Manitowoc, Wisconsin 54220 (with Enclosures 2 & 3)

MFR: Transmittal of Lake
Odessa Phase II Cultural
Report with request for
SHPO comment on proposed
data recovery and reservation
recommendations.

Mr. David G. Stanley
Director
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (with Enclosures 2 & 3)



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

January 26, 1998

Planning Division (1165-2-26a)

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Pandullo:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a two-volume, October 1997 draft report (Enclosure 1) entitled Phase II Archaeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa, (BCA #466). It was authored by Dr. David Benn, Principal Investigator, and submitted by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 24, Modifications 1 & 2. Please reference your R&C# 950558014. Enclosure 1 includes all the information in an earlier report forwarded with our March 24, 1997, letter (see paragraph immediately below) plus new information resulting from the summer 1997 field season.

As you may recall, our letter of March 24, 1997, forwarded the draft report of the summer 1996 field season entitled Phase II Archaeological Testing of 14 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa, (BCA #466). Please note that we received no reply from your office regarding this letter. Enclosure 1 completely ~~supersedes~~ this earlier report.

Enclosure 2, a table entitled "Archaeological Site Status Following 1997 Phase II Testing....," summarizes the Corps' opinion regarding the eligibility of sites at the Lake Odessa Habitat Rehabilitation & Enhancement Project. This table also gives treatment recommendations for the sites which are considered eligible for the National Register and which are within the area of potential effect (n=14). These treatment recommendations are the same as those in Tables 16 and 17 of the report.

Please note one pencil correction which needs to be made on Table 16 (page 236): change "preserve" to "no effect" for Site 13LA104.

The Corps concurs with the draft report data recovery and/or preservation plans and ~~treatment recommendations presented for each of the National Register of Historic Places~~ eligible sites (see the report text and the summary recommendations in Tables 16 and 17).

The data recovery and preservation recommended in this Phase II draft report are designed to mitigate the Adverse Effects of the Corps' undertaking at the Lake Odessa Habitat Rehabilitation and Enhancement Project during its projected life of 50 years.

We request your concurrence in the National Register eligibility status and in the Treatment Recommendations for the sites as set out at Enclosure 2.

Please provide your concurrence or comments within 30 days of the date of this letter. Should we fail to hear from you within that time, we will proceed to finalize this report as written.

Should the Lake Odessa project be approved for implementation, the Corps will prepare a Memorandum of Agreement formalizing the treatment recommendations proposed in this draft report.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosures

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (with Enclosure 2)

Mr. David G. Stanley
Director
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (with Enclosure 2)

Copies Furnished (Continued):

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Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 – 48th Avenue Court
Rock Island, Illinois 61201 (with Enclosure 2)

Mr. Dick Steinbach
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Mr. Kevin Szcodronski
Iowa Department of Natural Resources
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Mr. Bil Ohde
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Wapello, Iowa 52653 (with Enclosure 2)

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Wapello District
Mark Twain National Wildlife Refuge
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Wapello, Iowa 52653 (with Enclosure 2)



TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

LARRY J. WILSON, DIRECTOR

March 2, 1998

**Dudley M. Hanson, P.E.
Chief, Planning Division
Department of the Army
Rock Island District, Corps of Engineers
Clock tower Building - P.O. Box 2004
Rock Island, IL 61204-2004**

Dear Mr. Hanson:

Our Division has reviewed your January 26 letter concerning archaeological site treatments at the Lake Odessa Habitat Rehabilitation & Enhancement Project (HREP). We support the archaeological review and impact resolution or avoidance that is related to the scope and impacts of this HREP. However, in this case the archaeological review and recommendations exceed the impacts and area of influence of this project.

The Odessa HREP has several components, mainly designed to make the wetland system more secure and to be able to maintain and improve wetland characteristics on the area. It includes broadening the levee, construction of an additional moist soil unit, a green tree subimpoundment, a fish nursery area, selective dredging, and other enhancement features. The HREP as proposed will not change the water level management on this area.

We feel that maintaining the water levels within the operational limits (532.5 to 535.5 feet MSL) will not impact the archaeological sites. We believe that our management actually decreases shoreline erosion, because we try to get the water off the shorelines every year during the growing season to promote vegetative growth, tree survival and regeneration. That promotes a much more stable shoreline. Experience has shown us that there is little shoreline erosion in years we can get the water down, and extremely active shoreline erosion in high water years when the water level is out of our control. A more stable levee as proposed in this project could also result in fewer levee breaks, which would also tend to protect shorelines.

We recognize only one site that could suffer impacts from the HREP, and that site could be avoided during construction. We feel that the remaining sites will not be impacted by this HREP, therefore we question the use of HREP funds to protect these archaeological sites. It would seem more appropriate to use Corps

Mississippi River operational funds to protect existing sites that have been or are being impacted by shoreline erosion.

Thank you for your consideration in this matter and we welcome further dialogue on this matter.

Sincerely,



**Dr. Allen Farris,
Fish & Wildlife Division, IDNR
Wallace State Office Building
Des Moines, IA 50319**

AF061A.pa

**cc: Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, IA 50319-0290**

**Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish & Wildlife Service
4469 48th Avenue Court
Rock Island, IL 61201**

**Dick Steinbach
U.S. Fish & Wildlife Service
1704 North 24th Street
Quincy, IL 62301**

**District Manager - Wapello District
Mark Twain National Wildlife Refuge
10728 Country Road X61
Wapello, IA 52653**

**Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, IA 52653**



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 2, 1998

Planning Division (1165-2-26a)

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Pandullo:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for signature by the Iowa State Historic Preservation Officer (Enclosure 1). The MOA provides for mitigation of adverse effects occurring at the Horseshoe Site (13LA27) at Lake Odessa in Louisa County, Iowa.

The Horseshoe Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation and one of the top three sites recommended for data recovery in the Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers prepared under Engineering Regulation No. 1130-2-438.

The Corps has committed FY 98 Operation and Maintenance (O&M) funds to initiate this work. The effect of this commitment is to reduce total costs of any future mitigation for Lake Odessa EMP work by removing one of the two sites that could be mitigated only by excavation.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

After signature please return the signed MOA to Mr. Pulcher in the envelope provided.

Sincerely,

ORIGINAL SIGNED BY

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished (without enclosure):

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136

Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 – 48th Avenue Court
Rock Island, Illinois 61201

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301

Mr. Kevin Szcodronski
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, Iowa 52653

District Manager
Wapello District
Mark Twain National Wildlife Refuge
10728 Country Road X61
Wapello, Iowa 52653



State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

April 20, 1998

In reply please refer to:
R&C#: 950558014

Dudley M. Hanson, P. E.
Chief, Planning Division
Rock Island District Corps of Engineers
Clock Tower Building
P. O. Box 2004
Rock Island, IL 61204-2004

RE: COE - LOUISA - DACW25-92-D-0008 - BCA #466 - PHASE II ARCHAEOLOGICAL TESTING
OF 14 SITES, LAKE ODESSA HABITAT REHABILITATION & ENHANCEMENT PROJECT,
UPPER MISSISSIPPI RIVER SYSTEM, POOLS 17 & 18, IOWA

Dear Mr. Hansen,

We have received and reviewed the above referenced report prepared by Bear Creek Archaeology, Inc. Eighteen sites were investigated during this survey. Fifteen sites (13LA30, 13LA47, 13LA290, 13LA293 a, c-e, g, & h, 13LA299, 13LA300, 13LA303, 13LA309, 13LA423, 13LA426, 13LA437 south, 13LA438, 13LA439, 13LA446, and 13LA450) were evaluated with Phase II archaeological testing and three sites (13LA27, 13LA98, and 13LA99) were only mapped.

The consultant recommended that sites 13LA290, 13LA293 b & f, 13LA303, 13LA426, 13LA437 north, 13LA439, and 13LA450 are not potentially eligible for listing on the National Register of Historic Places and that no further archaeological work needs to be conducted for these sites. However, the consultant recommended that sites 13LA27, 13LA30, 13LA47, 13LA98, 13LA99, 13LA293 a, c-e, g, & h, 13LA299, 13LA300, 13LA309, 13LA423, 13LA437 south, 13LA438, and 13LA446 are potentially eligible for listing on the national register. The consultant recommended avoidance and preservation for eight sites (13LA47, 13LA98, 13LA99, 13LA300, 13LA423, 13LA437 south, 13LA438, and 13LA446) and Data Recovery for four sites or portions of these sites (13LA27, 13LA30, 13LA299, and 13LA309). We concur with the above recommendations.

In the process of archaeological investigations for the Phase I survey of this project, the consultant had not previously evaluated sites: 13LA3, 13LA288, 13LA289, 13LA291, 13LA292, 13LA296, 13LA297, 13LA298, 13LA300, 13LA301, 13LA302, 13LA304, 13LA305, 13LA308, 13LA424, and 13LA455. As a result of Phase II investigations, the consultant reassigned these sites not previously evaluated and two others to a different status.

The consultant now states that sites 13LA3, 13LA288, 13LA292, 13LA296, 13LA297, 13LA298, 13LA305, 13LA308, and 13LA455 lie outside the Lake Odessa EMP impact zones and therefore were placed in the no effect category. Because these sites no longer appear to be within the area of potential effect, we concur with

☐ 402 Iowa Avenue
Iowa City, Iowa 52240-1806
(319) 335-3916

☒ 600 E. Locust
Des Moines, Iowa 50319-0290
(515) 281-6412

☐ Montauk
Box 372
Clermont, Iowa 52135-0372
(319) 423-7173

the consultant's recommendations for these sites. If the project changes in any way and these sites will again be subjected to the area of potential effect, Phase II evaluation should be conducted for these sites.

The consultant revisited sites 13LA289, 13LA291, 13LA301, 13LA302, and 13LA304 and judged that these sites are no longer potentially eligible for listing on the National Register because they are "damaged beyond hope of salvaging significant research data" (Benn 1997:iii). . Because these sites no longer appear to be eligible for listing on the National Register, we concur with the consultant's recommendations concerning these sites.

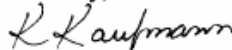
The consultant stated in this report that sites 13LA300 and 13LA424 should be preserved and the cutbanks should be riprapped or otherwise protected. We concur with the recommendations. If these sites cannot be preserved and protected, Phase II evaluations and/or Phase III data recovery should be implemented for these sites prior to any construction activities for the project.

According to a previous letter from our office (Gourley 1996), our office was not ready to concur that sites potentially eligible for listing on the National Register should receive no further work in the form of a Phase II evaluation. Ms. Gourley stated that this office would be willing to develop a formal Memorandum of Agreement regarding treatment of these sites. This view-point still stands and encompasses any additional sites not evaluated during the scope of the archaeological work. Considering the Corps does not plan to continue with the Lake Odessa EMP project at the current time (State of Iowa/Corps of Engineers Coordination meeting; Col. Mudd 1998), we suggest that the status of any unevaluated sites be reconsidered if and when the project continues.

If other design modifications are designated for this project which would involve undisturbed new R.O.W. or easements, please forward additional information to our office for further comment. However, if the proposed project work uncovers an item(s) which might be of archeological, historical or architectural interest, or if important new archeological, historical or architectural data come to light in the project area, you should make reasonable efforts to avoid or minimize harm to the property until the significance of the discovery can be determined.

Should you have any questions please contact me at the number below.

Sincerely,



Kira E. Kaufmann, Archaeologist
Community Programs Bureau
(515) 281-8744

cc: Ron Pulcher, Archeologist, Environmental Analysis Branch, Rock Island Corps of Engineers
Mr. David Benn, Principal Investigator, Bear Creek Archaeology, Inc.



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 24, 1998

Planning Division (1165-2-26a)

Mr. William Hartwig
Regional Director, Region III
U.S. Department of the Interior
Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

Dear Mr. Hartwig:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for your signature (Enclosure 1). This MOA has already been signed by the Corps, the Iowa State Historic Preservation Office, and the Iowa Department of Natural Resources. The MOA provides for mitigation of adverse effects occurring at the Horseshoe Site (13LA27) at Lake Odessa in Louisa County, Iowa.

The Horseshoe Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation and one of the top three sites recommended for data recovery in the Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers prepared under Engineering Regulation No. 1130-2-438.

The Corps has committed FY 98 Operation and Maintenance (O&M) funds to initiate this work. The effect of this commitment is to reduce total costs of any future mitigation for Lake Odessa EMP work by removing one of the two sites that could be mitigated only by excavation.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

After signature, please return the signed MOA to Mr. Pulcher in the envelope provided.

Sincerely,

ORIGINAL SIGNED BY

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (wo/enclosure)

Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 – 48th Avenue Court
Rock Island, Illinois 61201 (wo/enclosure)

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301 (wo/enclosure)

Mr. Kevin Szcodronski
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319 (wo/enclosure)

Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, Iowa 52653 (wo/enclosure)

District Manager
Wapello District
Mark Twain National Wildlife Refuge
515 Townsend Avenue
Wapello, Iowa 52653 (wo/enclosure)



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

May 19, 1998

Planning Division

Mr. Don Klima
Chief, Eastern Division Project Review
Advisory Council on Historic Preservation
Old Post Office Building, #809
1100 Pennsylvania Avenue, NW.
Washington, DC 20004

Dear Mr. Klima:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for mitigation of adverse effects occurring at the Horseshoe Site (13LA27) at Lake Odessa in Louisa County, Iowa (Enclosure 1).

The Horseshoe Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation. This site also is one of the top three sites recommended for data recovery in the Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers, prepared under Engineering Regulation No. 1130-2-438. Documentation as required under 36 CFR 800.8(b) and (c) is incorporated into the MOA.

We are providing the signed MOA for your 30-day review and acceptance in accordance with 36 CFR Part 800.6(a)(1).

If you have any questions regarding the MOA, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,
ORIGINAL SIGNED BY
P. BURKE

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (without enclosure)

Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 – 48th Avenue Court
Rock Island, Illinois 61201 (without enclosure)

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301 (without enclosure)

Mr. Kevin Szcodronski
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319 (without enclosure)

Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, Iowa 52653 (without enclosure)

District Manager
Wapello District
Mark Twain National Wildlife Refuge
10728 Country Road X61
Wapello, Iowa 52653 (without enclosure)



REPLY TO
ATTENTION OF:

Planning Division

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

May 22, 1998

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding an April 1998 final report (minus separately bound site forms) entitled Phase II Archaeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #466), authored by David W. Benn, Principal Investigator.

The report was prepared by Bear Creek Archeology, Inc., under Corps Contract Number DACW25-92-D-0008, Work Order No. 24, Modifications 1 & 2. Please reference State Historical Society of Iowa R&C No. 950558014.

If you have questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division.

Sincerely,

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosure

Copies Furnished:

Mr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (without Enclosure)

Mr. David G. Stanley
Director
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (without Enclosure)

DISTRIBUTION LIST

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust
Des Moines, Iowa 50319-0290
(includes separately bound site forms)

Office of the State Archaeologist
University of Iowa
700 South Clinton Street Building
Iowa City, Iowa 52242-1030

Center for American Archeology
P.O. Box 22
Kampsville, Illinois 62053

Mr. Lawrence A. Conrad
Archaeology Laboratory
Western Illinois University
201 Tillman Hall
Macomb, Illinois 61455

Mr. H. John Dobrovlny
Regional Historic Preservation Officer
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

Mr. Michael J. McNerney
American Resources Group, Ltd.
127 North Washington Street
Carbondale, Illinois 62901

Research and Collections Center Library
Illinois State Museum
1011 East Ash Street
Springfield, Illinois 62703



REPLY TO
ATTENTION OF:

Planning Division

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

June 16, 1998

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding for your files the fully executed Memorandum of Agreement (MOA) for mitigation of adverse effects occurring at the Horseshoe Site (13LA27) at Lake Odessa in Louisa County, Iowa (Enclosure 1).

The Horseshoe Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that required mitigation through excavation. This site also is one of the top three sites recommended for data recovery in the Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers, prepared under Engineering Regulation No. 1130-2-438.

If you have any questions regarding the MOA, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Patrick T. Burke, P.E.
Acting Chief, Planning Division

Enclosure

DISTRIBUTION LIST

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. William Hartwig
Regional Director, Region III
U.S. Department of the Interior
Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 – 48th Avenue Court
Rock Island, Illinois 61201

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301

ATTN: Mr. Kevin Szcodronski
Mr. Larry J. Wilson
Director
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, Iowa 52653

District Manager
Wapello District
Mark Twain National Wildlife Refuge
10728 Country Road X61
Wapello, Iowa 52653

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136

9 Feb 1999
PULCHER/5384

MEMORANDUM FOR RECORD:

SUBJECT: Lake Odessa EMP Historic Properties 50-Year Mitigation

1. Reference:

- a. Benn, David W.
1998 Phase II Archaeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #466). Report to Rock Island District Corps Engineers under Contract No. DACW25-92-D-0008, Delivery Order No. 24. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa.
- b. State Historical Society of Iowa letter dated April 20, 1998 (R&C#: 950558014) commenting on report, above.

2. A preliminary list of historic properties mitigation requirements were distributed in September, 1997, prior to the receipt of Benn's 1998 report which presents the final recommendations for historic properties mitigation at the Lake Odessa EMP Project.

3. These recommendations have been concurred in by the State Historical Society of Iowa/State Historic Preservation Officer (SHSI/SHPO) in the letter referenced in para. 1b.

4. Attachment 1 summarizes the mitigation required.

- a. Two sites (13LA27 & 309) require excavation because shoreline protection is not an option due to access for equipment; importance of the remaining deposits; and the nature and extent of the erosion. Excavations were conducted at 13LA27 with O&M funds in FY98, but money was unavailable to do the analysis and report production.

- b. Four sites (13LA30, 299, 300, & 423) can either be excavated or have their banks protected. Three of these (13LA30, 299, & 300) are near proposed dredging and should be protected by placement of dredged material along the banks. One site, 13LA423, is in backwater, but has a bank that can probably be stabilized by fabric/vegetation.

- c. One site (13LA438) should simply be avoided by cross-dike construction. If it can not be avoided, excavation will be needed.


- d. Seven sites, or portions thereof, (13LA47; 98; 99; 293a, c-e, g, & h; 424; 437 south; & 446) can be mitigated with bank protection from deposition of dredged material (5 sites) or by fabric/vegetative solutions (2 sites).

5. \$60K is needed to complete analysis and report writing at 13LA27. O&M money was used to conduct the excavation there in FY98.

6. \$150 is needed for mitigation at site 13LA309.

6. All remaining mitigation should concentrate on bank protection. Design and cost estimates for these solutions should be prepared in coordination with ED-DN. A total of roughly 2540 meters of bank protection is required.

7. POC: Ron Pulcher (PM-R), Ext. 5384.


RONALD E. PULCHER
Archaeologist
Environmental Analysis Branch

1 Atch



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 16, 1999

Planning, Programs, and
Project Management Division (1165-2-26a)

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Pandullo:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for your signature (Enclosure 1). The MOA provides for mitigation of adverse effects at the Cross Site (13LA309) at Lake Odessa in Louisa County, Iowa.

The Cross Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation. The second site (Horseshoe Site, 13LA27) was mitigated last year under an MOA signed by your office on April 6, 1998.

All remaining mitigation for cultural resources at the Lake Odessa EMP will occur through site avoidance and shoreline protection, which will be coordinated with your office as detailed plans are developed.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please place the MOA in the envelope addressed to Mr. Paul W. Johnson at the Iowa Department of Natural Resources and drop it in the mail.

Sincerely,

ORIGINAL SIGNED BY

Dorene A. Bollman
Acting Chief, Environmental Analysis Branch

Enclosure

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (wo/enclosure)

Mr. William Hartwig
Regional Director, Region III
U.S. Department of the Interior
Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111 (wo/enclosure)

Mr. Paul W. Johnson, Director
Iowa Department of Natural Resources
Henry A. Wallace Bldg.
East 9th and Grand
Des Moines, Iowa 50319 (wo/enclosure)

Mr. Richard Nelson
Field Supervisor
Rock Island Field Office
U.S. Fish and Wildlife Service
4469 - 48th Avenue Court
Rock Island, Illinois 61201 (wo/enclosure)

Mr. Bill Ohde
Iowa Department of Natural Resources
515 Townsend Avenue
Wapello, Iowa 52653 (wo/enclosure)

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301 (wo/enclosure)

Copies Furnished (Continued):

Mr. Kevin Szcodronski
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319 (wo/enclosure)

District Manager
Wapello District
Mark Twain National Wildlife Refuge
515 Townsend Avenue
Wapello, Iowa 52653 (wo/enclosure)



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

April 16, 1999

Planning, Programs, and
Project Management Division (1165-2-26a)

Mr. Paul W. Johnson
Director
Iowa Department of Natural Resources
Henry A. Wallace Building
East 9th and Grand
Des Moines, Iowa 50319

Dear Mr. Johnson:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for your signature (Enclosure 1). This MOA has already been signed by the Corps and the Iowa State Historic Preservation Office. The MOA provides for mitigation of adverse effects at the Cross Site (13LA309) at Lake Odessa in Louisa County, Iowa.

The Cross Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation. The second site (Horseshoe Site, 13LA27) was mitigated last year under an MOA signed by your office on April 17, 1998.

All remaining mitigation for cultural resources at the Lake Odessa EMP will occur through site avoidance and shoreline protection.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please return the signed MOA to Mr. Pulcher in the envelope provided.

Sincerely,

ORIGINAL SIGNED BY

Dorene A. Bollman
Acting Chief, Environmental Analysis Branch

Enclosure



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

May 13, 1999

Planning, Programs, and
Project Management Division (1165-2-26a)

Mr. William Hartwig
Regional Director, Region III
U.S. Department of the Interior
Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

Dear Mr. Hartwig:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for your signature (Enclosure 1). This MOA has already been signed by the Corps, the Iowa State Historic Preservation Office, and the Iowa Department of Natural Resources. The MOA provides for mitigation of adverse effects at the Cross Site (13LA309) at Lake Odessa in Louisa County, Iowa.

The Cross Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation. The second site (Horseshoe Site, 13LA27) was mitigated last year under an MOA signed by your office on May 12, 1998.

All remaining mitigation for cultural resources at the Lake Odessa EMP will occur through site avoidance and shoreline protection.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please return the signed MOA to Mr. Pulcher in the envelope provided.

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Environmental Analysis Branch.

Enclosures



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

June 16, 1999

Planning, Programs, and
Project Management Division

Mr. Don Klima
Chief, Eastern Division Project Review
Advisory Council on Historic Preservation
Old Post Office Building, #809
1100 Pennsylvania Avenue, NW.
Washington, DC 20004

Dear Mr. Klima:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Memorandum of Agreement (MOA) for mitigation of adverse effects occurring at the Cross Site (13LA309) at Lake Odessa in Louisa County, Iowa (Enclosure 1).

The Cross Site has been identified as one of the two sites in the Lake Odessa Environmental Management Program (EMP) that needs mitigation through excavation. This site also is one of the sites recommended for data recovery in the Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers, prepared under Engineering Regulation No. 1130-2-438. Documentation as required under 36 CFR 800.8(b) and (c) is incorporated into the MOA.

We are providing the signed MOA for your 30-day review and acceptance in accordance with 36 CFR Part 800.6(a)(1). The Iowa Department of Natural Resources lost the original Corps and State Historic Preservation Office signatures, but photocopies have been included in the MOA.

If you have any questions regarding the MOA, please call Mr. Ron Pulcher of our Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Environmental Analysis Branch

Enclosure

Barb Kimler
Rock Island District Corps of Engineers
Clocktower Bldg.
Rock Island IL 61204-2004

Mike Griffin
IA DNR
206 Rose St.
Bellevue IA 52031

04/11/2000

MS Barb Kimler:

Barb, this letter concerns the HREP at Odessa. Bill Ohde, Kathleen Maycroft, Karen Westphall and myself met Feb. 17 at Ohde's office to refine and refresh some of the information needs and project features for the Odessa HREP project.

Information needs:

- Bathymetry on Prairie Pocket.
- Core sediment samples from main lake.
- Two foot contour map to plan project features.
- A plan and engineering for an independent water delivery system to the refuge moist soil units (MSUs). This will allow simultaneous water delivery to the MSU's and the rest of the lake.
- Ballpark costs of 3-phase power and pump to Toolesboro subimpoundment located at south end.
- Ballpark cost on 3-phase power and pump capable of flooding 120 acres in the refuge.
- Look into feasibility of raising 120-acre area in crop field with material from main lake.
- Evaluate pumping alternatives at Fox Pond
- What are the dredging alternatives available to the project?
- Where are we with archeology study and requirements?
- Set up an interagency meeting.

Project features; (in addition and deletion from previous features).

- Inlet structures need to be modified to allow 1 structure to be dedicated to the MSU's, without flow reductions at any crossings below the structure. This may mean we have to replace the agricultural crossing below the inlet as well as road culverts and eight water control structures for MSU's.
- Explore scraping of existing MSU's to facilitate more reliable food production. This would be accomplished by scraping areas and depositing the material in strips within the MSU. At low water this would give a water, land, water, land

configuration. With the higher elevations more consistent manageable moist soil production is achieved.

- Investigate making a perched wetland/containment site on a field in the refuge. This area would be raised with dredged spoil; the berms for the containment would be left in place for use as a moist soil unit. A drain with water level control would be installed and a pump with water source for flooding.
- The cross dike on the FWS/DNR boundary referred to in early documents is eliminated.
- Green tree reservoir on DNR section is eliminated.

Previous project features not mentioned above should still be considered desired features and part of the project.

We would like to meet with the Corps on these issues and the older features at your earliest convenience. We would like to offer any help we can be in any of the needs outlined above.

Sincerely;
Mike Griffin
Mississippi River Wildlife Biologist
IA DNR
206 Rose St.
Bellevue IA 52031
319-872-5893
Michael.Griffin@dnr.state.ia.us

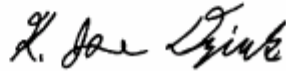
CC: Ohde Bill.Ohde@dnr.state.ia.us
Westphall Karen_Westphall@fws.gov
Maycroft Kathleen_Maycroft@fws.gov

MEMORANDUM FOR RECORD

SUBJECT: 17 July, 2000 on site coordination meeting for Lake Odessa EMP DPR.

1. On 17 July, an onsite coordination meeting was held to go over and verify the various elements of the Lake Odessa EMP DPR.
2. Joe Dziuk(ED-DG), John Behrens(ED-DG), Gene Rand(ED-G), Darron Niles(PM-M), Karen Hagerty(PM-R), Bill Ohde(Iowa DNR), and Kathy Maycroft(US Fish and Wildlife Service) were all present for the meeting.
3. Proposed elements of the EMP that were discussed at the meeting are as follows;
 - a. Moist Soil Management Unit (MSMU) in North end of refuge.
 - Proposed depth would be 2' to 3'.
 - Time to fill to proposed depth would be 14 days.
 - Approximate area of unit would be 135 acres.
 - Was stated that Little Goose Pond, the area where water would be pumped from to fill the unit, dries up regularly. Bill Ohde said that this would not be a problem because at the times when they would be pumping, the pond always has water.
 - John Behrens gave a possible alternative which is as follows;
 - Locate the pump at the existing inlet structure by the river and build up an elevated ditch to bring the water to the unit.
 - The main concern that the DNR and FWS had was cutting off the current tubes and outlets that feed the fields on the way to the proposed unit.
 - It was decided that control structures could be placed in the areas to let water into the areas as needed.
 - b. Diversion Dike
 - If we don't place the pump at the inlet structure for the above mentioned MSMU, the DNR and FWS want to dedicate one of the structure inlet bays to run towards Fox Pond
 - With the current situation, they have to close the stop logs just down stream of the inlet structure to gain head and send the water into the tube that feeds the fields towards Fox Pond, and then open the gates once they have what they need by Fox Pond. Due to heavy seepage in the area, this process has to continuously be performed to maintain desired water levels.
 - c. Fox Pond
 - The existing pump at Fox Pond needs to be repaired.
 - If possible, would like Fox Pond to be dry in the summer for vegetation growth.
 - There is an existing gravity drain at Fox Pond that may need some structural repair.

- The stop log structures that are proposed for the ditches that empty into Fox Pond need to be examined because they may not work due to seepage.
 - For the proposed scraping of the fields by Fox Pond, will need to look at work sequencing so that the area can be dried as much as possible so equipment can be taken into the fields.
- d. Prairie Pocket
 - Was proposed by FWS to perform deep hole dredging for fish habitat.
 - e. Fish Nursery
 - For the proposed site, the needed depth already exists.
 - The main work that would be needed would be to place a control structure at the opening to keep it separated from the lake.
 - The road area where the structure would go should be elevated enough so vehicles can pass at all times.
 - f. Moist Soil Management Unit in South end of refuge
 - Already has an existing unit.
 - DNR would like to place a pump and some kind of outlet to control the water levels in the unit.
 - Currently, they are able to fill up some pockets in the unit, but once the water gets up to a certain level, it seeps out.
 - May have to do some kind of lining to control seepage.
 - The DNR believes that the perimeter levee is adequate.
4. Proposed elements of the EMP that were not discussed are as follows;
 - a. Dredge lateral ditches
 - b. Dredge access to Yankee Chute
 - c. Deep hole dredging in the main Lake
 - d. Spillway in the South end of refuge
 - e. Mast tree planting



K. Joe Dziuk, P.E.
Project Engineer, ED-DG



DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

August 3, 2000

REPLY TO
ATTENTION OF

Planning, Programs, and
Project Management Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is currently preparing a Definite Project Report (DPR) with an Environmental Assessment (EA) for the rehabilitation of the Lake Odessa complex, Louisa County, Iowa. Lake Odessa has been funded for design as a Habitat Rehabilitation and Enhancement Project (HREP) of the Upper Mississippi River System – Environmental Management Program (EMP), under authority of the Water Resources Development Act (WRDA) of 1986. In accordance with the provisions of Section 906(e) of WRDA, cost sharing for general design and construction would be 100-percent Federal. The U.S. Fish and Wildlife Service (USFWS) and the Iowa Department of Natural Resources (IADNR) are the project sponsors.

Lake Odessa is a 6,800-acre backwater complex of open water, marsh, timbered islands, ponds, and chutes, separated from the Mississippi River by a levee. The project is located entirely on Federal lands, half above and half below Lock and Dam (L/D) 17, approximately 15 miles south of Muscatine, Iowa (see attached location map). Management of the complex is split between the USFWS (north of L/D 17) and the IADNR (south of L/D 17). While Lake Odessa has traditionally had high fall duck and geese populations and significant duck production, the existing water control structures and overall complex size limit water level management with regard to drawdown, excess water release, and fall reflooding. Sedimentation from frequent levee breaks and overtopping flood events has increased the preponderance of shallow water habitat, which may reduce circulation of well-oxygenated water and cause winter fishkills.

The overall goal of the HREP for the Lake Odessa complex is the enhancement of wetland and aquatic habitats. The following objectives have been identified to meet the restoration goals: (1) improve water quality; (2) increase reliable food production for migratory birds; (3) improve overwintering and nursery habitat for fish; and (4) improve bottomland hardwood diversity. Several rehabilitation measures to meet the identified objectives will be addressed and evaluated in the DPR and EA. These measures are described in the following paragraphs.

a. Restore perimeter levee and construct a spillway along the Iowa River tieback levee to protect the Lake Odessa complex from future levee breaches and overtopping flood events. The controlled overtopping spillway would be sized to allow high water from the Mississippi River into the area, reducing the likelihood of a levee breach by reducing head differential.

- b. Improve and create water level control for moist soil management units on USFWS and IADNR areas. The construction of pump stations, water control structures, ring levees, and a diversion dike would provide reliable food production for migratory waterfowl use.
- c. Increase vegetation diversity in existing wetlands by creating elevation changes to promote submergent/emergent vegetation as well as areas of standing water.
- d. Improve fisheries habitat through various means. Excavate deep holes in Lake Odessa to provide overwintering habitat. Construct water control structure in backwater area off Little Goose Pond for nursery area. Dredge Lateral Ditch and Yankee Chute access to enhance fish movement.
- e. Enhance bottomland forest diversity through mast tree plantings on areas of higher elevation.

The overall effect of the project is expected to be beneficial to wetland habitat with no significant adverse impacts to the quality of the human environment. While construction of project features will initially affect some existing habitat within the project area, anticipated increases in habitat values throughout the area should offset any negative impacts. Because construction of some project features would require placement of fill material into waters of the United States, the project will require processing under Section 404 of the Clean Water Act.

We request your preliminary comments concerning the proposed project within 30 days of the date of this letter. We further request any information concerning rare, threatened or endangered species, sensitive habitats, or other important resources in the study area. Additional opportunities to comment will be provided as part of our processing of the initial draft and public review draft DPRs for the subject project. Distribution of these documents is currently scheduled for December 2000 and February 2001, respectively.

If you have any questions or need additional information, please call Ms. Karen Hagerty of our Environmental Analysis Section, telephone 309/794-5286. Written comments may be sent to our address above, ATTN: Planning, Programs, and Project Management Division.

Sincerely,



Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Attachment

DISTRIBUTION LIST

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Director
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Marvin Hubbell
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Springfield, IL 62706



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING — P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

October 25, 2000

Planning, Programs, and
Project Management Division (1165-2-26a)

Ms. Maria Pandullo
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Pandullo:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) has reviewed the draft report at Enclosure 1 entitled *Data Recovery Excavations at the Late Woodland Cross Site (13LA309) Louisa County, Iowa* (BCA #746 – 3 volumes) dated October 2000. Dr. David W. Benn *et al.* of Bear Creek Archeology, Inc., Cresco, Iowa, prepared the report under Corps Contract DACW25-98-D-0001, Work Order No. 0014. Please reference your R&C No. 950558014 for the Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) and the Memorandum of Agreement (MOA) for 13LA309 signed by the Corps on April 15, 1999.

The Corps finds this report to fulfill the requirements for data recovery as set out in the MOA. The Corps has determined that this data recovery completes the Section 106 process for the Late Woodland Cross Site (13LA309) under the Lake Odessa HREP.

Please forward any comments you may have regarding this report within 30 days of the date of this letter.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Environmental Analysis Section, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosure

Copies Furnished:

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (wo/enclosure)

MEMORANDUM FOR RECORD

SUBJECT: Baseline WHAG Meeting Summary for Lake Odessa HREP

1. A meeting was held at 12:30 p.m. on October 30, 2000, at the Lake Odessa Refuge Office in Wapello, IA. The following people were in attendance:

Karen Hagerty, CEMVR-PM-AR
Gary Swenson, CEMVR-OD-MN
Joe Lundh, CEMVR-OD-MN
Bill Ohde, Iowa DNR
Tim Julison, USFWS, asst. refuge manager
Karen Westphall, USFWS, EMP coordinator

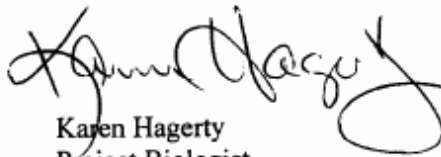
2. The goal of the meeting was to fill out baseline WHAG field data sheets for the Lake Odessa HREP.
3. The group focused on three primary issues:
 - Verify project features. The most proposed project areas remained the same as shown on the plates 3 & 4, dated 17 July 2000 (attached). Exceptions: in the area adjacent to the Mississippi levee, no lateral ditches will be dug, instead wetland scrapes will be constructed; other mast tree planting areas will be identified later; exact locations of deep water holes has yet to be determined; lateral ditches at Swarms Pond are for moist soil management.
 - WHAG assumptions:
 - 1) 50 year project life;
 - 2) future years=1, 25, 50;
 - 3) levee will continue to protect against flooding;
 - 4) bottomland hardwood area, as shown on plate 4 is representative of all such areas;
 - 5) Assumed no change in aquatic areas from 1992 MOFISH data sheets for Yankee Chute, Blackhawk Slough, and Main Lake;
 - 6) assumed current management practices will continue.

- Appropriate sites for without-project conditions were selected. They include the following, by site and type (see attached plates 3 & 4):

- #1 - moist soil cropland (USFWS), wetland cropland sheet
- #2 - proposed wetland scrape area, non-forested wetland sheet
- #3 - wet field, non-forested wetland sheet
- #4 - Swarms Pond, non-forested wetland sheet
- #5 - DNR moist soil area, non-forested wetland sheet
- #6 - mast tree planting, bottomland hardwoods wetland sheet
- #7 - fish nursery site, MOFISH overflow waters sheet
- #8 - Yankee Chute, MOFISH overflow waters sheet
- #9 - Main Lake, MOFISH overflow waters sheet
- #10 - Blackhawk Slough, MOFISH overflow waters sheet

4. Action items:

- Please review attached data sheets for accuracy. Please provide comments to Karen Hagerty by November 30, 2000.
- Estimated time until with-project WHAG is 1-2 months.



Karen Hagerty
Project Biologist

Attachments

External Distribution (w/attachments):

Tim Julison
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Mark Twain National Wildlife Refuge, Wapello District
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Wapello, IA 52653

Don Kline
Iowa DNR
Lake Darling State Park
R.R 1
Brighton, IA 52540

2000 Baseline WHAG

Luke Olson
30 Oct 2000

Karen Hagerly	COE	309/794-5286 Karen.h.hagerly@usace.army.mil
GARY SWENSON	OD-MN	309/794-4489 GARY.V.SWENSON@usace.army.mil
JOE Lundh	OD-MN	309-794-4528 Joseph.S.Lundh@USACE-army.mil
Bill Ohde	Iowa DNR	319/523-8319 Bill.Ohde@dnr.state.ia.us
Tim Julison	USFWS	319-523-6982 TimJulison@fws.gov
Karen Westphall	USFWS	317-224-3550 Karen.Westphall@fws.gov

10/20/00

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - CROPLAND

WILDLIFE AREA <u>Lake O</u>			DATE <u>30 Oct 00</u>
SAMPLE SITE <u>cropland (site #1)</u>			ANIMAL HABITAT 1 2
<u>(Same # 2 '92)</u>			<u>W/O project</u>
LAND USE IN 2 MILE WIDE CIRCLE			
2	2	2	PERCENT NONFOREST WETL, ANNUALLY FLOODED CROPLAND AND LAKES OR RESERVOIRS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
3	1	1	BOTTOMLAND HARDWOODS, ANNUALLY FLOODED CROPLAND AND NONFOREST WETLANDS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
SAMPLE SITE, TRACT OR STAND CHARACTERISTICS			
4	4	4	FALL AND WINTER WATER CONDITIONS (1)ANNUALLY PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)EVERY OTHER YEAR & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
6	5	5	WATER DEPTH 4IN-18IN FALL-WINTER (PERCENT OF FIELD) (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
29	2	2	CROPFIELD MANAGEMENT (1)NO FALL TILL (2)WINTER WHEAT (3)CHISEL PLOW (4)CHOP/GRAZED/BALED (5)FALL DISC (6)FALL PLOW
30	1	1	CROPPING PRACTICE (1)>50 UNHARV (2)25-50 UNHARV (3)10-25 UNHARV (4) <10 UNHARV
31	2	2	CROP ROTATION (1)SG-RC-L (2)SG-RC; OR IDLE SOME YEARS (3)CONT SG OR RC
32	4	4	FIELD SIZE (% W/IN 660' WOODL OR COMPLETE TREELINE WITH DISTANCE BETWEEN TREES <50') (1)<25 (2)25-50 (3)50-75 (4)>75
DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)			
48	3	3	DISTANCE NONFOREST WETL, OXBOW, SLOUGH (1)<250' WATER PREDICT (2)250'-1/8 MI WATER PREDICT (3)1/8-1 MI WATER PREDICT (4)<250' WATER PREDICT 1 OUT OF 3 YEARS (5)250'-1/8 MI WATER PREDICT 1 OUT OF 3 YEARS (6)1/8-1 MI WATER PREDICT 1 OUT OF 3 YEARS (7)>1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR STAND CAPABLE OF BEING FLOODED.)
49	2	2	DISTANCE BOTTOMLAND HARDWOODS (1)<1/4 MI WATER PREDICT (2)1/4-1/2 MI WATER PREDICT (3)1/2-1 MI WATER PREDICT (4)<1/4 MI WATER PREDICT 1 OUT OF 3 YEARS (5)1/4-1/2 MI WATER PREDICT 1 OUT OF 3 YEARS (6)1/2-1 MI WATER PREDICT 1 OUT OF 3 YEARS (7)>1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR STAND CAPABLE OF BEING FLOODED.)
51	4	4	DISTANCE TO GRASSLAND (1)<1/2 MI <6" AND >40 AC (2)1/2-1 MI <6" AND >40 AC (3)<1 MI <6" AND <40 AC (4)>1 MI; OR >6"
53	1	1	DISTANCE MAJOR RIVER OR LAKE >100 AC (1)<1 MI (2)1-5 MI (3)5-10 MI (4)>10 MI
54	1	1	DISTANCE FALL GOOSE CONCENTRATION AREA (1)<4 MI (2)4-10 MI (3)10-25 MI (4)>25 MI

WETLAND

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - NONFOREST

WILDLIFE AREA Lake Chessa

DATE 10/30/00

SAMPLE SITE #2 (proposed wetland scrape area)

ANIMAL HABITAT 27 28 29
w/o project

LAND USE IN 2 MILE WIDE CIRCLE

- 1 3 PERCENT NONFOREST WETLANDS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 2 2 PERCENT NONFOREST WETL, ANNUALLY FLOODED CROPLAND AND LAKES OR RESERVOIRS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 3 2 PERCENT BOTTOMLAND HARDW, ANNUALLY FLOODED CROPLAND AND NONFOREST WETL (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10

SAMPLE SITE, TRACT OF STAND CHARACTERISTICS

- 4 4 FALL AND WINTER WATER CONDITIONS (1)ANNUALLY - PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)1 OUT OF 3 YEARS & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
- 5 1 FALL AND WINTER FLOOD CONDITIONS (1)FOOD PLANTS UNAFFECTED BY FLOODS (2)REDUCED <25; OR 1 IN 4 YRS. (3)REDUCED 25-50; OR 2 IN 4 YRS. (4)REDUCED 50-75; OR 3 IN 4 YRS. (5) REDUCED >75; OR YEARLY
- 6 5 WATER DEPTH 4IN-18IN FALL-WINTER (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 7 4 WATER DEPTH <4IN DURING MAY (1)>90 (2)75-90 (3)50-75 (4) 25-50 (5)<25
- 8 4 WATER DEPTH 4IN-18IN BY AUGUST (1)>75 (2)50-75 (3)25-50 (4)<25
- 9 5 PERMANENT WATER ENTIRE YEAR (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 10 4 PERCENT EMERGENT VEGETATION W/IN 2YDS WATER (1)>75 (2)50-75 (3)25-50 (4)<25
- 11 1 WOODY INVASION (1)<10 (2)10-25 (3)25-50 (4)50-75 (5)>75
- 12 2 EMERGENT VEGETATION COVERAGE (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)10-25 (6)<10
- 13 2 CATTAIL AND BULLRUSH COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 14 1 WETLAND SIZE-ACRES (1)>200 (2)100-200 (3)50-100 (4)25-50 (5)5-25 (6)<5
- 15 5 WETLAND EDGE (& WOODY OR ADJ BOTTOMLAND HARDW) (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 16 4 WATER REGIME - GRADUAL DRYING WITH & WATER REMAINING BY AUG. 1 (1) >75 (2)50-75 (3)25-50 (4)<25 (5)STABLE WATER (6)RAPID DRYING; OR NO WATER AFTER JUNE 1
- 17 4 IMPORTANT FOOD PLANT COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 18 1 PLANT DIVERSITY (1)>7 (2)4-7 (3)<4
- 19 4 PERSISTENT EMERGENT AND WOODY COVERAGE (1)5-15 (2)15-25 (3)25-50 (4)<5 OR >50
- 20 2 SUBSTRATE-SURFACE WATER INTERSPERSION (1)SUBSTRATE WATER INTERSPERSED (2)SHALLOW WATER AS 1 OR FEW POOLS
- 21 1 PERCENT OPEN WATER (AVERAGE WHEN WATER PRESENT <50% CANOPY COVERAGE VEGETATION) (1)<10 (2)10-25 (3)25-50 (4)50-90 (5) >90
- 22 4 WINTER WATER DEPTH OCT-MARCH (1)15-24" (2)10-15 (3)6-10" OR 30-36" (4)<6" OR >36"

- 23 5 SEDGE CANOPY COVERAGE (1) >90 (2)75-90 (3)50-75 (4)25-50
(5)1-25 (6)ZERO
- 24 1 WETLAND SUBSTRATE (1)MUDDY (2)SANDY (3) GRAVEL
- 25 1 PERCENT SOIL WATERLOGGED DURING MAY (1)>90 (2)75-90 (3)50-75
(4)25-50 (5)<25
- 26 6 PERCENT EXPOSED SUBSTRATE AND SHALLOW WATER AREAS COVERED BY
VEGETATION MAY-JUNE (1)<10 (BARE GROUND OR OPEN WATER) (2)10-25
(3)25-50 (4)50-75 (5)75-90 (6)>90 WELL VEGETATED)

DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)

- 49 6 DISTANCE BOTTOMLAND HARDWOODS (1)<1/4 MI WATER PREDICT
(2)1/4-1/2 MI WATER PREDICT (3)1/2-1 MI WATER PREDICT
(4)<1/4 MI WATER PREDICT 1 OUT OF 3 YEARS (5)1/4-1/2 MI WATER
PREDICT 1 OUT OF 3 YEARS (6)1/2-1 MI WATER PREDICT 1 OUT OF 3
YEARS (7)>1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER
PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR
STAND CAPABLE OF BEING FLOODED)
- 50 4 DISTANCE CROPLAND (1)<1/4 MI, UNHARV AND WATER PREDICT
(2)<1/4-1/2 MI, UNHARV AND WATER PREDICT (3)1/2-1 MI UNHARV AND
WATER PREDICT (4)<1/4 MI, UNHARV AND FLOODING PREDICT 1 OUT OF
3 YEARS; OR <1/4 MI UNFLOODED RESIDUES UNDISTURB (5)1/4-1/2 MI
UNHARV AND WATER PREDICT 1 OUT OF 3 YEARS; OR 1/4-1/2 MI
UNFLOODED RESIDUES UNDISTURB (6)1/2-1 MI UNHARV AND WATER
PREDICT 1 OUT OF 3 YEARS; OR 1/2-1 MI UNFLOODED RESIDUES
UNDISTURBED (7)>1 MI TO CROFFIELD; OR <1 MI UNFLOODED DISC OR
PLOW (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25%
OF THE FIELD OR STAND CAPABLE OF BEING FLOODED)
- 51 4 DISTANCE GRASSLAND (1)<1/2 MI <6" AND >40 AC (2)1/2-1 MI <6"
AND >40 AC (3)<1 MI <6" AND <40 AC (4)>1 MI; OR >6"
- 52 1 DISTANCE STREAM OR RIVER (1)<1/4 MI (2)1/4-1/2 MI (3)>1/2 MI
- 53 1 DISTANCE MAJOR RIVER OR LAKE >100 AC (1)<1 MI (2)1-5 MI
(3)5-10 MI (4)>10 MI
- 54 1 DISTANCE GOOSE FALL CONCENTRATION AREA (1)<4 MI (2)4-10 MI
(3)10-25 MI (4)>25 MI

WETLAND

assume no change
for target yrs 1, 25, 50
assume same mgmt practices over 4

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - NONFOREST

WILDLIFE AREA Lake Odessa

DATE 10/30/00

SAMPLE SITE #3 (northern most wet field)

ANIMAL HABITAT 27 28 29
w/o project

LAND USE IN 2 MILE WIDE CIRCLE

- 1 3 PERCENT NONFOREST WETLANDS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 2 2 PERCENT NONFOREST WETL, ANNUALLY FLOODED CROPLAND AND LAKES OR RESERVOIRS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 3 2 PERCENT BOTTOMLAND HARDW, ANNUALLY FLOODED CROPLAND AND NONFOREST WETL (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10

SAMPLE SITE, TRACT OF STAND CHARACTERISTICS

- 4 4 FALL AND WINTER WATER CONDITIONS (1)ANNUALLY - PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)1 OUT OF 3 YEARS & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
- 5 1 FALL AND WINTER FLOOD CONDITIONS (1)FOOD PLANTS UNAFFECTED BY FLOODS (2)REDUCED <25; OR 1 IN 4 YRS. (3)REDUCED 25-50; OR 2 IN 4 YRS. (4)REDUCED 50-75; OR 3 IN 4 YRS. (5) REDUCED >75; OR YEARLY
- 6 5 WATER DEPTH 4IN-18IN FALL-WINTER (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 7 5 WATER DEPTH <4IN DURING MAY (1)>90 (2)75-90 (3)50-75 (4) 25-50 (5)<25
- 8 4 WATER DEPTH 4IN-18IN BY AUGUST (1)>75 (2)50-75 (3)25-50 (4)<25
- 9 5 PERMANENT WATER ENTIRE YEAR (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 10 4 PERCENT EMERGENT VEGETATION W/IN 2YDS WATER (1)>75 (2)50-75 (3)25-50 (4)<25
- 11 1 WOODY INVASION (1)<10 (2)10-25 (3)25-50 (4)50-75 (5)>75
- 12 6 EMERGENT VEGETATION COVERAGE (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)10-25 (6)<10
- 13 5 CATTAIL AND BULLRUSH COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 14 2 WETLAND SIZE-ACRES (1)>200 (2)100-200 (3)50-100 (4)25-50 (5)5-25 (6)<5
- 15 2 WETLAND EDGE (3 WOODY OR ADJ BOTTOMLAND HARDW) (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 16 4 WATER REGIME - GRADUAL DRYING WITH 3 WATER REMAINING BY AUG. 1 (1) >75 (2)50-75 (3)25-50 (4)<25 (5)STABLE WATER (6)RAPID DRYING; OR NO WATER AFTER JUNE 1
- 17 1 IMPORTANT FOOD PLANT COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 18 1 PLANT DIVERSITY (1)>7 (2)4-7 (3)<4
- 19 2 PERSISTENT EMERGENT AND WOODY COVERAGE (1)5-15 (2)15-25 (3)25-50 (4)<5 OR >30
- 20 2 SUBSTRATE-SURFACE WATER INTERSPERSION (1)SUBSTRATE WATER INTERSPERSED (2)SHALLOW WATER AS 1 OR FEW POOLS
- 21 3 PERCENT OPEN WATER (AVERAGE WHEN WATER PRESENT <50% CANOPY COVERAGE VEGETATION) (1)<10 (2)10-25 (3)25-50 (4)50-90 (5) >90
- 22 4 WINTER WATER DEPTH OCT-MARCH (1)15-24" (2)10-15 (3)6-10" OR 30-36" (4)<6" OR >36"

- 23 5 SEDGE CANOPY COVERAGE (1) >90 (2)75-90 (3)50-75 (4)25-50
(5)1-25 (6)ZERO
- 24 2 WETLAND SUBSTRATE (1)MUDDY (2)SANDY (3) GRAVEL
- 25 1 PERCENT SOIL WATERLOGGED DURING MAY (1)>90 (2)75-90 (3)50-75
(4)25-50 (5)<25
- 26 2 PERCENT EXPOSED SUBSTRATE AND SHALLOW WATER AREAS COVERED BY
VEGETATION MAY-JUNE (1)<10 (BARE GROUND OR OPEN WATER) (2)10-25
(3)25-50 (4)50-75 (5)75-90 (6)>90 WELL VEGETATED)

DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)

- 49 7 DISTANCE BOTTOMLAND HARDWOODS (1)<1/4 MI WATER PREDICT
(2)1/4-1/2 MI WATER PREDICT (3)1/2-1 MI WATER PREDICT
(4)<1/4 MI WATER PREDICT 1 OUT OF 3 YEARS (5)1/4-1/2 MI WATER
PREDICT 1 OUT OF 3 YEARS (6)1/2-1 MI WATER PREDICT 1 OUT OF 3
YEARS (7)>1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER
PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR
STAND CAPABLE OF BEING FLOODED)
- 50 7 DISTANCE CROPLAND (1)<1/4 MI, UNHARV AND WATER PREDICT
(2)<1/4-1/2 MI, UNHARV AND WATER PREDICT (3)1/2-1 MI UNHARV AND
WATER PREDICT (4)<1/4 MI, UNHARV AND FLOODING PREDICT 1 OUT OF
3 YEARS; OR <1/4 MI UNFLOODED RESIDUES UNDISTURB (5)1/4-1/2 MI
UNHARV AND WATER PREDICT 1 OUT OF 3 YEARS; OR 1/4-1/2 MI
UNFLOODED RESIDUES UNDISTURB (6)1/2-1 MI UNHARV AND WATER
PREDICT 1 OUT OF 3 YEARS; OR 1/2-1 MI UNFLOODED RESIDUES
UNDISTURBED (7)>1 MI TO CROPFIELD; OR <1 MI UNFLOODED DISC OR
PLOW (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25%
OF THE FIELD OR STAND CAPABLE OF BEING FLOODED)
- 51 4 DISTANCE GRASSLAND (1)<1/2 MI <6" AND >40 AC (2)1/2-1 MI <6"
AND >40 AC (3)<1 MI <6" AND <40 AC (4)>1 MI; OR >6"
- 52 1 DISTANCE STREAM OR RIVER (1)<1/4 MI (2)1/4-1/2 MI (3)>1/2 MI
- 53 1 DISTANCE MAJOR RIVER OR LAKE >100 AC (1)<1 MI (2)1-5 MI
(3)5-10 MI (4)>10 MI
- 54 1 DISTANCE GOOSE FALL CONCENTRATION AREA (1)<4 MI (2)4-10 MI
(3)10-25 MI (4)>25 MI

WETLAND

assume no changes for
target yrs 1, 25, 50

assume same mgmt practices don't

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - NONFOREST

WILDLIFE AREA Lake Odessa
 SAMPLE SITE #4 (centered on Swamps pond)

DATE 10/30/00

ANIMAL HABITAT 27 28 29

W/O project

LAND USE IN 2 MILE WIDE CIRCLE

- 1 4 PERCENT NONFOREST WETLANDS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 2 2 PERCENT NONFOREST WETL, ANNUALLY FLOODED CROPLAND AND LAKES OR RESERVOIRS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 3 2 PERCENT BOTTOMLAND HARDW, ANNUALLY FLOODED CROPLAND AND NONFOREST WETL (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10

SAMPLE SITE, TRACT OF STAND CHARACTERISTICS

- 4 2 FALL AND WINTER WATER CONDITIONS (1)ANNUALLY - PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)1 OUT OF 3 YEARS & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
- 5 1 FALL AND WINTER FLOOD CONDITIONS (1)FOOD PLANTS UNAFFECTED BY FLOODS (2)REDUCED <25; OR 1 IN 4 YRS. (3)REDUCED 25-50; OR 2 IN 4 YRS. (4)REDUCED 50-75; OR 3 IN 4 YRS. (5) REDUCED >75; OR YEARLY
- 6 3 WATER DEPTH 4IN-18IN FALL-WINTER (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 7 5 WATER DEPTH <4IN DURING MAY (1)>90 (2)75-90 (3)50-75 (4) 25-50 (5)<25
- 8 3 WATER DEPTH 4IN-18IN BY AUGUST (1)>75 (2)50-75 (3)25-50 (4)<25
- 9 5 PERMANENT WATER ENTIRE YEAR (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 10 4 PERCENT EMERGENT VEGETATION W/IN 2YDS WATER (1)>75 (2)50-75 (3)25-50 (4)<25
- 11 1 WOODY INVASION (1)<10 (2)10-25 (3)25-50 (4)50-75 (5)>75
- 12 6 EMERGENT VEGETATION COVERAGE (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)10-25 (6)<10
- 13 5 CATTAIL AND BULLRUSH COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 14 2 WETLAND SIZE-ACRES (1)>200 (2)100-200 (3)50-100 (4)25-50 (5)5-25 (6)<5
- 15 1 WETLAND EDGE (% WOODY OR ADJ BOTTOMLAND HARDW) (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 16 3 WATER REGIME - GRADUAL DRYING WITH % WATER REMAINING BY AUG. 1 (1) >75 (2)50-75 (3)25-50 (4)<25 (5)STABLE WATER (6)RAPID DRYING; OR NO WATER AFTER JUNE 1
- 17 4 IMPORTANT FOOD PLANT COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 18 1 PLANT DIVERSITY (1)>7 (2)4-7 (3)<4
- 19 4 PERSISTENT EMERGENT AND WOODY COVERAGE (1)5-15 (2)15-25 (3)25-50 (4)<5 OR >50
- 20 2 SUBSTRATE-SURFACE WATER INTERSPERSION (1)SUBSTRATE WATER INTERSPERSED (2)SHALLOW WATER AS 1 OR FEW POOLS
- 21 5 PERCENT OPEN WATER (AVERAGE WHEN WATER PRESENT <50% CANOPY COVERAGE VEGETATION) (1)<10 (2)10-25 (3)25-50 (4)50-90 (5)>90
- 22 1 WINTER WATER DEPTH OCT-MARCH (1)15-24" (2)10-15" (3)6-10" OR 30-36" (4)<6" OR >36"

- 23 5 SEDGE CANOPY COVERAGE (1) >90 (2)75-90 (3)50-75 (4)25-50
(5)1-25 (6)ZERO
- 24 1 WETLAND SUBSTRATE (1)MUDDY (2)SANDY (3) GRAVEL
- 25 1 PERCENT SOIL WATERLOGGED DURING MAY (1)>90 (2)75-90 (3)50-75
(4)25-50 (5)<25
- 26 1 PERCENT EXPOSED SUBSTRATE AND SHALLOW WATER AREAS COVERED BY
VEGETATION MAY-JUNE (1)<10 (BARE GROUND OR OPEN WATER) (2)10-25
(3)25-50 (4)50-75 (5)75-90 (6)>90 WELL VEGETATED)

DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)

- 49 1 DISTANCE BOTTOMLAND HARDWOODS (1)<1/4 MI WATER PREDICT
(2)1/4-1/2 MI WATER PREDICT (3)1/2-1 MI WATER PREDICT
(4)<1/4 MI WATER PREDICT 1 OUT OF 3 YEARS (5)1/4-1/2 MI WATER
PREDICT 1 OUT OF 3 YEARS (6)1/2-1 MI WATER PREDICT 1 OUT OF 3
YEARS (7)>1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER
PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR
STAND CAPABLE OF BEING FLOODED)
- 50 7 DISTANCE CROPLAND (1)<1/4 MI, UNHARV AND WATER PREDICT
(2)<1/4-1/2 MI, UNHARV AND WATER PREDICT (3)1/2-1 MI UNHARV AND
WATER PREDICT (4)<1/4 MI, UNHARV AND FLOODING PREDICT 1 OUT OF
3 YEARS; OR <1/4 MI UNFLOODED RESIDUES UNDISTURB (5)1/4-1/2 MI
UNHARV AND WATER PREDICT 1 OUT OF 3 YEARS; OR 1/4-1/2 MI
UNFLOODED RESIDUES UNDISTURB (6)1/2-1 MI UNHARV AND WATER
PREDICT 1 OUT OF 3 YEARS; OR 1/2-1 MI UNFLOODED RESIDUES
UNDISTURBED (7)>1 MI TO CROPFIELD; OR <1 MI UNFLOODED DISC OR
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OF THE FIELD OR STAND CAPABLE OF BEING FLOODED)
- 51 4 DISTANCE GRASSLAND (1)<1/2 MI <6" AND >40 AC (2)1/2-1 MI <6"
AND >40 AC (3)<1 MI <6" AND <40 AC (4)>1 MI; OR >6"
- 52 2 DISTANCE STREAM OR RIVER (1)<1/4 MI (2)1/4-1/2 MI (3)>1/2 MI
- 53 1 DISTANCE MAJOR RIVER OR LAKE >100 AC (1)<1 MI (2)1-5 MI
(3)5-10 MI (4)>10 MI
- 54 1 DISTANCE GOOSE FALL CONCENTRATION AREA (1)<4 MI (2)4-10 MI
(3)10-25 MI (4)>25 MI

WETLAND

assume no changes
for target yrs 1, 25, 50

assume same mgmt practices over +

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - NONFOREST

WILDLIFE AREA Lake Odessa

DATE 10/30/00

SAMPLE SITE #5 (DNR moist soil)

ANIMAL HABITAT 27 28 29

w/o project

LAND USE IN 2 MILE WIDE CIRCLE

- 1 5 PERCENT NONFOREST WETLANDS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 2 5 PERCENT NONFOREST WETL, ANNUALLY FLOODED CROPLAND AND LAKES OR RESERVOIRS (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 3 1 PERCENT BOTTOMLAND HARDW, ANNUALLY FLOODED CROPLAND AND NONFOREST WETL (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10

SAMPLE SITE, TRACT OF STAND CHARACTERISTICS

- 4 2 FALL AND WINTER WATER CONDITIONS (1)ANNUALLY - PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)1 OUT OF 3 YEARS & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
- 5 1 FALL AND WINTER FLOOD CONDITIONS (1)FOOD PLANTS UNAFFECTED BY FLOODS (2)REDUCED <25; OR 1 IN 4 YRS. (3)REDUCED 25-50; OR 2 IN 4 YRS. (4)REDUCED 50-75; OR 3 IN 4 YRS. (5) REDUCED >75; OR YEARLY
- 6 2 WATER DEPTH 4IN-18IN FALL-WINTER (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 7 5 WATER DEPTH <4IN DURING MAY (1)>90 (2)75-90 (3)50-75 (4) 25-50 (5)<25
- 8 5 WATER DEPTH 4IN-18IN BY AUGUST (1)>75 (2)50-75 (3)25-50 (4)<25
- 9 5 PERMANENT WATER ENTIRE YEAR (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 10 4 PERCENT EMERGENT VEGETATION W/IN 2YDS WATER (1)>75 (2)50-75 (3)25-50 (4)<25
- 11 3 WOODY INVASION (1)<10 (2)10-25 (3)25-50 (4)50-75 (5)>75
- 12 5 EMERGENT VEGETATION COVERAGE (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)10-25 (6)<10
- 13 4 CATTAIL AND BULLRUSH COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 14 4 WETLAND SIZE-ACRES (1)>200 (2)100-200 (3)50-100 (4)25-50 (5)5-25 (6)<5
- 15 1 WETLAND EDGE (& WOODY OR ADJ BOTTOMLAND HARDW) (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 16 4 WATER REGIME - GRADUAL DRYING WITH & WATER REMAINING BY AUG. 1 (1) >75 (2)50-75 (3)25-50 (4)<25 (5)STABLE WATER (6)RAPID DRYING; OR NO WATER AFTER JUNE 1
- 17 3 IMPORTANT FOOD PLANT COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 18 1 PLANT DIVERSITY (1)>7 (2)4-7 (3)<4
- 19 3 PERSISTENT EMERGENT AND WOODY COVERAGE (1)5-15 (2)15-25 (3)25-50 (4)<5 OR >50
- 20 2 SUBSTRATE-SURFACE WATER INTERSPERSION (1)SUBSTRATE WATER INTERSPERSED (2)SHALLOW WATER AS 1 OR FEW POOLS
- 21 3 PERCENT OPEN WATER (AVERAGE WHEN WATER PRESENT <50% CANOPY COVERAGE VEGETATION) (1)<10 (2)10-25 (3)25-50 (4)50-90 (5) >90
- 22 2 WINTER WATER DEPTH OCT-MARCH (1)15-24" (2)10-15 (3)6-10" OR 30-36" (4)<6" OR >36"

- 23 5 SEDGE CANOPY COVERAGE (1) >90 (2) 75-90 (3) 50-75 (4) 25-50
(5) 1-25 (6) ZERO
- 24 2 WETLAND SUBSTRATE (1) MUDDY (2) SANDY (3) GRAVEL
- 25 1 PERCENT SOIL WATERLOGGED DURING MAY (1) >90 (2) 75-90 (3) 50-75
(4) 25-50 (5) <25
- 26 2 PERCENT EXPOSED SUBSTRATE AND SHALLOW WATER AREAS COVERED BY
VEGETATION MAY-JUNE (1) <10 (BARE GROUND OR OPEN WATER) (2) 10-25
(3) 25-50 (4) 50-75 (5) 75-90 (6) >90 WELL VEGETATED)

DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)

- 49 1 DISTANCE BOTTOMLAND HARDWOODS (1) <1/4 MI WATER PREDICT
(2) 1/4-1/2 MI WATER PREDICT (3) 1/2-1 MI WATER PREDICT
(4) <1/4 MI WATER PREDICT 1 OUT OF 3 YEARS (5) 1/4-1/2 MI WATER
PREDICT 1 OUT OF 3 YEARS (6) 1/2-1 MI WATER PREDICT 1 OUT OF 3
YEARS (7) >1 MI; OR <1 MI WATER UNPREDICTABLE (NOTE: WATER
PREDICT = WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR
STAND CAPABLE OF BEING FLOODED)
- 50 1 DISTANCE CROPLAND (1) <1/4 MI, UNHARV AND WATER PREDICT
(2) 1/4-1/2 MI, UNHARV AND WATER PREDICT (3) 1/2-1 MI UNHARV AND
WATER PREDICT (4) <1/4 MI, UNHARV AND FLOODING PREDICT 1 OUT OF
3 YEARS; OR <1/4 MI UNFLOODED RESIDUES UNDISTURB (5) 1/4-1/2 MI
UNHARV AND WATER PREDICT 1 OUT OF 3 YEARS; OR 1/4-1/2 MI
UNFLOODED RESIDUES UNDISTURB (6) 1/2-1 MI UNHARV AND WATER
PREDICT 1 OUT OF 3 YEARS; OR 1/2-1 MI UNFLOODED RESIDUES
UNDISTURBED (7) >1 MI TO CROPFIELD; OR <1 MI UNFLOODED DIST OR
PLOW (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25%
OF THE FIELD OR STAND CAPABLE OF BEING FLOODED)
- 51 4 DISTANCE GRASSLAND (1) <1/2 MI <6" AND >40 AC (2) 1/2-1 MI <6"
AND >40 AC (3) <1 MI <6" AND <40 AC (4) >1 MI; OR >6"
- 52 1 DISTANCE STREAM OR RIVER (1) <1/4 MI (2) 1/4-1/2 MI (3) >1/2 MI
- 53 1 DISTANCE MAJOR RIVER OR LAKE >100 AC (1) <1 MI (2) 1-5 MI
(3) 5-10 MI (4) >10 MI
- 54 1 DISTANCE GOOSE FALL CONCENTRATION AREA (1) <4 MI (2) 4-10 MI
(3) 10-25 MI (4) >25 MI

WETLAND

assume no changes

for target yrs 1, 25, 50

assume same mgmt practices exist

WILDLIFE HABITAT APPRAISAL GUIDE - WETLANDS - BOTTOMLAND HARDWOODS

WILDLIFE AREA Wetlands

DATE 30 Oct 00

SAMPLE SITE 6 (±10 from 1912)

ANIMAL HABITAT 26 27

no project photo 17 July 00
most tree area

wb project

1 25 50 LAND USE IN 2 MILE WIDE CIRCLE

3 1 PERCENT BOTTOMLAND HARDWOOD AND ANNUALLY FLOODED CROPLAND & NONFOREST WETLAND (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10

SAMPLE SITE, TRACT OR STAND CHARACTERISTICS

- 4 4 FALL-WINTER WATER CONDITIONS (1)ANNUALLY-PREDICTABLE & CONTROLLED (2)MOST YEARS & CONTROLLED (3)EVERY OTHER YEAR & CONTROLLED (4)IRREGULAR, UNPREDICTABLE; DRY IN FALL; OR NO CONTROL WHEN PRESENT
- 5 1 FALL-WINTER FLOOD CONDITIONS (1)FOOD PLANTS UNAFFECTED BY FLOODS (2)REDUCED <25; OR 1 IN 4 YRS. (3)REDUCED 25-50; OR 2 IN 4 YRS. (4)REDUCED 50-75; OR 3 IN 4 YRS. (5)REDUCED >75; OR YEARLY
- 6 5 WATER DEPTH 4IN-18IN FALL WINTER (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)<25
- 12 6 EMERGENT VEGETATION COVERAGE (1)>90 (2)75-90 (3)50-75 (4)25-50 (5)10-25 (6)<10
- 14 1 WETLAND SIZE-ACRES (1)>200 (2)100-200 (3)75-100 (4)50-75 (5)25-50 (6)<25
- 15 1 WETLAND EDGE (% ADJ. WATER OR NONFOREST WETLAND) (1)>75% (2)50-75 (3)25-50 (4)10-25 (5)<10
- 17 1 IMPORTANT FOOD PLANT COVERAGE (1)>75 (2)50-75 (3)25-50 (4)10-25 (5)<10
- 18 1 PLANT DIVERSITY (1)>7 (2)4-7 (3)<4
- 27 2 PERCENT CHANNEL WITH AQUATIC VEGETATION 1/4 MI FROM CENTER STAND (TRACT) (1)>10 (2)5-10 (3)1-5 (4)NONE; OR CHANNEL >1/4 MI. FROM CENTER OF STAND (TRACT)
- 28 1 WATER FLUCTUATION IN CHANNEL-BANK FULL PER YEAR (1)<3 (2)3-5 (3)5-7 (4)>7; OR CHANNEL >1/4 MILE FROM CENTER OF STAND (TRACT)
- 35 3 WOODLAND TREE SPECIES (1)>50% E,W,C,S,WI,M,A (2)25-50% E,W,C,S,WI,M,A (3)<25% E,W,C,S,WI,M,A; OR <25% PIN OAK (OR SMALL ACORN TREES) (4)25-50% PIN OAK (5)>50% PIN OAK
- 36 3 PERMANENT WATER IN WOODLAND (% FOREST FLOOR) (1)>25 (2)10-25 (3)5-10 (4)1-5 (5)ZERO
- 37 4 FOREST OPENINGS (<2 AC) (1)15-30% SCATTER; REGEN; OR <40 ACRE TRACT (2)15-30 ONE OR FEW (3)5-15 (4)<5 OR >30
- 38 5 WOODLAND SIZE CLASS (1)SAWTIMBER-OPEN CANOPY (2)SAWTIMBER-CLOSED CANOPY (3)POLE + 25-50% SAWTIMBER (4)REGEN + 25-50% SAWTIMBER (5)REGEN (6)POLE
- 39 3 PERCENT CANOPY OLD GROWTH (DBH >16") (1)>25 (2)10-25 (3)5-10 (4)1-5 (5)ZERO
- 40 4 FOREST OVERSTORY CANOPY HEIGHT (1)>80' (2)65-80' (3)40-65' (4)<40' dom. 10-15' - regen
- 41 4 PERCENT SUBCANOPY CLOSURE (1)>75 (2)50-75 (3)25-50 (4)<25
- 42 3 WOODLAND SIZE (%W/IN 660' OPEN) (1)<25 (2)25-50 (3)50-75 (4)>75
- 43 1 PERCENT FOREST CANOPY ADJACENT (<250FT) OR OVER WATER (1)>25 (2)10-25 (3)5-10 (4)<5
- 44 1 NUMBER OF SNAGS PER ACRE (DEAD TREE >6" DBH & >10' TALL) (1)>4 (2)3-4 (3)1-2 (4)<1

1 25 50 (target yrs)

2	1	1	45	2	NUMBER OF CAVITY TREES/ACRE (1)>9 (2)3-9 (3)1-3 (4)ZERO
1	3	4	46	1	STEMS PER SQ. YARD SHRUB & TREE REGENERATION >3' TALL
					(1)>3(2)1-3 (3).5-1 (4)<.5
1	1	1	47	1	PERCENT WOODLAND WITHIN 660 FT. OF WATER (1)>75 (2)50-75
					(3)25-50 (4)<25

DISTANCE BETWEEN HABITAT TYPES (INTERSPERSION)

2	2	48	2	DISTANCE NONFOREST WETL, OXBOW, SLOUGH (1)<250' WATER PREDICT
				(2)250'-1/8 MI WATER PREDICT (3) 1/8-1 MI WATER PREDICT
				(4) <250' WATER PREDICT 1 OUT OF 3 YEARS (5)250'-1/8 MI WATER
				PREDICT 1 OUT OF 3 YEARS (6)1/8-1 MI WATER PREDICT 1 OUT OF 3
				YEARS (7)>1 MI; OR <1 MI WATER UNPREDICT (NOTE: WATER PREDICT
				= WATER MANAGEMENT WITH AT LEAST 25% OF THE FIELD OR STAND
				CAPABLE OF BEING FLOODED).
5	5	5	50	5
				DISTANCE CROPLAND (1)<1/4 MI UNHARV AND WATER PREDICT
				(2)1/4-1/2 MI UNHARV AND WATER PREDICT (3)1/2-1 MI UNHARV AND
				WATER PREDICT (4)<1/4 MI UNHARV AND WATER PREDICT 1 OUT OF 3
				YEARS; OR <1/4 MI UNFLOODED RESIDUES UNDISTURB (5)1/4-1/2 MI
				UNHARV AND WATER PREDICT 1 OUT OF 3 YEARS; OR 1/4-1/2 MI
				UNFLOODED RESIDUES UNDISTURB (6)1/2-1 MI UNHARV AND WATER
				PREDICT 1 OUT OF 3 YEARS; OR 1/2-1 MI UNFLOODED RESIDUES
				UNDISTURBED (7)>1 MI TO CROPFIELD; OR <1 MI UNFLOODED DISC OR
				PLOW (NOTE: WATER PREDICT = WATER MANAGEMENT WITH AT LEAST 25%
				OF THE FIELD OR STAND CAPABLE OF BEING FLOODED).
1	1	1	52	1
				DISTANCE STREAM OR RIVER (1)<1/4 MI (2)1/4-1/2 MI (3)>1/2 MI

WETLAND

assume that this area is representative
of all areas for most tree planting

WILDLIFE HABITAT APPRAISAL GUIDE - MOFISH (OVERFLOW WATERS)

PROJECT NAME Lake Odessa

DATE 10/30/00

SAMPLE SITE Fish Nursery (#1)

W/o project

LAND USE IN 2 MILE WIDE CIRCLE (PERCENT)

- 1 5 % BACKWATER, OXBOWS, AND CHANNELS IN 2-MILE WIDE CIRCLE > 8 FEET DEEP
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1% OR NONE
 2 1 CHANNEL STRUCTURE (%CHANNEL COVERED BY SNAGES, RT WADS, DIKES, ETC
 PER 1/4 mile
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1%

SAMPLE SITE OR FIELD CHARACTERISTICS

- 3 1 BANK STRUCTURE (% COVERED WITH SNAGS, EXPOSED ROOTS, CUTBANKS, ETC.)
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) <5% (SMOOTH BANK)
 4 4 AQUATIC VEGETATION (% CHANNEL COVERED W/EMERGENT & SUBMERGENT VEG.
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 1-25% 5.) 0
 5 1 SUBSTRATE (CHANNEL BOTTOM)
 1.) MUD/SILT 2.) SAND 3.) GRAVEL/COBBLE 4.) BEDROCK
 6 6 % CHANNEL DEPTH >8 FEET FOR ENTIRE YEAR
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 10-25% 5.) 1-10% 6.) 0
 10 4 WATER LEVEL STABILITY (MAY-JUNE)
 2.) STABLE WATER (< 1 FT CHANGE OR <2 FLOODS) 2.) 1-2 FT CHANGE OR
 3-4 FLOODS 3.) 2-4 FT CHANGE OR 4-5 FLOODS 4.) > 4 FT CHANGE OR >5
 FLOODS
 11 1 % SHORELINE SHADED BY OVERSTORY TREES
 1.) >90% 2.) 75-90% 3.) 50-75% 4.) 25-50% 5.) <25%
 12 5 AVERAGE SIZE (IN ACRES) OF WATER DEPTHS >8 FEET IN WINTER AVE YR
 1.) >25 ACRES 2.) 10-25 ACRES 3.) 5-10 ACRES 4.) 1-5 ACRES
 5.) <1 ACRE
 13 2 TURBIDITY (AVE ANNUAL CONDITIONS EXCLUDING FLOODS-SECCHI DISK INCHES
 1.) <5 INCHES (HIGH) 2.) 5-10 INCHES 3.) 10-20 INCHES
 4.) 20-30 INCHES 5.) >30 INCHES (LOW)
 17 2 STREAM SYSTEM INTERACTION (TIMES/YEAR FISH CAN MOVE TO MAIN CHANNEL
 1.) >TWICE/YEAR 2.) TWICE/YEAR 3.) ONCE/YEAR 4.) <ONCE/YEAR
 21 1 DISTANCE TO EMERGENT VEGETATION IN WATER 1-4 FEET DEEP
 2.) <0.25 MILES 2.) 0.25-0.5 MILES 3.) 0.5-0.75 MILES
 3.) 0.75-1.0 MILES 5.) >1.0 MILES

MATRIX MOFISH 10-1992

assume no changes
 for target yrs 1, 25, 50

WILDLIFE HABITAT APPRAISAL GUIDE - MOFISH (OVERFLOW WATERS)

PROJECT NAME Lake Odessa

DATE 10/30/00

SAMPLE SITE Yankee Chute (#8)

W/o project

LAND USE IN 2 MILE WIDE CIRCLE (PERCENT)

- 1 4 % BACKWATER, OXBOWS, AND CHANNELS IN 2-MILE WIDE CIRCLE > 3 FEET DEEP
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1% OR NONE
- 2 1 CHANNEL STRUCTURE (% CHANNEL COVERED BY SNAGES, RT WADS, DIXES, ETC
 PER 1/4 mile
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1%

SAMPLE SITE OR FIELD CHARACTERISTICS

- 3 1 BANK STRUCTURE (% COVERED WITH SNAGS, EXPOSED ROOTS, CUTBANKS, ETC.)
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) <5% (SMOOTH BANK)
- 4 4 AQUATIC VEGETATION (% CHANNEL COVERED W/EMERGENT & SUBMERGENT VEG.)
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 1-25% 5.) 0
- 5 2 SUBSTRATE (CHANNEL BOTTOM)
 1.) MUD/SILT 2.) SAND 3.) GRAVEL/COBBLE 4.) BEDROCK
- 6 6 % CHANNEL DEPTH >8 FEET FOR ENTIRE YEAR
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 10-25% 5.) 1-10% 6.) 0
- 10 3 WATER LEVEL STABILITY (MAY-JUNE)
 2.) STABLE WATER (< 1 FT CHANGE OR <2 FLOODS) 2.) 1-2 FT CHANGE OR
 3-4 FLOODS 3.) 2-4 FT CHANGE OR 4-5 FLOODS 4.) > 4 FT CHANGE OR >5
 FLOODS
- 11 3 % SHORELINE SHADED BY OVERSTORY TREES
 1.) >90% 2.) 75-90% 3.) 50-75% 4.) 25-50% 5.) <25%
- 12 5 AVERAGE SIZE (IN ACRES) OF WATER DEPTHS >8 FEET IN WINTER (AVE YR.)
 1.) >25 ACRES 2.) 10-25 ACRES 3.) 5-10 ACRES 4.) 1-5 ACRES
 5.) <1 ACRE
- 13 2 TURBIDITY (AVE ANNUAL CONDITIONS EXCLUDING FLOODS-SECCHI DISK INCHES)
 1.) <5 INCHES (HIGH) 2.) 5-10 INCHES 3.) 10-20 INCHES
 4.) 20-30 INCHES 5.) >30 INCHES (LOW)
- 17 1 STREAM SYSTEM INTERACTION (TIMES/YEAR FISH CAN MOVE TO MAIN CHANNEL)
 1.) >TWICE/YEAR 2.) TWICE/YEAR 3.) ONCE/YEAR 4.) <ONCE/YEAR
- 21 2 DISTANCE TO EMERGENT VEGETATION IN WATER 1-4 FEET DEEP
 2.) <0.25 MILES 2.) 0.25-0.5 MILES 3.) 0.5-0.75 MILES
 3.) 0.75-1.0 MILES 5.) >1.0 MILES

MATRIX MOFISH 10-1992

assume no change

for target yrs 1, 25, 50

WILDLIFE HABITAT APPRAISAL GUIDE - MOFISH (OVERFLOW WATERS)

PROJECT NAME Lake Olesca DATE 10/30/00
 SAMPLE SITE main Lake (#9) w/o project

LAND USE IN 2 MILE WIDE CIRCLE (PERCENT)

- 1 5 % BACKWATER, OXBOWS, AND CHANNELS IN 2-MILE WIDE CIRCLE > 8 FEET DEEP
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1% OR NONE
 2 2 CHANNEL STRUCTURE (%CHANNEL COVERED BY SNAGS, RT WADS, DIKES, ETC
 PER 1/4 mile
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1%

SAMPLE SITE OR FIELD CHARACTERISTICS

- 3 1 BANK STRUCTURE (% COVERED WITH SNAGS, EXPOSED ROOTS, CUTBANKS, ETC.)
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) <5% (SMOOTH BANK)
 4 4 AQUATIC VEGETATION (% CHANNEL COVERED W/EMERGENT & SUBMERGENT VEG.)
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 1-25% 5.) 0
 5 2 SUBSTRATE (CHANNEL BOTTOM)
 1.) MUD/SILT 2.) SAND 3.) GRAVEL/COBBLE 4.) BEDROCK
 6 6 % CHANNEL DEPTH >8 FEET FOR ENTIRE YEAR
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 10-25% 5.) 1-10% 6.) 0
 10 3 WATER LEVEL STABILITY (MAY-JUNE)
 1.) STABLE WATER (< 1 FT CHANGE OR <2 FLOODS) 2.) 1-2 FT CHANGE OR
 3-4 FLOODS 3.) 2-4 FT CHANGE OR 4-5 FLOODS 4.) > 4 FT CHANGE OR >5
 FLOODS
 11 5 % SHORELINE SHADED BY OVERSTORY TREES
 1.) >90% 2.) 75-90% 3.) 50-75% 4.) 25-50% 5.) <25%
 12 5 AVERAGE SIZE (IN ACRES) OF WATER DEPTHS >8 FEET IN WINTER (AVE YR.)
 1.) >25 ACRES 2.) 10-25 ACRES 3.) 5-10 ACRES 4.) 1-5 ACRES
 5.) <1 ACRE
 13 1 TURBIDITY (AVE ANNUAL CONDITIONS EXCLUDING FLOODS-SECCHI DISK INCHES)
 1.) <5 INCHES (HIGH) 2.) 5-10 INCHES 3.) 10-20 INCHES
 4.) 20-30 INCHES 5.) >30 INCHES (LOW)
 17 1 STREAM SYSTEM INTERACTION (TIMES/YEAR FISH CAN MOVE TO MAIN CHANNEL
 1.) >TWICE/YEAR 2.) TWICE/YEAR 3.) ONCE/YEAR 4.) <ONCE/YEAR
 21 1 DISTANCE TO EMERGENT VEGETATION IN WATER 1-4 FEET DEEP
 1.) <0.25 MILES 2.) 0.25-0.5 MILES 3.) 0.5-0.75 MILES
 4.) 0.75-1.0 MILES 5.) >1.0 MILES

MATRIX MOFISH 10-1992

assume no changes
 for target yrs 1, 25, 50

WILDLIFE HABITAT APPRAISAL GUIDE - MOFISH (OVERFLOW WATERS)

PROJECT NAME Lake Olesca

DATE 10/30/00

SAMPLE SITE Blackhawk Slough (#10) w/o project

LAND USE IN 2 MILE WIDE CIRCLE (PERCENT)

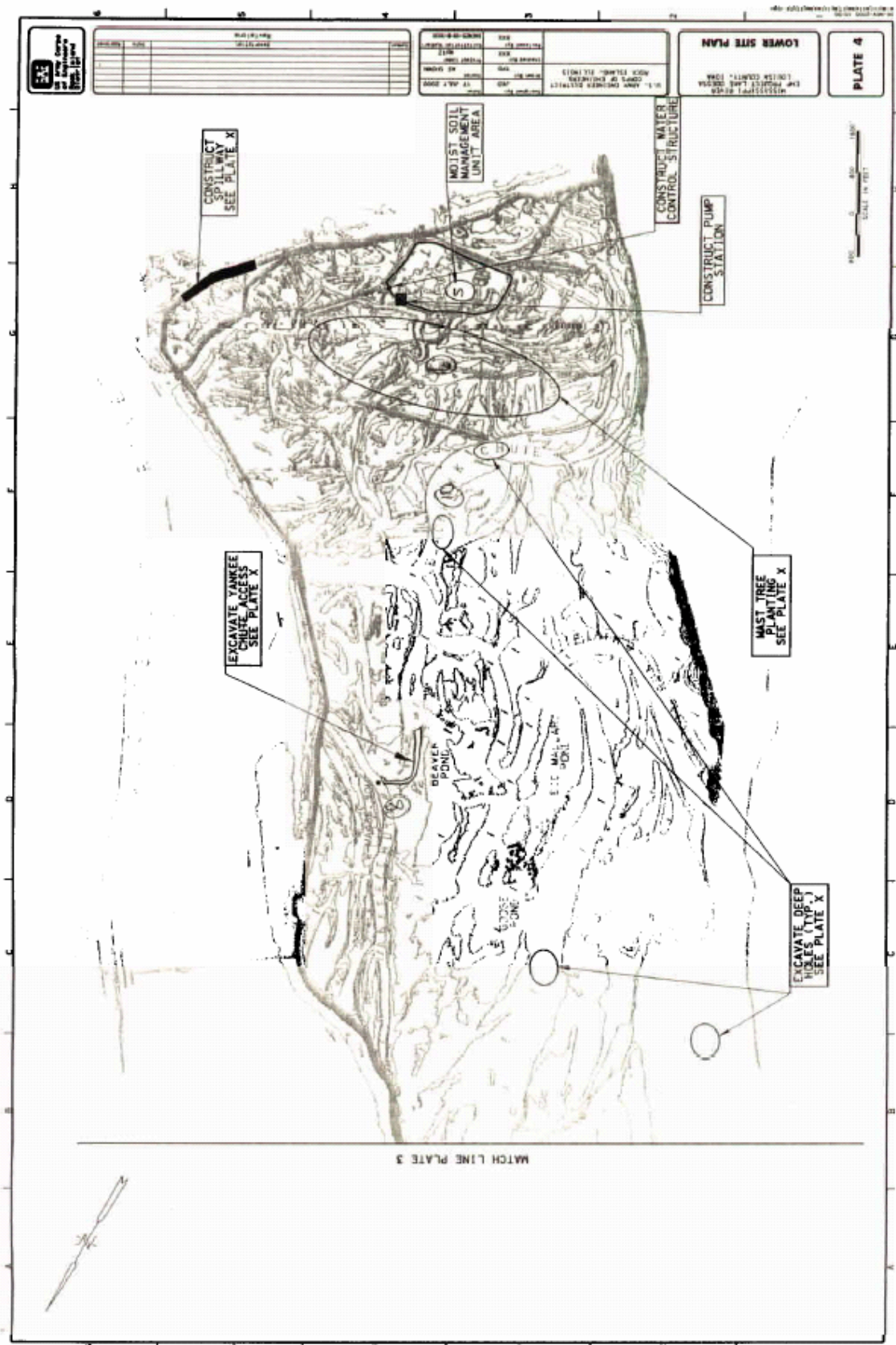
- 1 5 % BACKWATER, OXBOWS, AND CHANNELS IN 2-MILE WIDE CIRCLE > 8 FEET DEEP
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1% OR NONE
 2 1 CHANNEL STRUCTURE (%CHANNEL COVERED BY SNAGS, RT WADS, DIKES, ETC
 PER 1/4 mile
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) 1-5% 5.) <1%

SAMPLE SITE OR FIELD CHARACTERISTICS

- 3 1 BANK STRUCTURE (% COVERED WITH SNAGS, EXPOSED ROOTS, CUTBANKS, ETC.
 1.) >25% 2.) 10-25% 3.) 5-10% 4.) <5% (SMOOTH BANK)
 4 4 AQUATIC VEGETATION (% CHANNEL COVERED W/EMERGENT & SUBMERGENT VEG.
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 1-25% 5.) 0
 5 2 SUBSTRATE (CHANNEL BOTTOM)
 1.) MUD/SILT 2.) SAND 3.) GRAVEL/COBBLE 4.) BEDROCK
 6 6 CHANNEL DEPTH >8 FEET FOR ENTIRE YEAR
 1.) >75% 2.) 50-75% 3.) 25-50% 4.) 10-25% 5.) 1-10% 6.) 0
 10 3 WATER LEVEL STABILITY (MAY-JUNE)
 2.) STABLE WATER (< 1 FT CHANGE OR <2 FLOODS) 2.) 1-2 FT CHANGE OR
 3-4 FLOODS 3.) 2-4 FT CHANGE OR 4-5 FLOODS 4.) > 4 FT CHANGE OR >5
 FLOODS
 11 4 % SHORELINE SHADED BY OVERSTORY TREES
 1.) >90% 2.) 75-90% 3.) 50-75% 4.) 25-50% 5.) <25%
 12 5 AVERAGE SIZE (IN ACRES) OF WATER DEPTHS >8 FEET IN WINTER (AVE YR)
 1.) >25 ACRES 2.) 10-25 ACRES 3.) 5-10 ACRES 4.) 1-5 ACRES
 5.) <1 ACRE
 13 2 TURBIDITY (AVE ANNUAL CONDITIONS EXCLUDING FLOODS-SECCHI DISK INCHES)
 1.) <5 INCHES (HIGH) 2.) 5-10 INCHES 3.) 10-20 INCHES
 4.) 20-30 INCHES 5.) >30 INCHES (LOW)
 17 1 STREAM SYSTEM INTERACTION (TIMES/YEAR FISH CAN MOVE TO MAIN CHANNEL
 1.) >TWICE/YEAR 2.) TWICE/YEAR 3.) ONCE/YEAR 4.) <ONCE/YEAR
 21 5 DISTANCE TO EMERGENT VEGETATION IN WATER 1-4 FEET DEEP
 2.) <0.25 MILES 2.) 0.25-0.5 MILES 3.) 0.5-0.75 MILES
 3.) 0.75-1.0 MILES 5.) >1.0 MILES

MATRIX MOFISH 10-1992

assume no change
 f. - target yrs 1, 25, 50



MEMORANDUM FOR RECORD

SUBJECT: 5 December 2001 On-site Coordination Meeting for the Environmental Management Program's (EMP) Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) Definite Project Report (DPR).

1. On 5 December, an on-site coordination meeting was held to review and verify the Lake Odessa DPR project features.
2. Attendees were as follows;
 - Tom Cox (US Fish and Wildlife Service)
 - Dick Steinbach (US Fish and Wildlife Service)
 - Bill Ohde (Iowa DNR)
 - Mike Griffin (Iowa DNR)
 - John Behrens (US Army Corps of Engineers)
 - Joe Dziuk (US Army Corps of Engineers)
 - Tom Gambucci (US Army Corps of Engineers) afternoon only
 - Karen Hagerty (US Army Corps of Engineers)
 - Darron Niles (US Army Corps of Engineers)
 - Roger Perk (US Army Corps of Engineers)
3. Proposed project features that were discussed at the meeting are as follows:
 - a. FWS Moist Soil Management Units (MSMU's) in upper end (Unit 2, Fields 4 & 5, Field 21, and MSU 20)
 - Crown widths on berms shall be 12'
 - 3 horizontal to 1 vertical side slopes
 - Criteria for constructing the berms is as follows;
 - If the existing berm in the upper end of Fields 4 & 5 and 21 is 538.5' or higher, it will be left alone. If the existing berm in the lower end is 539' or higher, the berm will be left alone.
 - Borrow from the berms shall come from the interior of the units, with the surface being scraped 6" and stockpiled, borrow being scraped in thin surface scrapes, and the stockpiled surface scrape replaced over the borrow areas.
 - The northern berm of Fields 4 & 5 will be relocated to the north side of the proposed mast tree planting site and include a 24" gated culvert for filling the area to the north when desired (see attached drawings).
 - In the south end of MSU 20, the berm construction was reduced in length to what is shown on the drawings.
 - Information on the MSMU's pump's follows in the next section.
 - The existing concrete stop log structure at Fox Pond shall be replaced with another concrete control structure.

b. Pumps for FWS MSMU's in upper end

- By the end of December, Tom Cox will send the pump data on the pumping effort this fall (water levels, pump times, etc.).
- Criteria for all pumps, except the pump that feeds into Fox Pond, remains at raising the water level in the units 6" in 7 days, hold for 3 weeks, and repeat. This shall be done for a total of 3 cycles, having a maximum depth of 1.5' and elevation of 538.5'.
 - It was decided that 8-hour pump periods should be used to size the pumps. If the costs are considered too high, other pump times will be considered.
- The criteria for the pump that feeds into Fox Pond shall be to raise the water level 6" in 7 days, hold for 3 weeks, and repeat. This shall be done for 2 cycles, and shall raise the water level from 536' to 537', and hold at 537' for the remainder of the pumping season. The delineation of the area to be filled by the pump was increased; refer to the drawings to see area.
- The pump location for Unit 2 shall be relocated to be adjacent to the proposed water control structure as shown on the drawing. This will eliminate deepening and maintaining the ditch needed for locating the pump between Unit 2's sub-impoundments. The FWS will install a stop log structure between the sub-impoundments to allow water to reach both. A Michael Creek water supply structure for Unit 2 was discussed by the group, but will be pursued separately by the FWS.
- It was decided that alternative pump schemes would be developed due to the size and cost of the permanent pump stations.
 - The sponsors agreed that they would accept self-powered crisafulli type pumps at each MSMU (total of 3 crisafulli pumps) except for the pump that would pump into Fox Pond, which would be a permanent in place pump. The crisafulli type pump locations would be improved by constructing a concrete ramp, excavating a sump area, and erecting a permanent discharge pipe, which would reduce setup time and O&M costs. These same site improvements would be constructed near the Fox Pond permanent pump to allow the sponsors to use one of the three aforementioned crisafulli type pumps to draw down Fox Pond during the growing season.
 - The sponsors will be talking to other individuals/agencies to help come up with alternative pump designs to help reduce costs. This information will be relayed to Corps reps to help develop the pumping alternatives for the first draft of the DPR by the end of December 2001.
 - Roger Perk and Darron Niles will contact the Mississippi Valley Division (CEMVD) office to verify that crisafulli type pumps can be used instead of permanent in-place pumps for the MSMU's.

c. Dedicated Water Bay

- The details of the dedicated water bay remain the same as previously discussed and are as follows:

- ❑ Farthest downstream bay of the inlet structure will be used.
- ❑ A concrete wall will extend off of the bay wall to the end of the sill of the inlet structure, where it will tie into a new sheet pile wall that will angle downstream to empty into a newly excavated channel that leads to the existing MSMU feeder channel.
- ❑ The new channel will require tree clearing and culverts under the existing access road.
- ❑ All culvert sizes downstream of the inlet structure will have to be checked to make sure they are large enough to pass the required flow.

d. Iowa DNR MSU

- The details of this MSMU remain the same as previously discussed and are as follows:
 - ❑ Existing berms are sufficient for containment.
 - ❑ Unit will be cleared and grubbed.
 - ❑ 1' layer of material (predominantly fine material) will be hydraulically dredged into the unit from the fisheries enhancement feature.
 - ❑ Dredged material will be worked into the existing soil to reduce the seepage rate.
 - ❑ A water control structure will be installed to provide gravity drainage.
 - ❑ Iowa DNR criteria is to raise the water level 4' in 14 days and hold at that elevation.
 - ❑ As in the upper MSMU's, a self-powered crisafulli type pump will be evaluated as a method to supply water to the unit.

e. Main Stem Levee Restoration

- Instead of only working on the sections that fall below the design height, the entire levee will be analyzed and all areas that require clearing/grubbing, raising and/or need slopes flattened, shall be analyzed. This will increase the overall costs and will be evaluated to minimize the increase.
- Crown width shall be 12'.
- Levee slopes shall be repaired to the interior and shall have 5 horizontal to 1 vertical side slopes.
- Material to repair the levee shall be dredged from the river and shall be predominantly sand.
- Different levels of protection (25-year, 20-year, etc.), and regrading of higher sections to lower sections shall be analyzed to compare costs. The Corps will also analyze past Mississippi and Iowa River flood events to determine how a completed project (at different protection levels) would have performed.
- Spillways in multiple locations (upper and lower end) will be analyzed to allow interior areas to equalize before overtopping. This will be done to minimize head difference during overtopping events, which will help minimize damages (scouring, breaks). The FWS has recommended the Prairie Pocket area as an area to construct a spillway in the upper end. The majority of the filling will be done

from a spillway to be constructed in the lower end, any remaining filling will come from the spillway(s) to be constructed in the upper end. The FWS will construct the upper spillway(s) with flood damage money from the 2001 flood. The Corps will provide the FWS with design information (length, elevation) to help construct the spillway(s) in the upper end. The Corps will analyze whether it is advantageous to move the lower spillway from the tie back levee to the main stem levee in order avoid frequent flood events on the Iowa River.

f. Fisheries Enhancement

- The following areas shall be hydraulically dredged to a final depth of 8', with locations shown on the drawings;
 - Lake Odessa (1600' long x 800' wide x 2' cut);
 - Big Goose Pond (5600' long x 100' wide x 4' cut); and
 - Yankee Chute to Blackhawk Chute (5750' long x 100' wide x 4' cut) would be dredged to provide overwintering fish habitat.
 - The Yankee Chute to Blackhawk Chute dredged material would be placed in the IADNR MSMU to reduce seepage, while the Lake Odessa and Big Goose Pond dredged material would be placed in the mast tree planting area between these dredging sites to increase the elevations.
- In addition, channels leading to Swarms Pond and Bebee Pond (2160' long x 100' wide x 1' cut) would be dredged to reestablish a connection with the rest of the refuge. A centrifuge pump, which sprays dredged material into adjacent vegetation, may be investigated to dredge the Swarms and Bebee areas.

g. Fish Nursery

- Install stop log structure with 36" pipe.
- Perform minor grading.

h. Mast Tree Planting

- Planting area that was labeled as C on the drawings was removed as a feature.
- Mast Trees will be planted on existing high ground as shown on the drawings.
- Mast trees will be planted on the 43-acre site to be raised with dredged material (next to opening to Sand Run Chute) as shown on drawings.

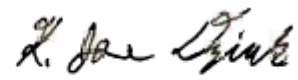
i. Sand Prairie Planting

- Area to be planted is approximately 36 acres.
- Plant a seed mix harvested from a central Iowa mesic to dry prairie.
- Seed will be spread at rate of 12 to 15 pounds per acre.

j. Archeological sites

- Sites on interior areas shall be protected by means of mechanically dredged material being placed on them.
- Sites located on the west side of Lake Odessa shall be protected with riprap placed from a barge or dumped over the bank.

4. Please review the boxed text for agency action items.

A handwritten signature in black ink, appearing to read "K. Joe Dziuk". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

K. Joe Dziuk, P.E.
Project Engineer, ED-DG



MFR of 1/31/02 Phone Conversation

- Participants were as follows;
CEMVR: Joe Dziuk
John Behrens

USFWS: Dick Steinbach
Tom Cox
- Subject of phone conference was to discuss the pump station scenarios for the Lake Odessa feasibility study.
- First item that was discussed was the pump station drawings that Dick sent to Darron Niles.
 - One set was of an electric powered pump in Ohio (Ottawa), and the second was a diesel powered pump with removable power source in Illinois (Gilbert Lake).
 - Upon reviewing the drawing, it was decided that the pump stations were similar to previous alternatives submitted by the Corps, with the exception that the Corps proposals utilized electric power mounted on poles to be generated by diesel generators.
 - Dick stated that he would locate costs on the items and relay this data to John Behrens.
- Pump preferences
 - Tom Cox confirmed that he prefers crisafulli pumps with self contained power units to be utilized at Unit 2, Fields 4&5, and Field 21. Each site would receive its own crisafulli set up.
 - Tom also confirmed that for Fox Pond, his preference is a permanent in place pump to fill Fox Pond, and one of the crisafulli pumps from the other sites would be used to drain the pond.
 - All sites, including Fox Pond, would have a permanent pad and piping system (through the berm) to place each crisafulli when pumping is to take place.
 - Even though crisafulli pumps are desired in all areas except for Fox Pond filling, which would be a permanent in place pump, both permanent in place pumps and crisafulli pumps will be evaluated.
 - The sponsors want the permanent pumps to be belt driven, and have diesel drivers that hook directly to the pump (no electrical mounts on poles).
 - Tom Cox will fax data to John Behrens concerning the crisafulli pumps he selected for use at Unit 2, Fields 4&5, and Field 21.
 - After the phone conversation, Roger Perk was contacted concerning the crisafulli pumps to confirm that they can be considered for pump alternatives. Roger stated that he found no evidence stating that they can't be used, and that he will send a memo to CEMVD to ask for written confirmation that they can be considered.

K. Joe Dziuk, P.E.
Project Engineer, CEMVR-ED-DG

MFR of 2/15/02 Phone Conversation

- Participants were as follows;
 - CEMVR: Joe Dziuk
John Behrens
Tom Gambucci
Darron Niles
Roger Perk
 - USFWS: Dick Steinbach
Tom Cox
Karen Westphall
 - IADNR Bill Ohde
Michael Griffin
- Objective of phone conference was to discuss the pump station and perimeter levee scenarios for the Lake Odessa feasibility study.
- For the pumps, a list of different pumping scenarios was reviewed and the following decisions were made:
 - For all portable pump situations, a 12-hour pumping period will be assumed. There is room for change with this item in the future, as the same sized portable pump will accommodate all pump scenarios except for filling Fox Pond, and an 8-hour pump time for the DNR moist soil unit.
 - The pump station for filling the Fox Pond area shall be a single fixed pump with a portable belt driven generator.
- For the perimeter levee, data was reviewed pertaining to the 20-year and 25-year levee, which also includes the proposed spillways. The data that was discussed was historical flood levels and how the proposed designs would work (overtopping, time to fill, etc.). The following decisions were made:
 - For the design, the 25-year elevation will be the design level for the perimeter levee.
 - The spillway will be sized for the 25-year levee height, and shall consist of an 1100 ft spillway with a 10-year crest in the lower end, and a 700 ft spillway with a 11.1-year crest in the upper end.
- Dates for the draft were discussed, and the following items brought up:
 - The sponsors brought up that they have funding to work on levee/spillways as a result of the spring flooding in 2001.
 - They indicated that they would like to step up the dates for the report to better mesh in with their deadlines for expending the repair money.
 - Darron Niles will check into different possibilities to try to accommodate the time frames that the sponsors are dealing with.
- Sponsors also indicated that the dredging plan and its explanation will be an important item for the public review meeting that will take place in the future.

- The sponsors also indicated that they will help locate possible borrow sites in the river to be utilized with the proposed perimeter levee enhancement.

K. Joe Dziuk, P.E.
Project Engineer, CEMVR-ED-DG



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Rock Island Field Office

4469 48th Avenue Court

Rock Island, Illinois 61201

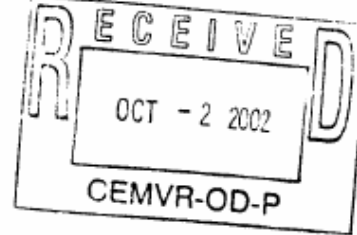
Phone: (309) 793-5800 Fax: (309) 793-5804



IN REPLY REFER
TO:

FWS/RIFO

September 30, 2002



Colonel William J. Bayles
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Bayles:

This letter constitutes our draft Fish and Wildlife Coordination Act (FWCA) report for the Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP), Mississippi River miles 438 through 441, between Louisa County, Iowa, and Mercer County, Illinois. It has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 et seq.); the Endangered Species Act of 1973, as amended; and in accordance with the Fish and Wildlife Service's Mitigation Policy.

The Lake Odessa HREP is a component of the Upper Mississippi River System Environmental Management Program (EMP) authorized in Section 1103 of the Water Resources Development Act of 1986. The goal of the EMP is to implement "...numerous enhancement efforts...to preserve, protect, and restore habitat that is deteriorating due to natural and man-induced activities."

DESCRIPTION OF THE PROJECT AREA

The 2,609-acre Louisa Division stretches from Mississippi River miles 438 to 441, right descending bank (Iowa). It is protected from average to moderate flooding by a U.S. Army Corps of Engineers (COE) levee stretching to Lock and Dam 17, approximately 1 mile south of the division border. The levee is integral to maintaining the nine-foot navigation channel due to its proximity to the dam. However, seep water from the navigation pool makes some units in the division difficult to manage. The Port Louisa Refuge headquarters area includes 48 acres of wooded bluff, a four-acre prairie restoration and the office building site situated on the bluff overlooking the Mississippi River floodplain. Only this upland administrative

acreage is owned fee title by the Service; the remaining acreage is administered under the General Plan.

Traditional waterfowl management has been the primary objective on this division since its conversion from an agricultural levee district in the 1940's to a national wildlife refuge. Some cropping still occurs on the slightly higher elevations, but 800 acres are dedicated to promoting growth of moist soil plants for use by waterfowl. Other habitat types include a permanent 45-acre body of water (Prairie Pocket), and bottomland forest. Existing hardwoods in the floodplain were devastated by prolonged flooding in 1993 and a high percentage have died, although the 18-acre pecan grove continues to survive. A small 25-acre sand prairie was established on the highest ridge of Louisa Division in 1985. Even though this site was inundated by 1993 flood waters, some warm season grasses and forbs survived and prescribed burning on the unit has helped invigorate the stand.

Louisa Division is bordered to the south by Lake Odessa State Wildlife Area, managed by the Iowa Department of Natural Resources. Primary management on this area is for migratory waterfowl and fisheries. Lake Odessa and the Louisa Division share recently constructed water control structures at the north end (inlet from the river) of the Louisa Division, and south end of Lake Odessa (outlet). Water travels via gravity-flow through the inlet structure and is diverted into Louisa Division or sent on to Lake Odessa. The Refuge and Lake Odessa Unit coordinate water delivery to satisfy both management objectives. Often times both entities need flow at the same time.

Up to 330 acres are currently cropped on the Louisa Division. Corn, soybeans, buckwheat and winter wheat have been traditionally planted. Following the Flood of 1993, vehicle access to the Division was lost due to a large levee break. No mechanical manipulations occurred to deter natural succession, and the area quickly began converting to silver maple, cottonwood and willow saplings. In the last few years farming and burning have been used to reduce tree invasion in the moist soil units.

Louisa Division functions as a migratory bird sanctuary each fall and is closed to public entry. No hunting of any kind is permitted on the Division, however the adjacent Lake Odessa receives heavy hunting pressure. A concrete double boat ramp allows access directly to the river from the northern boundary of the Louisa Division. An accessible fishing pier allows fishermen to cast their lines into the diversion ditch leading to Lake Odessa.

PROJECT OBJECTIVES

The goals of the Lake Odessa HREP are to rehabilitate, enhance, and protect aquatic habitats for fish, and both resident and migratory birds. To evaluate the area for potential improvements, the project area was divided into an aquatic (fishery) component, a waterfowl (ducks and geese) component, and a nongame component (herons, songbirds, amphibians, etc.). Specific objectives for each of the above species components were developed according to the management plans and input of State and Federal biologists. Several alternatives were considered for each component to determine the best way to meet the project objectives.

The array of alternatives includes combinations of construction features and management practices that will result in the following: reduce suspension of sediments; create areas with flow and depth diversity; increase abundance and diversity of aquatic and terrestrial plants; enhance nesting and brooding habitat for migratory birds; reduce sedimentation in backwaters; and increase wintering fish habitat for centrarchids and associated species. In addition, the levee rehabilitation will increase the capability to control and manage water levels in moist soil areas and within the interior of the Lake Odessa complex benefitting both fish and wildlife species.

METHODOLOGY

Habitat analysis of existing study area conditions, future conditions without the project, and impacts of the several proposed alternatives and increments was accomplished using the Wildlife Habitat Appraisal Guide (WHAG) procedures developed by the Missouri Department of Conservation and the USDA Natural Resources Conservation Service. The WHAG is a numerical habitat appraisal methodology based on USFWS Habitat Evaluation Procedures (HEP) (1980). The analysis employed an inter-agency team approach with representatives from the Corps of Engineers, the Iowa Department of Natural Resources and the U.S. Fish and Wildlife Service.

The WHAG analysis is a numerical system for evaluating the quality and quantity of particular habitats for animal species selected by the WHAG team members. The evaluation species used in this analysis are an established set in the WHAG model. Although a set list of species has been used, each species represents a guild of other similar species that utilize the habitat in similar ways. Each species represents an array of habitat variables for the species being evaluated. These species represent key management goals and objectives of the Lake Odessa HREP (see table below for list of evaluation species). The qualitative component of the analysis is known as the Habitat Suitability Index (HSI) and is rated on a 0.1 to 1.0 scale. The quantitative component of the WHAG analysis is the measure of acres of habitat that are available for the selected evaluation species. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula ($HSI \times Acres = HUs$).

Seven fish species were used to evaluate restoration and protection of side channel habitat and the other aquatic components (fish nursery) of the project. Important sport fishing species such as black and white crappie, largemouth bass, and bluegill commonly inhabit side channels and channel border habitats. These four species also use deep water overwintering habitat. Channel catfish, gizzard shad, and black bullhead were included in the WHAG model for which habitat benefits were considered. All seven species also utilize backwater areas as spawning habitat.

Fourteen wildlife species were used to evaluate the mast tree, wetland, sand prairie and levee rehabilitation features of the project. Some of the species included are as follows. Mallard and Canada goose are migratory waterfowl that utilize early successional wetland habitat and have socioeconomic importance as game species. The green-backed heron is a wading bird

found in midsuccessional herbaceous and shrub dominated wetland habitat. American coot is a waterfowl species utilizing both open water and backwater areas. The least bittern, muskrat and king rail prefer emergent marsh habitat. The lesser yellowlegs utilizes shoreline, mudflat habitat. The beaver is a resident furbearing mammal that utilizes early successional forest habitat. The wood duck is a waterfowl species that favors mature forested wetland habitat with abundant snags and cavity trees. The parula and prothonotary warbler are neotropical migrant songbirds that utilize mature forested wetland habitat during the breeding season. The dickcissel was used for the habitat evaluation of the sand prairie portion of this HREP project. This species is a native grassland indicator species and is, therefore, probably not adequately indicative of the benefits to be gained from this unique restoration area.

The levee rehabilitation was evaluated by determining the three dominant land use classifications (non-forested wetland, bottomland hardwood forest, and open water) and evaluating these habitat types using the same species by habitat type, as described above.

Changes in the quality of the habitats and HUs for each species will occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HU derived over the life of the project. Cumulative HUs are annualized and averaged. This determines what is known as the Average Annual Habitat Units (AAHUs). AAHUs are used as an output measurement to compare all the features and the project as a whole.

To complete the habitat evaluation, the study team reviewed aerial photography, topographic maps, and preliminary design drawings. The study team based much of the existing condition information on prior sampling of the study areas. Assumptions were developed regarding existing conditions and project/post-project conditions relative to limiting factors and management practices.

For project planning and impact analysis, project life was established as 50 years. To facilitate comparison, target years were established at 0 (existing conditions) 1, 25, and 50 years. HSI and AAHU for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

Selected data will be presented in this report with reference to the habitat analysis. However, to avoid duplication of tables, we refer the reader to the Habitat Evaluation and Quantification Appendix in the main body of the Draft Definite Project Report for the complete tabular results of HSI and AAHU values for each of the project features.

THREATENED AND ENDANGERED SPECIES

To facilitate compliance with Section 7C of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Fish and Wildlife Service information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action.

Therefore, we are furnishing you the following list of species which may be present in the concerned area:

<u>Classification</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Habitat</u>
Threatened	Bald eagle	<i>Haliaeetus leucocephalus</i>	Winters along major rivers and reservoirs
Endangered	Higgins' eye pearly mussel	<i>Lampsilis higginsii</i>	Mississippi River
Endangered	Indiana bat	<i>Myotis sodalis</i>	Caves, mines; small stream corridors with well developed riparian woods; upland forests
Candidate	Eastern massasauga rattlesnake	<i>Sistrurus c. catenatus</i>	Shrub wetlands

Bald eagles breed and winter along the Mississippi River, including Pool 17. Suitable perch trees where eagles can loaf and perch are numerous. Migrating bald eagles perch in trees in the area, occasionally feeding on migrating waterfowl. Nest sites occur within the project area. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

The endangered Higgins' eye pearly mussel (*Lampsilis higginsii*) is listed for the Mississippi River which includes Louisa County, Iowa. This species prefers sand/gravel substrates with a swift current and is most often found in the main channel border or an open, flowing side channel. If the project is located near a known Higgins' eye mussel bed, it may be necessary to conduct a survey to determine the presence of the species.

The endangered Indiana bat (*Myotis sodalis*) is listed as occurring in Louisa County, Iowa. During the summer, the Indiana bat frequents the corridors of small streams with well developed riparian woods as well as mature upland forests. It forages for insects along the stream corridor, and within the canopy of floodplain and upland forests. It has been shown that the foraging range for the bats varies by season, age and sex and ranges up to 81 acres (33ha). It roosts and rears its young beneath the loose bark of large dead or dying trees. If the project site contains Indiana bat habitat, it may be necessary to conduct a survey to determine whether the bat is present. If Indiana bats are known to be present, they must not be harmed, harassed, or disturbed when present.

The project lies within the range of the eastern massasauga, a docile rattlesnake that is declining throughout its national range and is currently a Federal Candidate species. The

snake is currently listed as endangered by the State of Iowa and is believed to occur in Louisa County. The massasauga is often found in or near wet areas, including wetlands, wet prairie, or nearby woodland or shrub edge habitat. This often includes dry goldenrod meadows with a mosaic of early successional woody species such as dogwood or multiflora rose. Wet habitat and nearby dry edges are utilized by the snakes, especially during the spring and fall. Dry upland areas up to 1.5 miles away are utilized during the summer, if available.

In cases where massasaugas are known to occur or potential habitat is rated moderate to high, massasauga surveys may be necessary. In portions of projects where massasaugas will be affected, clearing and construction activities should occur during the summer when air and ground temperatures are above 65° F. These warm season temperatures allow the snakes to be warm enough to move out of harm's way, if encountered during construction.

The proposed HREP project will not adversely affect endangered species or their habitats. This precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended. Should this project be modified or new information indicate endangered species may be affected, consultation should be initiated.

EXISTING FISH AND WILDLIFE RESOURCES

The results of the WHAG analysis for existing conditions indicate a broad range of values for the evaluation species, reflective of the variety of habitat requirements for those species. A complete summary of the habitat analysis and associated incremental analysis is included in the Detailed Project Report.

The project area for the Lake Odessa HREP provides habitat for a variety of wildlife including waterfowl, wading birds, muskrats (*Ondatra zibethicus*), bald eagles (*Haliaeetus leucocephalus*), and turtles. The Lake Odessa area is also considered an essential river otter (*Lutra canadensis*) (Illinois endangered species) habitat. Mallards and Canada geese have successfully nested in the project area. The area is an integral part of the Mississippi Flyway, a major migratory corridor for birds in the central United States. The area fulfills the needs of migratory species. It has been estimated that 20 percent of all ducks in North America utilize the Upper Mississippi River.

Fish sampling in the area of Lake Odessa and the main channel with hoop, fyke, and gill nets and electrofishing gear yielded many sportfishery species such as bullhead (*Ictalurus spp.*), channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), warmouth (*Lepomis gulosus*), largemouth bass (*Micropterus salmoides*), and crappie (*Pomoxis spp.*). Samples of foraging species included carp (*Cyprinus carpio*), longnose gar (*Lepisosteus osseus*), gizzard shad (*Dorosoma cepedianum*), and mooneye (*Hiodon tergisus*), among others. Other game and forage species were present but categorized as uncommon.

Extensive mussel surveys have been conducted in the main channel border of Pool 17. Common species include three-ridge (*Amblema plicata*), mapleleaf (*Quadrula quadrula*), hickorynut (*Obsoletia olivaria*), washboard (*Megalania nervosa*), and pimpleback (*Quadrula pustulosa*) (Theil 1981). Other species found include the following: giant floater (*Pyganodon*

grandis), wartyback (*Quadrula nodulata*), Wabash pigtoe (*Fusconaia flava*), deertoe (*Truncilla truncata*), three-horned wartyback (*Obliquaria reflexa*), fragile papershell (*Leptodea fragilis*), pink heelsplitter (*Potamilus alatus*), white heelsplitter (*Lasmigona complanata*), fawnsfoot (*Truncilla donaciformis*), yellow sandshell (*Lampsilis teres*), squawfoot (*Strophitus undulatus*), plain pocketbook (*Lampsilis cardium*), and rock-pocketbook (*Arcidens confragosus*).

Terrestrial vegetation in lower Pool 17 exists on the islands and adjacent shorelines. Dominant tree species include silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), cottonwood (*Populus deltoides*), box elder (*Acer negundo*), elm (*Ulmus americana*), and willow (*Salix* sp.). Understory tree species include willow, silver maple, green ash, box elder, mulberry (*Morus* sp.), hackberry (*Celtis occidentalis*), and false indigo (*Amorpha fruticosa*). Herbaceous species include *Leersia* sp., *Scirpus* sp., reed canary grass (*Phalaris arundinacea*), and sedges (*Carex* sp.).

Aquatic vegetation in lower Pool 17 is varied. Plants commonly found in shallow areas include sago pondweed (*Potamogeton pectinatus*), coontail (*Ceratophyllum demersum*), elodea (*Elodea canadensis*), curly pondweed (*Potamogeton crispus*), floating-leaf pondweed (*Potamogeton natans*), lotus (*Nelumbo lutea*), water-lily (*Nymphaea* sp.), water milfoil (*Myriophyllum verticillatum*), duckweed (*Lemna* sp.), arrowhead (*Sagittaria latifolia*), and bulrush (*Scirpus* sp.). Other species include Beggartick (*Bidens cernua* L.), Smartweed (*Polygonum* spp.), Rice cutgrass (*Leersia* sp.), wild millet (*Echinochloa crusgalli*), Deeper areas contain water milfoil (*Myriophyllum verticillatum* L.), coontail *Ceratophyllum demersum* L.), with some small beds of wild celery (*Vallisneria americana*) in secondary channels.

Output generated by the WHAG model is consistent with observations from on-site visits and discussions with local field biologists who manage the area. The HSI values indicate that the existing area is of value to both game and nongame species at present. However, since these values fall in the middle of the range, by TY50, they will decline in value as more aquatic habitat is degraded by sedimentation.

FUTURE WITHOUT PROJECT

The No Federal Action alternative is considered the future without the project condition allowing the area to continue to function as is. Without active management, successional changes in habitat and increasing sedimentation will result in continued degradation of wildlife and fisheries habitat. The protective levee system will be subjected to further degradation over time, jeopardizing management of the entire complex. The without project values that have been calculated for this analysis assume that the dike system remains intact over the next 50 years. Erosional forces of the Mississippi River at flood stages further degrade the levee each year, increasing the potential for failure at some point in the future. Damage to the protective levee system would permanently alter the habitat types and water regime of the Lake Odessa complex subjecting the area to the flooding and sedimentation of the Mississippi River.

Habitat values projected under this scenario would be much lower, reflecting the overall negative impacts that would result without the afforded protection of the levee.

The without project analysis for backwater restoration indicated these habitats have a pool-wide affect on the fishery resource. Loss of these backwater habitats affects aquatic acreage on a scale much greater than the actual project area dimensions. The value of protected backwater areas as protected off-channel lacustrine fisheries habitat is limited due to a lack of depth and vegetation diversity. Over the 50-year life of the project, it was estimated that the acreage figure would be reduced by TY50. The corresponding AAHU's includes slight improvements in habitat quality at TY25, but an overall decrease in qualitative value by TY50.

FUTURE WITH PROJECT

Enhancement options for the Lake Odessa HREP project include increasing the quality of existing habitat types, increasing the acreage of a particular habitat type(s), or a combination of both. Several increments of each alternative feature were evaluated to determine the best management of the habitat types at the most reasonable cost. To meet the overall goals of increasing the reliability of mid-migration habitat for migratory birds and to create overwintering habitat for the benefit of fish, continued active management of the area was evaluated. This included evaluating the existing degree of flood protection, the current water control and pumping facilities as well as improved pumping capacity to flood additional acreage in the fall after desired vegetation has matured. One of the primary objectives is to ensure the future value of the Lake Odessa complex by protecting it with a reliable levee system. The overall diversity of habitats in the area would be increased with the inclusion of features such as the mast tree planting and sand prairie restoration.

Moist Soil Management Unit (MSMU) Enhancement: This feature will improve water level control and the reliability of water supply to the units. All units are currently in service, although problems with the water supply, inadequate/aging water control structures, limits on water level heights achievable, and/or extreme seepage prevent maximum use of each unit. The units include:

1) (M1) - USFWS Complex (Fields 4 and 5, 21, MSMU 20). Proposals for this feature consist of berm height increases for all three fields, a new water control structure at Fields 4 and 5, and water pumps with pads at Fields 4, 5, and 21. A dedicated water supply would be constructed for these units which would include modification of the current inlet structure by isolating one of the four bays. In addition, a supply ditch and road crossing would be added. All of these proposals would allow for flooding the units completely, when desired, and at any time. 238 acres of the moist soil management units were assumed to benefit from increases in water level control and reliability. Total benefits for M1 were calculated to be 83.2 AAHUs.

2) (U1) - MSMU Unit 2. Two new water control structures and pump with pad are provided with this feature. This would allow complete flooding of this unit. Management options for this unit would be enhanced achieving a more desirable vegetative community. Total benefits

for this area would be 69.2 AAHUs.

3) (F1) MSMU Fox Pond. This feature includes the replacement of an aging pump with a larger capacity pump and replacing the water control structure. A pump pad would be added to allow for bringing in a portable pump to add water to the pond. Two-way pumping would be possible instead of the current operation which allows for pumping out of the area only. The total area available for flooding is 336 acres which would exceed the existing pond (previous limit of 72 acres). Total benefits were calculated to be 236.6 AAHUs.

4) (S1) MSMU Swarms/Beebe Ponds. Mechanical re-dredging of the channels from the main lake to Swarms Pond and from Swarms to Beebe Pond is the focus of this feature. Currently, the channels have silted in and, during low water, cut off access from the ponds to deeper, more highly oxygenated waters. The ponds are currently isolated from the main lake during low water conditions and no water level control benefitting aquatic vegetation is possible. The calculated non-forested wetland benefits total 207.5 AAHUs.

5) (D1) MSMU IDNR. This feature would include clearing and grubbing the area, then lining the unit with fine, silty material in order to reduce current seepage problems. A pump with pad and water control structure would be added. These measures would allow for full use of the currently under utilized unit. Total benefits were calculated to be 43.6 AAHUs. *For all of the above features benefits beyond the limits of the unit are expected to be realized, however, this evaluation was limited only to the areas of the respective units.*

Sand Prairie Restoration: The planting of 36 acres to restore and recreate native prairie originally found on the site is the goal of this feature. Much of a previous restoration effort (1985) was destroyed by the flood of 1993. A bulk seed mix from a local source, grown under similar site conditions, would be used to ensure plant survival and reproductive success. The only species used for evaluating of this feature is the dickcissel. Total benefits were calculated to be 21.8 AAHUs, with a net result of 11.3 AAHUs for all evaluation species (net result included for general information purposes only).

Fisheries Enhancement - Upper Fish Nursery: The proposed fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking practice is to release fingerlings, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake. A water control structure would be replaced with an open culvert to allow fish release into the main lake at the end of the season. Benefits for this option totaled -0.7 AAHUs. Because the model used for evaluation of this feature, MOFISH, lacks the ability to evaluate this area isolated from the main lake (a non-natural situation), the benefits are negative. However, using best professional judgement, this feature is assumed to provide the intended nursery benefits. Model results are included in the DPR for completeness.

Fisheries Enhancement - Dredge Deep Water/Access: This feature includes deep-water dredging locations at Lake Odessa (main lake) - (L1), Goose Pond - (G1), and Yankee/Blackhawk Chutes - (B1); and dredging to improve fish access at Swarms/Bebee Ponds - (S1) and Yankee/Blackhawk Chutes. In addition, the dredged material removed from the Yankee/Blackhawk Chutes site would be used to line the Iowa Department of Natural Resources moist soil management unit, reducing seepage and increasing water level control of that unit. Sedimentation and flood damage have reduced deep-water habitat. Access channels have silted in, reducing ingress and egress for fish. This feature would restore overwintering fish habitat and create improved access to deeper water. The benefits for the respective fisheries enhancements are listed below.

Dredge Main Lake (L1)	-	418.6 AAHUs
Dredge Goose Pond (G1)	-	67.9 AAHUs
Dredge Blackhawk/Yankee Chutes (B1)	-	32.3 AAHUs
Swarms/Bebee Ponds (S1)	-	5.9 AAHUs

Reforestation (Mast Tree Planting): Restoration of historic bottomland hardwood forest at the Lake Odessa complex would involve the cessation of row crop cultivation at Sites A and B, totaling 93 acres, and include the planting of mast producing tree species in those areas. Site A adjoins an existing 18-acre natural pecan grove. At Site C, 26 acres of existing forest stand would be augmented through interplanting. Higher elevations at the 40-acre dredged material placement Site D would be created for mast tree planting, increasing the diversity and health of the bottomland hardwood forest. All areas will be planted using the Root Prune Method (RPM) mast trees. This is expected to enhance the survival rate of plantings, promote faster acorn production, and in the long term, provide a seed base to promote future natural regeneration of these species. Northern pecan, swamp white oak, bur oak, pin oak, sycamore, and shellbark hickory, will be planted in equal proportions. For sites A and B (A1) the benefits provided are calculated as 60.2 AAHUs. For Site C (C1) the benefits were calculated to total 1.3 AAHUs. Because this features interplants mast-producing trees species into an area of existing forest habitat a relatively subtle change occurs in habitat quality. WHAG is not sensitive to the qualitative changes within habitat types, but rather, more sensitive to more drastic changes from one habitat type to another. Levee system rehabilitation should also reduce the frequency and duration of future flood events, improving survival of mast tree plantings. Analysis of Site D (D1) resulted in the loss of -24.0 AAHUs in habitat benefits. The loss reflects the significant disturbance of existing floodplain forest due to dredged material placement. The current forest is dominated by silver maple and cottonwood, two flood tolerant species, less desirable for wildlife. Replacement of the existing soft mast producing forest with hard mast-producing tree species is a subtle change in habitat quality. Again, this is a change relating to species composition and diversity to which the WHAG Model is not sensitive. The results of the analysis, therefore, may not reflect reasonable expectations. In addition, raising the elevation of the site will assist natural regeneration of hard mast producing trees.

Levee Rehabilitation: This feature includes increasing flood protection and reducing the incidence of levee failure by raising all sections of the current exterior levee system to the 25-year level of protection and reducing all slopes steeper than 5 horizontal to 1 vertical, thereby improving section stability. Two spillways will be added to the levee system which will enable more controlled flooding of the interior, rather than by levee overtopping or breaching. Also, a wing dam will be constructed between Michael Creek and the upper inlet structure in the Mississippi River. The wing dam will reduce sedimentation which can interfere with water control capabilities at the inlet structure. This feature was estimated to provide total benefits of 1671.5 AAHUs for three distinct habitat types; non-forested wetland, bottomland hardwood forest, and aquatic. All interior features are assumed to be constructed under this evaluation.

DISCUSSION

The primary goals of the Lake Odessa HREP are 1) to enhance the existing moist soil management units, 2) to increase deep-water overwintering habitat for fish by dredging, 3) to increase floodplain forest species diversity through mast-producing tree planting on higher elevations; and 4) to protect the interior features with levee improvement and a spillway. Two additional features include the reestablishment of the sand prairie, a terrestrial habitat enhancement, and construction of the upper fish nursery, an additional fisheries benefit. Because the projected fishery value of Lake Odessa is expected to decline over the next 25-50 years, a combination of creating deep water areas and improved access channels will improve fisheries habitat. The plan which includes all of the features discussed in this report is the plan preferred by the USFWS and the IDNR (project sponsors). This is also a "best buy" plan as outlined in the cost incremental analysis in the Corps of Engineer's Draft Definite Project Report (DPR), and meets all the project objectives for the enhancement of the moist soil management units, fisheries enhancements increasing overwintering habitat and providing year around benefits for spawning and rearing of fish, as well as the fish nursery. In addition, other wildlife species, including diving ducks, herons, and invertebrates will benefit from the backwater improvements. The improvement of terrestrial habitat diversity and species composition will result from both the mast-tree plantings and the sand prairie restoration. The success of the Lake Odessa complex in providing a reliable mid-migration food source for the thousands of migratory birds that use the Mississippi River flyway annually lies in the ability to accomplish draw down of the area in later spring to expose mudflats and promote growth of plants which are protected from flooding until after the growing season. Also necessary to success is the ability to reflood the area upon arrival of the first migrants south in the fall and to be able to manipulate water levels as needed to meet specific management goals (i.e. mudflats for shorebirds vs. 2-feet of water for dabbling ducks). Current inadequacies in the pumping capabilities and levee integrity have limited the potential success of Lake Odessa complex, sometimes leaving the complex vulnerable to random flooding during the growing season and unpredictable flooding in the fall. The capacity to pump and draw down water is critical to successful waterfowl management during migration. In addition, fisheries habitat (both winter and summer conditions) management options, usually contrary to wildlife management, will also be improved due to this comprehensive HREP plan for Lake Odessa.

CONCLUSIONS AND RECOMMENDATIONS

The Lake Odessa HREP offers a unique multi-faceted opportunity to restore and enhance a diverse fishery and wildlife resource. In addition, the proposed HREP will contribute directly to achieving the goals of the North American Waterfowl Management Plan (an international inter-agency plan to increase waterfowl populations) and the goals of the Partners for Flight program to protect and increase the habitats for neotropical migrants.

Therefore we recommend the preferred alternative which includes:

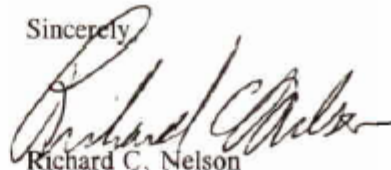
1. Moist Soil Management Unit Enhancement (USFWS complex, Unit 2, Fox Pond, Swarms/Beebe Ponds, IDNR MSMU), through increased water level control and reliability. This will include berm height increases, mechanical dredging, clearing and grubbing, new water control structures, water pumps, and dedicated water supplies. In addition, various seepage problems will be addressed.
2. Sand Prairie Restoration, through seeding 36 acres to replicate native prairie originally found on the site.
3. Fisheries Enhancement - Upper Fish Nursery. This feature involves replacing the water control structure and providing an open culvert through which fish may egress into the main lake. Predatory fish can be excluded resulting in a protected nursery for fish to reach greater maturity prior to release into the main lake.
4. Fisheries Enhancement - Dredge Deep Water/Access. This includes (L1)= Dredge Main Lake, (G-1)= Dredge Goose Pond, (B-1)= Dredge Blackhawk/Yankee Chutes, and (S-1)= Swarms/Beebe Ponds. Various hydraulic dredging to address siltation, water quality and fish access problems are the focus of these features.
5. Reforestation (Mast Tree Planting). This includes sites A and B (USFWS Fields) through planting of Root Prune Method (RPM) mast trees and cessation of row crop cultivation. Augmenting existing forest stands through interplanting (Site C) and providing higher elevations for mast tree planting (Site D) will contribute to the diversity and health of the bottomland hardwood forest. This feature affects 93 acres. Species planted includes northern pecan, swamp white oak, bur oak, pin oak, sycamore, and shellbark hickory.
6. Levee Rehabilitation. The implementation of this feature will increase flood protection to the 25-year level for the current exterior levee system at the Lake Odessa complex and reduce the incidence of levee failure. The steepness of some slopes will be reduced to improve section reliability. Two spillways will be added to allow the interior to flood in a more controlled manner rather than overtopping or breaching.

Colonel William J. Bayles

13

We appreciate the opportunity to provide these comments and look forward to continued coordination on this project. If you have any questions, please contact Ms. Heidi Woeber of my staff at (309) 793-5800, ext. 517.

Sincerely,

A handwritten signature in dark ink, appearing to read "Richard C. Nelson", written in a cursive style.

Richard C. Nelson
Supervisor

cc: USFWS/UMRWFR (Cox, Steinbach,)
IADNR (Griffin, Ohde, Pfeiffer, Kline)

REFERENCES

U.S. Fish and Wildlife Service, 1987. Final Environmental Impact Statement/Refuge Master Plan, Upper Mississippi River National Wildlife and Fish Refuge. Twin Cities, MN.

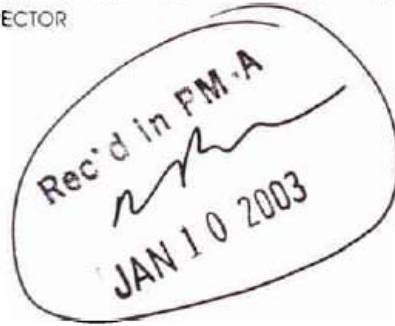
BEAR CREEK ARCHEOLOGY, INC.

ARCHEOLOGICAL AND HISTORICAL CONSULTANTS

DAVID G. STANLEY, DIRECTOR

January 8, 2003

Mr. Ron Pulcher
Environmental Analysis Branch
U.S. Army Engineer District, Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, IL 61204-2004



RE: Contract No. DACW25-98-D-0001, Work Order 0037; Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa; BCA 1094

Dear Mr. Pulcher:

Enclosed is an invoice for the submission of the draft report for the above referenced investigation. Three copies of this draft report, as well as the GIS CD, are also enclosed.

If you have any questions regarding this, please do not hesitate to contact this office.

Sincerely,

A handwritten signature in cursive script that reads "Patricia Halvorson".

Patricia Halvorson
Business Manager

ph
Enclosures

PM DIST FILE

PM-A Pulcher

PM-M PERK, NILES

☐ David W. Benn
Research Coordinator
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Office/FAX: (507) 864-7316

☒ Home Office
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Cresco, IA 52136
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FAX: (563) 547-5403

CEMVER-PM-A

6 Feb 03
Pulcher/5384

MEMORANDUM FOR RECORD

SUBJECT: Summary of 4 Feb 03 Lake Odessa EMP Meeting on Historic Properties

1. Reference:

a. January 2003 draft report entitled *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, by David W Benn and Bill Isenberger of Bear Creek Archeology, Inc. (DACW25-98-D-0001, WO#37).

b. Pulcher (PM-A) email dated 31 Jan 03, subj: Lake Odessa EMP Mtg forwarding agenda and file: ArchSiteStatus--OdessaEMPJan03.xls.

2. Meeting attendees were:

Ron Pulcher & Karen Hagerty, PM-A
Darron Niles & Roger Perk (1st half of meeting), PM-M
Joe Dziuk, ED-DG
David Benn, Bear Creek Archeology, Inc. (by phone, 2nd half of meeting)

3. Niles, Hagerty, & Dziuk confirmed that the Recommended Plan as in the Scope of Work for the para. 1a report was unchanged, and particularly, that the location of the downstream spillway in the vicinity of archaeological site 13LA312 was correct.

4. Niles, Perk, Hagerty, Dziuk, and Pulcher confirmed that rip rap would be used as a means of shoreline protection for archaeological sites to ensure a 50-year level of protection.

5. All attendees expressed concern that the data recovery zone at 13LA27 was now projected to be eroded through completely in under 50 years and would now need rip rap after expenditures for data recovery were already made. Primarily because of this fact, Niles, Perk, Hagerty, & Dziuk requested that the PM-M GIS staff duplicate the erosion measurements that were presented in the para. 1a draft report. Pulcher agreed and requested this be accomplished by COB, 18 Feb 03, so as not to adversely impact the schedule for a draft MOA by the end of April 03. POC for this is Darron Niles, PM-M.

6. Pulcher noted that any changes in erosion rates that might result from PM-M GIS staff reanalysis would potentially impact on the 200 feet of rip rap at 13LA27 and the lower 200-400 feet of the 1330 feet of rip rap at 13LA30 (all out of a total of 3410 feet of rip rap).

7. When Benn was brought on by phone, all present agreed that:

a. Site 13LA30 would have to be avoided by dredge material placement which is currently mapped as covering part of the site;

b. Site 13LA84, contrary to the para 1b email, is again considered not to be in the APE since the spillway location is now positively confirmed in the location shown on Figure 9 of the para 1a report (meaning no deep testing, potential mitigation or avoidance needed);

c. Sites 13LA288 and 455 are in the APE and will require Phase II archaeological testing;

Archaeological Site Status As Documented by Phase II Testing,* the Corps Letter Dated 26 January 1998, the State Historical Society of Iowa Letter Dated 20 April 1998, Benn and Isenberger 2003 (January 2003, draft report), and a 4 Feb 03 Corps Meeting. Lake Odessa Habitat Rehabilitation and Enhancement Project Environmental Management Program - Upper Mississippi River System					
Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect	Mitigation Treatment Recommendations for the 14 National Register Sites Within the Area of Potential Effect	Length of Bank Protection (ft) (rounded to nearest 10 ft)	Comment
3	NE	No	N/A		This NR Status applies only to that small portion of site area in Federal ownership
13	NE	Yes	N/A		
27	E	Yes	Data Recovery & Bank Protection	200	Data Recovery Completed, but Bank Protection needed since erosion will be in undisturbed deposits before 50 years. No Dredged Material Placement will be allowed on 13LA30
30	E	Yes	Bank Protection/Avoid Dredge Material Placement	1330	
38	NE	Yes	N/A		Site has been mitigated through excavation. National Register status changed from E to NE due to destruction by recent bank erosion.
47	NE	Yes	N/A		
84	E	No			
97	NE	Yes	N/A		
98 & 99	E	Yes	Bank Protection	520	
100	NE	Yes	N/A		
104	E	No	N/A		
261	UNK	No	N/A		
288	UNK	Yes	To Be Determined		Requires Phase II Testing
289	NE	Yes	N/A		
290	NE	Yes	N/A		
291	NE	Yes	N/A		
292	UNK	No	N/A		
293 b & f	NE	Yes	N/A		
293 a, c-e, g, & h	NE	Yes	N/A		National Register status changed from E to NE due to destruction by recent bank erosion.
296	UNK	No	N/A		
297	UNK	No	N/A		
298	UNK	No	N/A		
299	E	Yes	Bank Protection	250	
300	E	Yes	Bank Protection	400	
301	NE	Yes	N/A		
302	NE	Yes	N/A		
303	NE	Yes	N/A		
304	NE	Yes	N/A		
305	UNK	No	N/A		
308	UNK	No	N/A		
309	E	Yes	Data Recovery		Data Recovery Completed
					Burns City in APE due to spillway in vicinity. Boundary establishment and Phase II testing to be accomplished in order to evaluate potential effects from spillway (Benn and Isenberger 2003).
312	E	Yes	Potential Mitigation/Avoidance TBD		
318	UNK	No	N/A		
420	UNK	No	N/A		
421	UNK	No	N/A		
422	UNK	No	N/A		
423	E	Yes	Bank Protection	270	
424	E	Yes	Bank Protection	200	
425	NE	Yes	N/A		
426	NE	Yes	N/A		
427	UNK	No	N/A		
430	UNK	No	N/A		
431	NE	Yes	N/A		
432	NE	Yes	N/A		
433	UNK	No	N/A		

ArchSiteStatus--OdessaEMP-4Feb03

Archaeological Site Status As Documented by Phase II Testing,* the Corps Letter Dated 26 January 1998, the State Historical Society of Iowa Letter Dated 20 April 1998, Benn and Isenberger 2003 (January 2003, draft report), and a 4 Feb 03 Corps Meeting. Lake Odessa Habitat Rehabilitation and Enhancement Project Environmental Management Program - Upper Mississippi River System					
Site Number 13LA	National Register of Historic Places Status	Site Is Within Area of Potential Effect	Mitigation Treatment Recommendations for the 14 National Register Sites Within the Area of Potential Effect	Length of Bank Protection (ft) (rounded to nearest 10 ft)	Comment
434	UNK	No	N/A		
435	UNK	No	N/A		
436	UNK	No	N/A		
437 North	NE	Yes	N/A		
437 South	E	Yes	Preserve by Avoidance		
438	E	Yes	Preserve by Avoidance		
439	NE	Yes	N/A		
440	NE	Yes	N/A		
441	UNK	No	N/A		
442	NE	Yes	N/A		
443	NE	Yes	N/A		
444	NE	Yes	N/A		
445	NE	Yes	N/A		
446	E	Yes	Bank Protection	240	
447	UNK	No	N/A		
448	UNK	No	N/A		
449	UNK	No	N/A		
450	NE	Yes	N/A		
451	NE	Yes	N/A		
455	UNK	Yes	To Be Determined		Requires Phase II Testing
458	UNK	No	N/A		
459	UNK	No	N/A		
Total Length of Bank Protection				3410	
E: Eligible NE: Not Eligible UNK: Unknown N/A: Not applicable					
*: This table summarizes the Corps' opinion following the reevaluation and recommendations in the Phase II final report dated April 1998 (BCA# 466) -- and the State Historical Society of Iowa Letter Dated 20 April 1998 (SHSI R&C#: 950558014) -- and the January 2003 draft report (Benn and Isenberger 2003).					
Highlighting marks 14 sites which require mitigation of some type based on the Phase I Survey of Potential Lake Odessa EMP Project Features summarized in Benn (1998:Figure 5). (13LA27 and 13LA309 are marked in bold type and have data recovery completed .)					
Highlighting marks changes resulting from information in Benn and Isenberger (2003).					
Highlighting marks Corps mitigation method chosen in January 2003.					
Highlighting marks changes from 4 Feb 04 meeting between Corps & David Benn.					
Reference: Benn, David W. 1998 <i>Phase II Archeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation & Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa</i> . Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 24, Modifications 1 and 2. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #466 - 2 volumes).					
Benn, David W., and Bill Isenberger 2003 <i>Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa</i> . Report submitted to the US Army Corps of Engineers Rock Island District under Contract No. DACW25-92-D-0008, Work Order No. 37. Report submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #1094, draft, January 2003).					

ArchSiteStatus--OdessaEMP-4Feb03

SUBJECT: Summary of 4 Feb 03 Lake Odessa EMP Meeting on Historic Properties

7. (cont.)

d. Bear Creek will eventually be requested to have maps in the para 1a report for 13LA27 and 13LA30 revised to show the projected 50-year line of erosion using both the smallest and the largest rate of erosion projected by Bear Creek.

e. Bear Creek will eventually be requested to remove reference to shoreline protection by dredged material and include in the report the Corps decision to use rip rap.

f. David Benn said he would be available for questions as the PM-M GIS staff duplicate the measurements as noted in para. 5, above.

8. The file ArchSiteStatus--OdessaEMPJan03.xls (see para. 1b) has been revised per the results of this meeting and is found at Attachment 1.

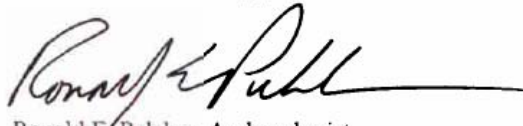
9. The meeting failed to address two subjects on the agenda:

a. typical profiles for the rip rap, and

b. information on rip rap methods.

Pulcher (PM-A) requests this information be provided with the same 18 Feb 03 suspense as the information noted in para. 5, above. POC for this is Joe Dziuk, PM-M.

10. All attendees were given two calendar days to review this MFR prior to its finalization. One comment was received. Dziuk requested para. 4 read, "The group confirmed that rip rap would be used as a means of shoreline protection for archaeological sites to ensure a 50-year level of protection." This change was made with the names retained. No other comments were received.



Ronald E. Pulcher, Archaeologist
Economic & Environmental Analysis Branch

1 Attachment (ArchSiteStatus—OdessaEMP-4Feb03.xls)

CF:

PM Dist File

PM-A (Pulcher, Hagerty, Bollman)

PM-M (Perk, Niles)

ED-DG (Dziuk)

Bear Creek Archeology, Inc. (David Benn)

February 12, 2003

Planning, Programs, and
Project Management Division

Dr. David W. Benn
Principal Investigator
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136

Dear Dr. Benn:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) has reviewed your January 2003 draft report entitled *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System, Louisa County, Iowa (BCA No. 1094)*. David W. Benn, Principal Investigator of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc. prepared the report under Corps Contract No. DACW25-98-D-0001, Delivery Order No. 37.

Please prepare the final reports taking into account the comments at Enclosure 1. Please note that because this report is being prepared as background for eventual coordination of a Memorandum of Agreement for the Lake Odessa project, the draft report was not provided to the Iowa State Historic Preservation Officer for review.

Please include this letter without its enclosure in a correspondence section of the report.

If you have any questions regarding this matter, please call me at 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division, Economic and Environmental Analysis Branch (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Ronald E. Pulcher
Authorized Representative
of the Contracting Officer

Enclosure

Copy Furnished:

Mr. David G. Stanley
President
Bear Creek Archeology, Inc.
P.O. Box 347
Cresco, Iowa 52136 (without enclosure)

(all wo/encl):
Dist File (PM-M)
✓ PM-M (Niles, Perk)
PM-A (Pulcher, Hagerty)
ED-DG (Dziuk)
CT

BEAR CREEK ARCHEOLOGY, INC.

ARCHEOLOGICAL AND HISTORICAL CONSULTANTS

DAVID G. STANLEY, DIRECTOR

February 19, 2003

Mr. Ron Pulcher
Environmental Analysis Branch
U.S. Army Engineer District, Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, IL 61204-2004



RE: Contract No. DACW25-98-D-0001, Work Order 0037; Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa; BCA 1094

Dear Mr. Pulcher:

Enclosed is an invoice and the Corporate Release Form for the submission of the final report for the above referenced investigation. Ten copies of this final report, as well as a CD, are also enclosed.

If you have any questions regarding this, please do not hesitate to contact this office.

Sincerely,

Patricia Halvorson

Patricia Halvorson
Business Manager

ph
Enclosures

CF

PM DKT FILE

PM-A Pulcher, Hagerthy

PM-M N.Tes

☐ David W. Benn
Research Coordinator
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Rushford, MN 55971
Office/FAX: (507) 864-7316

☐ Home Office
P.O. Box 347
Cresco, IA 52136
(563) 547-4545
FAX: (563) 547-5403

CONVERSATION RECORD		TIME 0915	DATE 24 Feb 03
TYPE <input type="checkbox"/> VISIT <input type="checkbox"/> CONFERENCE <input checked="" type="checkbox"/> TELEPHONE		ROUTINE NAME/SVMRO INT	
Location of Visit/Conference:		<input type="checkbox"/> INCOMING <input checked="" type="checkbox"/> OUTGOING	
NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU Heidi Woerber	ORGANIZATION (Office, dept., bureau, etc.) RIFO	TELEPHONE NO: 793-5800, ext 517	
SUBJECT Mussel survey for Lake Odessa HREP			

SUMMARY

I called Heidi to discuss the need for a mussel survey for the Lake Odessa HREP. Two areas for dredging in Turkey Chute were delineated in the draft DPR sent for sponsor review this month. These dredge cuts would provide material for the levee rehabilitation. MVR wanted to verify whether a mussel survey would be necessary. Higgins Eye mussels are found in the main channel of the Mississippi River nearby.

Heidi had reviewed the draft DPR and plates. She said there were no known Higgins Eye populations in Turkey Chute; not ideal habitat. Therefore, RIFO did not feel that a mussel survey would be necessary prior to the proposed dredging.

ACTION REQUIRED

To file

NAME OF PERSON DOCUMENTING CONVERSATION Karen Hagerty	SIGNATURE //s//	DATE 24 Feb 03
--	--------------------	-------------------

ACTION TAKEN

SIGNATURE	TITLE	DATE
-----------	-------	------

CONVERSATION RECORD

OPTIONAL FORM 271 (12-76)
DEPARTMENT OF DEFENSE



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

March 28, 2003

Planning, Programs, and
Project Management Division (1145)

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is currently developing plans for the Lake Odessa Habitat Rehabilitation and Enhancement Project (LO-HREP) in Louisa County, Iowa, and the project is being developed as part of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP). Please reference State Historical Society of Iowa (SHSI) R&C# 950558014.

Federal Undertaking

The Corps has determined that, for purposes of Section 106 of the National Historic Preservation Act [see 36 CFR 800.3(a) and 800.16(y)], the Federal "undertaking" which has the potential to cause effects on historic properties is limited to the "Project Features" and shoreline of Lake Odessa, as shown within the boundary of the Project Area on the map at Enclosure 1a and defined below under the Area of Potential Effect.

Consulting Parties

The Corps finds the following organizations entitled to be consulting parties, as set out in 36 CFR 800.2, and invites them by copy of this letter to participate in the Section 106 process:

- Advisory Council on Historic Preservation (Council)
- Citizen Band Potawatomi
- Forest County Potawatomi
- Governor's Liaison for Indian Affairs
- Hannahville Indian Community Council
- Ho-Chunk Nation
- Iowa Department of Natural Resources
- Iowa State Historic Preservation Officer at the Iowa State Historical Society

- Iowa Tribe of Nebraska and Kansas
- Iowa Tribe of Oklahoma
- Kickapoo of Kansas Tribal Council
- Kickapoo of Oklahoma Business Committee
- Kickapoo Traditional Tribe of Texas
- Louisa County Historical Society
- Office of the State Archaeologist Indian Advisory Committee
- Otoe-Missouria Tribe
- Peoria Indian Tribe
- Prairie Band Potawatomi
- Sac and Fox of the Mississippi in Iowa
- Winnebago Tribe of Nebraska
- U.S. Fish and Wildlife Service

Area of Potential Effect (APE)

The APE is illustrated on the map at Enclosure 1a and includes all Project Features shown there, as well as the shorelines within the Project Area, as these are affected by the fluctuating water levels designed into the water control aspects of the project. The Project Features are in six basic categories: moist soil unit enhancements; fisheries enhancements; mast tree plantings; levee restoration; sand prairie planting; and a fish nursery. The Project Features are described in detail at Enclosure 1b under the heading Recommended Plan. The APE is all on Federal land; none is on tribal lands [36 CFR 800.16(d) and 36 CFR 800.4(a)(1)].

State Historic Preservation Officer (SHPO) and Tribal Historic Preservation Officers (THPOs) Invitations

The Corps invites the SHPO/THPOs to:

- Identify any other consulting parties as per 36 CFR 800.3(f);
- Comment as per 36 CFR 800.2(d)(3) on the Corps' plan to involve the public by utilizing the Corps' normal procedures for public involvement under the National Environmental Policy Act;
- Concur in the Corps' decision that it is appropriate to address multiple steps in 36 CFR 800.3-800.6 as provided at 36 CFR 800.3(g); and,

- Comment on or contribute to identification efforts including definition of the APE, all as per 36 CFR 800.4(a-b).
- Comment on the draft Programmatic Memorandum of Agreement (PA) at Enclosure 2.

Identification of Historic Properties

Review of Existing Information and Level of Future Identification Efforts:

Review of existing information [36 CFR 800.4(a)(2)] indicates that initial geomorphological investigations were conducted in the mid-1990s (Benn and Anderson 1995) prior to a Phase I survey (Benn 1996) of the Lake Odessa project [36 CFR 800.4(b)]. Benn (1998) reported on Phase II testing of sites in the Lake Odessa project with revised recommendations on site status and sites included in the APE [36 CFR 800.4(c)]. Under separate Memoranda of Agreement, two sites, 13LA27 (Benn *et al.* 1999) and 13LA309 (Benn *et al.* 2001), were mitigated through data recovery.

The Corps and the SHPO last communicated on this undertaking as a whole through a Corps letter dated January 26, 1998, and with a SHPO response dated April 20, 1998, (R&C number as above). This SHPO letter states that "According to a previous letter from our office (Gourley 1996), our office was not ready to concur that sites potentially eligible for listing on the National Register should receive no further work in the form of Phase II evaluation." The Corps recognized this 1996 SHPO concern as valid, and in the January 26, 1998, Corps letter addressed all sites within the APE. Since 1998 the project scope has been modified slightly to arrive at its present configuration (Enclosure 1a-b). This necessitated a review of the project's APE and the status of cultural resources within it.

The Corps obtained such a review with the February 2003 report entitled *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, prepared under Corps Contract No. DACW25-98-D-0001, Work Order No. 37, by David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc., (Benn and Isenberger 2003, Enclosure 3).

The Table 2 from Benn and Isenberger (2003) is at Enclosure 4. It shows the current identification of sites within the overall project area that are in the APE (n=40) and the current National Register of Historic Places (NRHP) status of sites following this review by Benn and Isenberger (13 sites eligible, 25 sites ineligible, and 2 sites yet to be evaluated for eligibility).

Changes from the 1998 status as summarized in Benn and Isenberger (2003:Table 2) are as follows:

- Three sites have been added to the APE (13LA288, 312, and 455) and
- NRHP status of 13LA47 and 293 has changed to Not Eligible due to destruction by bank erosion (13LA293 now counted as one site, no longer subdivided, since all parts are determined no longer eligible for the NRHP).

The Corps finds that historic properties identification has been completed for the entire APE [reference 36 CFR 800.4(b)], with the exception of the following:

- the old town site of Burris City (13LA312), a site already determined eligible for the NRHP. This site will have its boundary established and any portion of the site found within the APE will be fully evaluated for the effects of the spillway to be placed in the levee at this point (see Benn and Isenberger 2003:14); and of
- Sites 13LA288 and 455 which may be affected by earthmoving related to Moist Soil Management Units. These two sites still require Phase II testing to determine their eligibility for inclusion in the NRHP and may require work to prepare a data recovery or avoidance plan should the sites meet NRHP eligibility criteria.

Request for Information from Consulting Parties:

The Corps is seeking information from all consulting parties regarding their concerns with issues relating to this undertaking's potential effects on historic properties and, particularly, the tribes' concerns with identifying properties which may be sacred sites under Executive Order No. 13007 or of religious and cultural significance to them and may be eligible for the National Register [36 CFR 800.4(a)(3-4)]. Concerns about confidentiality [36 CFR 800.11(c)] regarding locations of properties can be addressed under Section 304 of the National Historic Preservation Act which provides withholding from public disclosure the location of properties under several circumstances including in cases where it would cause a significant invasion of privacy, impede the use of a traditional religious site by practitioners, endanger the site, etc.

Agency Evaluation of Historic Significance, Determination of National Register Eligibility, and Invitation to the SHPO/THPOs and Consulting Parties to Comment:

The status of sites as listed at Enclosure 4 contains the current Corps determination of those sites that are within the APE and the current Corps determination of the eligibility status of sites within the APE for inclusion in the National Register of Historic Places (NRHP) under the criterion found at 36 CFR 60.4(d)—sites that have yielded, or may be likely to yield, information important in prehistory or history.

A total of 40 sites are within the APE. Thirteen of these are already determined to be NRHP-eligible; twenty-five are NRHP-ineligible; and two remain in an unknown eligibility status (see Enclosure 4).

The Corps invites the opinion of the SHPO/THPOs and consulting parties on this determination [36 CFR 800.4(c)].

Agency Determination of Historic Properties Affected and Invitation to All Consulting Parties to Submit their Views on the Effects:

The Corps finds that within the APE there are 13 historic properties affected [36 CFR 800.4(d)]. These are the sites coded on Enclosure 4 as both within the APE and with a NRHP status of eligible. Two sites within the APE which currently have a NRHP status of unknown may join the affected sites should they be determined eligible for the NRHP after NRHP evaluation as provided for in the draft Programmatic Memorandum of Agreement (PA) at Enclosure 2.

Assessment of Effects to Historic Properties

Agency Finding of No Adverse Effect and Invitation to All Consulting Parties to Review the Finding and Participate in the Development and Finalization of the Programmatic Agreement:

The Corps finds this undertaking will have an No Adverse Effect [36 CFR 800.5(b)] on the 13 sites coded on Enclosure 4 as both within the APE and with a NRHP status of eligible and potentially upon the two sites within the APE which currently have a NRHP status of unknown. This determination is based upon the provisions in the draft PA found at Enclosure 2.

The Corps hereby notifies all consulting parties including the SHPO/THPOs and the Council of this Finding of No Adverse Effect and provides them with the documentation summarized at Enclosure 5 as specified at 36 CFR 800.11(e). The Corps invites the Council and all other consulting parties to review the finding as per 36 CFR 800.5(c) and to participate in the development and finalization of the PA [36 CFR 800.14] as found in draft at Enclosure 2.

If any consulting party disagrees with any finding or determination herein, they have 30 days from the date of the letter transmitting this finding to specify to the Corps the reasons for disagreeing with the finding [36 CFR 800.5(c)].

If the consulting party is an Indian tribe which attaches religious or cultural significance to an historic property subject to this finding or otherwise within the APE (traditional cultural property or sacred site), they may, in addition to specifying to the Corps the reasons for disagreeing with the finding, also request the Council to review the finding pursuant to 36 CFR 800.5(c)(3).

We request your comments within 30 days from the date of this letter. If we do not hear from you within this time, we shall proceed with the Section 106 process as outlined herein and provided for in 36 CFR 800.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or you may write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

John P. Carr
Acting Chief, Economic and
Environmental Analysis Branch

Enclosures

**Lake Odessa Habitat Rehabilitation and Enhancement
Consulting Parties List**

Don Klima
Director - Eastern Office of Review
Advisory Council on Historic Preservation
1100 Pennsylvania Ave NW., #809
Washington DC 20004

Lavon Grimes
R&C Coordinator
State Historical Society of Iowa
600 East Locust
Des Moines, IA 50319-0290

Donald L. Robidoux
NAGPRA Coordinator
Iowa Tribe of Nebraska and Kansas
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Marianne Long
Cultural Preservationist
Iowa Tribe of Oklahoma
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Perkins, OK 74059

Johnathan Buffalo
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Sac and Fox of the Mississippi in Iowa
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Tama, IA 52339-9629

Mildred Hudson
NAGPRA Coordinator
Otoe-Missouria Tribe of Oklahoma
Otoe-Missouria Tribal Office
8151 Highway 177
Red Rock, OK 74651

David Lee Smith
Cultural Preservation Officer
Winnebago Tribe of Nebraska
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Winnebago, NE 68071

Chairman
Forest County Potawatomi Executive
Council
P.O. Box 346
Crandon, WI 54520

Maria Pearson
Governor's Liaison for Indian Affairs
1001 North Dakota Avenue
Ames, IA 50010

Indian Advisory Committee
Office of the State Archaeologist
700 Clinton Street Building
Iowa City, IA 52242-1030

Chairman
Hannahville Indian Community Council
N14911 Hannahville Boulevard Road
Wilson, MI 49896-9728

Chairman
Prairie Band Potawatomi Tribal Council
P.O. Box 97
Mayetta, KS 66509

Charla K. Reeves
Peoria Indian Tribe of Oklahoma
P.O. Box 1527
Miami, OK 74355

**Lake Odessa Habitat Rehabilitation and Enhancement
Consulting Parties List (Continued)**

Chairman
Kickapoo Traditional Tribe of Texas
P.O. Box 972
Eagle Pass, TX 78853

Chairperson
Kickapoo of Kansas Tribal Council
Route 1, box 157
Horton, KS 66349

Ho-Chunk Nation
Historic Preservation Department
P.O. Box 667
Black River Falls, WI 54615

Chairman
Citizen Band Potawatomi Business
Committee
1901 South Gordon Cooper Drive
Shawnee, OK 74801

Chairman
Kickapoo of Oklahoma Business Committee
P.O. Box 70
McCloud, OK 74851

Louisa County Historical Society
819 Townsend Avenue
Columbus Junction, IA 52738

Jeffery R. Vonk
Director
Iowa Department of Natural Resources
Henry A. Wallace Building
East 9th and Grand
Des Moines, IA 50319

Mr. William Hartwig
Regional Director, Region III
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, MN 55111

LIST OF ENCLOSURES

Enclosure 1a. U.S. Army Corps of Engineers, Rock Island District, Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System (map completed September 27, 2002) (1 oversize page).

Enclosure 1b. Recommended Plan (10 pages).

Enclosure 2. Draft Programmatic Memorandum of Agreement (13 pages).

Enclosure 3. Report by Benn and Isenberger (2003)—hard copies provided to State Historical Society of Iowa, Office of the State Archaeologist of Iowa Indian Advisory Committee, and the Advisory Council on Historic Preservation with the report's Executive Summary provided to remaining addressees.

Enclosure 4. Table 2 from Benn and Isenberger (2003).

Enclosure 5. Documentation of Finding of No Adverse Effect as specified at 36 CFR 800.11(e).



PEORIA TRIBE OF INDIANS OF OKLAHOMA

118 S. Eight Tribes Trail (918) 540-2535 FAX (918) 540-2538
P.O. Box 1527
MIAMI, OKLAHOMA 74355

CHIEF
John P. Froman

SECOND CHIEF
Joe Goforth

Rec'd in PM-A
APR 07 2003

April 2, 2003

Department of the Army
Attn: Planning, Programs, and Project Management Division
US Army Corps of Engineers
Rock Island District
Clock Tower Building PO Box 2004
Rock Island IL 61204-2004

RE: State Historical Society of Iowa (SHSI) R&C# 950558014

[LAKE ODESSA EMP]

Thank you for notice of the referenced project. The Peoria Tribe of Indians of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the proposed construction. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Peoria Tribe request notification and further consultation.

The Peoria Tribe has no objection to the proposed construction. However, if any human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, the construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted.

John P. Froman
Chief

xc: Bud Ellis, Repatriation/NAGPRA Committee Chairman

CF
PM DIST FILE
PM-A Pulcher, Hagerly
PM-M NILES

TREASURER
LeAnne Reeves

SECRETARY
Hank Downum

FIRST COUNCILMAN
Claude Landers

SECOND COUNCILMAN
Jenny Rampey

THIRD COUNCILMAN
Jason Dollarhide



Rec'd in PM-A
APR 16 2003

April 3, 2003

John P. Carr, Acting Chief
Economic and Environmental Analysis Branch
Department of the Army
Rock Island District, Corps of Engineers
P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: Lake Odessa Habitat Rehabilitation and Enhancement Project (LO-HREP)
Iowa

Dear Mr. Carr:

On April 2, 2003, we received your invitation to participate in consultation to develop a Programmatic Agreement for the referenced undertaking submitted in accordance with 36 CFR § 800.6(a)(1) of the regulations, "Protection of Historic Properties" (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act. We have reviewed the supporting documentation which you have provided, and request that you clarify the relationship between the Memoranda of Agreement which were executed to mitigate archeological sites 13LA27 and 13LA309 and the referenced undertaking. In addition, complete documentation meeting the requirements set forth in 36 CFR § 800.11(e) was not submitted with your invitation. We ask that you provide this additional information so that we may determine whether the criteria established by Appendix A of our regulations, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases*, apply to this undertaking. Specifically, we ask that you provide us with a copy or summary of the views of the consulting parties and the public.

Should you have any questions or require the further assistance, please contact Laura Henley Dean, PhD, by telephone at 202-606-8527 or by e-mail at ldean@achp.gov.

Sincerely,

David L. Klima
Director
Office of Federal Agency Programs

CF:
PM DIST FILE
PM-A Hagerly, Pulcher
PM-M NILES

ADVISORY COUNCIL ON HISTORIC PRESERVATION

1100 Pennsylvania Avenue NW, Suite 809 • Washington, DC 20004
Phone: 202-606-8503 • Fax: 202-606-8647 • achp@achp.gov • www.achp.gov



A Division of the Iowa Department of Cultural Affairs

April 16, 2003

Mr. Ron Pulcher, Archaeologist
Economic and Environmental Analysis Branch
Corps of Engineers - Rock Island District
Clock Tower Building P.O. Box 2004
Rock Island, IL 61204-2004

Rec'd in PM-A
R. Pulcher
APR 28 2003

In reply refer to:
R&C#: 959558014

CF:
PM DIST FILE
PM-A Pulcher, Hagarty
PM-M NILES

RE: COE - LOUISA COUNTY - DASW25-98-D-001, WORK ORDER NO. 0037 -- LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT UNDER THE UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM - MARK TWAIN NATIONAL WILDLIFE REFUGE/LAKE ODESSA STATE WILDLIFE MANAGEMENT AREA - SUMMARY DOCUMENTATION OF HISTORIC PROPERTIES CONDITIONS FINAL DRAFT 2003 [BCA #1094] - CORPS NOTIFICATION OF UNDERTAKING AND DRAFT PROGRAMMATIC AGREEMENT

Dear Mr. Pulcher,

By this letter, the Iowa State Historic Preservation Office (henceforth SHPO) accepts the Corp's (Rock Island District) invitation to consult on this undertaking. Our comments and recommendations are presented below in the order of their occurrence within the letter dated March 28, 2003 under the heading SEE DISTRIBUTION LIST.

Federal Undertaking

1. The SHPO agrees that the proposed action(s) constitutes a Federal undertaking eliciting review under section 106 of the National Historic Preservation Act of 1966 and its implementing regulations, 36 CFR part 800.

Consulting Parties

2. We have reviewed the Corps' list of consulting parties and agree that those identified have a valid interest in the proposed undertaking. We recommend the addition of the State Archaeologist of Iowa and the Yankton Sioux. The Office of the State Archaeologist Indian Advisory Committee (page 2) should be changed to the Governor's Indian Advisory Council to the State Archaeologist. If other parties come forward during the review process, the SHPO encourages the Corp to consider their interests and invite their consultation when deemed appropriate per 36 CFR part 800.3(f).
 - a. In accordance with section 101 (b) (3) the SHPO agrees to assist the Corp in carrying out their section 106 responsibilities for this undertaking.
 - b. In doing so, the SHPO will act in the best interests of the State of Iowa and its citizens in the preservation of their cultural heritage as mandated by 36 CFR 800.2 (c) (1).

Area of Potential Effects (APE)

3. The SHPO agrees to the Corps' current definition of the project Area of Potential Effects (Enclosures 1a and 1b) with the understanding that it is likely to change through time. We recommend the following considerations: a) The 'Project Boundary' legend identified within the Project Features key of the Map should be changed to 'Refuge Boundary' to avoid the impression that the refuge boundary and APE are the same; b) Future modifications to the APE will be documented and attached as an appendix to the programmatic.

Identification of Historic Properties (Agency Evaluation of Historic Significance, etc.)

4. Upon reviewing the available project documentation, it is our opinion that the Mark Twain National Wildlife Refuge (FWS Management) and the Lake Odessa State Wildlife Management Area (DNR Management) where

future undertakings may occur and all locations currently designated as the Area of Potential Effects have high potential to contain significant historic properties that may be eligible for listing on the National Register of Historic Places.

5. We have received and reviewed the document entitled *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa [BCA #1094]* prepared by Messrs. David W. Benn and Bill Isenberger (2003) of Bear Creek Archeology, Inc., Cresco, Iowa. Upon completion of our review, we had the opportunity to discuss the results further with Benn and with you (April 15, 2003). Based on information obtained from all sources consulted we understand the following.
 - a. Table 2 summary reflects the current status of archaeological sites identified within the refuge boundaries as they relate to the current project APE and with respect to their National Register eligibility. From that we understand that the Corps has determined:
 1. Site 13LA003 is not eligible and is located outside of the project APE.
 2. Sites 13LA103, 097, 100, 289, 290, 291, 301, 302, 303, 304, 425, 426, 431, 432, 437 North, 439, 440, 442, 443, 444, 445, 450, and 451 are within the current APE but are determined to be ineligible for listing in the National Register. **THE SHPO CONCURS WITH THIS ASSESSMENT AND WITH THE CORPS DETERMINATION.**
 3. Sites 13LA084 and 13LA104 have been determined to be eligible but are not located within the project APE. **THE SHPO CONCURS WITH THIS ASSESSMENT AND WITH THE CORPS' DETERMINATION.**
 4. The National Register status of sites 13LA261, 292, 296, 297, 298, 305, 308, 318, 420, 421, 422, 427, 430, 433, 434, 435, 441, 447, 448, 449, 458, and 459 has not been determined, but all are outside the current APE therefore no further investigation is proposed at the present. **THE SHPO CONCURS WITH THIS ASSESSMENT AND WITH THE CORPS' DETERMINATION.**
 5. Effects to site 13LA309 have been successfully mitigated through data recovery. **THE SHPO CONCURS WITH THIS CONCLUSION.**
 6. Data recovery for site 13LA027 has been completed, however, the Corps proposes bank stabilization using riprap to protect undisturbed portion of landform. **THE SHPO CONCURS WITH THE REMEDIAL ACTION PROPOSED BY THE CORPS.**
 7. Site 13LA030 has been determined to be National Register eligible and is situated within the project APE. The Corps proposes bank stabilization using riprap to protect undisturbed portions of the landform. The Corps proposes to mitigate project effects through preservation by avoidance. **THE SHPO CONCURS WITH THE REMEDIAL AND MITIGATION ACTIONS PROPOSED BY THE CORPS.**
 8. Sites 13LA098, 099, 299, 300, 423, 424, and 446 have been determined to be National Register-eligible and are located within the project APE. The Corps proposes bank stabilization using riprap to protect undisturbed portions of the landform. **THE SHPO CONCURS WITH THE REMEDIAL ACTION PROPOSED BY THE CORPS.**

9. Sites 13LA437 South and 13LA438 have been determined to be National Register-eligible and are located within the project APE. The Corps proposes to mitigate project effects through preservation by avoidance. **THE SHPO CONCURS WITH THE MITIGATION ACTION PROPOSED BY THE CORPS.**
10. Sites 13LA047 and 13LA293 (a-h), which were previously declared to be eligible have been reevaluated and are now found to be ineligible due to severe erosion. **THE SHPO CONCURS WITH THIS ASSESSMENT AND WITH THE CORPS' DETERMINATION.**
11. The Corps finds that historic properties identification has been completed for the entire APE with the exception of the following:
 - The old town site of Burris City (13LA312), a site already determined eligible for the NRHP. This site will have its boundary established and any portion of the site found within the APE will be fully evaluated for the effects of the spillway to be placed in this levee at this point; and of
 - Sites 13LA288 and 13LA455, which may be affected by earthmoving related to Moist Soil Management Units. These two sites still require Phase II testing to determine their eligibility for inclusion in the NRHP and may require work to prepare a data recovery or avoidance plan should the sites meet NRHP eligibility criteria.

The SHPO concurs with the Corps that historic properties identification has been completed for the APE as it is currently defined with the understanding that any modifications to the project APE will require a concurrent reassessment of the need for additional historic properties investigations. SHPO's concurrence is also contingent upon the understanding that borrow and construction activities at the Fish Nursery Water Control Structure shall be confined to previously surveyed or disturbed areas and shall avoid unsurveyed areas on adjacent terraces (see Benn's caution page 10). With regard to sites 13LA312, 13LA288, and 13LA455, the SHPO also agrees with the Corps' proposal for follow up survey.

12. Site 13LA38, which is recorded within the project APE, has been mitigated through excavation. According to Benn, the forces of erosion have removed unexcavated portions of this site to the extent that nothing remains.

Programmatic Agreement

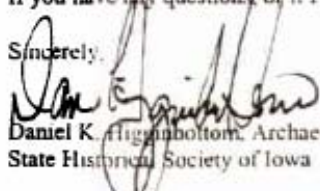
6. We have reviewed the draft programmatic agreement (PA) and recommend the following revisions.
 - a. Section I.A.2.3 (page 3). SHPO recommends that the phrase 'all significant historic properties' be changed to 'all cultural resources exceeding 50 years in age' because in the federal sense 'historic properties' have already been evaluated as significant and therefore eligible for the National Register. We urge the Corps to differentiate cultural resources that are eligible for consideration but as yet unevaluated and historic properties that have been evaluated and determined eligible.
 - b. Section I.A.2.3.3, misnumbered should be I.A.2.3.1 (page 3). SHPO recommends 'For those sites that the Corps and the SHPO/THPOs agree 1) are not eligible for inclusion in the National Register; or, 2) are eligible or potentially eligible for listing in the National Register but will not be affected or adversely affected, no further investigation will be required, and the project may proceed in those areas.
 - c. Section I.A.2.3.3 (page 3). Does the Corps wish to address potential disagreements regarding level of effect at this point (i.e., no effect versus adverse effect and no adverse effect versus adverse effect)? Or is this best dealt with under the dispute resolution clause at section VIII (page 9)?
 - d. Section II.B.2.1 (page 5). The Corps proposes to repair riprap failure within the space of two years following the time it is reported. Why so long? Based on the rate of shoreline erosion reported by BCA, it seems that fairly substantial damage would occur before obligatory repairs were made. Unless special circumstances warrant, we would like to see this time frame reduced to one year.
 - e. Section D.1. (page 6). Change to read 'The Corps has chosen to avoid sites 13LA288 and 13LA455...'

- f. Section IV (page 7). Change to read, 'The Corps will ensure that all materials and records resulting from LO-HREP historic properties studies are curated at the Office of the State Archaeologist of Iowa or at another repository in Iowa that adheres to comparable conservation standards.
- g. Section XI (page 9). Change to read 'This documentation shall contain the name of the project, *the SHPO R&C # and the Corps contract #...*'
- h. Dave Benn remarked the considerable damage to archaeological sites that had been caused by tree throws. The Corps needs to develop a stipulation within the PA that will allow for the routine identification and removal of dead trees that are in danger of toppling and unearthing deposits on sites of significance.

In conclusion, we find that the Corps has sufficiently addressed SHPO's earlier concerns (Gourley 1996). We would like to thank you for inviting our consultation on this undertaking. At this time we have no further comments or recommendations. Please feel free to forward those stated above to the other consulting parties identified for this undertaking. We look forward to receiving a finalized version of the programmatic agreement for our review and signature and await the opportunity to review the results of the proposed supplemental historic properties investigations.

If you have any questions or if I can be of further assistance please feel free to contact me at (515) 281-8744.

Sincerely,


Daniel K. Higginbotham, Archaeologist
State Historical Society of Iowa

Cc: Mr. Jeffrey Vank, Director, IDNR
Mr. John Dobrovolsky, RHPO, USFWS
Mr. David Benn, Principal Investigator, Bear Creek Archeology



THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

STATE OF IOWA

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

Colonel William J. Bayles
U.S. Army Corps of Engineers,
Rock Island District
Clock Tower Building, PO Box 2004
Rock Island, IL 61204-2004

May 2 2003

Colonel Bayles;

Field biologists from the Iowa DNR have reviewed the Lake Odessa Habitat Rehabilitation and Enhancement Project DPR dated March 2003.

The document covers the proposed EMP project at Lake Odessa near Wapello IA.

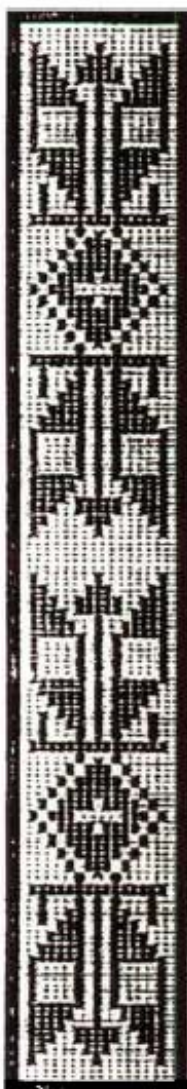
We believe the document explains the project very well. We have no comments at this time and look forward to the project implementation and construction in the near future.

Thank you for the opportunity to comment.

Sincerely;


Mike Griffin

IA DNR
Mississippi River Wildlife Biologist



HO-CHUNK HERITAGE PRESERVATION

P.O. Box 667
Black River Falls, WI 54615
(715) 284-7181 or (800) 561-9918
FAX (715) 284-7449

FAX COVER SHEET

DATE: *MAY 05, 2003*

TIME: *4:15 PM*

TO: *RON P - 309 794-5157*

PHONE: *800 294-9343*

FAX: *X 1068*

FROM: *EMMA SNOWBALL*

PHONE: *(800) 561-9918*

Ho-Chunk Heritage Preservation

FAX: *(715) 284-7449*

RE: *Lake Odessa*

CC:

Number of pages including cover sheet: *6*

Message



Lake Odessa
Rock Island, Illinois District
Findings Summation

Per Department of the Army Corps of Engineers – Rock Island District regarding their memo dated March 28, 2003 an investigative report was made as to our findings regarding the plans made for Lake Odessa and the surrounding area.

Since we were given only 30 days from March 28, 2003 within which to respond, our time is very limited to our completing a thorough investigation on Lake Odessa. We, the Hochunk Nation are 1 of the parties out of some 20+ consulting parties who may claim to any cultural/sacred sites at Lake Odessa.

As of this writing, our Lands Division here at the Hochunk Nation is unable to provide an exact location to any of our cultural sites located near Lake Odessa. However, per a paper entitled Ancient Mounds of Iowa *1 "Over 2,500 years ago, Indian people in Iowa and throughout North America began to bury their dead beneath earthen mounds. This custom continued for more than 1,500 years with some locations becoming "sacred spaces" as later people added new structures and reshaped earlier ones. When non-Indians settled Iowa in the 1800's, thousands of these monuments still existed along the bluffs and terraces of prominent rivers and streams."

The writing goes on to say "Many people are familiar with the large earthworks and conical-shaped burial mounds constructed by Middle Woodland communities around the beginning of the first millennium A.D. Sites such as Toolesboro Mounds in Louisa County, Cook Farm Mounds at Davenport, Pine Creek Mounds in Muscatine County, and the Boone Mound on the central Des Moines River were part of the Hopewell Interaction Sphere." Clearly some claims can be made in Louisa County where Lake Odessa is located.

However, after much discussion among the staff of the Hochunk Nation Heritage Preservation Department, regarding the improvement plans for Lake Odessa, we have reached the consensus that what ever mounds, cemeteries, or other sacred/cultural sites there may have been, they have already been dug up, buried under, or otherwise destroyed. Thereby, we can give no conclusive well informed answer at this time. Unless, of course, the Hochunk Nation President or Legislators feel that we need to make a decision contrary to what we have made.

*1 <http://www.uiowa.edu/~usa/campus/historic/ancientmounds.htm>
see attached

State Historical Society of Iowa



Toolesboro Mounds History

The Hopewell Tradition

The Hopewell tradition dates from approximately 200 BC to AD 450, during a time period known to archaeologists as the Middle Woodland. The name of the tradition comes from an excavation of a mound on the Ohio farm of Mordecai Hopewell, and not from the name these people called themselves. Since we only know the Hopewell people through archaeological excavations and no evidence of written language was preserved, we will never know how they referred to themselves.

The Hopewell tradition is defined by a common set of burial practices among certain Native American groups: the burial of high status individuals in large, conical, earthen mounds with exotic trade goods. The term "Hopewell" refers to this set of shared burial customs, and not to a culture. The phrase "Hopewell people" is used to refer to those groups that participated in the mortuary rituals and constructed the mounds. The Hopewell tradition can be compared to a world religion—an overarching system of beliefs with minor differences, such as language, on the local and individual levels.

The "Mound Builders"

The construction of burial mounds and geometric earthworks occurred throughout the eastern half of the United States, centered in Ohio. The Hopewell tradition is one of many burial traditions that constructed mounds throughout the United States. During the nineteenth century, the construction of these earthworks, Hopewell and others, was incorrectly attributed to a "long-lost race" of people referred to as "the Mound Builders." At the time, few scholars believed that the mounds and other earthworks could have been built by ancient Native American groups. Since then, the notion of a "long-lost race" has been discredited through scientific excavation and study of the mounds.

Mound Structure

The Hopewell had various ways of interring their dead within the mounds. Some individuals were placed lying down, others propped in a sitting position against the side of the tomb. Some individuals were cremated, others were placed in structures called charnel houses where the decomposition process was begun, and then later buried. The tombs and the mounds themselves were constructed in a number of

different ways. Mound construction typically began with the laying of a sand or clay floor, or a platform in the center, upon which the body and artifacts were placed. Over this, layers of earth, clay, sand, and gravel were piled up to make a mound. Alternatively, the mound was built up around a tomb made of logs or large stone slabs. Many mounds contain several burials dispersed through the different layers.

Lifeways

The Hopewell diet was based on hunting and gathering, and supplemented by rudimentary agriculture. They lived in villages located along the flood plains of rivers. They built mounds near their villages, typically on high bluffs. The large clusters of mounds, such as those at Toolesboro, probably served as ceremonial centers for regions. The Hopewell groups also had an extensive exchange network, indicated by artifacts made from Great Lakes copper, Rocky Mountain obsidian (volcanic glass), marine shells and pearls from the Gulf of Mexico, Appalachian mica, and shark teeth from Chesapeake Bay.

Those groups participating in the Hopewell traditions had a high degree of social stratification, that is, they had a social hierarchy. The individuals buried within the mounds represent only the highest level of society. The highest level was made up of leaders, probably chiefs and priests. When the leaders died, they were interred with the exotic goods that symbolized their power. These items were not used daily, but only for ceremonial purposes, as indicated by the absence of marks showing frequent usage.

What Happened to the Hopewell?

After approximately AD 500, the Hopewell tradition of mound building disappears from the archaeological record, an occurrence that has puzzled scholars. Two things could have happened to the people of the Hopewell groups and their traditions. One, they could have shifted south and merged with a later mound building tradition known as the Mississippian. Alternatively, they could have been absorbed by the other local, non-Hopewell groups. This blending would have caused their traditions to change over time into what archaeologists classify as a different cultural and burial tradition.

The Toolesboro Indian Mounds Site

The Toolesboro site consists of seven burial mounds on a bluff overlooking the Iowa River near where it joins the Mississippi River. The conical mounds were constructed between 100 BC and AD 200 by a local Hopewell group. At one time, there may have been as many as twelve mounds, but subsequent settlement and excavation have reduced that number to the present seven. As of yet, no village site near the Toolesboro mounds has been located, and this is attributed to the shifting path of the Iowa River which has obliterated possible village sites on the flood plain over the last 2000 years.

Of the seven mounds, only two are visible on the grounds of the Educational Center. The rest are off in the woods, and are separated by a wire fence from the

Educational Center. One of the mounds maintained near the Center, known as Mound 2, is the largest of the remaining mounds, measuring 100 feet in diameter and 8 feet in height. This mound was possibly the largest Hopewell mound in Iowa.

After the Hopewell

The mounds have been excavated by different groups of people since the middle of the nineteenth century. The Davenport Academy of Natural Sciences undertook extensive excavations in the last half of the nineteenth century. Contained within the mounds were typical Hopewell artifacts: copper tools, stone platform pipes, shell and pearl beads, chipped stone tools, and mica sheets. It is difficult to say the number of individuals contained within the mounds and their association to the artifacts and to each other, because of the non-scientific excavations. The mounds did contain a number of burials, although the human remains still available for analysis are few in numbers and poorly preserved.

Since the Hopewell construction and use of the mounds at Toolesboro, there have been many other groups of people associated with the site. Originally, a nearby earthwork referred to as "the old fort" was considered to be a part of the Toolesboro Hopewell mound group. It is possible, however, that this enclosure was actually constructed approximately one thousand years later by a different Native American culture, known as the Oneota, who lived in the same area.

Also in the vicinity of the Toolesboro mounds are the McKinney and Poison Ivy sites, which are Oneota sites as well. Local tradition places the 1673 "discovery" of Iowa by Marquette and Joliet in the shadows of the Toolesboro mounds. The Poison Ivy site supposedly corresponds with the description in Marquette's journal of a village close to their landing site. Recently, however, the validity of this belief has come under question.

Early Excavations

The beginning of the nineteenth century marks the start of the European-American settlement of the land around the mounds. While clearing out earth for root cellars and foundations for their farmsteads, as well as plowing fields that contained mounds, the early farmers began the destruction of the mounds. They removed the artifacts and human remains from the mounds without documenting where items came from or sketching the internal structure of the mounds.

This practice was continued by the early archaeologists from the Davenport Academy of Natural Sciences using crude excavation techniques, causing the loss of artifacts as well as the opportunity to study the mounds further. Some of the mounds have since been restored, that is, the pits caused by excavations or construction have been filled in or the mounds themselves rebuilt.

A National Historic Landmark

The family of George H. Mosier donated the land containing the mounds to State of Iowa in 1963. Since then additional adjoining plots have been purchased to make a state preserve. In 1966, the Toolesboro mounds were designated as a National

Historic Landmark. The Educational Center with the museum was constructed in 1969. Since the site became a National Historic Landmark, the State Historical Society of Iowa has managed and maintained the mounds and the museum.

No further excavations are being planned for the Toolesboro mounds. This is for two main reasons. First, it is important to remember that the mounds are sacred burial sites, analogous to modern cemeteries. Many people today would find it offensive if their relatives' graves were excavated in order to learn more about how their relatives lived. While it is difficult to trace the modern descendants of the Hopewell, further excavations of the burial mounds are nonetheless considered disrespectful.

Second, archaeology can be a destructive science. Opening the mounds destroys the possibility of future study. Artifacts that are removed from a site can never be replaced in the exact context and position in which they were originally deposited. Currently, archaeologists prefer to use non-intrusive methods to explore ancient sites such as the Toolesboro mounds. Non-intrusive methods include: aerial photography focusing on the features or contours of the land, surface surveys looking for signs of past occupation (such as artifacts), and remote sensing of the ground, which works similar to an x-ray.

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REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

May 9, 2003

Planning, Programs, and
Project Management Division

Mr. Don Klima
(ATTN: Laura Henley Dean)
Chief, Eastern Division Project Review
Advisory Council on Historic Preservation
Old Post Office Building
1100 Pennsylvania Avenue Northwest, #809
Washington, DC 20004

Dear Mr. Klima:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) received your letter dated April 3, 2003, regarding the Lake Odessa Habitat Rehabilitation and Enhancement Project (LO-HREP), Iowa, in response to our letter of March 28, 2003. Also reference State Historical Society of Iowa R&C # 959558014.

The relationship between prior mitigation at Sites 13LA27 and 13LA309 and the referenced undertaking is that both sites are on the shoreline of Lake Odessa and in the Area of Potential Effect of this undertaking. At Site 13LA27, mitigation was based solely upon recommendations in the *Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers* (Benn et al. 1995) prepared for the Corps in accordance with U.S. Army Corps of Engineers Engineering Regulation No. 1130-2-438 which had identified Site 13LA27 as a top priority for data recovery. This mitigation was not associated with the LO-HREP undertaking at that time.

At Site 13LA309, the Corps determined that operation of the Lake Odessa lands managed under agreement with the Iowa Department of Natural Resources and the U.S. Fish and Wildlife Service had had -- and that the LO-HREP would have -- an adverse effect upon Site 13LA309. This mitigation was associated both with the ongoing operation of the Lake Odessa lands and the proposals then current for the LO-HREP.

As it turned out, the mitigation at Site 13LA27 did not sufficiently extend to a 50-year level of mitigation for the shoreline erosion (Benn and Isenberger 2003) which has resulted in the Programmatic Agreement incorporating provision for riprap of this shoreline. Site 13LA309 mitigation was sufficient to address a 50-year level of mitigation, and no additional action is proposed.

Views of consulting parties and the public as received by the Corps in response to its March 28, 2003, letter are found at Enclosures 1-3: Peoria Tribe letter dated April 2, 2003; State Historical Society of Iowa, dated April 16, 2003; and Ho-Chunk Nation facsimile dated May 5, 2003, respectively. Aside from your letter, these were the only responses received. We are in the process of addressing the State Historical Society of Iowa comments. All consulting party input and Corps responses will be included in forthcoming National Environmental Policy Act coordination documents, and all consulting parties will be on the mailing list for these documents.

If you have any questions after reviewing this material, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or you may write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

REFERENCES

- Benn, David W., Robert C. Vogel, E.A. Bettis III, and J.D. Anderson
1995 *The Historic Properties Management Plan for the Mississippi River, Pools 11 through 22, Rock Island District, Corps of Engineers*. Report to the U.S. Army Corps of Engineers, Rock Island District, prepared under Corps Contract Number DACW25-92-D-0008, Work Order No. 5. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (BCA #271).
- Benn, David W., and Bill Isenberger
2003 *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, prepared under Corps Contract No. DACW25-98-D-0001, Work Order No. 37 (David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc.)



May 28, 2003

Mr. Kenneth A. Barr
Chief, Economic and Environmental Analysis Branch
Rock Island District, Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

REF: Proposed Lake Odessa Habitat Rehabilitation and Enhancement Project
Louisa County, Iowa

Dear Mr. Barr:

On May 13, 2003, we received the additional information in support of your notification of adverse effects of the referenced project on properties listed on and eligible for listing on the National Register of Historic Places. Based upon the information you provided, we do not believe that our participation in consultation to resolve adverse effects is needed. However, should circumstances change and you determine that our participation is required, please notify us. Pursuant to 36 CFR 800.6(b)(iv), you will need to file the final Memorandum of Agreement and related documentation at the conclusion of the consultation process. The filing of the Agreement with us is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with your notification of adverse effect. If you have any questions or require further assistance, please contact Laura Dean at 202-606-8505.

Sincerely,

Raymond V. Wallace
Raymond V. Wallace
Historic Preservation Technician
Office of Federal Agency Programs

CF
PM (DIST FILE)
PM-M (NILES)
PM-A (PULCHER, HAGERTY)

ADVISORY COUNCIL ON HISTORIC PRESERVATION

1100 Pennsylvania Avenue NW, Suite 809 • Washington, DC 20004
Phone: 202-606-8503 • Fax: 202-606-8647 • achp@achp.gov • www.achp.gov



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

June 18, 2003

Planning, Programs, and
Project Management Division (1145)

Ms. Lavon Grimes
R&C Coordinator
State Historical Society of Iowa
600 East Locust
Des Moines, Iowa 50319-0290

Dear Ms. Grimes:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) received your letter dated April 16, 2003, in response to our historic properties coordination letter to you dated March 28, 2003, regarding the Lake Odessa Habitat Rehabilitation and Enhancement Project (LO-HREP – Iowa). Please reference State Historical Society of Iowa R&C # 959558014.

You recommended adding the State Archaeologist of Iowa (OSA) and the Yankton Sioux to the consulting parties list, as well as noting the name change of the OSA Indian Advisory Committee to the Governor's Indian Advisory Council to the State Archaeologist (we will make this change in future communications). Regarding adding the OSA, we have provided OSA an opportunity to comment through their Indian Advisory Committee. Regarding the Yankton Sioux, we have never included the Yankton Sioux as consulting parties for actions along this section of the Mississippi here at the mouth of the Iowa River; however, we note that Ms. Maria Pearson, the Yankton point of contact, received our communication in her capacity as the Governor's Liaison for Indian Affairs.

We noted your recommendation to change the name of our Project Boundary to Refuge Boundary and do not concur.

You requested changes to the Programmatic Agreement (PA) in paragraph 6 of your letter. We have considered those requests and acted on them as set out below:

6a. Change made.

6b. Change made.

6c. Leave for the Dispute Resolution clause.

6d. The issue of repairing riprap failure within two years, as opposed to the one year you suggested, is a practical matter of scheduling the funding and lining up the necessary contractual efforts to accomplish such repair. Reducing the two year stipulation would simply set us up for failure.

6e. Change made.

6f. Change made.

6g. Change made.

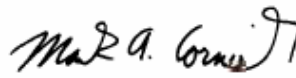
6h. While recognizing both the potential for damage to cultural deposits from tree falls and for the benefits to wildlife from standing dead trees, the Corps has determined that the issue of tree falls is not an undertaking for the purpose of Section 106 of the National Historic Preservation Act.

Enclosure 1 contains the PA (with tracked changes) as modified following our coordination letter of March 28, 2003.

For your files we also are enclosing all communications we received in response to our March 28, 2003, letter (including our follow up communications with the Advisory Council on Historic Preservation and their response). We anticipate routing the final PA for your signature in the near future.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,



for

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

List of Enclosures

1. PA with tracked changes—28 pages.
2. Peoria Tribe of Indians of Oklahoma letter dated April 2, 2003—1 page.
3. Advisory Council on Historic Preservation (ACHP) letter dated April 3, 2003—1 page .
4. Ho-Chunk Heritage Preservation facsimile dated May 5, 2003—6 pages.
5. Corps letter to ACHP dated May 9, 2003, with enclosures—14 pages.
6. ACHP letter dated May 28, 2003—1 page.

July 17, 2003

Planning, Programs, and
Project Management Division (1165-2-26a)

Mr. Jeffrey R. Vonk
Director
Iowa Department of Natural Resources
Henry A. Wallace Building
East 9th and Grand
Des Moines, Iowa 50319

Dear Mr. Vonk:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Programmatic Agreement (PA) for your signature (Enclosure 1). The PA provides for mitigation of adverse effects at the Lake Odessa Habitat Rehabilitation and Enhancement Project in Louisa County, Iowa.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please return the signed PA to Mr. Pulcher in the envelope provided. Thank you for your cooperation.

Sincerely,

ORIGINAL SIGNED BY

John P. Carr (for)

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosure

MFR: Transmittal of PA for IA DNR
signature, Lake Odessa HREP, all under
Sec. 106 of the National Historic
Preservation Act.

July 17, 2003

Planning, Programs, and
Project Management Division (1165-2-26a)

Ms. Lavon Grimes
R&C Coordinator
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Dear Ms. Grimes:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Programmatic Agreement (PA) for your signature (Enclosure 1). The PA provides for mitigation of adverse effects at the Lake Odessa Habitat Rehabilitation and Enhancement Project in Louisa County, Iowa.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please retain a copy of the signature page, place the PA in the envelope addressed to Mr. Jeffrey R. Vonk at the Iowa Department of Natural Resources, and drop it in the mail. Thank you for your cooperation.

Sincerely,

ORIGINAL SIGNED BY

JOHN P. CARR (for)

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosure

CF (all wo/encl):
Dist File (PM-M)
PM-A (Pulcher, Hagerty)
✓ PM-M (Perk, Niles)
ED-DG (Dziuk)
OD-MN (Bollman)

MFR: Transmittal of PA for SHPO & IADNR
signature, Lake Odessa HREP, all under Sec.
106 of the National Historic Preservation Act.

August 15, 2003

Planning, Programs, and
Project Management Division (1165-2-26a)

Mr. Richard Steinbach
Complex Manager
Mark Twain Refuge
US Fish and Wildlife Service - Region 3
1704 - 24th Street
Quincy, Illinois 62301

Dear Mr. Steinbach:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a Programmatic Agreement (PA) for your signature (Enclosure 1). The PA provides for mitigation of adverse effects at the Lake Odessa Habitat Rehabilitation and Enhancement Project in Louisa County, Iowa.

If you have any questions regarding this matter, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

After signature, please return the signed original PA to Mr. Pulcher in the envelope provided. Thank you for your cooperation.

Sincerely,

ORIGINAL SIGNED BY
JOHN P. CARR (for)

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosure

MFR: Transmittal of PA for FWS
signature, Lake Odessa HREP, all
under Sec. 106 of the National
Historic Preservation Act.

CF (all wo/encl):
Dist File (PM-M)
PM-A (Pulcher, Hagerty)
✓ PM-M (Perk, Niles)
ED-DG (Dziuk)
OD-MN (Bollman)

October 28, 2003

Planning, Programs, and
Project Management Division

Mr. Don Klima
Chief, Eastern Division Project Review
Advisory Council on Historic Preservation
Old Post Office Building, #809
1100 Pennsylvania Avenue, NW.
Washington, DC 20004

Dear Mr. Klima:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding for filing, as per 36 CFR 800.6, the signed Programmatic Agreement (PA) for mitigation of adverse effects occurring at the Lake Odessa Habitat Rehabilitation and Enhancement Project in Louisa County, Iowa (Enclosure 1).

Documentation as required under 36 CFR 800.11 is on the CD at Enclosure 2.

If you have any questions regarding the PA, please call Mr. Ron Pulcher of our Economic and Environmental Analysis Branch, telephone 309/794-5384, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Pulcher).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

MFR: Transmittal of PA for
ACHP filing -- Lake Odessa
HREP, all under Section 106 of the
National Historic Preservation Act.

Copies Furnished:

Mr. Dick Steinbach
U.S. Fish and Wildlife Service
1704 North 24th Street
Quincy, Illinois 62301 (with Enclosure 1)

Mr. Jeffrey R. Vonk
Director
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319 (with Enclosure 1)

Ms. Lavon Grimes
R&C Coordinator
State Historical Society of Iowa
600 East Locust
Des Moines, Iowa 50319-0290 (with Enclosure 1)

Mr. John Dobrovolny
Historic Preservation Officer
U.S. Fish and Wildlife Service
Federal Building – Fort Snelling
Twin Cities, Minnesota 55111 (with Enclosure 1)

(all wo/encls):
Dist File (PM-M)(w/encl 1)
PM-A (Pulcher, Carmack)
PM-M (Hubbell, Perk, Niles)
OD-MN (Bollman)

PROGRAMMATIC AGREEMENT

**Among the
Rock Island District of the U.S. Army Corps of Engineers,
the Iowa State Historic Preservation Officer,
the State of Iowa Department of Natural Resources,
and the United States Fish and Wildlife Service,
Regarding Implementation of the
Lake Odessa Habitat Rehabilitation and Enhancement Project, under the
Upper Mississippi River System - Environmental Management Program**

WHEREAS, the Rock Island District of the U.S. Army Corps of Engineers (Corps), the State of Iowa Department of Natural Resources (DNR), and the United States Fish and Wildlife Service (FWS) are cooperating in implementing the Lake Odessa Habitat Rehabilitation and Enhancement Project (LO-HREP) under the Upper Mississippi River System Environmental Management Program authorized by the Upper Mississippi River Management Act of 1986 (P.L. 99-662) and extended by the 1990 Water Resources Development Act (WRDA), Section 405; the 1992 WRDA, Section 107; and the 1999 WRDA, Section 509; and

WHEREAS, the Corps, the DNR, and the FWS have determined that the implementation of the LO-HREP may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (National Register), and have consulted with the Advisory Council on Historic Preservation (Council) and the Iowa State Historic Preservation Officer (SHPO) pursuant to 36 CFR 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]), and to Section 110(f) of the same Act (16 U.S.C. 470h-2[f]); and

WHEREAS, the LO-HREP “area of potential effect” (APE) is illustrated on the map at Appendix 1a and includes all project features shown there as well as the shorelines within the Project Area as these are affected by the fluctuating water levels designed into the water control aspects of the project. The Project Features are in six basic categories: moist soil unit enhancements; fisheries enhancements; mast tree plantings; levee restoration; sand prairie planting; and a fish nursery. The Project Features are described in detail at Appendix 1b under the heading Recommended Plan. The APE is all on Federal land; none is on tribal lands [reference 36 CFR 800.16(d)]; and

WHEREAS, the Council has been notified and invited to participate as a signatory to the agreement and has declined, and

WHEREAS, the DNR and FWS participated in the consultation and have been invited to concur in this Programmatic Agreement (PA); and

WHEREAS, pursuant to 36 CFR 800.3 of the Council’s regulations and to the Corps’ responsibilities under the National Environmental Policy Act of 1969, the Corps has addressed multiple steps in 36 CFR 800.3 through 800.6 [36 CFR 800.3(g)] and has

contacted the Indian Tribes (Tribes) and other consulting parties (**INTERESTED PARTY LIST**) that may have an interest in the effects of this project on historic properties, and inquired whether any other sites and/or traditional cultural properties or sacred sites may be potentially affected by this undertaking. Those on the **INTERESTED PARTY LIST (PA Appendix 2)** are included in the Corps' procedures for public involvement under the National Environmental Policy Act [36 CFR 800.2(d)(3)], and

NOW, THEREFORE, the Corps and the SHPO/Tribal Historic Preservation Officers (THPOs) agree that subsequent to completion of National Environmental Policy Act documentation requirements, the project shall be implemented in accordance with the following stipulations of this PA to satisfy the Corps' Section 106 responsibility for all individual aspects of the project.

I. HISTORIC PROPERTY AREA OF POTENTIAL EFFECT, SURVEYS, EVALUATION, AND NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY

A. AREA OF POTENTIAL EFFECT (APE)

1. The APE is illustrated on the map at Appendix 1a and includes all project features shown there as well as the shorelines within the Project Area as these are affected by the fluctuating water levels of the project. The Project Features are in six basic categories: moist soil unit enhancements; fisheries enhancements; mast tree plantings; levee restoration; sand prairie planting; and a fish nursery. The Project Features are described in detail at Appendix 1b under the heading Recommended Plan. The APE is all on Federal land; none is on tribal lands [reference 36 CFR 800.16(d) and 36 CFR 800.4(a)(1)].

2. Should any changes in the APE occur that differ from those in Appendix 1a-b, the Corps will take all measures necessary to discover, preserve, and avoid significant historic properties, listed on, or eligible for, inclusion in the National Register of Historic Places, burials, cemeteries, or sites likely to contain human skeletal remains/artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the SHPO/THPO(s) through the implementation of historic property surveys and testing, and the treatments of historic properties. The Corps will ensure that the following measures are implemented:

2.1. The Corps has defined the area of potential effects in consultation with the SHPO and will conduct historic property identification and assessment on any as yet uninvestigated portions of the APE (see Part I.B.5, below) or on any areas that may be added to the APE as currently established (see Appendix 1a-b).

2.2. The Corps will ensure that all historic properties investigations are conducted in a manner consistent with the Guidelines for Archaeological Investigations in Iowa, the Secretary of the Interior's Standards and Guidelines for Identification and

Evaluation (48 FR 44720-23), and take into account the National Park Service publication The Archaeological Survey: Methods and Uses (1978) and any extant or most recent version of SHPO guidelines for historic properties reconnaissance surveys/reports, related guidance, and etc. These investigations will be implemented by the Corps and reviewed by the SHPO/THPO(S).

2.3. In consultation with the SHPO/THPO(s), and as appropriate, the Tribes and other consulting parties, the Corps will evaluate for eligibility all cultural resources exceeding 50 years in age by applying the National Register criteria (36 CFR Part 60.4).

2.3.1. For those sites that the Corps and the SHPO/THPOs agree 1) are not eligible for inclusion in the National Register; or, 2) are eligible or potentially eligible for listing on the National Register but will not be affected or adversely affected, no further investigation will be required, and the project may proceed in those areas.

2.3.2. If the survey results in the identification of properties that the Corps and the SHPO/THPO(s) agree are eligible for, or inclusion on, the National Register, the Corps shall treat such properties in accordance with Part II below.

2.3.3. If the Corps and the SHPO/THPO(s) do not agree on National Register eligibility, or if the Council or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the National Register, National Park Service, whose determination shall be final.

B. SURVEYS, EVALUATION, AND NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY ALREADY ACCOMPLISHED AND TO BE COMPLETED

1. Review of existing information [36 CFR 800.4(a)(2)] indicates that initial geomorphological investigations were conducted in the mid-1990s (Benn and Anderson 1995) prior to a Phase I survey (Benn 1996) of the Lake Odessa project. Benn (1998) reported on Phase II testing of sites in the Lake Odessa project with revised recommendations on site status and sites included in the APE. Under earlier Memoranda of Agreement two sites, 13LA27 (Benn et al. 1999) and 13LA309 (Benn et al. 2001), were mitigated through data recovery.

2. The Corps and Iowa State Historic Preservation Office (SHPO) last communicated on this undertaking as a whole through a Corps letter dated January 26, 1998, and with a SHPO response dated April 20, 1998, (R&C number 950558014). This SHPO letter states that "According to a previous letter from our office (Gourley 1996), our office was not ready to concur that sites potentially eligible for listing on the National Register should receive no further work in the form of Phase II evaluation." The Corps recognized this 1996 SHPO concern as valid, and in the January 26, 1998, Corps letter addressed all sites

within the APE. Since 1998 the project scope has been modified slightly to arrive at its present configuration (Appendix 1a-b). This necessitated a review of the project's APE and the status of cultural resources within it.

3. The Corps has obtained such a review with the 2003 report entitled *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, prepared under Corps Contract No. DACW25-98-D-0001, Work Order No. 37, by David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc., (Benn and Isenberger 2003).

4. Table 2 from Benn and Isenberger (2003) is at Appendix 3. This table presents information on the identification of sites within the overall project area that are within the APE and gives their National Register of Historic Places (NRHP) status as of the date of the signing of this PA. Changes in this table that differ from the January 26, 1998, status as coordinated with the Iowa SHPO are as follows and are derived from the review by Benn and Isenberger (2003):

- three sites are added to the APE (13LA288, 312, and 455) and
- the NRHP status of 13LA47 and 293 is changed to Not Eligible due to destruction by bank erosion.

5. Historic properties identification has been completed for the entire APE as defined at Appendix 1a-b, with the exception of

- the mid-nineteenth century town site of Burris City (13LA312)—a site already determined eligible for the NRHP—will have its boundary established and any portion of the site found within the APE will be fully evaluated for the effects of the spillway to be placed in the levee at this point (see Benn and Isenberger 2003:14), and of
- sites 13LA288 and 455 which still require assessment to determine their eligibility for inclusion in the NRHP.

II. TREATMENT OF HISTORIC PROPERTIES FOR MITIGATION OF ADVERSE EFFECTS

A. PRIOR MITIGATION.

1. Adverse effects of bank line erosion were previously mitigated at sites 13LA27 and 13LA309 under individual Memoranda of Agreement (Benn *et al.* 1999 and Benn *et al.* 2001, respectively)—see Part B.1.2, below, for riprap now found to be required for 13LA27.

B. RIPRAP BANK PROTECTION.

1. The Corps will ensure that 9 sites determined eligible for inclusion in, the National Register will be protected from erosion for the 50-year life of the LO-HREP by having a

total of 3,410 linear feet of rock riprap placed along the shoreline of Lake Odessa (site numbers and lengths of bank protection are set out at Appendix 3).

1.1. The riprap will be placed without any bankline grading or shaping and will conform to the typical riprap shoreline protection cross section shown at Appendix 4. Riprap is to be 400 pound size. Either Illinois RR5 or Iowa Class E riprap shall be used.

1.2 Although adverse effects of shoreline erosion were previously mitigated through data recovery at 13LA27, this site was determined to also require 200 feet of riprap due to projected rates of erosion established by Benn and Isenberger (2003).

2. The Corps will ensure that the riprap is monitored at 10-year intervals following its installation (beginning at Year 5 following installation and continuing through Years 15, 25, 35, and 45) to ensure the riprap is successfully protecting the sites from bank erosion. A Riprap Monitoring Letter Report will be furnished to the SHPO within 6 months following the monitoring activity.

2.1 The Corps will ensure that any failure of the riprap to provide bank protection will be repaired within two years following the monitoring report, and

2.2 The Corps will also ensure that a Riprap Repair Letter Report is furnished to the SHPO within 6 months following repair activity setting out the details of the repair.

3. The Corps will make sites 13LA30 and 13LA423 the first sites to be protected by riprap under this PA in order to address the most severe erosion at the earliest possible date. Any other shoreline site(s) that may be found eligible for the National Register may be protected in a similar manner without further coordination under this PA.

C. SITE AVOIDANCE.

1. The Corps will ensure that all adverse impacts to sites 13LA437 South and 13LA438 will be avoided by restricting dredging from the lateral ditch to cleaning out only recent deposits from the ditch and by placing the material removed from the ditch within 100 feet of the southern side of the ditch.

2. The Corps will ensure that the eastern edge of site 13LA30 which lies in the immediate vicinity of proposed dredged material placement shall have its eastern limits marked by archaeologists prior to dredged material placement in this vicinity. No placement of dredged material and no activity of any type associated with the placement of dredged material shall be allowed within the area of 13LA30 or within a 50-foot buffer around the site area, thereby avoiding any adverse impacts to the site from dredged material placement.

3. The Corps will ensure that should either site 13LA288 or 13AL455—both sites far away from the shoreline—be found eligible for the National Register (see below) all adverse impacts will be avoided by restricting all earth moving activity within the site area

and a 100-foot buffer around the site area. Any other non-shoreline site(s) that may be found eligible for the National Register may be avoided in a similar manner without further coordination under this PA.

D. DATA RECOVERY.

1. No data recovery is currently proposed. The Corps has chosen to avoid sites 13LA288 and 13AL455 should they be found eligible for the National Register. However, Burris City, 13LA312, holds the possibility of data recovery as the only feasible alternative for mitigation of adverse effects, but this is yet to be determined (see Part I.B.5, above).

1.1 If the Corps determines, in consultation with the SHPO/THPO(s), that no other actions are feasible to avoid and minimize effects to properties, then the Corps will develop a data recovery plan in consultation with the SHPO/THPO(s).

1.2. The data recovery plan will address substantive research questions developed in consultation with the SHPO/THPO(s). The plan shall be consistent with the Guidelines for Archaeological Investigations in Iowa, the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37), and take into account the Council's publication, Treatment of Archaeological Properties (Advisory Council on Historic Preservation, 1980) and SHPO/THPO(s) guidance. It shall specify, at a minimum, the following:

- a. the property, properties, or portions of properties where the treatment plan is to be carried out,
- b. the research questions to be addressed, with an explanation of research relevance and importance,
- c. the methods to be used, with an explanation of methodological relevance to the research questions,
- d. proposed methods of disseminating results of the work to the interested public, and,
- e. a proposed schedule for the submission of progress reports to the SHPO/THPO(s).

2. The Corps shall submit the plan to the SHPO/THPO(s) for 30 days review and comment. The Corps will take into account SHPO/THPO comment, and shall ensure that the treatment plan is implemented. The SHPO/THPO(s) may monitor this implementation.

3. The Corps will ensure that the treatment plan is carried out by or under the direct supervision of an archaeologist(s), architectural historian(s) and/or other appropriate cultural resource specialist that meets, at minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9).

4. The Corps will ensure that adequate provisions, including personnel, time, and laboratory space, are available for the analysis and curation of recovered materials from historic properties.

5. The Corps will develop and implement an adequate program in consultation with the SHPO/THPO(s) to secure historic properties from vandalism during data recovery.

E. ADDITIONAL SITE-SPECIFIC TREATMENT MEASURES.

1. Prior to the implementation of any treatment measure(s) not already addressed in Part II.A-D, above, the Corps shall consult with the SHPO/THPO(s) to determine whether these measures are sufficient to avoid, reduce, or mitigate adverse effects to historic properties. Should there be a disagreement between the Corps and a SHPO/THPO(s) that cannot be resolved; the Corps shall seek the consultation of the Council for resolution. The Corps shall take into account the comments of the Council in making decisions about the adequacy of such measures. The Corps shall provide to the Council and the SHPO/THPO(s) a written response to the comment of the Council.

III. FUTURE PROJECT INVESTIGATIONS RESULTING FROM CURRENT CONDITIONS OR FROM CHANGES TO THE AREA OF POTENTIAL EFFECT.

A. HISTORIC PROPERTIES IDENTIFICATION, EVALUATION, AND TREATMENT.

1. Any future investigations resulting from current conditions (see Part I.B.5, above) or from changes to the APE differing from those in found in Appendix 1a-b shall have historic properties identification and evaluation of sites for National Register eligibility carried out following the Guidelines for Archaeological Investigations in Iowa and the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and with personnel meeting the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9) and meeting all requirements set out in Parts IV-VI, below.

B. COORDINATION OF FUTURE IDENTIFICATION, EVALUATION, AND TREATMENT.

1. Identification and Evaluation. Results of these investigations shall be coordinated with the SHPO/THPO(s) along with any additional treatment measures proposed for sites determined eligible for the National Register.

2. Treatment Measures. Any future treatment measures utilizing riprap bank protection as described under Part II.B, above, or utilizing site avoidance with the buffer zones described above under Part II.C, will require no further coordination under this PA except to be documented in the report under Part XI, Periodic Review.

IV. CURATED ITEMS

The Corps will ensure that all materials and records resulting from LO-HREP historic properties studies are curated at the Office of the State Archaeologist of Iowa or at another repository in Iowa that adheres to comparable conservation standards that are in accordance with 36 CFR Part 79.

V. TREATMENT OF HUMAN REMAINS, FUNERARY OBJECTS, SACRED OBJECTS, OR OBJECTS OF CULTURAL PATRIMONY

A. Human Remains, Funerary Objects, Sacred Objects, or Objects of Cultural Patrimony.

1. The Corps will coordinate with the appropriate federally recognized Native American tribes should human remains, funerary objects, sacred objects, or objects of cultural patrimony be discovered. The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 U.S.C. § 3001 et seq.) and its implementing regulations (43 CFR Part 10) apply to the entire APE as it is all in Federal ownership.
2. In addition to ensuring that all provisions of NAGPRA are adhered to, the Corps will report all discoveries of human remains under the laws of Iowa (Iowa Code Chapter 263B.7-9, 716.5, and Iowa Administrative Code 658-11, as appropriate) including notifying the Office of the State Archaeologist of Iowa upon the discovery of human remains.

VI. REPORTS

The Corps will ensure that all final historic property reports resulting from the actions pursuant to this Agreement will be provided in a format that is consistent with contemporary professional standards including the Guidelines for Archaeological Investigations in Iowa, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery (42 FR 5377-79). Precise locations of significant historic properties may be provided only in a separate appendix if it appears that the release of this data could jeopardize historic properties. Precise locational data of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or surface or buried archaeological sites, identified in coordination with Tribe(s), will be considered to be sensitive information and pursuant to Section 304 of the NHPA the Corps will not make this information available for public disclosure. The Corps will make available for publication and public dissemination the reports and associated data, minus precise aforementioned locational data and sensitive information.

VII. PROVISION FOR POST-REVIEW DISCOVERIES

In accordance with 36 CFR 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the SHPO/THPO(s) to determine if additional investigation is required. If further archaeological investigations are warranted or required, any treatment plan will be performed by the Corps in accordance with Part II TREATMENT OF HISTORIC PROPERTIES, Part IV CURATION, Part V TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE, and Part VI REPORTS, all of this Agreement. If both the Corps and the SHPO/THPO(s) determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps and the SHPO/THPO(s) concerning the need for further investigations will be handled pursuant to Part VIII DISPUTE RESOLUTION of this Agreement.

VIII. DISPUTE RESOLUTION

Should the SHPO/THPO(s) or the Council object within 30 days to any plans or actions provided for review pursuant to this Agreement, the Corps will consult with the objecting party to resolve the objection. If the Corps determines that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36 CFR Part 800.7. The Corps in accordance with 36 CFR Part 800.7(c)(4) will take any Council comment provided in response into account, with reference only to the subject of the dispute. The Corps' responsibility to carry out all actions under this Agreement that are not the subjects of the dispute will remain unchanged.

IX. TERMINATION

Any of the signatories to this Agreement may request a reconsideration of its terms or revoke the relevant portions of this Agreement upon written notification to the other signatories, by providing thirty (30) days notice to the other signatories, provided that these signatories will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR Parts 800.3 through 800.7 with regard to individual undertakings covered by this Agreement.

X. AMENDMENTS

Any signatories to this Agreement may request that it be amended, whereupon the other signatories parties will consult in accordance with 36 CFR Part 800.13, to consider such amendment.

XI. PERIODIC REVIEW

A. The Corps will provide the SHPO/THPO(s) with evidence of compliance with this Agreement by letter on November 15, 2004, and biannually thereafter on said date. This documentation shall contain the name of the project, the appropriate Iowa SHPO R&C number(s), the appropriate Corps Contract number(s), title of the documents which contained the Agreement, historic properties identified, determinations of effect, avoidance procedures, level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed.

B. The Corps shall review the necessity of this PA after a period of ten years from the date of Corps signature in order to determine whether it should be reissued or allowed to expire. If the PA requires reissue, the Corps shall consult with the SHPO/THPO(s) in order to ensure compliance with the most current version of the federal regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act; (16 U.S.C. 470f); [and Section 110(f) of the same Act (16 U.S.C. 470h-2(f))].

C. Because of the requirement in this agreement for riprap shoreline protection and its maintenance over the 50-year life of the LO-HREP, this agreement may not be allowed to expire without consultation with the SHPO/THPO(s) in order to taken into account, and provide for, the continued protection of the sites behind the riprap.

XII. EXECUTION AND IMPLEMENTATION

A. Nothing in this Agreement is intended to prevent the Corps from consulting more frequently with the SHPO/THPO(s) or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this Agreement. Any resulting modifications to this agreement will be coordinated in accordance with Section 800.5(e)(5).

B. The undersigned concur that the Corps has satisfied its Section 106 responsibilities for all individual undertakings through this agreement regarding the implementation of the LO-HREP.

XIII. SIGNATORIES TO THIS AGREEMENT

ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS:

BY: _____ Date: _____
Colonel William J. Bayles
District Engineer
U. S. Army Corps of Engineers
Rock Island District

IOWA STATE HISTORIC PRESERVATION OFFICER:

BY: _____ Date: _____

Lowell Soike

Iowa Deputy State Historic Preservation Officer

State Historical Society of Iowa

CONCUR:

IOWA DEPARTMENT OF NATURAL RESOURCES

BY: _____ Date: _____

Jeffrey R. Vonk

Director

Iowa Department of Natural Resources

U.S. FISH AND WILDLIFE SERVICE - REGION 3

BY: _____ Date: _____

Richard Steinbach

Complex Manager,

Mark Twain Refuge

U.S. Fish and Wildlife Service - Region 3

References

Benn, David W., and Jeffrey D. Anderson

1995 Geomorphological Investigations for Historic Property Contexts, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17-18, Iowa (BCA #342—2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0011.

Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W.

1996 Phase I Cultural Resources Survey, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #405—2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-92-D-0008, Work Order No. 0018. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W.

1998 Phase II Archaeological Testing and Mapping of 18 Sites, Lake Odessa Habitat Rehabilitation and Enhancement Project, Upper Mississippi River System, Pools 17 & 18, Iowa (BCA #466—2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island

District, under Contract No. DACW25-92-D-0008, Work Order No. 0024. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W., Lowell R. Blikre, Arne J. Hengesteg, Jeffrey R. Straka, and Patti Wright
1999 *Data Recovery Excavations at the Late Woodland Horseshoe Site (13LA27), Louisa County, Iowa* (BCA #646 –2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-98-D-0001, Work Order No. 0008. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W.; Lowell R. Blikre; Arne J. Hengesteg; Derek V. Lee; Jeffrey R. Straka; E. Arthur Bettis III (Department of Geology, University of Iowa, Iowa City); and Neal Lopinot and Gina Powell (Southwest Missouri State University, Springfield)
2001 *Data Recovery Excavations at the Late Woodland Cross Site (13LA309), Louisa County, Iowa* (BCA #746—2 volumes). Submitted to U.S. Army Corps of Engineers, Rock Island District, under Contract No. DACW25-98-D-0001, Work Order No. 0014. Submitted by Bear Creek Archeology, Inc., Cresco, Iowa (State Historical Society of Iowa R&C No. 950558014).

Benn, David W., and Bill Isenberger
2003 *Documentation of Historic Properties Conditions for the Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System Pools 17-18, Louisa County, Iowa*, prepared under Corps Contract No. DACW25-98-D-0001, Work Order No. 37 (David W. Benn of Bear Creek Archeology, Inc., and Bill Isenberger of Digital Mapping and Graphics, Inc.)

List of Appendices

Appendix 1a. US Army Corps of Engineers, Rock Island District, Lake Odessa Habitat Rehabilitation and Enhancement Project, Environmental Management Program, Upper Mississippi River System (map completed 27 September 2002) (1 oversize page)

Appendix 1b. Recommended Plan (10 pages)

Appendix 2. Interested Parties List (2 pages)

Appendix 3. Table 2 from Benn and Isenberger (2003) (2 pages)

Appendix 4. Typical Riprap Shoreline Protection, Lake Odessa (1 page)

APPENDIX B

**CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

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CONTENTS

Subject	Page
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SECTION I - PROJECT DESCRIPTION

A. Location	B-1
B. General Description	B-1
C. Authority and Purpose	B-2
D. General Description of Dredged and Fill Material	B-2
E. Description of Proposed Placement Sites	B-3
F. Description of Placement Method	B-4

SECTION II - FACTUAL DETERMINATIONS

A. Physical Substrate Determinations	B-5
1. Substrate Elevation and Slope	B-5
2. Sediment Type	B-5
3. Dredged/Fill Material Movement	B-5
4. Physical Effects on Benthos	B-6
5. Actions Taken to Minimize Impacts	B-6
B. Water Circulation, Fluctuation, and Salinity Determinations	B-6
1. Water	B-6
2. Current Patterns and Circulation	B-7
3. Normal Water Level Fluctuations	B-7
4. Salinity Gradients	B-7
5. Actions Taken to Minimize Impacts	B-7
C. Suspended Particulate/Turbidity Determinations	B-7
1. Expected Changes in Suspended Particles and Turbidity Levels in Vicinity of Placement Sites	B-8
2. Effects on Chemical and Physical Properties of the Water Column	B-8
3. Effects on Biota	B-8
D. Contaminant Determinations	B-8

CONTENTS (Continued)

Subject	Page
E. Aquatic Ecosystem and Organism Determinations	B-8
1. Effects on Plankton	B-9
2. Effects on Benthos	B-9
3. Effects on Nekton	B-9
4. Effects on Aquatic Food Web	B-9
5. Effects on Special Aquatic Sites	B-9
6. Threatened and Endangered Species	B-10
F. Proposed Placement Site Determinations	B-10
1. Mixing Zone Determination	B-10
2. Determination of Compliance with Applicable Water Quality Standards	B-10
3. Potential Effects on Human Use Characteristics	B-11
G. Determination of Cumulative Effects on the Aquatic Ecosystem	B-11
H. Determination of Secondary Effects on the Aquatic Ecosystem	B-11

SECTION III-- FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON PLACEMENT

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
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**APPENDIX B
CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION**

I. PROJECT DESCRIPTION

A. Location. The Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) is located 12 miles downstream of Muscatine, Iowa, adjacent to Lock and Dam 17. The project area lies in Louisa County, Iowa, between Upper Mississippi River Miles (RM) 434.5 and 441.5 on the right descending bank. The Lake Odessa complex is approximately 6,788 acres. The northern portion of this complex is a part of the Mark Twain National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service (USFWS). The Iowa Department of Natural Resources (IDNR) manages the southern portion of the Lake Odessa complex, the Odessa Wildlife Management Area. The Mississippi River, the Iowa River, and the bluffs of the river basin enclose the Lake Odessa refuge area. An approximately 9.5-mile-long levee protects the refuge from the two rivers. The refuge area encompasses the main lake of Lake Odessa and several other backwater bodies, wooded land, and open fields. The Lake Odessa refuge is located entirely on federally owned lands. See Figure ES-1 of the DPR's (Definite Project Report's) executive summary. Project features are shown on DPR plates 3 and 4.

B. General Description. By definition and Federal regulatory jurisdiction, much of the site is classified as wetland or "waters of the United States" and is therefore subject to evaluation and regulation under Section 404 of the Clean Water Act.

The Lake Odessa HREP includes four primary enhancement feature types: enhancing the six current moist soil units (MSU's), primarily through increased water level control; increasing the amount of and/or access to deep-water overwintering habitat for fish by dredging (4 sites); planting 93 acres of mast-producing trees on higher elevations at 4 sites; and protecting the interior features with levee restoration, to include construction of a lower spillway, a wing dam in the Mississippi River between Michael Creek and the complex inlet structure, and protection of interior archeological sites with riprap placement. Additional, but minor features include reestablishing the sand prairie (terrestrial habitat enhancement) and constructing the upper fish nursery (fisheries enhancement). These improvements would benefit both game and non-game fish and wildlife and would enhance overall habitat diversity. A more detailed description of project features and expected benefits is provided in the main text of the DPR, of which this Evaluation is an appendix.

Enhancement of the MSU's (Field 4&5, 21, MSU 20, Unit 2, Fox Pond, IDNR MSU) is covered under Nationwide Permit 30, Moist Soil Management for Wildlife, meets all of the conditions set forth therein, and is therefore exempt from this evaluation. Construction of the dedicated water

bay, new water control structures for the MSU's listed above, and fish nursery (replacing water control structure) are covered under Nationwide Permit #27; Wetland and Riparian Restoration and Creation Activities, and is therefore exempt from this evaluation.

A total of 93 acres of mast producing trees will be planted in the Lake Odessa complex, in previous cropfields, interplanted in existing forest, and on the proposed dredged material placement site. Restoration of the sand prairie will be accomplished through site preparation and reseedling. These planting actions, confined to terrestrial locations within the floodplain can be considered exempt from this evaluation.

The following proposed project features will be discussed in this evaluation: fisheries enhancement features through restoration of deep water and access; levee restoration, to include a spillway along the Iowa River and a wing dam downstream of Michael Creek; and archeological site protection by means of riprap protection.

C. Authority and Purpose. Authority for the proposed project is provided by the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-62), as amended (see Section 1.f. of the DPR).

The purpose of this project, under Section 1103, is "to ensure the coordinated development and enhancement of the Upper Mississippi River (UMR)". The project is the result of planning efforts by the State of Iowa, the U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers.

D. General Description of Dredged and Fill Material

1. Fisheries Enhancement Features. The Lake Odessa complex lacks deep-water areas for fish overwintering. In addition, siltation has reduced access to and from other areas. The objective for the fisheries enhancement features is to restore these features to the area. Sediments will be hydraulically dredged from the Main Lake (81,555 cubic yards), Goose Pond (90,170 cubic yards), and Blackhawk/Yankee Chutes (63,530 cubic yards). These areas vary in size and depth, but will be dredged to a final depth of 8 feet (winter pool 534.5 feet MSL). The dredged material will be confined in the containment sites described below. Swarms/Bebee Ponds (9,180 cubic yards) will be mechanically dredged and the material will be sidecast. Preliminary information for interior sites indicates that this material is fine, silty material. Design details for these actions can be found on Plate 32 of the DPR.

2. Levee Restoration. Two dredge cuts are proposed in Turkey Chute, a side channel of the Mississippi River, to provide sandy material needed for the levee restoration, one above and one below Lock and Dam 17. Both of these sites are off of the main channel. A total of 279,897 cubic yards is needed, 38% of the material will be hydraulically excavated from the upper location and 62% from the lower location (plates 3, 4, and 32 of the DPR).

The 1,100-foot lower spillway, bordering the Iowa River, will be constructed by shaping the existing levee section and placing 87,300 square feet of concrete matting on the crown and landside slope, 3,245 tons of riprap on the riverside slope and 1,489 tons of riprap on the landside toe, 150,800 square feet of geo-textile fabric to be placed under the riprap and concrete mat collectively, and a 6 feet high reinforced concrete cutoff wall running the length of the spillway. The finished crown of the spillway will be at the approximate 10-year protection level (elevation 545.2 MSL). The riprap will be a 2 feet thick blanket on the riverside, and a 3 feet thick key in on the landside, both for the entire length of the spillway. The base course and riprap would be inert, uncontaminated rock, obtained from an approved quarry. Rock up to 400-700 pounds in size

would be used for portions of the structure. The concrete cutoff wall will be located on the crown of the levee, and shall prevent water infiltrating through the levee at an elevation lower than the spillway crown elevation (plate 31 of the DPR).

Also included in the levee restoration is construction of a wing dam in the Mississippi River between Michael Creek and the inlet structure. For this structure, 90 tons of riprap, up to 400 pounds in size, would be required (plate 32 of the DPR). The proposed wing dam, constructed of riprap material, is approximately 35 feet in length, 3 feet in height, has an 8 feet wide crown, and 2 horizontal to 1 vertical side slopes. Part of the 35 feet section will run up on the bank to key the structure in to the bank. See plates 3, 4, and 32 of the DPR for details.

3. Archeological Site Protection. Shoreline protection of 9 known archeological sites will be accomplished through rock protection. The protection will have a 50-year project life. Due to the lack of slope at two of the sites, they will be protected with a breakwater structure. The breakwater structures shall be located immediately off shore from the sites, and shall be constructed of riprap having an 8 feet wide crown and 2H:1V side slopes. For the remaining seven sites, the protection shall be riprap placed directly on the shoreline that will extend 3 feet out from the bank and have a 2H:1V side slope (see plate 32). The total amount of riprap required for the proposed archeological site protection is 8,619 tons. . Shoreline protection of archeological sites is needed to protect known sites from further erosion caused by frequent water level fluctuations.

E. Description of Proposed Placement Sites

1. Fisheries Enhancement Features. Dredged material from the Main Lake and Goose Pond will be placed in an adjacent confined placement area (40 acres), specifically constructed for this action. This area is currently low quality bottomland forest, dominated by silver maple and cottonwood. A berm shall be constructed by first clearing woody debris to an approximate 100-foot width around the site. A berm shall be constructed by pushing material up in the cleared area and compacting with equipment such as bulldozers. See plates 4 and 32 of the DPR for details. When the dredged material has dried sufficiently, it will be graded to the proper slope, and planted to bottomland mast producing trees. The species to be planted include northern pecan, swamp white oak, bur oak, pin oak, sycamore, and shellbark hickory. Although the final site elevation will be raised by approximately 2 to 3 feet, it is expected to remain a forested wetland area. The increased elevation will ensure future growth and regeneration of the newly planted mast tree species. The dredged material from Blackhawk/Yankee Chutes will be used as impervious liner material for the existing IDNR MSU, a confined area. Swarms/Beebe Ponds will be mechanically dredged. The material will be sidecast onto the adjacent bankline.

2. Levee Restoration. All material needed to restore levee sections to the 50 to 25-year level of protection and/or to desired interior slope (5 horizontal:1 vertical) will be placed on the inside slope or crown of the existing perimeter levee protecting the Lake Odessa complex. Based on aerial photographs and existing levee cross sections, it is estimated that approximately 44,396 feet of levee will require restoration and/or regrading of the interior slopes to 5:1. The approximate lengths of restoration are 22,496 feet upstream of Lock and Dam 17 and 21,900 feet downstream of the dam. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland and open water areas. Based on the data currently available, the levee restoration construction activities will impact 56 acres of wetland or open water habitat inside the levee. Of this area, 17 acres of existing habitat will be permanently converted to levee and 39 acres will be temporarily impacted by construction. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may

be impacted. However, the protection provided by the levee and the large acreage of wetlands within the levee area offset any impacts to wetlands by construction activities.

The total acreage of habitat protected by the levee restoration is ~1,700 acres of non-forested wetland, ~2,900 acres of bottomland hardwood forest, and ~1,800 acres of open or deep water. The remaining 388 acres of the 6,788 project area are composed of uplands, developed areas, or cultivated lands. The amount of wetland or open water habitat adversely affected by the levee restoration is a very small percentage of the total habitat protected. The levee will be scraped prior to repair to form a containment area for the dredged material return water, and will then be regraded. The levee would be allowed to revegetate naturally.

The 1,100-foot spillway would provide a 10-year level of protection and would remain within the existing levee footprint. The proposed wing dam, constructed of riprap material, is approximately 35 feet in length, 3 feet in height, has an 8 feet wide crown, and 2 horizontal to 1 vertical side slopes. Part of the 35-foot section will run up on the bank to key the structure in. See plates 3, 4, 31, and 32 of the DPR for details.

3. Archeological Site Protection. The proposed rock placement sites are adjacent to the steep bluff on the western edge of the Main Lake, along the bankline, and along the eastern edge of the main lake and other interior locations. Most of these sites have actively eroding shorelines. These locations are depicted on Plates 3 and 4 of the DPR with details found on plate 32 of the DPR.

F. Description of Placement Method

1. Fisheries Enhancement. Placement of dredged material from the Main Lake, Goose Pond, and Blackhawk/Yankee Chutes into the containment area and the IDNR MSU would be by hydraulic dredging. Shoreline disturbance at the dredging sites is expected to be minimal. The interior of the IDNR MSU would be cleared of small woody plants and grubbed prior to placement. The dredged material would be placed to a 1-foot depth and worked into the existing soil. The main lake/Goose Pond containment area will have a 100-foot-wide perimeter cleared of woody vegetation for berm construction. The interior trees would remain. Material would be placed to a depth of 2 to 3 feet. After the material has dried sufficiently, the area would be graded and planted with mast trees.

2. Levee Restoration. Placement of dredged material for the mainstem levee restoration would be by hydraulic dredging, with bulldozers or other earth-moving equipment used to grade and shape the material. Minor clearing and grubbing may be required in some areas. Up to 56 acres of wetland areas would be affected by construction and, of those, 17 acres would be permanently converted to levee. After the material has been placed to the desired depth, the levee would be regraded. The area would be allowed to revegetate naturally. Shoreline disturbance at the dredging sites is expected to be minimal. Placement of riprap and concrete mat for the spillway would typically involve use of trucks, backhoes, and bulldozers. Placement of the rock for the wing dam typically involves the use of deck-mounted cranes with draglines, barges, endloaders, quarter boats, and tender craft.

3. Archeological Site Protection. Placement of rock for archeological site protection typically involves the use of trucks, draglines, backhoes, and bulldozers. Large-grade stone is placed by crane. Materials are dumped to alignment and spread to profile. Shoreline work may potentially involve clearing of flood debris or cottonwood and silver maple saplings by endloaders and/or bulldozers, accomplished with minimal soil disturbance.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope. All areas dredged for fisheries enhancements inside the levee would be cut to a final water depth of 8 feet with final slopes to be 6 horizontal:1 vertical side slopes, based on a winter pool water elevation of 534.5 MSL (plate 32 of the DPR). All areas dredged for levee restoration outside the levee would be cut to a final water depth of 10 feet with final slopes to be 6 horizontal:1 vertical side slopes, based on a flat pool water elevation of 528 MSL (plate 32 of the DPR). Over the life of the project, normal flood flows would reintroduce sediment into the dredged areas.

Dredged material placed into the main lake/Goose Pond containment area and the IDNR MSU is fine material. For the containment area, after the sediment has dried sufficiently, it would be graded and planted to mast trees. Although a 2 to 3-foot increase in elevation will occur, the site is expected to retain bottomland forest characteristics and hydrology. However, the increase in elevation is expected to increase survival and regeneration of mast trees. Prior to placement, the IDNR MSU will be cleared and grubbed. Following placement, the dredged material will be incorporated into the existing material to a depth of ~1 foot. This work will create a better seal between the new and existing materials. It is anticipated that, for both containment sites, natural herbaceous wetland vegetation will germinate on the site after construction.

The dredged material used for the levee restoration is sandy material. The material scraped from the levee sections to be repaired will be stockpiled at the toe of the levee. This material will act as a containment berm for the dredged material placement. As the material is placed, it will be shaped to the appropriate slope.

The elevation and slope of all rock placement sites would change as indicated on DPR Plate 31 for the spillway, plate 32 for the wing dam and for the archeological site protection. Placement of the concrete mat and rock will prevent erosion of the spillway during flood events. Placement of the rock for the wing dam will reduce sedimentation of the inlet structure. Placement of bankline and offshore protection should prevent degradation and ensure integrity of the archeological sites. Material placed for spillway, wing dam, and archaeological protection would be quarried limestone, up to 700 pounds in size. Movement of material off site would be negligible due to the large-sized rock used for construction.

Although the proposed project features would affect wetland habitat, it is anticipated that, over the long-term, these changes would promote wildlife benefits beyond what currently exists in the project area and what would be lost due to short-term construction impacts.

2. Sediment Type. All sediments dredged from the interior of the Lake Odessa complex are of a fine silty nature. Two representative samples were taken (Site E-M437.5E and S-M438.8F, shown on DPR plate 54). These materials were classified as lean clay and sandy lean clay, respectively. Analysis of this material is discussed in Appendix F, Water Quality. The dredged material from the Mississippi River is sandy.

3. Dredged/Fill Material Movement. For all of the proposed dredge cuts, normal flood flows would reintroduce sediment into the dredged areas. For archeological site protection using riprap, movement of the material is not expected. No movement of dredged material is expected from the containment area (Site D) or the IDNR MSU.

4. Physical Effects on Benthos. Material placement should not significantly affect benthic inhabitants. Effects to existing benthos populations along the shoreline are expected to be minimal due to the degraded and unstable condition of the banks. The newly deposited rock would provide a stable, permanent substrate that should increase benthos populations following construction. Any benthos disturbed by proposed dredging actions and wing dam construction are expected to recolonize the area quickly.

5. Actions Taken to Minimize Impacts. Minimal vegetation impacts are expected to result from the proposed action. Faunal impacts would be limited to short-term disruption of the aquatic and terrestrial shoreline community. The amount of wetland or open water habitat adversely affected by the levee restoration is a very small percentage of the total amount of habitat protected by the proposed levee restoration. Construction would be scheduled to avoid impacting threatened and endangered species. The proposed actions would provide a more diverse aquatic substrate than presently exists at the construction site. All dredging areas would employ containment or confinement to minimize impacts of hydraulic dredging. Mast tree planting on the dedicated containment site would minimize impacts and improve forest diversity. Use of the dredged material to line the IDNR MSU would improve the functionality of the unit.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water. Typically, analysis of sand and rock substrates, such as those found in the Mississippi River in the vicinity of the project area, reveals little evidence of pollutants due to the limited surface area of sand-size particles and the lack of strong chemical bonding of contaminants to sand grains. No impacts from hydraulic dredging of main channel sediments are expected. Sediments inside the levee tend to be of smaller particle size. Elutriates analyses were performed on 2 representative samples (E-M437.5E and E-M438.8F), inside the levee system. The results from the elutriate test are typical of those seen in fine-grained Mississippi River sediments. This analysis suggests that ammonia-nitrogen, metal (copper and lead), and turbidity values could exceed state standards should hydraulic dredging of sediments inside the levee occur.

Any contaminants in sandy or silty materials would be those typically contained or transported by normal fluvial processes and as such would be common constituents of the Upper Mississippi River System. A relatively small mixing zone can also be effective at reducing ammonia-nitrogen and metal concentrations to acceptable levels. Any activity that would disturb the existing substrate would therefore not be anticipated to significantly alter water chemistry in the water column.

A Lake Odessa water quality monitoring program was initiated in 1990 in order to define baseline water quality conditions and to identify potential problem areas. Sampling occurred throughout the year, and the program was discontinued in 1998. Results from the baseline water quality monitoring at four Lake Odessa sites found low dissolved oxygen concentrations during both winter and summer sampling times. Winter fish kills resulting from low dissolved oxygen in Yankee Chute have been documented by the IDNR. The proposed deep-water/access dredging for fisheries enhancement should alleviate these problems. This sampling and analyses is discussed in detail in Appendix F, Water Quality, and sampling locations are shown on Plate 20 of the DPR.

Clarity and turbidity of the river and the waters inside the levee vary with seasonal flow. Placement sites and methods have been selected to minimize impacts to clarity, color, odor, taste, dissolved gas levels, nutrients, and biochemical oxygen demand in the riverine and wetland environments. Discharge of rock would stabilize finer substrate materials; terrestrial placement of rock shoreline protection would minimize water quality impacts. Discharge of sand for levee

restoration would occur inside the levee within containment areas. The return water would be held by the proposed containment long enough for any sand to settle out. The water would eventually return to the existing water bodies within the levee system at Lake Odessa. Discharges of silty material placement resulting from dredging the Main Lake, Goose Pond, and Yankee/Blackhawk Chutes would be placed into confined areas. After passing over a weir or drop structure, the return water would flow into existing water bodies within the Lake Odessa levee. Material mechanically dredged from Swarms/Bebee Ponds would be sidecast onto the banklines and is not believed to significantly affect water quality.

Nonriverine originated components such as rock fill, capstone, concrete, and steel that may be placed temporarily or permanently during construction would be physically stable and chemically noncontaminating.

2. Current Patterns and Circulation. Deep-water fisheries dredging would have no impact on current patterns or circulation but would provide overwintering habitat that is currently thought to be limiting. Dredging the access channels for Swarms/Bebee Ponds and Yankee Chute would improve water circulation to those areas as well as provide improved escape routes for fish should water conditions become unfavorable. Placement of rock for shoreline and offshore protection at identified archeological sites would not significantly affect currents and flow. There would not be any noticeable alteration in current patterns upstream or downstream of the project. However, minor, localized changes in velocity would occur in the immediate vicinity of the proposed wing dam. Wing dams are built to cut off flow conveyance in the shallow off-channel areas and concentrate flow into the main channel. This tends to reduce sedimentation in the main channel. Experience indicates that these increased velocities result in scour holes immediately downstream of the dikes and off the tips, providing good habitat for fish. Main channel or interior velocities would not be affected by the proposed action.

3. Normal Water Level Fluctuations. No effects on normal seasonal river or complex interior stages are anticipated to result from any of the proposed placements. Levee restoration is expected to increase flood protection to the Lake Odessa complex.

4. Salinity Gradients. The proposed action would take place in a freshwater river system. Therefore, no consideration of salinity gradients is warranted for these actions.

5. Actions Taken to Minimize Impacts. Measures taken to avoid state water quality standard exceedences could include avoidance of hydraulic dredging activities during the summer months when water temperatures are higher and a greater percentage of the ammonia is in the toxic, un-ionized form, and /or utilizing a confined placement facility to allow for settling of the suspended solids. A relatively small mixing zone can also be effective at reducing ammonia-nitrogen and metal concentrations to acceptable levels.

C. SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

In an effort to assess existing water quality conditions in the vicinity of the proposed project, a water quality monitoring program was initiated in 1990 to define baseline water quality conditions and to identify problem areas (see Appendix F). In order to address permitting issues related to proposed dredging activities, bed sediment samples and overlying water were collected on August 28, 2001. Elutriate and grain size analyses were performed on two samples collected from potential dredge cuts within the backwater complex.

1. Expected Changes in Suspended Particles and Turbidity Levels in Vicinity of Placement Sites. The proposed project would have short-term adverse impacts during construction due to turbidity plumes, but long-term beneficial effects would occur from improved fisheries habitat and protection of the interior from flooding or levee failure.

2. Effects on Chemical and Physical Properties of Water Column. The proposed project would have short-term adverse impacts during construction due to turbidity plumes, but long-term beneficial effects would occur from improved fisheries habitat and protection of the interior from flooding or levee failure. No impacts are anticipated for the dredging actions with confined placement sites or those to be accomplished through mechanical dredging. The proposed action is not expected to have long-term impacts on light penetration, dissolved oxygen levels, toxic metals and organics, pathogens, or aesthetics.

3. Effects on Biota. Adverse effects to biota, including primary producers (e.g., zooplankton and phytoplankton), suspension/filter feeders, and sight feeders, are expected to be short-term. Invertebrate populations of mayflies, caddisflies, stoneflies, and other aquatic insects, as well as fish use, would increase on the additional rock substrate provided. Areas of deeper water or access to deeper water would result in increased survival of fish during freezing or low oxygen conditions. In fact, this project should have net beneficial impacts to the Lake Odessa complex and, potentially, to the regional ecosystem, creating deep-water habitat, enhancing the moist soil management units, and increasing the diversity of the bottomland hardwood forest.

D. CONTAMINANT DETERMINATIONS

Appendix F, Table F-1, shows elutriate and ambient water analysis results from samples collected at sited E-M437.5E and E-M438.8F. Elutriate analyses were performed on Lake Odessa samples in order to evaluate the impacts of dredged material placement on water quality. The analytical results suggest that ammonia-nitrogen, metal, and turbidity values could exceed state standards should dredging occur.

The results from the elutriate test are typical of those seen in fine-grained Mississippi River sediments. The results indicate that if hydraulic dredging is utilized, exceedances of state water quality standards may occur. Measures taken to avoid violations could include prohibiting dredging during the late summer when water temperatures are higher and a greater percentage of the ammonia is in the toxic un-ionized form, and/or utilizing a confined placement site which would allow for more settling. In addition, a relatively small mixing zone would likely reduce ammonia-nitrogen and metal concentrations to acceptable levels.

Rock fill material would be clean, uncontaminated stone from an approved source. No significant increase in contaminants in the aquatic environment would result from dredging or placing sediments from the Mississippi River or from the sites inside the mainstem levee. Possible introduction of equipment or construction-related contaminants would be controlled by adherence to runoff monitoring plans during construction activity. No toxic materials would be introduced into the area because of construction. Appropriate measures, such as hay bales, silt fences, containment or confinement units would be implemented to control stormwater discharge.

E. AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

The proposed project features are anticipated to benefit fish and wildlife at the Lake Odessa complex, through enhancement of the moist soil management units, fisheries enhancements (deep-

water and access), and increased protection of the interior features from flood and/or levee failure events.

1. Effects on Plankton. Effects on plankton are anticipated to be minimal.

2. Effects on Benthos. Negative effects on benthos would be limited to elimination of those organisms currently inhabiting the immediate dredging sites, wing dam location, and open water areas impacted by levee restoration. The placement of rock fill for archeological site protection should provide interstitial spaces for invertebrate production and limited vertebrate spawning potential.

3. Effects on Nekton. One of the primary purposes of this project is to restore aquatic habitat lost to sedimentation. Dredging will re-create deep-water habitat as well as restore access to and from Swarms/Beebe Ponds and Yankee Chute. Fish will benefit from these habitat improvements. Increased water exchange, thereby improving dissolved oxygen concentrations during seasonal stress periods would be an additional benefit. Negative effects on nekton would be limited to displacement and temporary disruption of foraging patterns. Dredging of known overwintering areas in the Main Lake and Turkey Chute will be avoided during the winter months, further reducing any adverse fisheries impacts.

4. Effects on Aquatic Food Web. Effects on the aquatic food web are expected to be beneficial overall by increasing production at the lower trophic levels.

5. Effects on Special Aquatic Sites. Effects on special aquatic sites should be negligible in the project area; no sanctuaries or refuges would be adversely affected by the proposed action. Project goals and features have been coordinated to match the management objectives of the U.S. Fish and Wildlife Service and the Iowa Department of Natural Resources, and these elements are expected to be enhanced by implementation of the project.

a. Sanctuaries and Refuges. The project area is located within the Upper Mississippi River Fish and Wildlife Refuge System, Mark Twain National Wildlife Refuge.

b. Wetlands, Mud Flats, and Vegetated Shallows. No wetlands or mudflats, vegetated shallows, coral reefs, or riffle and pool complexes would be adversely affected over the long-term by the proposed action. Levee restoration activities and new slopes may extend up to 65 feet beyond the existing levee footprint on land (100 feet in open water areas), affecting existing wetland areas and open water areas. This expanded footprint may impact up to 56 acres of existing wetland habitat; which includes converting 17 acres permanently to levee, based on the current information. If site conditions vary from current information, the levee restoration footprint may increase. A maximum of 75 acres of wetland and open water areas may be impacted. However, the protection provided by the levee and the large acreage of wetlands within the levee area offset any impacts to wetlands by construction activities.

The total acreage of habitat protected by the levee restoration is ~1,700 acres of non-forested wetland, ~2,900 acres of bottomland hardwood forest, and ~1,800 acres of open or deep water. The remaining 388 acres of the 6,788 acre project area are composed of uplands, developed areas, or cultivated lands. The amount of wetland or open water habitat adversely affected by the levee restoration is a very small percentage of the total habitat protected. The placement of dredged material at the proposed containment site (Site D) would negatively impact flood tolerant tree species, such as silver maple and cottonwood. However, the final elevation would still be considered wetland, and the mast tree planting at this site would increase bottomland forest

diversity, favoring mast production and regeneration of these trees, resulting in improved value of the area to wildlife. Project planning considered to the full extent the minimization of wetland loss, and it is intended that wetland values and extent would be improved as a result of project implementation.

6. Threatened and Endangered Species. Threatened and endangered species use of, or existence in, the project area is discussed in sections 2.h. and 9.c.(5) of the DPR. Construction activities would be timed to avoid impacts to bald eagles and Indiana bats, and no significant impacts are anticipated. Dredging in the Mississippi River will be located to avoid mussel beds; no impacts to Higgins eye are anticipated. No significant impacts or effects to any threatened or endangered species are anticipated to result from this action. During the summer, Indiana bats roost in trees and forage for insects in or near floodplain and upland forests. Tree clearing would not be conducted during the April 1-September 30 timeframe. Prohibiting clearing activity during this 6-month time window would avoid potential impacts to summer roosting Indiana bats. Any clearing of trees suitable for roosting would be avoided during times that eagles are present. No known eagle nests are located within the immediate levee restoration area. In addition, the Lake Odessa complex provides many wooded areas. The impacted areas are very small in comparison. Therefore, no significant impacts to Indiana bats or bald eagles are expected. Other wildlife is generally expected to benefit from this project due to increased overall habitat diversity.

Other wildlife in the project area includes both game and non-game species such as the river otter, muskrat, white-tailed deer, squirrel, waterfowl and migratory shorebirds, songbirds, and other small mammals and herptiles. No food chain or critical habitat requirements would be affected by the proposed actions. The proposed project is anticipated to contribute to overall habitat diversity in the project area and, thus will be of benefit to most species currently found in the project area.

F. PROPOSED PLACEMENT SITE DETERMINATIONS

1. Mixing Zone Determination. The material dredged from the interior of the Lake Odessa complex for fisheries enhancement is fine-grained material, typical of those seen in the Mississippi River sediments. This material will be hydraulically dredged and placed into confined sites. Mechanical dredging for Swarms/Bebee Ponds and archeological site protection should help minimize any impacts. A small amount of fine-grained material would migrate from placement sites and quickly become diluted with the complex interior waters. In addition, during construction, this fine material would result in temporary localized increases in suspended material. Monitoring results from a similar project in a backwater region of Pool 11 indicated that, given a sufficient settling time, acceptable total suspended solids concentrations can be met utilizing a 500-foot mixing zone.

The riprap fill material, used for archeological site protection, is inert and would not mix with the water. The lack of fine particulates typically contained in rock fill and main channel sand, used for levee restoration, indicates negligible chemical or turbidity effects resulting from this action.

2. Determination of Compliance with Applicable Water Quality Standards. Elutriate analyses were performed on Lake Odessa samples in order to evaluate the impacts of dredged material placement on water quality. The analytical results suggest that ammonia-nitrogen, metal, and turbidity values could exceed state standards should dredging occur. The results from the elutriate test are typical of those seen in fine-grained Mississippi River sediments. The results indicate that if hydraulic dredging is utilized, exceedances of state water quality standards may occur. Measures taken to avoid state water quality standard exceedances could

include avoidance of hydraulic dredging activities during the summer months when water temperatures are higher and a greater percentage of the ammonia is in the toxic, un-ionized form, and /or utilizing a confined placement facility to allow for settling of the suspended solids. A relatively small mixing zone can also be effective at reducing ammonia-nitrogen and metal concentrations to acceptable levels. These mitigating measures and the nature of the fill material should result in discharges anticipated to be in compliance with Iowa State water quality standards.

3. Potential Effects on Human Use Characteristics. The proposed project would have no adverse effects on municipal and private water supplies; recreational and commercial fisheries; water-related recreation; or parks, national and historic monuments, wilderness areas, research sites, or similar preserves. Aesthetics are generally negatively affected by this type of construction activity; however, the exposed rock or dredged material is confined to small areas along the shoreline would eventually blend in with the adjacent shoreline. Following construction, the proposed project would improve recreational fisheries in the area.

G. DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM. No negative cumulative impacts are expected to result from this action. Habitat modifications should have long-term benefits to the fish and wildlife utilizing this area. Long-term productivity would be enhanced by the proposed action. This project, in concert with other EMP projects in the Upper Mississippi River System, should counter other impacts to the river ecosystem such as sedimentation, pollution, and general decline in riverine habitats.

H. DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM. Any negative impacts resulting from the proposed placement are expected to remain localized and short-term in nature. Resuspension of existing substrate material during project construction would not contribute to any significant impacts to the aquatic ecosystem. No significant negative secondary effects should result from this project. Long-term benefits to aquatic vegetation, fish, and wildlife are expected.

III. FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the 404(b)(1) guidelines were made relative to this evaluation.

2. Alternatives that were considered for the proposed action were as follows:

No Federal Action. No Federal action in this instance means no change in land use, land cover or current management practices or facilities.

Preferred Alternative. The preferred alternative components for the project are: moist soil unit (MSU) enhancement (includes Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, Swarms/Beebe Ponds, IDNR MSU, dedicated water supply); restoration of main stem levee to 50 to 25-year level with lower spillway, wing dam construction at Michael Creek, and archeological site protection; fisheries enhancement through deep hole/access dredging (includes Main Lake, Goose Pond, Blackhawk/Yankee Chutes, Swarms/Beebe Ponds); construction of fish nursery; reestablishment of the sand prairie; and mast tree planting at four separate sites (A through D). Plates 3 and 4 of the DPR show the recommended plan.

Management Measures Considered but Not Selected. Several management measures were considered for construction, but not selected based on engineering feasibility, environmental impacts, cost, and/or inability to meet the goals and objectives of the Corps of Engineers, the U.S. Fish and Wildlife Service, and the State of Iowa. These measures included: field scraping at field 4&5, 21, and area east of Fox Pond; develop sand field (field 6) into an MSU; construction of a cross dike between USFWS and IDNR managed lands; construction of a fish nursery in Little Goose Pond or off Sand Run; addition of water control structure at Yankee Chute; several other areas for dredging for fisheries; island creation in the main lake; several other mast tree planting areas; creation of a green tree reservoir; and levee restoration to a 20-year level of protection. These non-preferred alternatives are shown on plates 7 and 8 of the DPR.

3. Permits, certification, or waiver of certification under Section 404 of the Clean Water Act would be obtained before construction begins. The project would be in compliance with water quality standards of the State of Iowa as applicable.

4. The project is not anticipated to introduce toxic substances into nearby waters or result in appreciable increases in existing levels of toxic materials. The proposed activity is in compliance with Applicable Toxic Effluent Standards or Prohibition under Section 307 of the Clean Water Act.

5. No significant impact to Federal or state listed threatened or endangered species would result from the proposed action. Prior to construction, full compliance with the Endangered Species Act would be documented.

6. The project is situated along an inland freshwater river system. No marine sanctuaries are involved or would be affected by the proposed action.

7. The proposed activities would not have a significant adverse effect on human health and welfare, municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife or special aquatic sties. No significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems are expected to result. The proposed

activities would have no significant adverse effects on aquatic ecosystem diversity, productivity, and stability. No significant adverse effects on recreational, aesthetic, and economic values would occur. While the Lake Odessa complex can be classified as a special aquatic site, environmental improvements resulting from the proposed actions would outweigh short-term construction impacts and offset some of the habitat degradation caused by siltation and levee failures. No long-term adverse effects to the river ecosystem are expected to result from this action.

8. Steps taken to minimize potential adverse impacts on the aquatic ecosystem include use of confined disposal sites (Site D and IDNR MSU), avoidance of dredging known fish overwintering areas during winter months, and avoidance of dredging during the summer months. The materials used for construction of the wing dam, spillway and riprap for archeological site protection would be chemically and physically stable and noncontaminating.

9. No other practical alternatives have been identified. The proposed action is in compliance with Section 404(b)(1) of the Clean Water Act, as amended. The proposed action would not significantly impact water quality. On the basis of the guidelines, the proposed placement sites for the discharge of dredged material are specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the environment.

Date

DUANE P. GAPINSKI
Colonel, U.S. Army
District Engineer

APPENDIX C

**DRAFT MEMORANDUM OF AGREEMENT AND
FINAL PROGRAMMATIC AGREEMENT FOR HISTORIC PROPERTIES**

**DRAFT
MEMORANDUM OF AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE UNITED STATES FISH AND WILDLIFE SERVICE
FOR
ENHANCING FISH AND WILDLIFE RESOURCES
OF THE
UPPER MISSISSIPPI RIVER SYSTEM
AT LAKE ODESSA, LOUISA COUNTY, IOWA,
HABITAT REHABILITATION AND ENHANCEMENT PROJECT**

I. PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (USFWS) and the Department of the Army (DA) will operate in constructing, operating, maintaining, and rehabilitating the Lake Odessa, Louisa County, Iowa, Habitat Rehabilitation and Enhancement Project, separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. The project area is managed by the USFWS and is on lands managed as a national wildlife refuge. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, 100 percent of the construction costs of those fish and wildlife features at Lake Odessa, Louisa County, Iowa Habitat Rehabilitation and Enhancement Project, are the responsibility of (DA), and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, 100 percent of operation and maintenance for the Lake Odessa, Louisa County, Iowa, Habitat Rehabilitation and Enhancement Project, project areas is the responsibility of USFWS.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of the following:

1. Moist Soil Unit (MSU) Enhancement

- Enhance water level management capability at Field 4 and 5. A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the area of water coverage would be approximately 83 acres.
- Enhance water level management capability at Field 21. Proposed details are similar to Field 4 & 5, except that no new water control structures are proposed. A portable pump and pump pad would be provided to augment an existing control structure to furnish a consistent flow of water to the field. The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). When flooded to 538.5, the approximate area of water coverage would be 83 acres.
- Enhance water level management capability at MSU 20 The natural topography of the field would be utilized, to impound water up to an elevation of approximately 538.5 feet MSL. At this elevation, water depths would range from 0 to 2.7 feet (typically 1.5 feet). The typical depth of 1.5 feet would be obtained by gravity flow and by directing water pumped into Field 21 through an adjoining water control structure. When flooded to 538.5, the approximate area of water coverage would be 72 acres.
- Enhance water level management capability at Unit 2. A portable pump would be provided to augment existing control structures to furnish a consistent flow of water to the field. Existing berms around Unit 2 are assumed to be adequate to impound water up to elevation 538.5 feet MSL. At this elevation, water depths range from 0 to 2.7 feet (typically 1.5 feet). To assist in water level management, a new water control structure is proposed to augment an existing water control structure under the adjacent road. When flooded to 538.5, the approximate area of water coverage would be 92 acres.
- Enhance water level management capability at Fox Pond. Currently, Fox Pond has a pump station that is dated and

under capacity to obtain desired water levels in the area. It is proposed that a new fixed pump station be constructed that has the capacity to raise water levels from 536.0 to 537.0 feet MSL, with 537.0 being maintained for approximately 2 months. Also at Fox Pond, a water control structure, along with a pump pad for a portable pump, is proposed to drain the area. One of the portable pumps from the above units would be utilized here because Fox Pond pumping would take place in the summer versus the fall for the other MSUs. The approximate area of water coverage would be 336 acres.

- Dredge access channels to Swarms and Bebee Ponds. consists of dredging the access channels connecting Lake Odessa to Swarms Pond and Bebee Pond. This action would allow drawdown of these ponds to occur when the main lake is drawn down, thereby increasing the area and diversity of wetland vegetation growth. Conversely, in the fall, when lake levels are raised, this area would be inundated, providing access to food resources for migrating waterfowl. This action also provides fisheries benefits, described in the deep-water fisheries enhancement section that follows in (2) of this MOA.
- Enhance water level management capability at IDNR MSU. This area has an existing berm that is adequate for the intended water levels in the unit. This unit also is proposed as a placement site for fine sediment dredged from the Blackhawk Chute/Yankee Chute feature which would act as a liner and enable the unit to better hold water. A portable pump, pump pad, and water control structure are proposed for construction to better facilitate water level management. The management plan for the unit is to raise the water level in the unit 4 feet in 14 days and then hold that water elevation for approximately 2.5 months through maintenance pumping. The approximate area of water coverage would be 49 acres.

2. Fisheries Enhancement

- Dredge roughly 1,490- by 751-foot area in Lake Odessa.
- Dredge roughly a 5,158-foot channel in Goose Pond.
- Dredge roughly 6,040-foot channel between Yankee and Blackhawk Chutes.
- Dredge access channels to Swarms and Bebee Ponds.

3. Mast tree planting

- Restore and improve the bottomland hardwood forest by planting approximately 27 acres of mast trees at Sites A and B.
- Restore and improve the bottomland hardwood forest by planting approximately 26 acres of mast trees at Site C.
- Restore and improve the bottomland hardwood forest by planting approximately 40 acres of mast trees at Site D.

4. Levee Restoration would include restoring the perimeter levee crown and interior levee side slopes, constructing a spillway and wing dam, and protecting archeological sites. The Perimeter Levee would be restored to a 25-50 year protection level and include construction of two spillways. One of the spillways would be located in the lower end of the refuge and is proposed to be roughly 1,100 feet in length and built to the 10-year level of protection. The second spillway would be located in the upper end and is proposed to be 700 feet long and built to the 17-year level of protection (to be constructed by the USFWS).

5. Sand Prairie Planting would include planting roughly a 36-acre field with sand prairie grasses and forbs.

6. Fish Nursery construction would include replacing a water control structure to allow for fish passage. This feature would consist of utilizing an existing containment area to construct a fish nursery. The area currently has a stoplog control structure, which is damaged and would be replaced. The area, with the new structure, would be able to pond water, allowing the area to be stocked with fry in the spring that would be released into Lake Odessa later in the season. This would allow fish to reach a larger size in a more protected environment, resulting in decreased mortality.

IV. RESPONSIBILITIES

A. The DA is responsible for:

1. **Construction:** creating deep-water habitat by dredging, installing weir structures, and constructing embankments and containment cells.

2. **Major Rehabilitation:** The Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in

the Definite Project Report and that is needed as a result of specific storm or flood events.

3. Construction Management: Subject to and using funds appropriated by the Congress of the United States, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, the DA will construct the Lake Odessa, Louisa County, Iowa, Habitat Rehabilitation and Enhancement Project, as described in the Definite Project Report with Integrated Environmental Assessment, Lake Odessa, Louisa County, Iowa, Habitat Rehabilitation and Enhancement Project, dated July, 2004, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of the Notice to Proceed. If the DA encounters potential delays related to construction of the project the DA will promptly notify the USFWS of such delays.

4. Maintenance of Records: The DA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the project to the extent and in such detail as will properly reflect total costs. The DA shall maintain such books, records, documents, and other evidence for a minimum of 3 years after completion of construction of the project and resolution of all relevant claims arising therefrom, and shall make available at its office, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the USFWS.

B. The USFWS is responsible for Operation, Maintenance, and Repair: Upon completion of construction as determined by the District Engineer, Rock Island, the USFWS shall accept the project and shall operate, maintain, and repair the project as defined in the Definite Project Report with Integrated Environmental Assessment, Lake Odessa, Louisa County, Iowa, Habitat Rehabilitation and Enhancement Project, dated July, 2004, in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties:

USFWS: Regional Director
 U.S. Fish and Wildlife Service
 Federal Building, Fort Snelling
 Twin Cities, Minnesota 55111

DA: District Engineer
 U.S. Army Engineer District, Rock Island
 Clock Tower Building
 P.O. Box 2004
 Rock Island, Illinois 61204-2004

EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF ARMY

THE U.S. FISH AND WILDLIFE SERVICE

BY: _____
 DUANE P. GAPINSKI
 Colonel, U.S. Army
 District Engineer

BY: _____
 WILLIAM F. HARTWIG
 Regional Director
 U.S. Fish and Wildlife
 Service

DATE: _____

DATE: _____

APPENDIX D

**HABITAT EVALUATION AND QUANTIFICATION
AND INCREMENTAL COST ANALYSIS**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX D
HABITAT EVALUATION AND QUANTIFICATION
AND INCREMENTAL COST ANALYSIS**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
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**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX D
HABITAT EVALUATION AND QUANTIFICATION
AND INCREMENTAL COST ANALYSIS**

CONTENTS

Subject	Page
1. Introduction	D-1
2. Habitat Evaluation Methodology	D-2
3. Evaluation Species Selection.....	D-2
4. Assumptions	D-4
a. Model Performance	D-4
b. Changes in Habitat Conditions Over Time.....	D-5
c. Future Management Use.....	D-6
5. Results of Habitat Analysis	D-6
a. Moist Soil Unit Enhancement.....	D-6
b. Sand Prairie Restoration	D-10
c. Fisheries Enhancement – Upper Fish Nursery	D-10
d. Fisheries Enhancement – Dredging Deep Water/Access	D-11
e. Reforestation (Mast Tree Planting).....	D-13
f. Levee Restoration.....	D-16
6. Incremental Analysis of Alternatives	D-18
a. Moist Soil Unit Enhancement.....	D-18
b. Fisheries Enhancements (dredging).....	D-20
c. Best Buy Plans.....	D-22
7. Discussion.....	D-23

Tables

No.	Title	Page
D-1	Evaluation Target Species Selected for Habitat Analysis.....	D-3
D-2	USFWS MSU Complex – Projected AAHUs.....	D-8
D-3	Unit 2 – Projected Habitat Benefits	D-8
D-4	Fox Pond – Projected Habitat Benefits.....	D-9
D-5	Swarms/Bebee Ponds – Projected Habitat Benefits.....	D-9
D-6	IDNR MSU – Projected Habitat Benefits	D-10

CONTENTS (Continued)

Tables (Continued)

No.	Title	Page
D-7	Sand Prairie Restoration – Projected Habitat Benefits.....	D-10
D-8	Fish Nursery – Projected Habitat Benefits	D-11
D-9	Dredge Main Lake – Projected Habitat Benefits.....	D-12
D-10	Dredge Goose Pond – Projected Habitat Benefits.....	D-12
D-11	Dredge Blackhawk/Yankee Chutes – Projected Habitat Benefits.....	D-13
D-12	Swarms/Beebe Ponds – Projected Habitat Benefits	D-13
D-13	Reforestation Sites A & B – Projected Habitat Benefits	D-14
D-14	Reforestation Site C – Projected Habitat Benefits	D-15
D-15	Reforestation Site D – Projected Habitat Benefits	D-15
D-16	Levee Restoration – Projected Non-forested Wetland Habitat Benefits	D-16
D-17	Levee Restoration – Projected Bottomland Hardwood Habitat Benefits	D-17
D-18	Levee Restoration – Projected Aquatic Habitat Benefits	D-17
D-19	Potential Combination of MSU Features Ranked by Output	D-19
D-20	MSU Enhancement – Incremental Cost Analysis of Best Buy Plans.....	D-20
D-21	Potential Combination of Dredging Features Ranked by Output.....	D-21
D-22	Fisheries Enhancement (dredging) – Incremental Cost Analysis Best Buy Plans ...	D-21

Figures

No.	Title	Page
D-1	MSU Best Buy Plans.....	D-20
D-2	Fisheries Best Buy Plans	D-22

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

**LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT
POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX D
HABITAT EVALUATION AND QUANTIFICATION
AND INCREMENTAL COST ANALYSIS**

1. INTRODUCTION

A habitat analysis was conducted to evaluate the potential benefits of alternative habitat improvement features at the Lake Odessa complex. Active participants included biologists and natural resource personnel from the Rock Island District of the U.S. Army Corps of Engineers; the U.S. Fish and Wildlife Service (USFWS) Rock Island Ecological Service, Field, and Refuge Offices; and the Iowa Department of Natural Resources (IDNR).

The need for quantification of Habitat Rehabilitation and Enhancement Project (HREP) outputs as a project performance evaluation tool, a project-ranking tool, and a project-planning tool has been discussed by various agencies associated with the UMRS-EMP. This application involves quantification solely for the purpose of project planning.

Quantification of outputs is expressed in Habitat Units (HUs). HUs is a measure of habitat quality (habitat suitability indices, or HSI) and quantity (acres). Annualization of HUs can then be used to determine changes brought about by project features/alternatives over time. This annualization computes average annual habitat units (AAHUs). Once construction begins and as a project matures, habitat changes occur, and therefore habitat benefits may change. Many features, such as tree planting, would not begin to show benefits until well into the project life. The particular dynamics of the ecosystem under study then determine the target years chosen for analysis. With or without a project, habitat conditions change over time; therefore, the overall value of a proposed project depends upon the comparison of with-project benefits and without-project benefits.

Comparison of alternative designs and combinations of features is accomplished through cost-effectiveness evaluation and incremental cost analysis. Cost-effectiveness evaluation is used to identify the least costly solution to achieve a range of project benefits. Incremental cost analysis is a tool that can be used to scale the size of the project or of individual features by determining changes in costs associated with increasing levels of benefits.

2. HABITAT EVALUATION METHODOLOGY

The methodology used in this evaluation was the Wildlife Habitat Appraisal Guide (WHAG).¹ The Missouri Department of Conservation and the U.S. Department of Agriculture, Soil Conservation Service (now NRCS), developed the WHAG. It is a field evaluation procedure designed to estimate habitat quality and account for changes due to land management practices. Checklist-type appraisal guides are used for upland, wetland, and aquatic habitats and computer programs are used to analyze field data in terms of habitat suitability for various evaluation species. This analysis employed a multi-agency team approach with representatives from the Corps of Engineers, the USFWS, and the IDNR.

The WHAG analysis is a numerical system for evaluating the quality and quantity of particular habitats, including target species, selected by WHAG team members. The qualitative component of the analysis is known as the habitat suitability index (HSI) and is rated on a 0.1 to 1.0 scale. The suitability of a given habitat type for a set of evaluation species is determined by the qualitative characteristics of the habitat type. The WHAG procedures include the use of limiting factors, which is a habitat requirement for an individual species during a critical time of year. Absence of that habitat characteristic makes the habitat unsuitable and results in the lowest HSI value of 0.1. Habitat quality ratings can be improved by: (1) increasing acreages for particular habitat types that may be limited or lacking; (2) altering a limiting factor, such as unpredictable water levels; (3) altering a management strategy, such as cropping practice or cover crop composition; or (4) a combination of the preceding, depending on management goals, target species requirements, or available funds.

The quantitative component of the WHAG analysis is the measure of acres of habitat that are available for the selected species. From the qualitative and quantitative determinations, the standard unit of measure, the habitat unit (HU), is calculated using the formula ($HSI \times Acres = HUs$). For project planning and impact analysis, project life was established as 50 years. To facilitate comparison, target years were established at 0 (existing conditions), 1, 25, and 50 years. HSIs and average annual habitat units (AAHUs) for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

The WHAG team evaluated existing habitat conditions by using existing survey data, aerial photographs (1989 and 1992), vegetative cover maps (1989), and first hand knowledge of the area. Projections of future with- and without-project conditions were based on predicted changes in the physical conditions of the project sites and professional judgment as to how these changed physical conditions would affect habitat components such as vegetation diversity and species composition.

3. EVALUATION SPECIES SELECTION

Proposed project features are shown on plates 3 and 4 of the Definite Project Report (DPR). Table D-1 lists the target evaluation species used in this analysis. These species are a subset of the established set in the WHAG model. Although a set list of species has been used, each species represents a guild of other similar species that utilize the habitat in similar ways. In essence, each species represents an array of habitat variables for the species being evaluated. These species represent key management goals and objectives of the Lake Odessa HREP. Target species for each

¹ D. L. Urich and others, "Habitat Appraisal of Private Land in Missouri", *Wildlife Society Bulletin* 12 (1984): 350-356.

habitat type were selected and were the focus of restoration or enhancement efforts but all species from the established set in the WHAG model were used to determine habitat benefits.

Table D-1. Evaluation Target Species Selected for Habitat Analysis

Species	Scientific Name	Habitat Evaluated
Mallard	<i>Anas platyrhynchos</i>	nonforested wetland
Canada goose	<i>Branta canadensis</i>	nonforested wetland
Least bittern	<i>Ixobrychus exilis</i>	nonforested wetland
Lesser yellowlegs	<i>Tringa flavipes</i>	nonforested wetland
Dickcissel	<i>Spiza americana</i>	upland grassland
White & Black crappie	<i>Pomoxis spp.</i>	aquatic
Largemouth bass	<i>Micropterus salmoides</i>	aquatic
Bluegill	<i>Lepomis macrochirus</i>	aquatic
Wood duck	<i>Aix sponsa</i>	forested wetland
Mallard	<i>Anas platyrhynchos</i>	forested wetland

Eight wildlife species, 7 avian and 1 mammalian, were used to evaluate the enhancement of the MSUs (non-forested wetland) at the Lake Odessa complex. Mallard and Canada goose are migratory waterfowl species that utilize early successional wetland habitat and have socioeconomic importance as game species. Least bittern and muskrat utilize permanent summer wetland as well as mid-successional herbaceous habitats, while king rails are found in permanent, sedge dominated summer wetlands. Lesser yellowlegs is a shorebird that utilizes waterlogged substrates and initial successional wetland habitats. The green-backed heron is a wading bird found in mid-successional herbaceous and shrub dominated wetland habitat. American coots are found in permanent summer wetland habitat. Target species for MSU enhancement were mallard, Canada goose, least bittern, and lesser yellowlegs. Benefits to these species were given extra consideration. Benefits for all species were taken into consideration for the WHAG model.

Dickcissel was used as the only target and evaluation species for the sand prairie restoration. This avian species is a native grassland indicator species. The sand prairie is a very unique area, and benefits from this restoration effort were not well captured by the upland grassland evaluation model.

Four fish species were used as target species to evaluate the restoration of aquatic habitat. Black and white crappie, largemouth bass, and bluegill are centrarchids that inhabit side channels and backwaters, and are important sport fish species. All four species utilize deep water for overwintering habitat. Carp habitat benefits were also evaluated to ensure this alien, invasive species does not benefit at the expense of desirable species. Other fish species included in the WHAG model for which habitat benefits were considered include channel catfish, gizzard shad, and black bullhead.

Mast tree planting efforts were evaluated using the bottomland hardwood forest evaluation criteria. The wood duck, the target species, is a waterfowl species that favors mature forested wetland habitat with abundant snags and cavity trees. The beaver is a resident furbearing mammal that utilizes early successional forest habitat. The northern parula and prothonotary warbler are neotropical migrant songbirds that utilize mature forested wetland habitat during the breeding season. Additional species evaluated in this category were Canada goose, mallard, and green back heron.

Levee restoration was evaluated by determining the 3 most dominant land use classifications (non-forested wetland, bottomland hardwood forest, and open water) protected inside the levee system and evaluating these habitat types utilizing the same species by habitat type, as described above.

4. ASSUMPTIONS

Several assumptions have been made in regards to model performance, changes in habitat conditions over time, and future management practices.

a. Model Performance. The WHAG model was designed to be applied to many different types of habitat. For the MSU features, the WHAG team members completed field data sheets for the non-forested wetland matrix in order to evaluate without-project and with-project conditions for the wetland enhancement features, located at Unit 2, Fox Pond, Swarms/Beebe Ponds, IDNR MSU, and the USFWS MSU complex (Field 4 & 5, Field 21, MSU 20). The three USFWS MSUs were evaluated as one area because of their similar nature, management strategies, and close proximity. In addition, these units alone would share the proposed dedicated water supply. Dredging the access channels to Swarms/Beebe Ponds provides benefits primarily for non-forested wetland habitat, by allowing draw down of the area and subsequent plant germination. However, this feature also provides fisheries benefits, as described below.

Two field data sheets were prepared for the sand prairie area, upland cropfield for existing and future without project conditions, and upland grassland for future with project. Because of the uniqueness of this area, a very sandy site located in the floodplain, and the management goals, only the dickcissel, an avian, native grassland indicator species, was used from the evaluation set.

In order to evaluate the benefits of restoring overwintering fish habitat, or restoring access to deeper water, a field data sheet was prepared for each location using the aquatic (MOFISH) matrix for overflow waters habitat. The deep-water dredging locations were Lake Odessa (main lake), Goose Pond, and Yankee/Blackhawk Chutes. Dredging locations to improve fish access were Swarms/Beebe Ponds and Yankee/Blackhawk Chutes. In addition, the dredged material removed from the Yankee/Blackhawk Chutes site would be used to line the IDNR MSU, which would reduce seepage and increase water level control of that unit.

Three separate areas were considered for mast tree planting; Sites A and B (combined for the WHAG evaluation), site C adjacent to Sand Run, and the proposed dredged material placement area, Site D. For Sites A and B, two different field data sheets were prepared—wetland cropfield for existing and future without project, and bottomland hardwoods wetland for future with project. Although a portion of Site A contains an existing pecan grove, wetland cropfield was chosen as most representative of the current conditions and future without project. The second field sheet represented future with-project conditions assuming successful planting of mast producing tree species (pin oak, bur oak, swamp white oak, northern pecan, shellbark hickory, and sycamore).

To assess the levee restoration feature, the lands inside the levee were broken down into three categories for evaluation, based on aerial photographs (1989 and 1992) and vegetative cover maps from 1989; bottomland hardwood wetlands, non-forested wetlands, and open water. These evaluations required two data sheets, existing and without project, and with project conditions. The matrices used were bottomland hardwood wetlands, non-forested wetlands, and MOFISH overflow waters, respectively. Acreages were determined using the 1989 vegetative cover map. An additional fisheries benefit from the levee restoration would result from dredging in Turkey Chute, both above and below Lock and Dam 17, to supply sandy material needed for the levee

restoration. Above L/D 17, Turkey Chute already contains a large amount of deep-water habitat. The proposed dredge cut would ensure the long-term water depth in this area. However, because of the WHAG model sensitivity limitations, no model runs were performed for this area. Below L/D 17, the current water depths are relatively shallow, with the exception of three existing deep-water areas. These three areas currently provide excellent fisheries habitat and will be avoided as dredging areas. In this portion of Turkey Chute, the proposed dredging would increase both the deep-water areas as well as the total water area in the side channel complex. The amount of deep-water habitat, as a percentage of the total water area, was increased proportionately. The MOFISH side channel model lacked sufficient sensitivity to detect the benefits of this increase in deep water habitat. However, the proposed dredge cut would ensure the continued presence of deep-water habitat in this area.

b. Changes in Habitat Conditions Over Time. Habitat conditions are not static. Through natural processes or human activity, habitat evolves and may change in quality and/or quantity. Imbedded in each cover type evaluation, change has been added to the model. To assess the change over the period of analysis, target years have been defined. At each target year, a change in the habitat variables may be noticed. Noticeable changes can be characterized by a change in habitat benefit output.

Target years of 0 (baseline condition), 1, 25, and 50 (future without- and future with-project conditions) are sufficient to analyze HUs and characterize habitat changes over the estimated project life. For all interior project features, it was assumed that the levee would be restored, thereby providing increased flood protection for the interior features.

Evaluation of the MSU features (Field 4 & 5, Field 21, MSU 20, Unit 2, Fox Pond, Swarms/Bebee Ponds, IDNR MSU), as non-forested wetland habitat, assumed that the units would continue to function as they do currently over the project life of 50 years; same management goals, control of woody vegetation, and water control less than ideal for both depth and reliability under without project conditions. Only portions of the existing MSUs could be flooded as desired under normal conditions. During low water years, water supply to flood the MSUs may be inadequate, leading to decreased value and use of the areas by migratory waterfowl and other wildlife species. With project conditions, water level control would be greatly increased, as would the extent of the areas available for flooding.

For evaluation of the proposed sand prairie feature, the without project assumption was that most of the area would remain in crop production to supplement natural food sources for wildlife. Under with project conditions, the site would be managed as a prairie; management practices would more replicate natural processes, such as burning, over more human driven practices, such as mowing. Seeding the prairie area, coupled with burning, would produce a more naturalized area, with greater diversity and complexity than exists currently.

For all fisheries features within the levee (fish nursery, dredging deep-water area, dredging deep-water access), the team assumed a sedimentation rate of 1-2 cm/year, as determined through hydraulic analysis. This sedimentation rate does include the sediments deposited by flood events. Most, but not all, of the areas for deep-water dredging have been surveyed. No water depths greater than 6 feet were found under average winter water conditions. Under without project conditions, the assumption was made that no significant areas deeper than 6 feet were within the leveed area of the Lake Odessa Complex and, with continued sedimentation, the number of isolated areas would increase. The model was not sensitive to water depths shallower than 6 feet; however, interaction with the main water body was evaluated. Under with project conditions, for the deep-

water dredging project features, an area of influence was determined, using best professional judgment, in order to assign an acreage number to the WHAG model. These areas greatly exceeded the actual dredging areas. Although the fish nursery feature was assessed for habitat benefits, the MOFISH WHAG evaluation tool was not sensitive to the unique, artificial feature's benefits. Finally, the dredged material from the Yankee/Blackhawk Chutes feature provided benefits for the IDNR MSU, but these benefits from placement were only assigned to the MSU, not to the fisheries component. Improved access achieved through dredging for Swarms/Bebee Ponds had limited fisheries benefits. More benefits for this feature were determined through the non-forested wetland evaluation.

Mast tree planting features at three different sites were evaluated. For Sites A and B baseline, the team assumed that the wet cropfield evaluation matrix was representative of the areas and that the future conditions would remain the same. The same similarity assumption was made for the with-project condition. For both Site C (interplanting) and Site D (dredged material placement site), it was assumed that the documented lack of natural mast tree regeneration was consistent throughout. In addition, the WHAG model placed more emphasis on the importance of soft mast over hard mast for the target species than current research indicates. For the dredged material placement site, the model did not accurately capture the change of the site's elevation after placement, assessing the site as more upland than wetland. Finally, the primary benefit for the dredging action is for fisheries benefits, with the placement site's use as a mast tree planting area as a secondary benefit.

Evaluation of the levee restoration project feature was based on reducing flood events produced by levee overtopping and/or failure, thereby protecting the interior features from flood damages such as increased sedimentation and/or destruction of infrastructure, both of which reduce habitat values. For this evaluation, it was assumed that all proposed interior features would be constructed, no change in total numbers of acres of all three habitat types (non-forested wetland, bottomland hardwood forest wetland, and open water) would occur, and, without project, the levee would continue to fail, but would be repaired after each event. Because of repeated future failures without project, the existing habitats would deteriorate over time, whereas, with levee restoration, existing habitat would be maintained.

An additional fisheries benefit from the levee restoration would result from dredging in Turkey Chute, both above and below Lock and Dam 17, to supply sandy material needed for the levee restoration. Above L/D 17, Turkey Chute already contains a large amount of deep-water habitat. The proposed dredge cut, to a final depth of 10 feet at flat pool, would ensure the long-term water depth in this area. However, because of the WHAG model sensitivity limitations, no model runs were performed for this area. Below L/D 17, the current water depths are relatively shallow, with the exception of three existing deep-water areas. These areas currently provide excellent fisheries habitat and will be avoided as dredging areas. The proposed dredge cut was coordinated with Mississippi River fisheries biologists to provide the maximum fisheries benefits for the upper reach of Pool 18. In the absence of specific data, a sedimentation rate of 1.6 cm/year is assumed, based on research data of backwaters in the general area. This rate may be an underestimate since flows over the L/D spillway occur regularly and would scour the dredge cut to some extent. However, because of the WHAG model sensitivity limitations, no model runs were performed for this area. This proposed dredging would add 11.5 acres of deep-water habitat.

c. Future Management Use. Evaluation of all feasible project features and alternatives assumed that current operation would continue essentially unchanged through the 50-year project life and that the current management objectives would remain in effect.

5. RESULTS OF HABITAT ANALYSIS

This section describes the benefits in AAHUs for each feature discussed in the DPR. These features are the enhancement of the MSUs through increased water level control and reliability; restoration of the sand prairie area by seeding; restoration of aquatic habitat by fish nursery construction, dredging deep-water areas, and/or enhancing access; restoration of floodplain terrestrial habitat by reforestation of historic cropfields and inter-planting mast-producing trees to restore diversity; and restoring the existing main stem levee in order to protect the habitats within it from flood events, siltation and concomitant habitat degradation.

Results of the habitat analysis, expressed in total AAHUs, are provided in Tables D-2 through D-18 for the preferred alternative for each of the project's six feature types (MSU enhancement, sand prairie restoration, fish nursery construction, aquatic habitat enhancements, mast tree planting, and levee restoration).

a. Moist Soil Unit (MSU) Enhancement. The primary emphasis on enhancement of the existing MSUs is to improve the water level control and reliability of the water supply to the units. Though all of the units are currently in service, problems with the water supply, inadequate/aging water control structures, limits on achievable water level heights, and/or extreme seepage prevent maximum use of each unit.

(1) MSU: USFWS Complex (Field 4 & 5, Field 21, MSU 20) (M1). This feature consists of enhancing the USFWS MSU complex (Field 4 & 5, Field 21, MSU 20), and includes portable pumps (with pads) at Field 4 & 5 and Field 21. Most importantly, a dedicated water supply would be constructed to supply these units. Construction of the dedicated water supply would include modification of the current inlet structure by isolating one of the four bays. In addition, a supply ditch and road crossing would be added. A small area of early successional forest would be disturbed during this construction. All of these features allow for flooding the units to elevation 538.5 MSL, when desired, and at any time. Currently, Field 4 & 5 can be flooded but is limited by water availability; only 10 acres flood reliably, and approximately 60% of the area can be flooded at all. Field 21 can only be flooded over 25% of the area. MSU 20 can be flooded, but water availability is limited. Current water supplies are directed either toward the main lake or toward the MSU units via a stoplog structure, but not both simultaneously. The dedicated water bay allows for independent or simultaneous filling of the main lake and/or the three USFWS MSUs. The three USFWS MSUs were evaluated as one area because of their similar nature, management strategies, and close proximity. Results of the analysis are summarized in Table D-2 below. While enhancement of these moist soil habitats is expected to benefit migratory waterfowl and other wildlife beyond the boundaries of these units, evaluation of benefits was limited to the area of the units themselves. About 238 acres of the moist soil management units were assumed to benefit from this increase in water level control and reliability. Total benefits for the proposed improvements were calculated to be 83.2 AAHUs.

**Table D-2. USFWS MSU Complex (Field 4 & 5, Field 21, MSU 20) —
Projected Habitat Benefits (AAHUs)**

Species	Without Project	With Project	Net HUs
MALLARD*	112.9	142.11	29.2
CANADA GOOSE*	129.9	153.5	23.6
LEAST BITTERN*	176.2	190.2	14.0
LESSER YELLOWLEGS*	97.6	107.4	9.8
MUSKRAT	8.7	7.2	-1.5
KING RAIL	99.6	142.4	42.8
GREEN-BACKED HERON	114.7	114.7	0.0
AMERICAN COOT	122.3	87.6	-34.7

TOTAL BENEFITS NON-FORESTED WETLAND ENCHANCEMENT 83.2

(AAHUs – 238 acres enhanced with gain in water level control)

* denotes target species

(2) MSU: Unit 2 (U1). This feature involves providing one new water control structure and a portable pump. All of these features allow for flooding the unit completely, when desired, and at any time. Woody invasion is a problem at this area. The proposed features would enhance management options in order to achieve the desired vegetative community for the area. While enhancement of this moist soil habitat unit is expected to benefit migratory waterfowl and other wildlife beyond the boundaries of the unit, evaluation of benefits was limited to the area of the unit itself (92 acres). Total benefits were calculated to be 69.2 AAHUs. Table D-3 displays the projected benefits identified for this option.

Table D-3. Unit 2 — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	44.6	64.3	19.7
CANADA GOOSE*	43.4	60.6	17.2
LEAST BITTERN*	56.5	73.7	17.2
MUSKRAT	0.0	10.7	10.7
KING RAIL	57.8	59.8	2.0
GREEN-BACKED HERON	56.3	58.7	2.4

TOTAL BENEFITS NON-FORESTED WETLAND ENCHANCEMENT 69.2

(AAHUs – 92 acres enhanced with gain in water level control)

* denotes target species

(3) MSU: Fox Pond (F1). This feature consists of constructing a pump station and water control structure. An additional pump pad would be added to allow a portable pump from one of the other MSUs to be set up here to complete dewatering of Fox Pond. Current operations only allow for pumping water out of the area, with gravity flow dewatering. Two-way pumping (achieved by bringing in a portable pump when needed) would, with the features proposed, allow for a greater level of water level manipulation than currently possible. The total area available for flooding is 336 acres, greater than the pond itself (previous limit of 72 acres). Total benefits were calculated to be 236.6 AAHUs. Table D-4 displays the projected benefits identified for this option.

Table D-4. Fox Pond — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	157.1	255.9	98.8
CANADA GOOSE*	168.0	261.5	93.5
LEAST BITTERN*	249.6	249.6	0.0
LESSER YELLOWLEGS*	189.7	240.6	50.9
MUSKRAT	41.5	47.4	5.9
KING RAIL	182.4	182.4	0.0
GREEN-BACKED HERON	142.3	142.3	0.0
AMERICAN COOT	210.0	197.5	-12.5

TOTAL BENEFITS NON-FORESTED WETLAND ENCHANCEMENT 236.6
(AAHUs – 336 acres enhanced with gain in water level control)

* denotes target species

(4) MSU: Swarms/Beebe Ponds (S1). This feature consists of mechanically dredging the channels from the main lake to Swarms Pond and from Swarms to Beebe Pond. Dredged material will be sidecast on the downstream bank. Currently, the channels have silted in and, during low water, cut off access from the ponds to deeper, better-oxygenated waters, affecting fish. In addition, when the ponds are isolated from the main lake during low water conditions, no water control for moist soil plants is possible. Total non-forested wetland benefits were calculated to be 207.5 AAHUs. Table D-5 displays the projected benefits identified for this option.

Table D-5. Swarms/Beebe Ponds — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	41.2	79.3	38.1
CANADA GOOSE*	40.2	76.6	36.4
LEAST BITTERN*	0.0	93.9	93.9
LESSER YELLOWLEGS*	91.6	79.3	-12.3
MUSKRAT	15.9	15.9	0.0
KING RAIL	88.6	73.7	-14.9
GREEN-BACKED HERON	79.2	71.5	-7.7
AMERICAN COOT	0.0	74.0	74.0

TOTAL BENEFITS NON-FORESTED WETLAND ENCHANCEMENT 207.5
(AAHUs – 132 acres enhanced with gain in water level control)

* denotes target species

(5) MSU: IDNR MSU (D1). This feature consists of clearing and grubbing the current MSU, then lining the 49-acre unit with 1 foot of fine, silty material from fisheries enhancement dredging to reduce the current seepage. In addition, a portable pump (with pad) and water control structure would be included. These improvements would allow full use of the unit. The current seepage problem only allows the unit to be partially filled. Total benefits were calculated to be 43.6 AAHUs. Table D-6 displays the projected benefits identified for this option.

Table D-6. IDNR MSU — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	29.8	39.3	9.5
LEAST BITTERN*	19.6	32.8	13.2
LESSER YELLOWLEGS*	25.4	33.4	8.0
MUSKRAT	0.0	5.0	5.0
KING RAIL	25.2	25.9	0.7
GREEN-BACKED HERON	36.3	38.6	2.3
AMERICAN COOT	20.2	25.1	4.9

TOTAL BENEFITS NON-FORESTED WETLAND ENCHANCEMENT 43.6

(AAHUs – 49 acres enhanced with gain in water level control)

* denotes target species

b. Sand Prairie Restoration. The proposed area for restoration contains the remnants of a previous restoration effort undertaken in 1985. Damage to the area during the flood of 1993 has destroyed much of this previous restoration attempt. In addition, a portion of this site is currently in rowcrop agriculture. The crops are not harvested to provide additional food resources for waterfowl and other wildlife. The proposed restoration would restore a unique and diverse habitat within the Lake Odessa complex. Using a bulk seed mix from a local source, grown under similar site conditions, would ensure plant survival and reproduction success.

(1) Restore Sand Prairie. This feature would involve planting 36 acres to replicate native prairie originally found on the site. Habitat benefits are shown in Table D-7 below. Only benefits for the dickcissel were considered. This species is a native grassland indicator and the best fit for capturing the intended benefits. Total benefits for this species were calculated to be 21.8 AAHUs, with a net result of 11.3 AAHUs for all evaluation species. The data for the other species included in the model's evaluation are shown for general information purposes only. Other areas within the Lake Odessa complex supply habitat for all other species shown below. The greater prairie chicken is not found in the area, but represents a guild of species, which are sensitive to grassland fragmentation. Because of the isolated nature of this unique area, fragmentation issues cannot be mitigated.

Table D-7. Sand Prairie Restoration — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
WHITE-TAILED DEER	26.9	26.7	-0.2
WILD TURKEY	26.9	23.8	-3.1
DICKCISSSEL*	0	21.8	21.8
BOBWHITE QUAIL	6.1	3.6	-2.5
EASTERN COTTONTAIL RABBIT	5.8	5.4	-0.4
PRAIRIE CHICKEN	26.6	22.3	-4.3

TOTAL BENEFITS UPLAND GRASSLAND (PRAIRIE RESTORATION) 11.3

(AAHUs -36 acres enhanced with seeding)

* denotes target species

c. Fisheries Enhancement – Upper Fish Nursery. The proposed fish nursery would provide a controlled environment where predatory fish can be excluded. The current stocking

practice is to release fingerling sized fish, rather than smaller (and less expensive) fry. Generally, survival rates for larger fish are greater. The nursery feature allows the stocking of fry and provides a safe environment for the fish to reach a larger size, prior to release into the main lake.

(1) Construct Fish Nursery. This feature would involve replacing an existing water control structure for this 21-acre area. Included in this design is a reinforced concrete pipe which would not be an impediment to fish release from the area into the main lake at the end of the season. Total benefits for this option were calculated to be -0.7 AAHU. This apparent lack of benefits reflects the MOFISH model's design to evaluate natural situations. The negative impacts reflect the isolation of this area from the main lake. The model results are included for completeness, but the assumption was made, using best professional judgment, that this feature would provide the intended nursery benefits. Post construction monitoring will be implemented to document the results of this feature.

Table D-8. Fish Nursery — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	3.4	3.3	-0.1
CRAPPIE (WH-BL)*	2.9	2.8	-0.1
LARGEMOUTH BASS*	3.1	3.0	-0.1
CARP	3.3	3.2	-0.1
BLUEGILL*	2.7	2.5	-0.2
BLACK BULLHEAD	2.8	2.7	-0.1
TOTAL BENEFITS FISHERIES ENHANCEMENT (NURSERY)			-0.7

(AAHUs - 21 acres protected nursery habitat provided)

* denotes target species

d. Fisheries Enhancement – Dredging Deep Water/Access. The primary emphasis of fisheries enhancement is creating areas of deeper water and/or access to deeper water at the Lake Odessa complex. Sedimentation and flood damage have reduced deep-water habitat over time. Additionally, access channels (natural or manmade) have silted in, reducing the ability of fish to leave some areas if conditions would necessitate (low dissolved oxygen or freezing water). For the deep-water dredging, a sedimentation rate of 1-2 cm/yr was calculated. After 50 years (project life), these areas would have reverted to the existing condition of 6-foot deep water found in the main lake and Blackhawk Chute. The access channels will be over-dredged and it is assumed that these channels will still be somewhat functional at the end of the proposed project life. Because it was assumed the levee restoration would occur, flood damages (sediment deposition) would be reduced over existing conditions.

(1) Fisheries Enhancement: Dredge Main Lake (L1). This feature consists of dredging 81,555 cubic yards of material. The dredging dimensions are 1,490 feet by 751 feet by 2 feet deep, to a final depth of 8 feet based on an average winter water elevation of 534.5 MSL. The sideslopes shall be cut at a slope of 6 horizontal to 1 vertical. The dredged material is mainly fine sediment and will be hydraulically dredged into a containment site. This containment site will be cleared and grubbed around the perimeter to allow for construction of a containment berm, using material from within the area. After the dredged material is placed and allowed to dry, it will be graded and used as a mast tree-planting site (Site D). Habitat benefits for the mast tree planting are found in section 5.e(3) of this appendix. Total benefits for the proposed fisheries improvements were calculated to be 418.6 AAHUs and are shown in Table D-9 below.

Table D-9. Dredge Main Lake — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	111.1	122.4	11.3
CRAPPIE (WH-BL)*	0.0	81.2	81.2
LARGEMOUTH BASS*	0	85.4	85.4
GIZZARD SHAD*	0	121.9	121.9
CARP	120.7	373.7	17.0
BLUEGILL*	0.0	81.5	81.5
BLACK BULLHEAD	102.7	123.0	20.3

TOTAL BENEFITS FISHERIES ENHANCEMENT

418.6

(AAHUs – 776 acres have access to deep-water overwintering habitat)

* denotes target species

(2) Fisheries Enhancement: Dredge Goose Pond (G1). This feature consists of dredging 90,170 cubic yards of material. A deep channel will be dredged to connect Goose Pond and Sand Run Chute in order to connect shallower water with the main lake, which contains areas of deeper water. The dimensions of the channel would be 5,158 feet long, 142 feet wide, by 4 feet deep with a final depth of 8 feet based on an average winter water elevation of 534.5 MSL. The sideslopes shall be cut at a slope of 6 horizontal to 1 vertical. The dredged material is mainly fine sediment and will be hydraulically dredged into a containment site (same as the main lake dredging). This containment site will be cleared and grubbed around the perimeter to allow for construction of a containment berm, using material from within the area. After the dredged material is placed and allowed to dry, it will be graded and used as a mast tree-planting site (Site D). Habitat benefits for the mast tree planting are found in section 5.e(3) of this appendix. Total benefits for the proposed fisheries improvements were calculated to be 67.8 AAHUs. Table D-10 displays the projected fisheries benefits identified for this option.

Table D-10. Dredge Goose Pond — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	48.5	51.9	3.4
CRAPPIE (WH-BL)*	41.2	44.9	3.7
LARGEMOUTH BASS*	43.8	47.9	4.1
GIZZARD SHAD*	0.0	36.5	36.5
CARP	47.4	52.9	5.5
BLUEGILL*	37.4	44.1	6.7
BLACK BULLHEAD	40.4	48.3	7.9

TOTAL BENEFITS FISHERIES ENHANCEMENT

67.8

(AAHUs – 305 acres have access to deep-water overwintering habitat)

* denotes target species

(3) Fisheries Enhancement: Dredge Blackhawk/Yankee Chutes (B1). This feature consists of dredging 63,530 cubic yards of material. A deep channel will be dredged to connect Yankee Chute and Blackhawk Chute in order to connect shallower water with areas of deeper water. The dimensions of the channel would be 6,040 feet long, 95 feet wide, by 4 feet deep with a final depth of 8 feet based on an average winter water elevation of 534.5 MSL. Because of an existing water depth gradient (shallower at Yankee to deeper at Blackhawk), the

final water depth in Blackhawk Chute would be 8 feet based on an average winter water elevation of 534.5 MSL. The sideslopes shall be cut at a slope of 6 horizontal to 1 vertical. The dredged material is mainly fine sediment and will be hydraulically dredged into the IDNR MSU for use as impervious liner material. Habitat benefits for the MSU enhancement are found in section 5.a(5) of this appendix. Total fisheries benefits were calculated to be 32.3 AAHUs. Table D-11 displays the projected benefits identified for this option.

Table D-11. Dredge Blackhawk/Yankee Chutes — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	26.1	27.7	1.6
CRAPPIE (WH-BL)*	20.5	22.1	1.6
LARGEMOUTH BASS*	21.2	23.0	1.8
GIZZARD SHAD*	0.0	17.8	17.8
CARP*	26.5	29.1	2.6
BLUEGILL	18.8	21.8	3.0
BLACK BULLHEAD	23.2	27.1	3.9

TOTAL BENEFITS FISHERIES ENHANCEMENT

32.3

(AAHUs – 149 acres have access to deep-water overwintering habitat)

* denotes target species

(4) Fisheries Enhancement: Swarms/Beebe Ponds (S1). This option consists of deepening the existing access channels from the main lake to Swarms Pond and from Swarms to Beebe Ponds by mechanical dredging. The dimensions of the channels would be 650 feet long by 126 feet wide between Beebe and Swarms, 1,517 feet long by 118 feet wide between Swarms and the main lake, with a depth equal to the existing pond depth (~ 1 foot of dredging). Dredged material will be sidecast on the downstream bank. Currently, the channels have silted in and, during low water, cut off access from the ponds to deeper, better-oxygenated waters, affecting fish. In addition, when the ponds are isolated from the main lake during low water conditions, no water control for moist soil plants is possible. Habitat benefits for the MSU enhancement are found in section 5.a(4) of this appendix. Total fisheries benefits were calculated to be 5.9 AAHUs. Table D-12 displays the projected benefits identified for this option.

Table D-12. Swarms/Beebe Ponds — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	20.1	21.0	0.9
CRAPPIE (WH-BL)*	18.5	19.5	1.0
LARGEMOUTH BASS*	20.1	20.9	0.8
CARP	22.4	23.5	1.1
BLUEGILL*	19.1	20.1	1.0
BLACK BULLHEAD	20.2	21.3	1.1

TOTAL BENEFITS FISHERIES ENHANCEMENT

5.9

(AAHUs – 132 acres have access to deep-water overwintering habitat)

* denotes target species

e. Reforestation (Mast Tree Planting). Restoration of historic bottomland hardwood forest at the Lake Odessa complex would involve the cessation of row crop cultivation (Sites A and

B) and planting of mast producing tree species in those areas. In addition, a higher water table and flood damages have significantly reduced mast tree regeneration and have induced mortality in many of the existing trees. Augmenting existing forest stands through interplanting (Site C) and providing higher elevations for mast tree planting (Site D) will contribute to the diversity and health of the bottomland hardwood forest. A total of 93 acres would be impacted by implementation of this feature. While the loss of cropfield habitat would reduce habitat for some game species such as mallard and Canada goose, numerous other bird and mammal species, represented by the five evaluation species listed in Tables D-13 through D-15 below, would derive substantial benefits from reduced forest fragmentation, increased cover, and improvements to the available food base provided by the increased presence of mast-producing trees. All areas will be planted utilizing Root Prune Method (RPM) mast trees, which are expected to enhance the survival rate of plantings, promote faster acorn production, and in the long term, provide a seed base to promote future natural regeneration of these species. The species mix includes equal proportions of northern pecan, swamp white oak, bur oak, pin oak, sycamore, and shellbark hickory.

(1) Plant USFWS Fields (Sites A & B) (A1). Table D-13 below summarizes the results of analyzing habitat changes resulting from planting mast trees on areas previously in row crops and now as idle fields. Site A adjoins an existing 18-acre natural pecan grove. This feature was estimated to provide total benefits of 60.2 AAHUs. Planting Root Prune Method (RPM) mast trees is expected to enhance the survival rate of plantings, promote faster mast production, and in the long term, provide a seed base to promote future natural regeneration of these species.

Table D-13. Reforestation Sites A&B — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	18.5	18.3	-0.2
CANADA GOOSE	18.3	0.1	-18.2
GREEN-BACKED HERON	0.0	20.3	20.3
WOOD DUCK*	0.0	14.9	14.9
BEAVER	0.0	20.7	20.7
NORTHERN PARULA	0.0	12.3	12.3
PROTHONOTARY WARBLER	0.0	10.4	10.4

TOTAL BENEFITS MAST TREE PLANTING

60.2

(AAHUs - 27 acres mast tree planting)

* denotes target species

(2) Interplant Site C (C1). This feature would involve interplanting mast-producing trees in an existing 26-acre tract of forest. Currently, a decline of mast producing trees and increasing numbers of silver maple and cottonwood trees in this area limits its wildlife value. Analysis of this feature resulted in calculated benefits of 1.3 AAHUs. Only 1.3 AAHUs were generated because reintroduction of mast-producing tree species into an area of existing forest habitat is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies, WHAG included, are generally less sensitive to such qualitative changes within a habitat type. More benefits are generated when there is a drastic change from one habitat type to another. In these circumstances, the results of the analysis may not reflect real life expectations. Current physical conditions at the site, specifically vulnerability to frequent flooding, could also affect the survival of plantings. It is assumed that restoration of the levee system will reduce the frequency and duration of future flood events, improving survival of any mast tree plantings. Planting Root Prune Method (RPM) mast trees is expected to enhance the survival rate of plantings, promote

faster mast production, and in the long term, provide a seed base to promote future natural regeneration of these species.

Table D-14. Reforestation Site C — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	17.2	17.4	0.2
GREEN-BACKED HERON	18.6	18.8	0.2
WOOD DUCK*	21.1	21.8	0.7
BEAVER	17.3	17.5	0.2
NORTHERN PARULA	14.1	14.1	0.0
PROTHONOTARY WARBLER	17.8	17.8	0.0
TOTAL BENEFITS MAST TREE PLANTING			1.3
(AAHUs - 26 acres mast tree planting)			
* denotes target species			

(3) Plant Dredged Material Placement Site (Site D) (D1). This feature would involve planting mast-producing trees over the entire 40-acre dredged material placement site. Analysis of this feature resulted in a calculated loss of 24.0 AAHUs. This loss represents the significant disturbance of the existing floodplain forest by the dredged material placement. However, the replacement of the existing soft mast producing forest by a mix of hard mast-producing tree species and soft mass species is a relatively subtle change in habitat quality. Existing habitat evaluation methodologies, WHAG included, are generally less sensitive to such qualitative changes within habitat types than to more drastic changes from one habitat type to another (e.g., cropfield converted to forest). From the landscape perspective, stands of hard mast producing trees are losing ground to more flood tolerant species, primarily silver maple and cottonwood. In these circumstances, the results of the analysis may not reflect real life expectations. Planting Root Prune Method (RPM) mast trees is expected to enhance the survival rate of plantings, promote faster mast production, and, in the long term, provide a seed base to promote future natural regeneration of these species. Finally, the primary purpose of this site is for dredged material placement resulting from fisheries enhancement features (dredging main lake and Goose Pond). The fisheries benefits from that action have been discussed in the previous section and will not be repeated here (see 5.d(1) and (2)). Though planting this site with mast trees incurs additional costs, this action offsets the habitat lost through containment site construction and use.

Table D-15. Reforestation Site D — Projected Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	26.2	24.4	-1.8
GREEN-BACKED HERON	28.8	29.2	0.4
WOOD DUCK*	34.6	24.8	-9.8
BEAVER	28.3	30.2	1.9
NORTHERN PARULA	25.5	19.5	-6.0
PROTHONOTARY WARBLER	28.4	19.7	-8.7
TOTAL BENEFITS MAST TREE PLANTING			-24.0
(AAHUs - 40 acres mast tree planting)			
* denotes target species			

f. Levee Restoration. The objective of the levee restoration feature is to increase flood protection of the Lake Odessa complex and reduce incidence of levee failure. This will be accomplished by restoring all sections of the current exterior levee system to the 50 to 25-year level of protection (from upstream to downstream), while also flattening interior slopes steeper than 5 horizontal to 1 vertical to improve section reliability. Sandy material, hydraulically dredged from Turkey Chute, a side channel of the Mississippi River, will be used for this repair. As a part of the levee restoration, two spillways will be added to the system. Construction of the upper spillway (17-year level of protection) is a USFWS initiative; though not yet completed, it was included under the ‘with project conditions’ of the habitat evaluation. The lower spillway, providing a 10-year level of protection, is part of this HREP. These spillways will allow interior and exterior water levels to nearly equalize prior to levee overtopping, which should limit damage to interior features and the levee itself (no breaches).

The second portion of the levee restoration includes construction of a wing dam between Michael Creek and the upper inlet structure on the Mississippi River. This wing dam will reduce sedimentation at or near the inlet structure that, if allowed to build up, interferes with water control capabilities of the inlet structure. Both the levee restoration and wing dam construction were considered in the habitat evaluation below.

The final component of the restoration involves archeological site protection. Shoreline protection of the sites will be accomplished using riprap. No habitat benefits or impacts were assumed for this feature, although the addition of rocky substrates will provide ancillary aquatic benefits.

(1) Levee Restoration with Spillway. Tables D-16 through D-18 below summarize the results of analyzing habitat changes resulting from levee restoration. This feature was estimated to provide total benefits of 1671.5 AAHUs for three distinct habitat types; non-forested wetland, bottomland hardwood forest, and aquatic. The acreage figures for these three habitat types were calculated from a map of vegetative cover types for the area. For this evaluation, it was assumed that all interior features would be constructed. A 20-year level of protection was also proposed. However, this potential alternative was eliminated from further consideration because of higher costs and no increase in habitat benefits.

Table D-16. Levee Restoration — Projected Non-forested Wetland Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	936.0	1218.5	282.5
CANADA GOOSE*	1189.0	1488.8	299.2
LEAST BITTERN*	1008.7	1220.0	211.3
LESSER YELLOWLEGS*	1226.2	1410.8	184.6
MUSKRAT	184.5	192.4	7.9
KING RAIL	1143.2	1220.0	76.8
GREEN-BACKED HERON	1186.0	1154.3	-31.7

TOTAL BENEFITS NON-FORESTED WETLAND

1030.6

(AAHUs – 1817 acres protected)

* denotes target species

Table D-17. Levee Restoration — Projected Bottomland Hardwood Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
MALLARD*	1671.1	1685.2	14.1
GREEN-BACKED HERON	1954.2	1954.2	0.0
WOOD DUCK*	1896.8	2115.2	218.4
BEAVER	1803.2	1780.2	-23.0
NORTHERN PARULA	1596.5	1596.5	0.0
PROTHONOTARY WARBLER	2022.1	2022.1	0.0
TOTAL BENEFITS BOTTOMLAND HARDWOODS			209.5
(AAHUs - 3002 acres protected)			
* denotes target species			

Table D-18. Levee Restoration — Projected Aquatic Habitat Benefits (AAHUs)

Species	Without Project	With Project	Net HUs
CHANNEL CATFISH	293.5	316.0	22.5
CRAPPIE (WH-BL)*	191.8	210.4	18.6
LARGEMOUTH BASS*	199.1	218.5	19.4
GIZZARD SHAD*	0.0	264.7	264.7
CARP	307.4	341.9	34.5
BLUEGILL*	176.1	204.0	27.9
BLACK BULLHEAD	271.3	315.1	43.8
TOTAL BENEFITS FISHERIES			431.4
(AAHUs – 1677 acres protected)			
* denotes target species			

6. INCREMENTAL ANALYSIS OF ALTERNATIVES

The environmental benefits (outputs) and costs of each feature are summarized in Table 5-1 in the Definite Project Report. Combinations of features were grouped by function for incremental analysis; all MSU features were grouped together; all fisheries enhancements, except the fish nursery, were grouped together. Alternative increments of each feature were then analyzed to identify the most cost-effective increments of each feature included in the selected plan. This analysis was performed in 2002, using the cost estimate prepared at that time and using the 2002 interest rate of 6.25%. The results for MSUs and fisheries dredging features are summarized below.

Incremental analysis is not necessary for features with only one possible alternative, other than no action, such as the fish nursery, sand prairie restoration, and levee restoration. Incremental analysis was also not performed for the mast tree planting alternatives. Lack of model sensitivity for these features skews the habitat impacts and results of the analysis may not reflect real life expectations. The mast tree-planting alternative has three potential features; however, Site D (dredged material placement site) was included as a potential mast tree site, but planting the containment area mitigates for the habitat loss of containment construction and use, and is considered a fisheries dredging feature primarily, with secondary use as a mast tree-planting site. Though planting this site with mast trees incurs additional costs, this action offsets the habitat lost through containment site construction and use.

a. Moist Soil Unit (MSU) Enhancement. For MSUs, a total of 32 potential combinations may be formulated with the identified increments of feasible project features. Table D-19 displays these combinations in ascending order based on output. Eight cost effective plans resulted from the analysis, six of which were considered best buys. Results of the incremental cost analysis are shown in Table D-20 and depicted in Figure D-1 below.

Table D-19. Potential Combination of MSU Features Ranked by Output

	Plan	Output (AAHUs)*	Annualized Cost (\$)**	Cost (\$)/ AAHU**
1.	M0+U0+F0+S0+D0=	0	0	0.0
2.	M0+U0+F0+S0+D1=	43.6	15173	348.0
3.	M0+U1+F0+S0+D0=	69.2	7103	102.6
4.	M1+U0+F0+S0+D0=	83.2	33321	400.5
5.	M0+U1+F0+S0+D1=	112.8	22276	197.5
6.	M1+U0+F0+S0+D1=	126.8	48494	382.4
7.	M1+U1+F0+S0+D0=	152.4	40424	265.2
8.	M1+U1+F0+S0+D1=	196.0	55597	283.7
9.	M0+U0+F0+S1+D0=	207.5	3097	14.9
10.	M0+U0+F1+S0+D0=	236.6	18796	79.4
11.	M0+U0+F0+S1+D1=	251.1	18270	72.8
12.	M0+U1+F0+S1+D0=	276.7	10200	36.9
13.	M0+U0+F1+S0+D1=	280.2	33969	121.2
14.	M1+U0+F0+S1+D0=	290.7	36418	125.3
15.	M0+U1+F1+S0+D0=	305.8	25899	84.7
16.	M1+U0+F1+S0+D0=	319.8	52117	163.0
17.	M0+U1+F0+S1+D1=	320.3	25373	79.2
18.	M1+U0+F0+S1+D1=	334.3	51591	154.3
19.	M0+U1+F1+S0+D1=	349.4	41072	117.6
20.	M1+U1+F0+S1+D0=	359.9	43521	120.9
21.	M1+U0+F1+S0+D1=	363.4	67290	185.2
22.	M1+U1+F1+S0+D0=	389.0	59220	152.2
23.	M1+U1+F0+S1+D1=	403.5	58694	145.5
24.	M1+U1+F1+S0+D1=	432.6	74393	172.0
25.	M0+U0+F1+S1+D0=	444.1	21893	49.3
26.	M0+U0+F1+S1+D1=	487.7	37066	76.0
27.	M0+U1+F1+S1+D0=	513.3	28996	56.5
28.	M1+U1+F1+S1+D0=	527.3	55214	104.7
29.	M0+U1+F1+S1+D1=	556.9	44169	79.3
30.	M1+U0+F1+S1+D1=	570.9	70387	123.3
31.	M1+U1+F1+S1+D0=	596.5	62317	104.5
32.	M1+U1+F1+S1+D1=	640.1	77490	121.1

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25 % interest, 50-yr project life. Construction costs only.

*** Shading denotes cost effective plans.

M0, U0, F0, S0, D0 - No Action

M1 - Enhance USFWS Complex (Field 4 & 5, Field 21, MSU 20)

U1 - Enhance Unit 2

F1 - Enhance Fox Pond

S1 - Enhance Swarms/Beebe Ponds

D1 - Enhance IDNR MSU

Table D-20. MSU Enhancement — Incremental Cost Analysis of Best Buy Plans

Plan	Output AAHUs*	Annual Cost**	Cost/ AAHU	Inc. Cost	Inc. Output	Inc. \$/ AAHU
M0+U0+F0+S0+D0	0.0	0.0	0.0	0	0.0	0.0
M0+U0+F0+S1+D0	207.5	3,097	14.9	3,097	207.5	14.9
M0+U0+F1+S1+D0	444.1	21,893	49.3	18,786	236.6	79.4
M0+U1+F1+S1+D0	513.3	28,996	56.5	7,103	69.2	102.6
M0+U1+F1+S1+D1	556.9	44,169	79.3	15,173	43.6	348.0
M1+U1+F1+S1+D1	640.1	77,490	121.1	33,321	83.2	400.5

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25 % interest, 50-yr project life. Initial construction costs only.

M0, U0, F0, S0, D0 - No Action

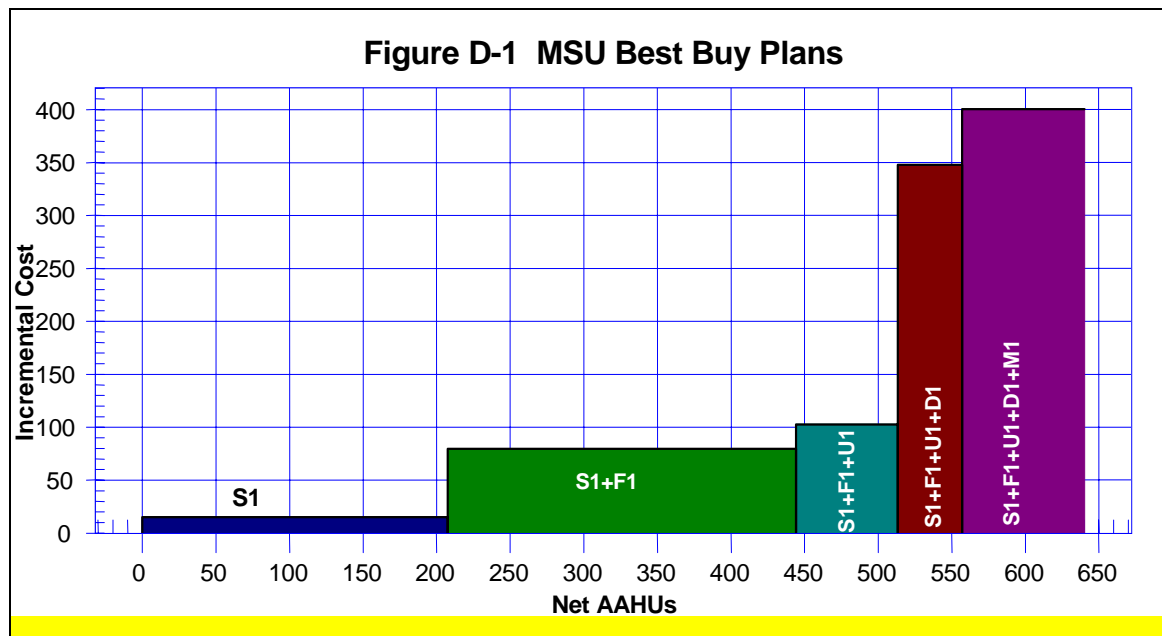
M1 - Enhance USFWS Complex (Field 4 & 5, Field 21, MSU 20)

U1 - Enhance Unit 2

F1 - Enhance Fox Pond

S1 - Enhance Swarms/Bebee Ponds

D1 - Enhance IDNR MSU



b. Fisheries Enhancements (dredging). For the fisheries enhancement by dredging deepwater and/or access to such, a total of 32 potential combinations were possible, but due to non-combinable features, only 16 actual combinations were analyzed as the identified increments of feasible project features. This was because the same containment area would be used for dredging either or both the main lake or Goose Pond. Since containment costs for one or both areas were virtually identical, another feature was added for incremental analysis, which included dredging both the Main Lake and Goose Pond and included containment costs. This kept the software from counting the costs of the containment area twice if both sites were dredged. This combined feature was therefore not combinable in the analysis with either the Main Lake or Goose Pond. Table D-

21 displays these combinations in ascending order based on output. Results of the incremental cost analysis are shown in Table D-22 and depicted in Figure D-2 below.

Table D-21. Potential Combination of Dredging Features Ranked by Output

Plan		Output (AAHUs)*	Annualized Cost (\$)**	Cost (\$)/ AAHU**
1.	S0+L0+G0+B0+C0=	0.0	0.0	0.0
2.	S1+L0+G0+B0+C0=	5.9	3097	524.9
3.	S0+L0+G0+B1+C0=	32.3	47215	1461.8
4.	S1+L0+G0+B1+C0=	38.2	50312	1317.1
5.	S0+L0+G1+B0+C0=	67.8	71791	1058.9
6.	S1+L0+G1+B0+C0=	73.7	74888	1016.1
7.	S0+L0+G1+B1+C0=	100.1	119006	1188.9
8.	S1+L0+G1+B1+C0=	106.0	122103	1151.9
9.	S0+L1+G0+B0+C0=	418.6	65388	156.2
10.	S1+L1+G0+B0+C0=	424.5	68485	161.3
11.	S0+L1+G0+B1+C0=	450.9	112603	249.7
12.	S1+L1+G0+B1+C0=	456.8	115700	253.3
13.	S0+L0+G0+B0+C1=	486.4	132403	272.2
14.	S1+L0+G0+B0+C1=	492.3	135499	275.2
15.	S0+L0+G0+B1+C1=	518.7	179617	346.3
16.	S1+L0+G0+B1+C1=	524.6	182714	348.3

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25 % interest, 50-yr project life. Construction costs only.

*** Shading denotes cost effective plans.

S0, L0, G0, B0, C0 - No Action

S1 – Dredge Swarms/Bebee Ponds

L1 – Dredge Main Lake+containment\$

G1 – Dredge Goose Pond+containment\$

B1 – Dredge Blackhawk/Yankee Chutes

C1 – Dredge Main Lake+Goose Pond+containment\$

The following features are not combinable: L+G, L+C, G+C (containment costs would be counted twice)

Table D-22. Fisheries Enhancement (dredging) — Incremental Cost Analysis Best Buy Plans

Plan	Output AAHUs*	Annual Cost**	Cost/ AAHU	Inc. Cost	Inc. Output	Inc. \$/ AAHU
S0+L0+G0+B0+C0	0.0	0.0	0.0	0.0	0.0	0.0
S0+L1+G0+B0+C0	418.6	65388	156.2	65388	418.6	156.2
S1+L1+G0+B0+C0	424.5	68485	161.3	3097	5.9	524.9
S1+L0+G0+B0+C1	492.3	135499	275.2	67014	67.8	988.4
S1+L0+G0+B1+C1	524.6	182714	348.3	47215	32.3	1461.8

* Outputs are calculated as Average Annual Habitat Units (AAHUs).

** All costs are listed in dollars, costs annualized at 6.25 % interest, 50-yr project life. Initial construction costs only.

S0, L0, G0, B0, C0 - No Action

S1 – Dredge Swarms/Bebee Ponds

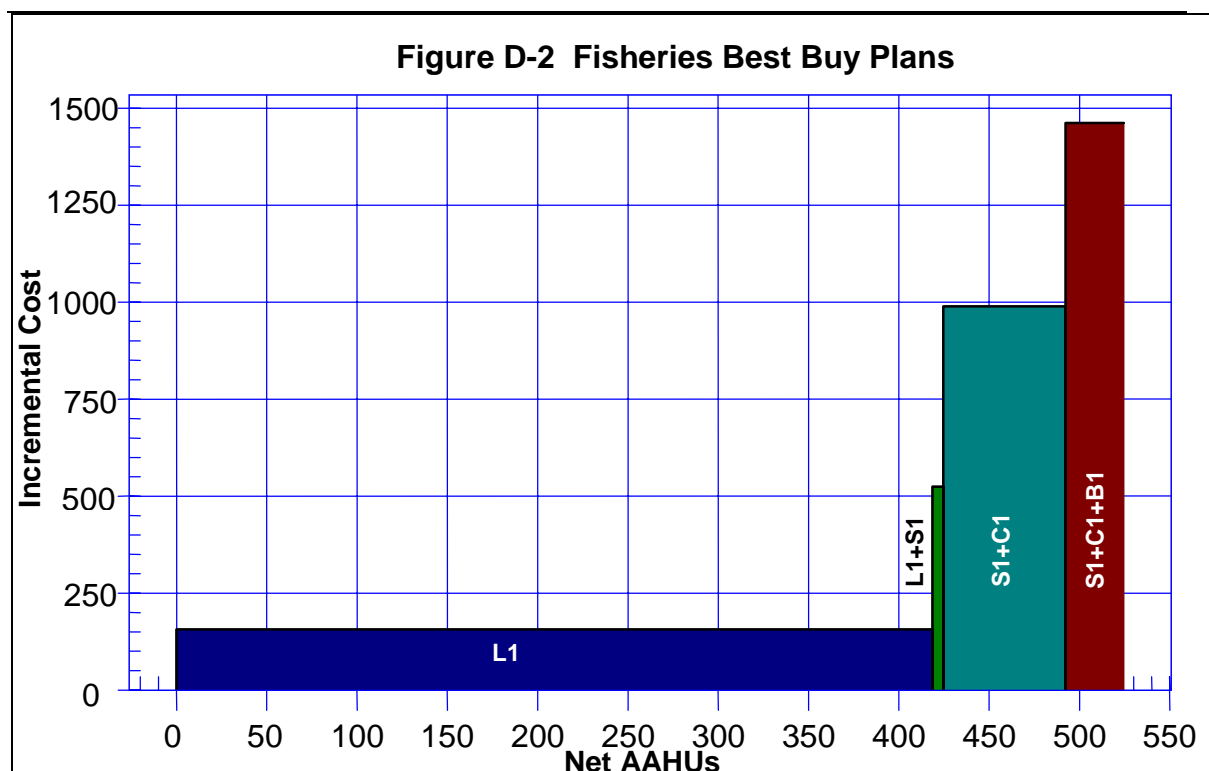
L1 – Dredge Main Lake+containment

G1 – Dredge Goose Pond+containment

B1 – Dredge Blackhawk/Yankee Chutes

C1 – Dredge Main Lake+Goose Pond+containment

The following features are not combinable: L+G, L+C, G+C (containment costs would be counted twice)



c. Best Buy Plans. Based on the results of the analyses presented above, the most cost-effective or “Best Buy” plan that would meet all project objectives for the moist soil manage units (MSUs) would be enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Bebee Ponds + IDNR MSU (M1+U1+F1+S1+D1). Based on comments and input received from both the USFWS and the IDNR (project sponsors) during the alternative formulation process of the DPR, the best buy plan mentioned here is also the sponsors’ preferred plan. Although enhancing Swarms Pond, Fox Pond, and Unit 2 (S1+F1+U1) is also a best buy plan, this combination does not address improvements for the USFWS MSU complex (Fields 4&5, 21, MSU 20), considered to be the most important MSUs at the Lake Odessa complex. In addition, improvement to IDNR MSU provides a confined placement site for the dredged material from Blackhawk/Yankee Chutes fisheries enhancement feature, yielding 32.3 average annual habitat units (AAHU) for fish.

Based on the results of the analyses presented above, the most cost-effective or “Best Buy” plan that would meet all project objectives for the fisheries enhancement (dredging) would be dredging Swarms/Bebee Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes (S1+C1+B1). Based on comments and input received from both the USFWS and the IDNR during the alternative formulation process of the DPR, the best buy plan mentioned here is also the sponsors’ preferred plan. This combination includes features that also have moist soil enhancement benefits, not included in the incremental analysis for fisheries features. Swarms/Bebee Pond dredging provides an additional 207.5 AAHUs and dredging Blackhawk/Yankee provides liner material for the IDNR MSU, providing 43.6 AAHUs.

7. DISCUSSION

The results of the WHAG analysis suggest that the Lake Odessa complex can be enhanced with the features proposed for this project. Results of the WHAG application were compared as increments to costs where applicable.

The proposed projects for the Lake Odessa complex involve four primary enhancement features: enhancing the current MSUs (847 acres), primarily through increased water level control; increasing the amount of deep-water overwintering habitat for fish (dredging 66 acres which provides overwintering access for 1,362 acres); planting 93 acres of mast-producing trees on higher elevations; and protecting the interior features with levee restoration and a spillway. Dredging in Turkey Chute below Lock and Dam 17, as part of the levee restoration, provides an additional 11.5 acres of deep-water overwintering habitat for fish. Additional, but minor features, included reestablishing the sand prairie (36 acres) (terrestrial habitat enhancement) and constructing the upper fish nursery (21 acres) (fisheries enhancement).

In conclusion, the WHAG analysis indicates that enhancing the USFWS complex (Field 4 & 5, Field 21, MSU 20) + Unit 2+ Fox Pond + Swarms/Beebe Ponds + IDNR MSU; dredging Swarms/Beebe Ponds + Main Lake + Goose Pond + Blackhawk/Yankee Chutes; restoring the sand prairie; constructing the upper fish nursery; planting mast trees at Sites A, B, C, and D, and restoring the levee for flood damage reduction from floods over 10-year frequency and levee overtopping protection to a higher level would provide the greatest outputs in a cost-effective manner. This combination would meet HREP goals and objectives, would add to habitat diversity and quality, and would best meet the sponsors' overall management objectives for the site.

APPENDIX E

**HAZARDOUS, TOXIC, AND RADIOACTIVE
WASTE DOCUMENTATION REPORT**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**UPPER MISSISSIPPI RIVER – MILES 434.5-441.5
LOUISA COUNTY, IOWA**

**APPENDIX E
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE
PHASE I ENVIRONMENTAL SITE ASSESSMENT**

Revision March 2003

Executive Summary

Introduction. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with ASTM Practices E 1527-00 and E 1528-00, ER 1165-2-132, and MVD DIVR 1165-2-9 for the Lake Odessa Habitat Rehabilitation and Enhancement Project. Any exceptions to, or deletions from, this practice are described in Section 1 of the report.

The Lake Odessa project area is located along the Mississippi River Pools 17 and 18. The United States Fish and Wildlife Service operate the northern portions of the project area, and the Iowa Department of Natural Resources operates the southern portions of the area. All lands involved in the Lake Odessa EMP project are owned by the United States Army Corps of Engineers. Dense woodlands, historical agricultural fields, and low-lying backwaters of the Mississippi River characterize the Lake Odessa area. Project features generally consist of levee enhancement, mast tree planting, excavation of deep holes and channels, sand prairie planting, and placement of riprap for bank protection. Figure 1 below identifies the project location.

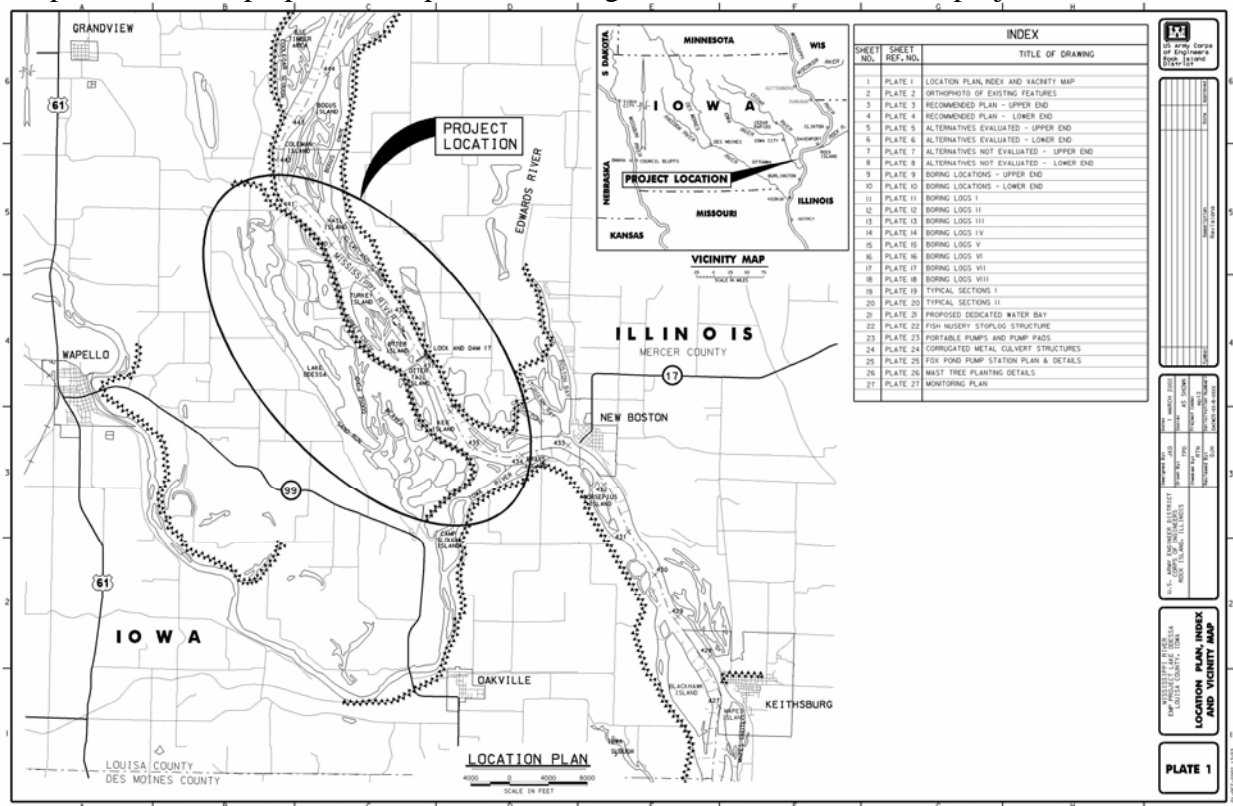


Figure 1. Location Plan, Index, and Vicinity Map.

Conclusions. This assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the project features as long as the project features do not include any areas associated with a small weapons firing range that is located along the existing levee surrounding the Lake Odessa WMA and the Mark Twain NWR.

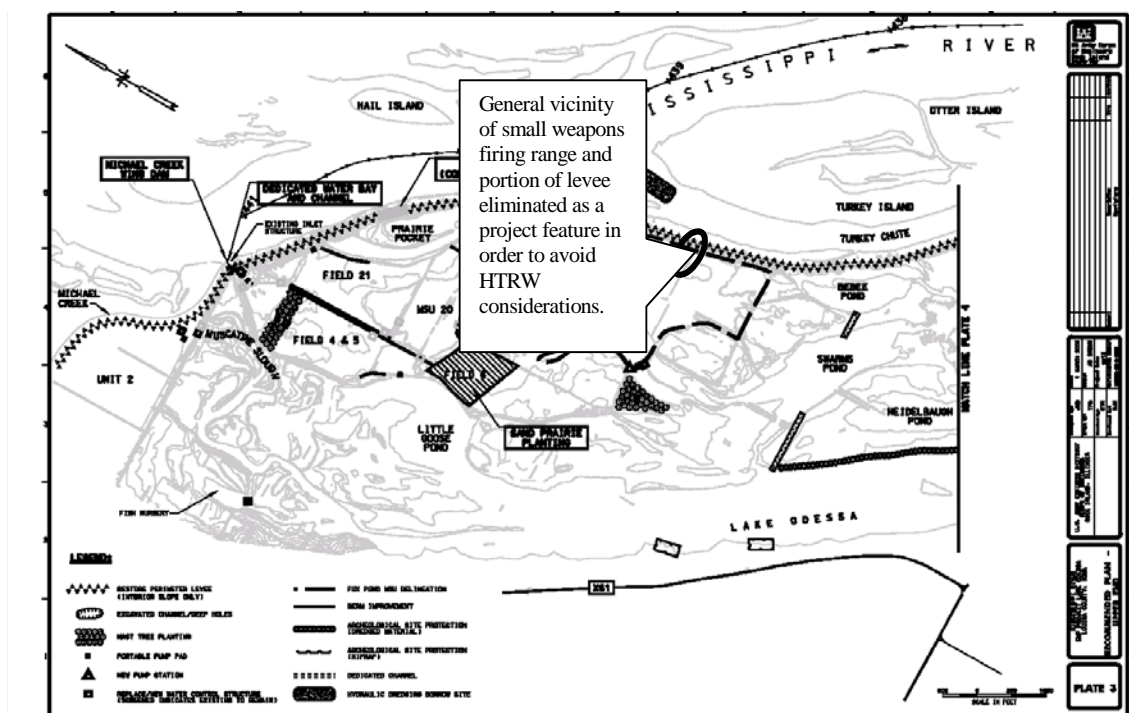


Figure 2. General Location of firing range and portion of levee eliminated as a project feature in order to avoid HTRW considerations.

Currently, the project features do not include the portion of the levee associated with the firing range. If the levee enhancement project feature would be changed to include the section of levee that was used as the ammunition trap for the small weapons firing range, then the Lake Odessa HREP would need to devise construction activities and disposal plans for the surface soils containing spent lead ball residue that are subject to Resource Conservation and Recovery Act (RCRA) statutory authority including section 7002 and 7003.

Military Munitions Rule 40 CFR Part 260¹ has assisted with defining when fired munitions are considered solid waste and when they fall under the Resource Conservation and Recovery Act (RCRA) requirements. According to US EPA-Region 2; “Lead shot is not considered a hazardous waste subject to RCRA at the time it is discharged from a firearm because it is used for its intended purpose. However, spent lead shot (or bullets) are subject to the broader definition of solid waste written by Congress and contained in the statute itself. Spent shot and bullets are thus potentially subject to RCRA statutory authority including section 7002 and 7003.” Construction activities may pose a problem since heavy equipment would likely disturb the surface soils and cause the spent lead shot to migrate and become a hazard to the environment. If these surface soils, that contain lead ball residue, were disturbed then prompt removal of surface soil layers for the levee modification would become necessary under RCRA regulation.

¹ “Environmental Fact United States Environmental Protection Agency, Solid Waste and Emergency Response (5305W), EPA530-F-97-004, February 1997.

Recommendations. No further HTRW Assessment is recommended at this time. After a thorough review of all information, only one environmental concern was identified and it related to the small weapons firing range that is not currently included as part of any project feature. All work on this section of the levee associated with the firing range should be avoided; otherwise, a plan would need to be developed for the prevention of exposure from spent lead residue, and to address disposal of the surface soils per EPA regulations that are removed from the levee and contain lead residue.

Limitations. No ESA can wholly eliminate uncertainty regarding the existence for recognized environmental conditions concerning a property. This assessment is intended to reduce, but not eliminate, uncertainty regarding the existence of recognized environmental conditions in connection with a property with reasonable limits of time and cost. Continuing the Environmental Due Diligence Audit process beyond this Phase I ESA would not reduce uncertainty, nor reveal any unidentified environmental liabilities. If any previously un-addressed recognized environmental condition should arise, this Phase I ESA will be revisited.

TABLE OF CONTENTS

1. INTRODUCTION.....	1
A. PURPOSE.....	1
B. AUTHORITY	1
C. SCOPE OF WORK.....	1
D. SIGNIFICANT ASSUMPTIONS	1
E. LIMITATIONS	3
F. EXCLUSIONS	3
G. SPECIAL TERMINOLOGY	3
2. SITE DESCRIPTION.....	4
A. LOCATION AND LEGAL DESCRIPTION	4
B. PROJECT FEATURES.....	4
3. RECORDS REVIEW	9
A. STANDARD ENVIRONMENTAL RECORD SOURCES	9
B. ADDITIONAL ENVIRONMENTAL RECORD SOURCES	10
C. PHYSICAL SETTING SOURCE(S).....	10
D. HISTORICAL USE INFORMATION ON THE PROPERTY AND ADJOINING PROPERTIES	10
E. CONCLUSIONS	11
4. SITE RECONNAISSANCE.....	11
A. SITE SAFETY	11
B. GENERAL SITE SETTING	11
C. INTERIOR OBSERVATIONS.....	12
D. CONCLUSIONS	12
5. INTERVIEWS	13
A. INTERVIEWS WITH OWNERS.....	13
B. INTERVIEWS.....	13
6. FINDINGS	14
7. OPINIONS	15
8. CONCLUSIONS	16
9. RECOMMENDATIONS.....	17
10. ADDITIONAL SERVICES.....	17

TABLE OF APPENDICES

APPENDIX A	ACRONYMS
APPENDIX B	REFERENCES AND ABSTRACTS
APPENDIX C	VICINITY MAPS AND SITE PLANS
APPENDIX D	SITE RECONNAISSANCE: NOTES, PHOTOGRAPHS, AND SAFETY PLAN
APPENDIX E	ENVIROFACTS AND ENVIROMAPPER DATABASE
APPENDIX F	REGULATORY RECORDS DOCUMENTATION
APPENDIX G	NATIONAL RESPONSE CENTER DATABASE
APPENDIX H	IOWA ENVIRONMENTAL PROTECTION DIVISION DATABASE
APPENDIX I	INTERVIEW DOCUMENTATION

1. Introduction

a. Purpose. The purpose of a Phase I Environmental Site Assessment (ESA) is to adequately document an appropriate inquiry into identifying recognized environmental conditions on target properties. This report documents the initial reconnaissance liability assessment for the Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) sites. The goal of HREP is to effectively preserve and improve fish and wildlife habitat on the Upper Mississippi River. This inquiry is required in order to aid in minimizing Federal liability under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), and to reduce any threats to project workers and avoid costly delays associated with environmental abatement activities. Appendix A contains definitions of key words and phrases, and a list of acronyms used in this report. A list of documents and records reviewed or referenced is contained in Appendix B.

b. Authority. The U. S. Army Corps of Engineers (Corps), Rock Island District (the District) is authorized by the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) to ensure the coordinated development and enhancement of the Upper Mississippi River System (UMRS). This effort includes an HREP program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; implementation of a long-term resource monitoring program; implementation of a computerized inventory and analysis system; implementation of a program of recreational projects; assessment of the economic benefits generated by recreational activities in the system; and monitoring of traffic movement on the system.

c. Scope of Work. This inquiry is guided by the level appropriate for each type of property, information developed in the course of the inquiry, project requirements, regulatory agency requirements, and potential risks. The screening methods used to prepare the Phase I ESA have been selected based on the location, physical setting, surrounding land uses, and particular nature of the proposed work. Intrusive field sampling and lab analyses are not used for the Phase I ESA, but are reserved for further ESA phases when required. The following documented resources were used to evaluate the existence of recognized environmental conditions within target properties as well as any recognized environmental conditions on properties within an approximate minimum search distance from the target properties:

- (1) Site Specific Information
- (2) Preliminary Information Review
- (3) Records Review
- (4) Site Reconnaissance
- (5) Interviews

d. Significant Assumptions. This subsection describes all assumptions made during the environmental site assessment.

(1) Federal and State NPDES permitted releases to water and NAAQS permitted releases to air, if found, are assumed to be *de minimus* recognized environmental conditions.

Federal and State National Pollutant Discharge (NPDES) permitted releases to water and National Ambient Air Quality Standard (NAAQS) permitted releases to air are not considered recognized environmental conditions as long as all reported released hazardous substances, HTRW, and other regulated contaminants were permitted or corrected in accordance with applicable or relevant and appropriate requirements. These permitted releases are assumed to be *de minimus* since permits and corrective action levels are designed by law to minimize material risk of harm to human health and the environment to an acceptable level. NPDES permitted biosludge application to land and uncorrected discharges to water and air in excess of permits are not assumed to be *de minimus*.

(2) Fertilizer, pesticide, and herbicide soil residues from normal agricultural activities, if found or suspected, are assumed to be *de minimus* recognized environmental conditions. Fertilizers, pesticides, and herbicides applied to lands during the course of normal agricultural activities, not including mixing and cleaning activities, are exempt from CERCLA and RCRA regulations. Additionally, contamination of soil from normal agricultural activities is generally not the subject of government enforcement action, therefore a *de minimus* environmental condition. Contamination associated with fertilizer, pesticide, and herbicide mixing/cleaning platforms is a recognized environmental condition.

(3) Trash and refuse from public recreation activities, if found or suspected, are assumed to be *de minimus* recognized environmental conditions. Public recreation is not considered a meaningful source of hazardous substance, HTRW, or other regulated materials. Public recreation is therefore a *de minimus* environmental condition. This assumption does not include the release of fuel or mechanical fluids.

(4) Unless it is made known by interview or record search or it is obvious during a site inspection, contamination related to transportation and utility features are not suspected. The release of hazardous substances, HTRW, or other regulated contaminants from utilities or transportation features is possible. Petroleum spills occur with vehicle accidents, hazardous substances are released with railway disasters, and oil slicks occur with navigational tragedies. However, the discover of such contamination by means other than interviews, record searches, and visual site inspection would require exhaustive site characterization measures to reduce uncertainty. At this time, reducing this uncertainty is not reasonably ascertainable within time and cost constraints, nor is the threat of a release necessarily preventable under the HREP program.

(5) Dredged material and return water discharges are subject to a permit under Section 404 of the Clean Water Act. If the dredged material and return water discharge is subject to a permit that has been issued under Section 404 of the CWA or Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA), then 40 CFR 261.5(g) states that RCRA Subtitle C requirements do not apply and the dredged material and return water cannot be considered a hazardous substance. The USEPA assumes that the CWA and MPRSA permit programs protect human health and the environment from consequences of dredged material disposal to an extent that is at least as protective as the RCRA Subtitle C program. (63 FR 229, 30 Nov 1998). Coordinate with the District's Water Quality Section (CEMVR-ED-HQ) and Operations Division (CEMVR-OD-T) for sediment and water quality evaluations with respect to

CWA 404 permit information and its applicability under Illinois Administrative Code 35 IAC Section 303.400 and published USEPA guidance (63 FR 229).

e. Limitations. This subsection describes limitations discovered during this site assessment.

(1) Uncertainty Limitations. No ESA can wholly eliminate uncertainty regarding the existence for recognized environmental conditions concerning a property. This assessment is intended to reduce, but not eliminate, uncertainty regarding the existence of recognized environmental conditions in connection with a property with reasonable limits of time and cost.

(2) Records Review Limitations. Historical and regulatory record reviews are limited by the level of data collected by the recording agency, availability of record coverage, and by data transparency. If provided by the recording agency, statements regarding the limits of database were included with a copy of the findings. Record coverage research was limited to records on the CEMVR Intranet, State and Federal regulatory agency web sites, and select mapping web sites. Data was considered transparent only if it could easily be geo-spatially referenced to a target property.

f. Exclusions. This subsection describes reasons why a project site would be excluded from being a target property in this environmental site assessment.

Inclusion of Historic Activity Sites. Whereas some reports may exclude historic activity sites, they were not excluded from the scope of this inquiry. CERCLA is strict and retroactive; therefore, the use of historic activity sites does not remove any risk of environmental liability. Continued use of any historic activity site identified by this inquiry as having recognized environmental conditions that impact human health and the environment could create legal and public relations difficulties. Furthermore, if recognized environmental conditions are discovered on any historic activity site, Phase II ESAs will immediately be recommended so the Corps can begin to quantify and manage any environmental risk, regardless of whether or not the site will remain part of this HREP program.

g. Special Terminology. Appendix A provides definitions and descriptions of terms used in this Phase I ESA that are critical for the understanding of this document.

2. Site Description

a. Location and Legal Description. The project study area consists of parts of the Lake Odessa Wildlife Management Area (WMA) and Mark Twain National Wildlife Refuge (NWR) and the general surrounding area near Lock and Dam 17 (see Figure 2). The Corps owns all lands involved. Iowa Department of Natural Resources maintains the Lake Odessa WMA, and the United States Fish and Wildlife Service maintain the Mark Twain NWR. The project study area is on the right descending bank of the Upper Mississippi River (UMR) between River Miles (RM) 434.5 – 441.5, in UMR Pools 17 and 18. The site is located within Louisa County and positioned northwest of New Boston, IL and east of Wapello, IA. The southern portion of the project area is located in the Lake Odessa WMA, while the northern portion of the project area is located in the Mark Twain NWR.

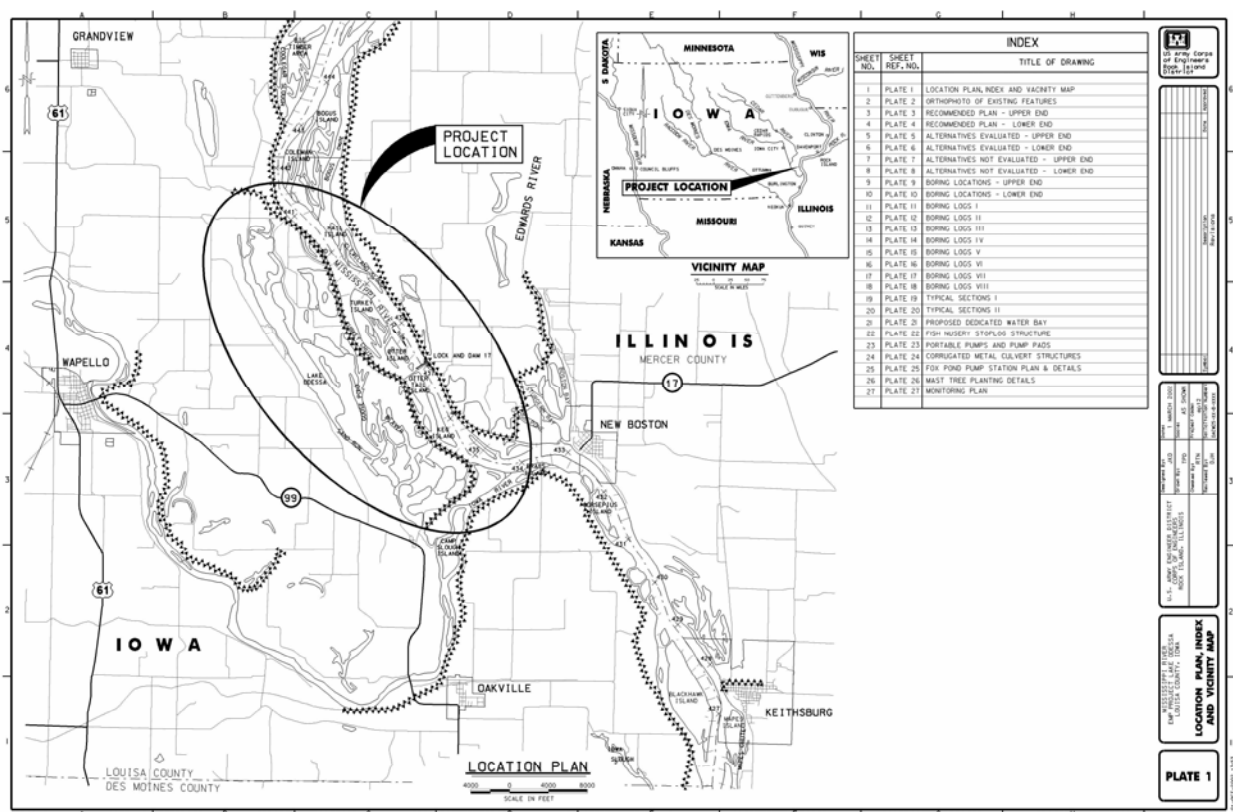


Figure 3. Project Location Map.

b. Project Features. See Figures 3, 4, and 5 for details of the recommended plan.

(1) Field 6 (Sand Prairie Planting) is characterized by low-lying prairie located adjacent to Little Goose Pond within the Mark Twain NWR. The site is located in the backwaters along the right-descending bank of the UMR main channel. Dense woods, open fields, and shallow backwaters of the UMR main channel characterize land adjacent to Field 6. Proposed designs include planting the area with typical prairie species found within a nearby growing area.

(2) Channel/Deep Hole Excavation sites are located at various positions throughout the Lake Odessa basin. The deep hole is located within Lake Odessa, and deep channels are located between Goose Pond and Sand Run, Yankee Chute and Blackhawk Chute, and Lake Odessa and Swarms/Bebee Pond. The area surrounding all of these potential work sites are backwaters of the UMR, with the adjacent bank lines primarily wooded. The deep channel between Lake Odessa and Bebee Pond is located in the Mark Twain NWR, while the deep hole and the other deep channels are located within the Lake Odessa WMA.

(3) Shoreline Protection (riprap placement) sites are located along the western edge of Lake Odessa. Dense woodlands and some residential area upstream of the project site characterize the land adjacent to this riprap placement site. The sites are located within the Mark Twain NWR.

(4) Shoreline Protection (dredged material placement) sites are located in both the Lake Odessa WMA and the Mark Twain NWR. Land adjacent to the shoreline protection sites is a variety of dense woodlands, low-lying prairie, and wetlands/backwaters of the UMR main channel.

(5) Mast Tree Planting Sites are located in the project study area. There are four tree-planting sites, two of which are located in the northern portion (Mark Twain NWR) of the project study area, while the other two are located within the Lake Odessa WMA. Land adjacent to the tree planting sites is a variety of dense woodlands, low-lying prairie, and wetlands/backwaters of the UMR main channel.

(6) Perimeter Levee Restoration will occur along the entire length of the existing levee surrounding the Lake Odessa WMA and the Mark Twain NWR, with a spillway also to be constructed in each section. The levee aids in protecting the project study area from high water events of the UMR and the Iowa River. Restoration will be accomplished by utilizing sandy material that is hydraulically dredged from the river to enhance the existing levee section. The land adjacent to the levee consists primarily of woodlands. Figure 5 provides typical sections depicting the levee enhancement feature.

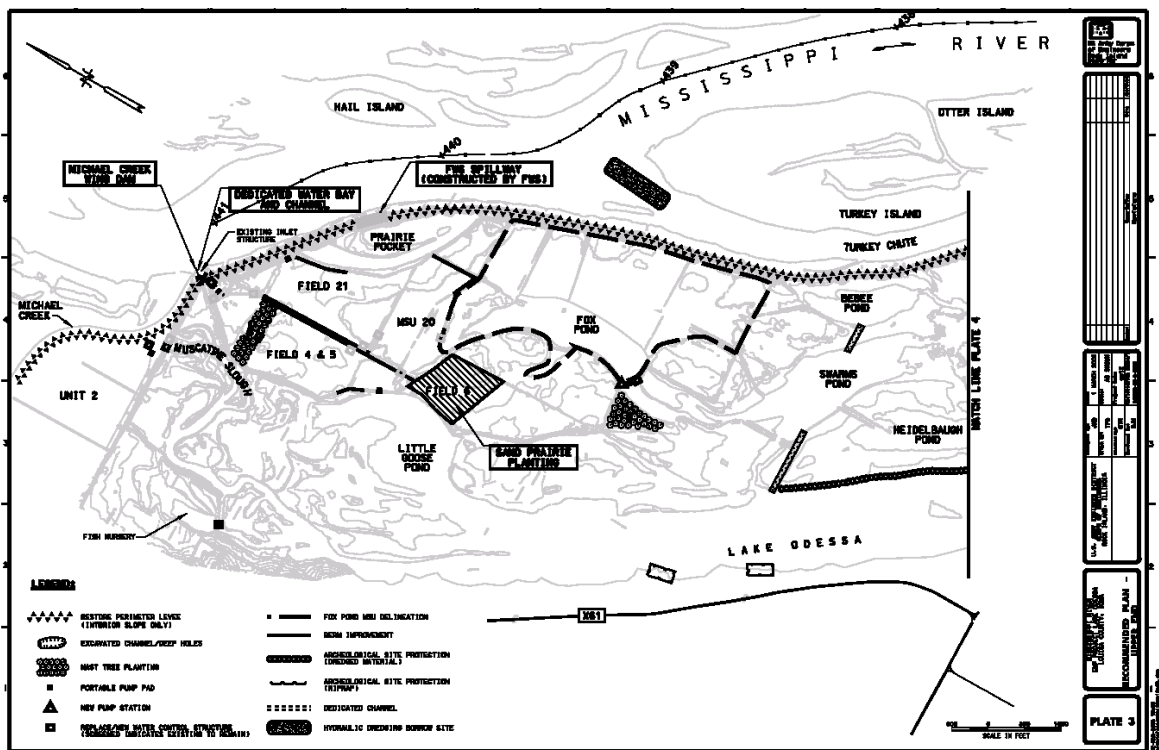


Figure 4. Recommended Plan, Upper End.

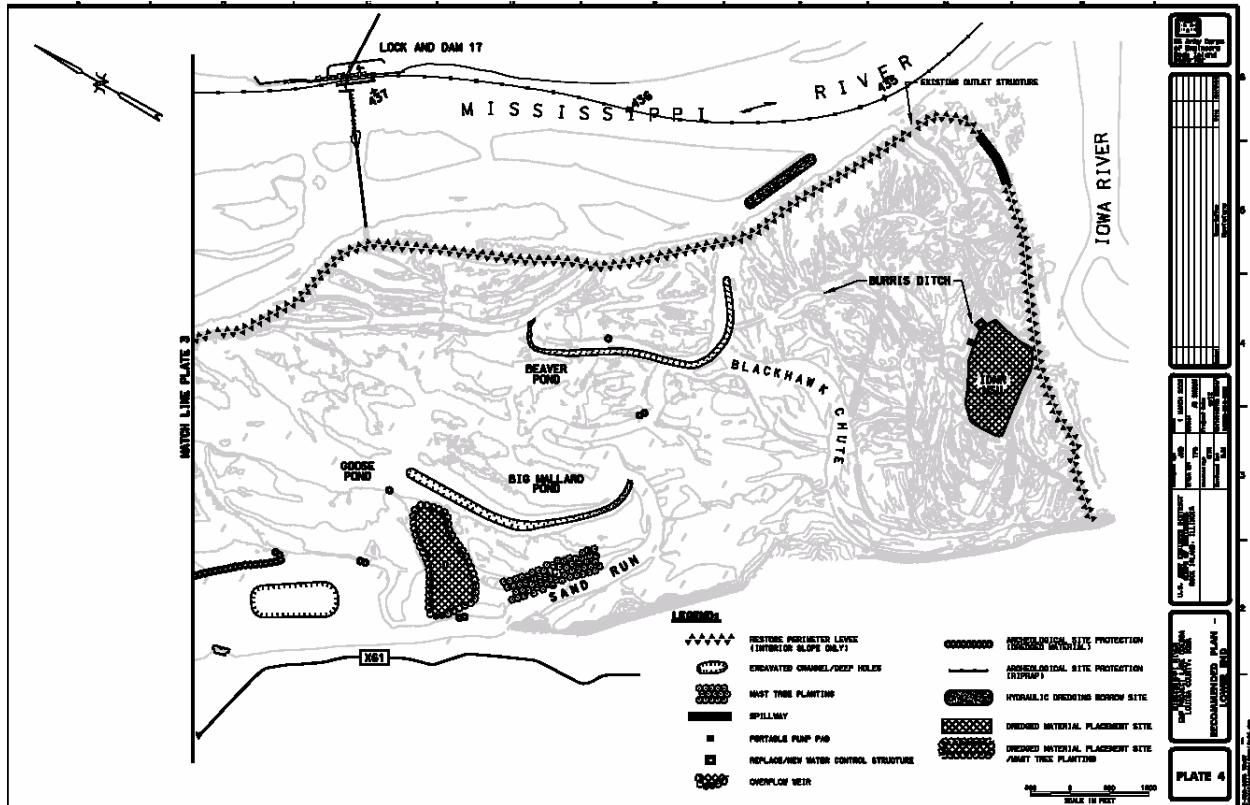


Figure 5. Recommended Plan, Lower End.

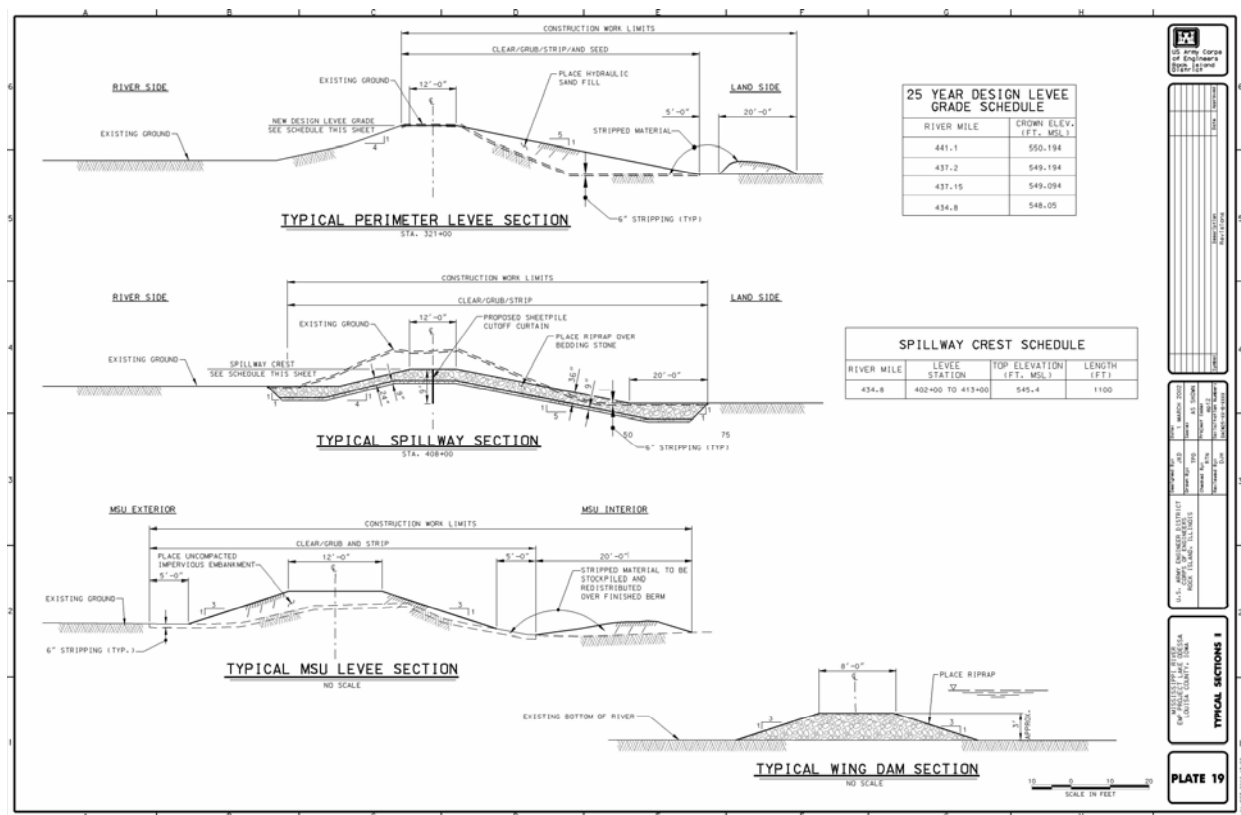


Figure 6. Typical Sections, Perimeter Levee Enhancement.

(7) **MSU Berm Construction/Enhancement** will occur in the Mark Twain NWR. Along with the berm construction, an existing ditch will be deepened to better facilitate gravity feed of water from the river into the MSU's. Land adjacent to the MSU sites is a variety of dense woodlands, low-lying prairie, and wetlands.

(8) Fish Nursery feature includes:

Upper Fish Nursery that would consist of utilizing an existing containment area to construct a fish nursery. The area currently has a stoplog control structure, which is damaged and would be replaced. The area, with the new structure, would be able to pond water, allowing the area to be stocked with fry in the spring that would be released into Lake Odessa later in the season. This would allow fish to reach a larger size in a more protected environment, resulting in decreased mortality.

Lower Fish Nursery that would be utilized in a similar manner to the upper fish nursery described above. A small bay off Sand Run would be screened off in the spring to allow stocked fry to grow in the absence of larger predatory fish. Proposed construction included a screen across the outlet and adding dredged material to the spit of land separating the bay from Sand Run. This location was eliminated from further consideration because it has a higher likelihood of drying up in the summer months and is currently providing good moist soil habitat.

3. Records Review

The purpose of a records review is to obtain and review records that will help identify recognized environmental conditions on target properties. Some of the records reviewed pertain not just to the property, but also to properties within an approximate minimum search distance, in order to help assess the likelihood of problems from migrating hazardous substance or other regulated contaminants. Factors considered in determining the approximate minimum search distance (Table A1) include ASTM Standards E 1527 and E 1528, the density of the setting, the distance that hazardous substances or other regulated contaminants are likely to migrate, local geologic or hydrogeologic conditions, and other observable factors. This review included querying several environmental databases and reviewing historical current maps and photos (see Appendices C, D, E, and F). A list of references reviewed or referred to in this report is contained in Appendix B.

a. Standard Environmental Record Sources. Table 1 describes the standard environmental record sources reviewed, the provider of the source, and the date the source was reviewed. Copies of standard environmental record sources are available in Appendix F.

Table 1. Standard Environmental Record Sources Searched.

Standard Environmental Record Sources Searched		
	Provider	Database
6/27/01	USEPA	Federal NPL Site
6/27/01	USEPA	Federal CERCLIS Site
6/27/01	USEPA	Federal CERCLIS NFRAP Site
6/28/01	USEPA	Federal RCRA CORRACTS TSD Facility
6/28/01	USEPA	Federal RCRA non-CORRACTS TSD Facility
6/28/01	USEPA	Federal RCRA Generator
6/28/01	NRC	Federal ERNS List
6/27/01	IAEPA	State-equivalent NPL
6/27/01	IAEPA	State-equivalent CERCLIS
6/27/01	IAEPA	State landfill and/or solid waste disposal site
	N/A	State Registered UST
6/27/01	USEPA	Local or State Brownfield Site Lists
7/2/01	IAEPA	Local Landfill/Solid Waste Disposal Lists
7/2/01	IAEPA	Contaminated Public Well Records

U. S. Environmental Protection Agency Records. USEPA records did not indicate the presence of any potential HTRW sites within 5 miles of the project study area. Further information is available in Appendix F.

National Response Center (NRC) Records. NRC records did not indicate any emergency response spill or release located on or adjacent to target properties. Further information is available in Appendix G.

Iowa Environmental Protection Agency (EPA) Records. Iowa EPA records did not indicate the existence of any sites of environmental concern within the scope of this report. Further information is available in Appendix H.

b. Additional Environmental Record Sources. No additional environmental record sources were reviewed.

c. Physical Setting Source(s). Physical setting information for the target properties and the general surrounding area was collected using the most recent (1992) USGS Quadrangle map (Appendix C), recent (1995) aerial photographs, and site reconnaissance. (Appendix C).

All potential target properties are located within the geologic flood basin of the Mississippi River and Iowa River Valleys. Sediments and soils are expected to be alluvial deposits relating to sedimentation, flood deposition, and upland erosion. Most of the water flows within the project study area is controlled by an inlet structure located at the upper end and an outlet structure at the lower end of Lake Odessa. These structures coupled with several drainage ditches control the majority of drainage within the area. Any remaining drainage is expected to flow toward the main channel.

Topography within the project study area is mainly floodplain, some of which is currently used as agricultural fields. There are some bluffs along the western edge of the project study area. There is also an existing perimeter levee.

d. Historical Use Information on the Property and Adjoining Properties. Appendix E, Table E2 describes the available historical coverage for the project study area. Timeframes that did have available historical coverage are listed below. A copy of these historical documents is located in Appendix E.

1925-1935. In 1929-30, the majority of the project study area was used for agricultural purposes, with some residential land primarily located along both the east and west banks of the river. The remainder of the project study area is still undeveloped natural woodlands and low-lying backwaters of the UMR.

1990-1995. The northern portion of the project study area is enveloped by the Mark Twain NWR, while the southern portion is contained within the Lake Odessa WMA. The surrounding land remains primarily agricultural with some residential land scattered throughout. The land contained within the project area remains primarily undeveloped woodlands and low-lying backwaters of the UMR. The Lock and Dam 17 is present, with inlet and outlet structures observed at each respective end of Lake Odessa. In the year following the release of this USGS map, the drainage structures were replaced after extensive damage resulting from the 1993 flood.

1995-2000. There were few changes in the land over this time. The federally owned and managed land is still surrounded by agricultural and residential lands, while the federally controlled land remains mostly undeveloped woodlands. No major features were removed or added to the project study area during this time.

Conclusions. After completing the records review for the Lake Odessa project study area, no indication was found as to the presence of any hazardous substances, HTRW, or other regulated contaminants. None of the information obtained via the environmental database searches reveals any indication of a potential environmental condition present within the accepted minimum search distance of the project study area. Historical use records did not reveal past environmental concerns within the project area.

4. Site Reconnaissance

a. Site Safety. A formal Site Specific Safety and Health Plan (SSHP) was developed and is contained in Appendix D. Investigators complied with the Corps Safety and Health Requirements Manual (EM 385-1-1) and the Safety and Occupational Health Requirements for HTRW Activities (ER 385-1-92). Site safety information was obtained from current aerial photographs and informal interviews with members of the project team. Assessment methods did not involve intrusive techniques, such as collecting and analyzing soil samples at the project sites for this report.

Members of the Rock Island District's Environmental Engineering Division (ED-DN) visited the project study area on 16 August 2001. Site visit photos are available in Appendix D.

b. General Site Setting. The Lake Odessa project area consists almost entirely of low-lying backwaters and wetlands from the Mississippi River. Over the entire area, there is very little variance in the topography. The only significant topographical change is that of the man-made levee that has been constructed on the site. Located throughout these backwaters are numerous small, wooded islands. There are some basic access roads built throughout the project area and some more substantial, improved roads that border the edges of the project area.

Hazardous Substances in Connection with Identified Uses. Information obtained during site reconnaissance did not indicate the existence of any hazardous substances in connection with the project area.

Hazardous Substance Containers, Drums, Sacks, and Unidentified Substance Containers. No hazardous substance containers, drums, sacks or other unidentified substance containers were identified on target properties.

Storage Tanks, Vent and Fill Pipes. No vent or fill pipes, vacant concrete pads, or decrepit pumps were discovered on target properties. There was aboveground propane storage tanks found in connection with the residential areas on the west side of Lake Odessa.

Solid Waste Disposal and Fill Dirt. The site reconnaissance did not reveal any indications of fill dirt, soil piles, disturbed soil surfaces, construction debris, or demolition debris on target properties. There was no indication of illegal dumping of household trash or refuse, recreational litter, appliances, automotive batteries, automotive parts or debris, tires, drums, or other forms of solid waste on target properties.

Stained Soil and Pavement. Site reconnaissance did not reveal any indications of stained soil, leaks, or spills associated with leaks, spills, discharge, or dumping.

Stressed Vegetation. No superficial indications of contamination, such as unexplainable stress to the ecosystem, were noted.

Wells. No indications of the property being served by private well or non-public water systems were observed. Site reconnaissance did not indicate the existence or suspected existence of dry wells, irrigation wells, injection wells, abandoned wells, or other forms of wells.

Pits, Ponds, and Lagoons. No pits, ponds, or lagoons were observed on target properties. No evidence indications the past presences of pits, ponds, or lagoons on target properties were observed. No evidence indicating the past or present existence of dry wells, irrigation wells, injection wells, abandoned wells, or other forms of wells.

Industrial Waste Discharge. No discharge points of drainage systems were observed on target properties.

Septic Systems. A septic tank is a watertight covered receptacle designed to receive or process, through liquid separation or biological digestion, the sewage discharged from a building or privy. Septic systems include buried septic tanks along with the absorption fields or leach fields. Site reconnaissance revealed residential septic systems near the Schafer and Snively boat access sites.

Lead-Based Paint. No structures or improvements were visually observed on the target properties.

Miscellaneous findings. Site reconnaissance and interviews identified the existence of a small firing range located just north of Bebee Pond, right next to the perimeter levee. More information is available in Section 7.

c. Interior Observations. The only structures that were noted on the project study area were the inlet and outlet structures located at opposite ends (North and South ends) of Lake Odessa.

d. Conclusions. Site reconnaissance on 16 August 2001 revealed the following:

- The existence of residential septic systems in the vicinity of the Schafer and Snively access sites.
- The existence of above ground storage (fuel) tanks in the vicinity of the Schafer and Snively access sites.
- The existence of a firing range north of Bebee Pond, near the perimeter levee.
- There was no further evidence of any hazardous substances, HTRW, or other regulated contaminant on or near the project study area.

5. Interviews

a. Specialized Knowledge Review. The following individuals were interviewed for any specialized knowledge regarding the existence of hazardous substance, HTRW, or other regulated contaminants on target properties. Conversation records are included in Appendix I

b. Interviews:

<u>Name</u>	<u>Interview Date</u>	<u>Phone</u>
Jerry Bartachek (Iowa DNR)	9 October 2001	(319) 563-2135
Matt Culp (Iowa DNR)	9 October 2001	(515) 242-5087
Joe Dzuik (ED-DG)	Various	(309) 794-5812
John Gall (ED-SO)	16 July 2001	(309) 794-5252
Karen Hagerty (PM-AR)	17 July 2001	(309) 794-5286
Bob Hoffman (ED-DO)	4 October 2001	(309) 794-5504
Tim Julison (USFWS)	17 July 2001	(319) 523-6982
Bill Ohde (Iowa DNR)	Various	(319) 523-8319
Ron Pulcher (PM-AR)	13 July 2001	(309) 794-5384

(1) Jack's Place. Bill Ohde (Iowa DNR) and Karen Hagerty (CEMVR-PM-AR) were aware of a former restaurant named Jack's Place which was located on the right descending bank of Lake Odessa (Appendix D). Jack's Place stored boat fuel on site in an above ground storage tank to sell to area boaters.

(2) Firing Range. Tim Julison (US FWS) provided information regarding the existence of a small weapon firing range located along the levee as shown on Figure D-1. State Fish and Wildlife employees who are also involved in law enforcement training use this target range. The firearms primarily used at the range include shotguns, 40 caliber handguns, and 9-millimeter handguns. With the shotguns there were regular slugs and buckshot used at the range. Bob Hoffman (Chief, Ordnance and Explosives ED-DO) indicated that there would be lead shots and bullets located in the levee behind the targets, but there was no concern with respect to unexploded ordnances being present. Matt Culp (Iowa DNR) was contacted regarding State clean-up requirements for firing range sites. From the information provided in the telephone conversation, he did not feel that this firing range would be of immediate threat to human health or safety, but noted that clean-up requirements for such sites varied among sites in the State of Iowa.

(3) Burris City. Ron Pulcher (CEMVR-PM-AR) and Karen Hagerty (CEMVR-PM-AR) were both able to provide information regarding Burris City. Burris City was a community located in the southeastern corner of the project area, near the joining of the UMR and the Iowa River, sometime around the 1850s. Burris City was originally slated to be approximately one square mile, but the city never became established, and was vacated quickly. The city is approximately 3 feet below ground at the present time.

The remainder of the interviews provided no specialized knowledge regarding the existence of hazardous substances, HTRW, or other regulated contaminants on target properties. A copy of each conversation record is found in Appendix I.

6. Findings. This section summarizes known or suspect environmental conditions associated with the property, and may include current recognized environmental conditions, historical recognized environmental conditions, *de minimus* environmental conditions, and other environmental conditions.

(1) Jack's Place/Fuel. Information obtained from interviews indicated the presence of above ground storage tanks containing boat fuel at this location. There were no records or indications of fuel spills or leaks in this area, and the restaurant and station were closed following the 1993 flood. (See Figure D-1)

(2) Schafer/Snively Access. There are residential areas located in the vicinity of both the Schafer and Snively boat access sites. Several of the homes had residential septic systems and above ground propane storage tanks.

(3) Firing Range. Recalling previous site reconnaissance, there is a small target range located within the project area. State Fish and Wildlife employees who are also involved in law enforcement training use this target range. An interview with Tim Julison (USFWS) revealed that the firearms that are primarily used at the range include shotguns, 40 caliber handguns, and 9-millimeter handguns. With the shotguns there were regular slugs and buckshot used at the range. Bob Hoffman (CEMVR- ED-DO) indicated that there would be lead shots and bullets located in the levee behind the targets, but there was no concern with respect to unexploded ordinances being present. Matt Culp (Iowa DNR) did not feel that this firing range would be of concern, but that cleanup of such sites was determined on a case-by-case basis. After this Phase I ESA was initiated, the project features were revised and did not include the portion of the levee that has the firing range.

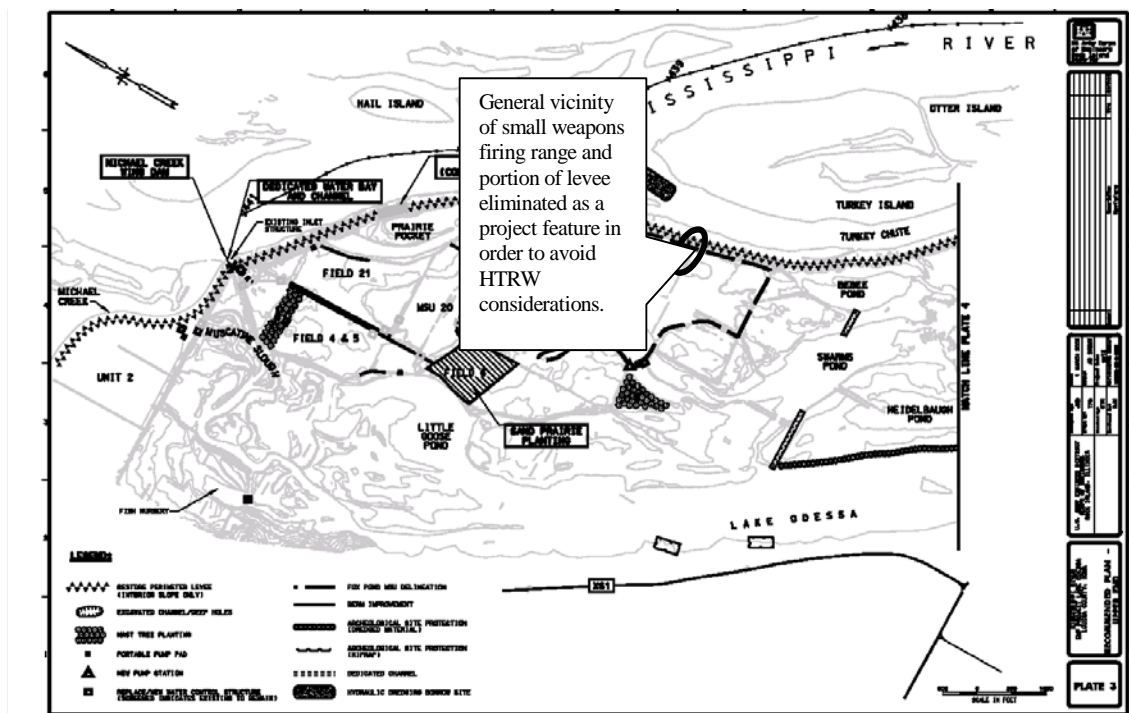


Figure 7. General Location of firing range and portion of levee eliminated as a project feature in order to avoid HTRW considerations.

(4) Burris City. From information gathered in interviews, it was discovered that a historic community was located in the southeastern corner of the project area, near the joining of the UMR and the Iowa River, sometime around the 1850s. Burris City was originally slated to be approximately one square mile, but the city never became established, and was vacated quickly. The city is approximately 3 feet below ground at the present time.

7. Opinions. The section shall include the environmental professional's opinion(s) of the impact on the property of known or suspect environmental conditions identified in the findings section.

(1) Jack's Place/Fuel. Knowledge obtained through interviews did not indicate any previous problems with the storage of the gas, or leaks from the tank. There was no indication of leaks or spills found in the records review. Site reconnaissance did not reveal any evidence of leaks or spills from the storage of gas. Therefore, this finding is considered a *de minimus* environmental condition.

(2) Schafer/Snively Access. The septic systems and above ground storage tanks were a sufficient distance from any proposed activities in the subject plan. Therefore, there are no environmental concerns associated with these areas, and this finding is considered a *de minimus* environmental conditions.

(3) Firing Range. The restoration of the surrounding flood control levee is initially planned in the immediate vicinity of the firing range. This firing range would be affected by the construction activities associated with restoring the levee height and the modification of the

landside slope of the levee (change to 1V:5H slope). Military Munitions Rule 40 CFR Part 260² has assisted with defining when fired munitions are considered solid waste and when they fall under the Resource Conservation and Recovery Act (RCRA) requirements. According to US EPA-Region 2; “Lead shot is not considered a hazardous waste subject to RCRA at the time it is discharged from a firearm because it is used for its intended purpose. However, spent lead shot (or bullets) are subject to the broader definition of solid waste written by Congress and contained in the statute itself. Spent shot and bullets are thus potentially subject to RCRA statutory authority including section 7002 and 7003.” Construction activities may pose a problem of causing the spent lead shot to migrate that may be a hazard to the environment. EPA has ruled that the removal of materials from the range may result in the generation of a solid waste and be subject to RCRA regulation. The EMP project calls for the surface soil layer of the levee to be stripped to allow for the modification of the levee, and this stripped soil would need to comply with RCRA solid waste handling requirements due to the lead shot that would be imbedded in the soil. However, if the lead shot is removed from the soil for recycling, the lead is considered a scrap metal pursuant to 40 Code of Federal Regulations (CFR) 261.6(a)(3)(ii) and is exempt from RCRA regulation. As stated in section 6 (3), the portion of the levee that includes the firing range is no longer a project features.

(4) Burris City. Considering the time of existence and the approximate amount of activity at this site, there is very little concern of prior environmental conditions. The presence of Burris City in the 1850s eliminates concern regarding many HTRW conditions present today. Currently the city is buried approximately 3 feet underground, further reducing any environmental concern with regards to surface work. Therefore, Burris City will be considered a *de minimus* environmental condition.

8. Conclusions. A Phase I Environmental Site Assessment (ESA) was performed in general conformance with the scope and limitations of ASTM Practices E 1527-00 and E 1528-00 for the HREP at Lake Odessa. The Phase I ESA is on file for review at Rock Island District Headquarters. Any exceptions to, or deletions from this practice are described in Section 1 of the report.

This assessment has revealed no evidence of hazardous, toxic, and radioactive waste, or other regulated contaminants in connection with the project features: Mast tree planting, excavation of deep holes and channels, sand prairie planting, fish nursery, and placement of riprap and dredged material for archeological site protection. The levee restoration project feature would not include an area that has been a small weapons firing range for the U.S. Fish and Wildlife Service’s law enforcement training. This firing range would be affected by the construction activities associated with restoring the levee height and the modification of the landside slope of the levee (change to 1V:5H slope). Military Munitions Rule 40 CFR Part 260³ has assisted with defining when fired munitions are considered solid waste and when they fall under the Resource Conservation and Recovery Act (RCRA) requirements. According to US EPA-Region 2; “Lead shot is not considered a hazardous waste subject to RCRA at the time it is discharged from a firearm because it is used for its intended purpose. However, spent lead shot (or bullets) are subject to the broader definition of solid waste written by Congress and contained in the statute

² Ibid

³ Ibid.

itself. Spent shot and bullets are thus potentially subject to RCRA statutory authority including section 7002 and 7003.” Construction activities may pose a problem since heavy equipment would likely disturb the surface soils and cause the spent lead shot to migrate and become a hazard to the environment. If these surface soils, that contain lead ball residue, are disturbed then prompt removal of surface soil layers for the levee modification would become necessary under RCRA regulation. A plan would have to be devised by the site manager (US Fish and Wildlife Service) to ensure that the firing range complies with regulatory management of the lead shot on the firing range and subsequent monitoring. The Coralville Lake Project, License Contract No. DA-11-117-CIVENG-60-0093, Hawkeye Wildlife Area, can be a useful reference and provide information regarding a similar firing range plan and management requirements. If this portion of the levee is restored, then the Lake Odessa HREP should devise construction activities associated with preventing the migration of spent lead munitions and enforce safety of construction workers from exposure to spent lead residue. This project would also need to address disposal of the surface soils removed from the levee that are used also to trap weapons fire and how regulations would be followed.

No ESA can wholly eliminate uncertainty regarding the existence for recognized environmental conditions concerning a property. This assessment is intended to reduce, but not eliminate, uncertainty regarding the existence of recognized environmental conditions in connection with a property with reasonable limits of time and cost. Continuing the Environmental Due Diligence Audit process beyond this Phase I ESA to a Phase II ESA may reduce uncertainty, or reveal unidentified environmental liabilities. If any previously unaddressed recognized environmental condition should arise, this Phase I ESA will be revisited.

9. Recommendations. No further HTRW Assessment is recommended at this time. After a thorough review of all information, only one environmental concern was identified and it related to the small weapons firing range that is not currently included as part of any project feature. All work on this section of the levee associated with the firing range should be avoided. If restoration and construction activities become required in the levee area associated with the firing range, then the project would need to follow guidelines provided in section 8 above.

10 Additional Services. Non-scope considerations were not included within this report. Other environmental issues or conditions in the project study area may be required as part of the Environmental Due Diligence Process. These issues, such as radon and asbestos, are outside of the standard Phase I ESA practice, and therefore not included in this assessment.

APPENDIX A

ACRONYMS

Acronyms.

ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CEMVR	Corps of Engineers, Mississippi Valley Division, Rock Island District
CFR	Code of Federal Regulations
CORRACTS	Facilities subject to Corrective Action under RCRA
CWA	Clean Water Act
DNR	Department of Natural Resources
DPR	Definite Project Report
ED-DN	Engineering Division – Design Branch, Environmental Engineering Section
ED-HQ	Engineering Division – Hydraulics Branch, Water Quality Section
ED-DG	Environmental Division – Design Branch, General Engineering Section
EM	Engineering Manual
EMP	Environmental Management Program
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
FR	Federal Register
HTRW	Hazardous, Toxic, and Radioactive Waste
HREP	Habitat Rehabilitation and Enhancement Project
MPRSA	Marine Protection, Research, and Sanctuaries Act
NAAQS	National Ambient Air Quality Standard
NFRAP	CERCLA Archive
NPL	National Priority List
NRC	National Response Center
RCRA	Resource Conservation and Recovery Act
RM	River Mile
SSHP	Site Specific Safety and Health Plan
TSD	Treatment, Storage, or Disposal Facility
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
WWW	World Wide Web

APPENDIX B REFERENCES AND ABSTRACTS

- ASTM E 1527. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. 2000.
- ASTM E 1528. Standard Practice for Environmental Site Assessments: Transaction Screen Process. 2000.
- Hejzlar, Zdenek. Technical Aspects of Phase I/II Environmental Site Assessments. ASTM Manual Series MNL 43. 1999.
- U. S. Army Corps of Engineers. Aerial Photos of Mississippi River, Pools 17 and 18: RM 434.6 – 441.7. 1932.
- U. S. Army Corps of Engineers. ER 385-1-92: Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities. 1 September 2000.
- U. S. Army Corps of Engineers. ER 1165-2-132: Hazardous, Toxic, and Radioactive Waste Guidance for Civil Works Projects. 26 June 1992.
- U. S. Army Corps of Engineers, Lower Mississippi Valley Division. DIVR 1165-2-9: Hazardous, Toxic, and Radioactive Waste Policy for Civil Works Projects. 14 June 1996
- U. S. Army Corps of Engineers, CECW-PA. Policy Guidance Letter No. 34: Non-CERCLA Regulated Contaminated Materials at Civil Works Projects. 5 May 1992.
- U. S. Army Corps of Engineers. EM 385-1-1: Safety and Health Requirements Manual. 3 September 1996.
- U. S. Army Corps of Engineers. ER 1105-2-100: Planning Guidance Notebook. 22 April 2000.
- U.S. Environmental Protection Agency, Office of Water. National Water Quality Inventory: 1996 Report to Congress. 1996.
- U. S. Geological Survey. Toolesboro Quadrangle, Iowa, 7.5 Minute Series (Topographic) USGS Map. 1992.
- Coralville Lake Project, Iowa Department of Natural Resources, Hawkeye Wildlife Area, License Contract No. DACW25-3-60-93, Proposed Shooting Range, 11 July 2002 (CEMVR-RE-M/Johanson)

“Military Munitions Rule 40 CFR Part 260.”

<http://www.denix.osd.mil/denix/Public/Policy/Range/mrule.html> (30 Sep 2002).

“Environmental Fact Sheet: EPA Finalizes Regulations Under RCRA for Military Munitions.”

United States Environmental Protection Agency, Solid Waste and Emergency Response
(5305W) EPA530-F-97-004, February 1997.

http://.epa.gov/epaoswer/hazwaste/military/muns_fs.txt (30 Sep 2002)

“Environmental Aspects of Construction Management of Outdoor Shooting Ranges.”

http://www.rangeinfo.org/resource_library/facility_mngmnt/environment/envaspct.htm (30
Sep 2002)

APPENDIX C
VICINITY MAPS AND SITE PLANS

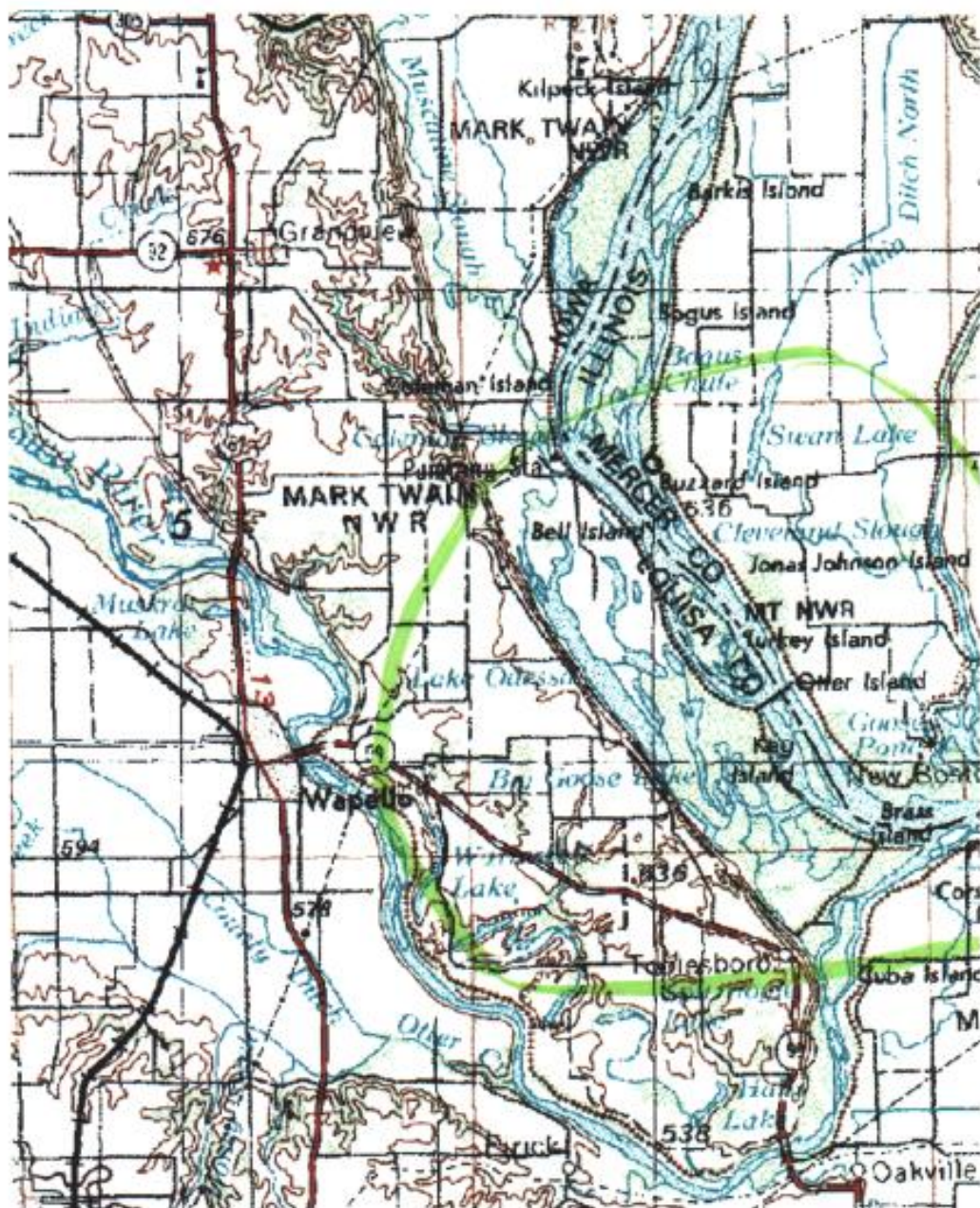


Figure C1. Vicinity Map Lake Odessa EMP (July 1981)

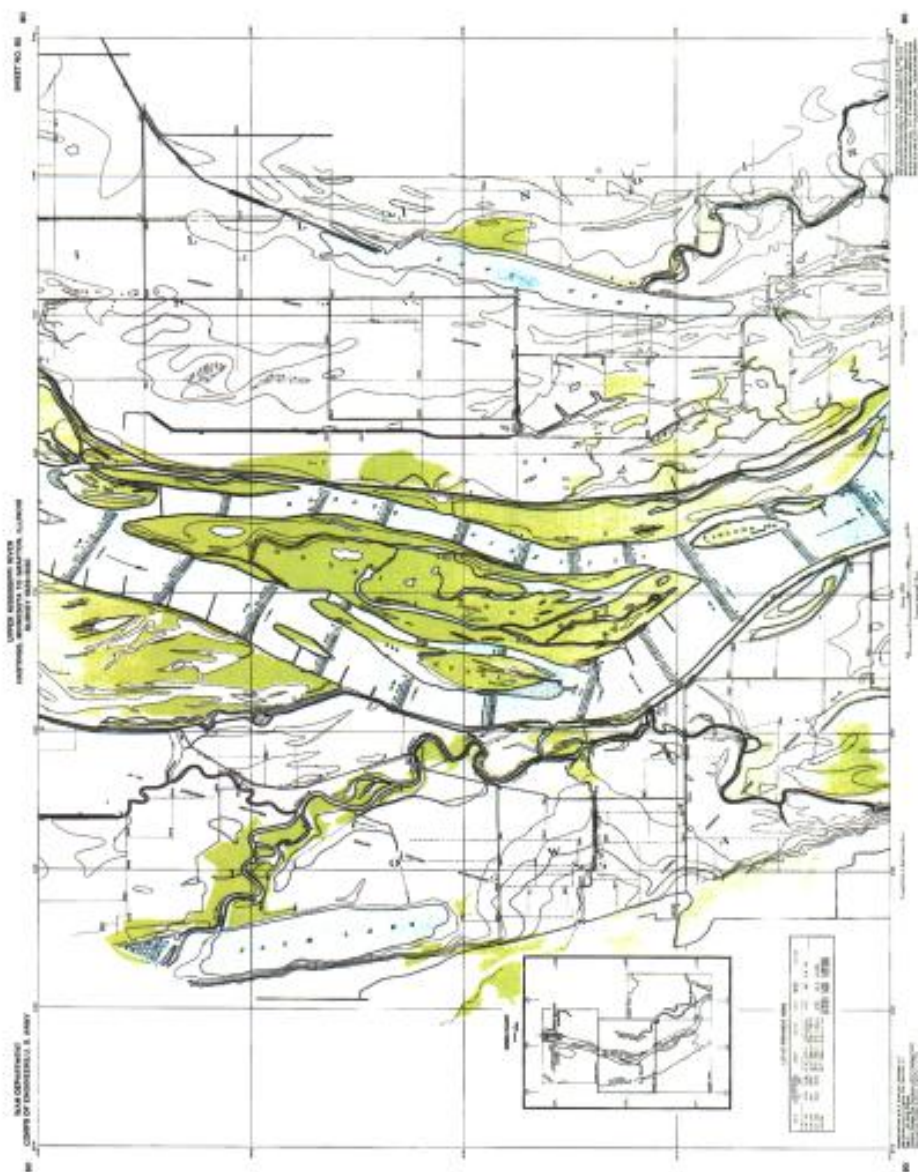


Figure C2. 1931 Mississippi Brown Map
1 of 3

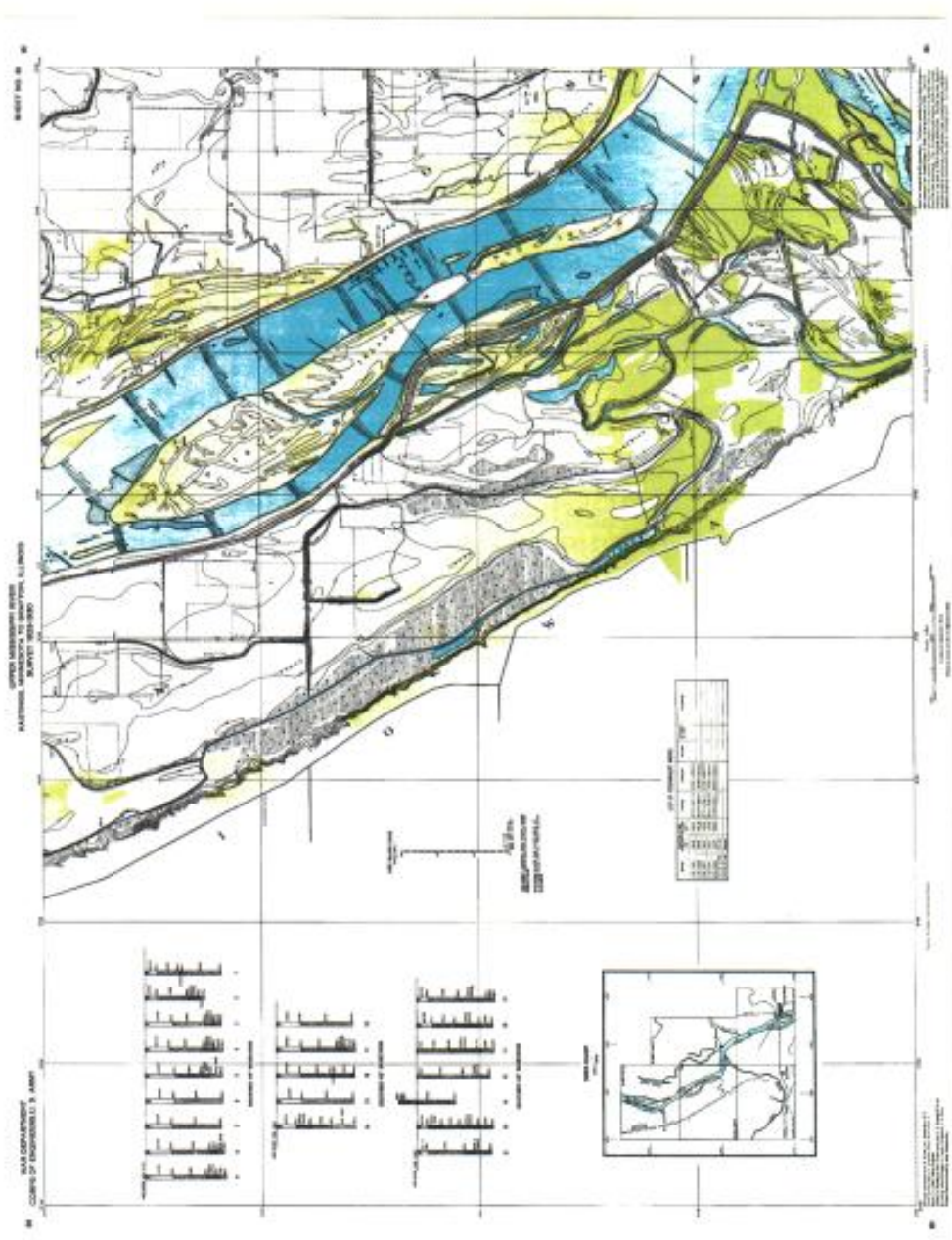


Figure C3. 1931 Mississippi Brown Map
2 of 3

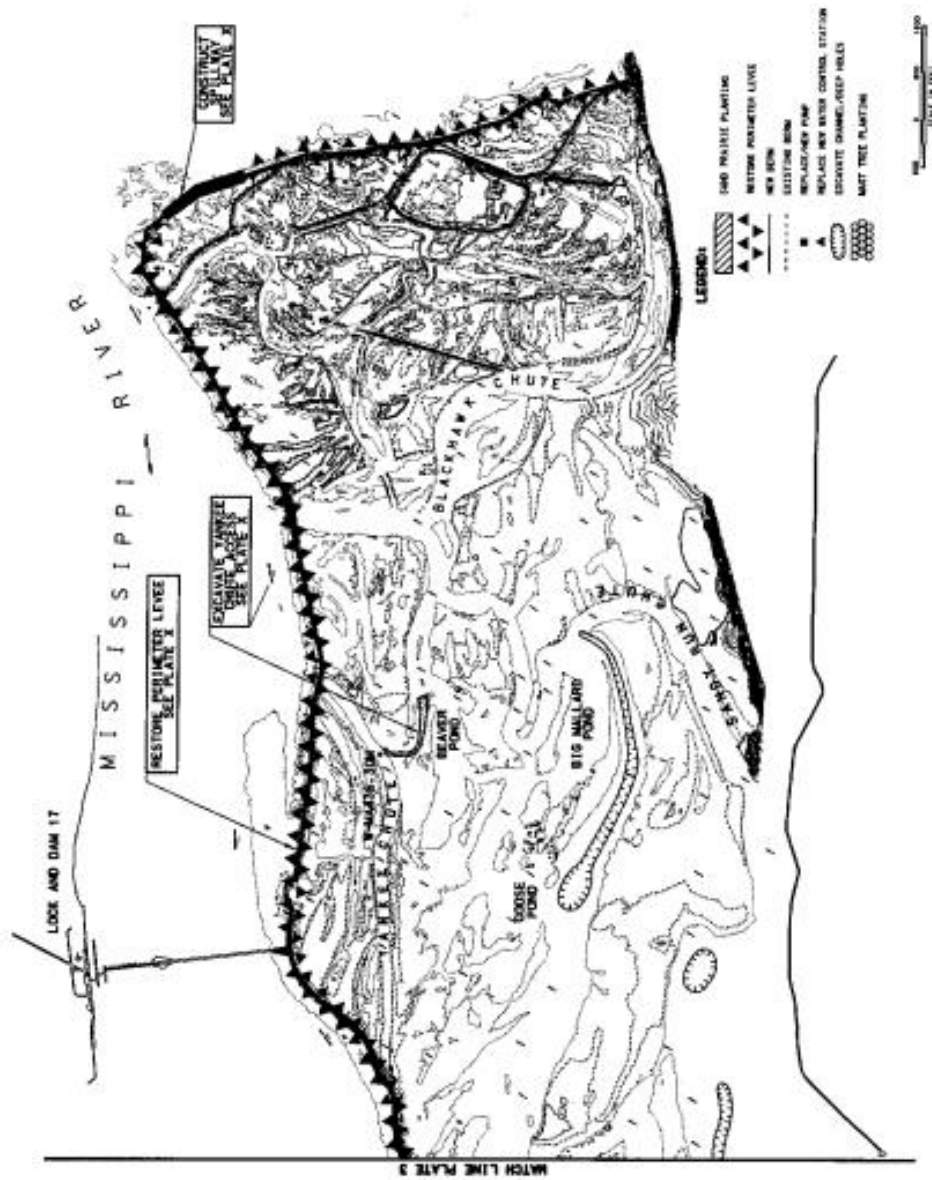


Figure C5. Lake Odessa Site Plan

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TOPOGRAPHIC QUADRANGLE
KING-EL PASO
1:25,000 SCALE (VERTICAL)

PORT LISTER
NEW BOSTON
EL PASO

MISSISSIPPI RIVER
ILLINOIS RIVER
KING RIVER
EL PASO RIVER

Scale 1:25,000

Published by the United States Geological Survey
Washington, D.C. 20540
First published 1968
Revised 1978
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C-7

LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PROGRAM
PHASE I ESA - 31 JULY 2001



Figure C8. 1929-30 Mississippi River Brown Photo
1 of 3

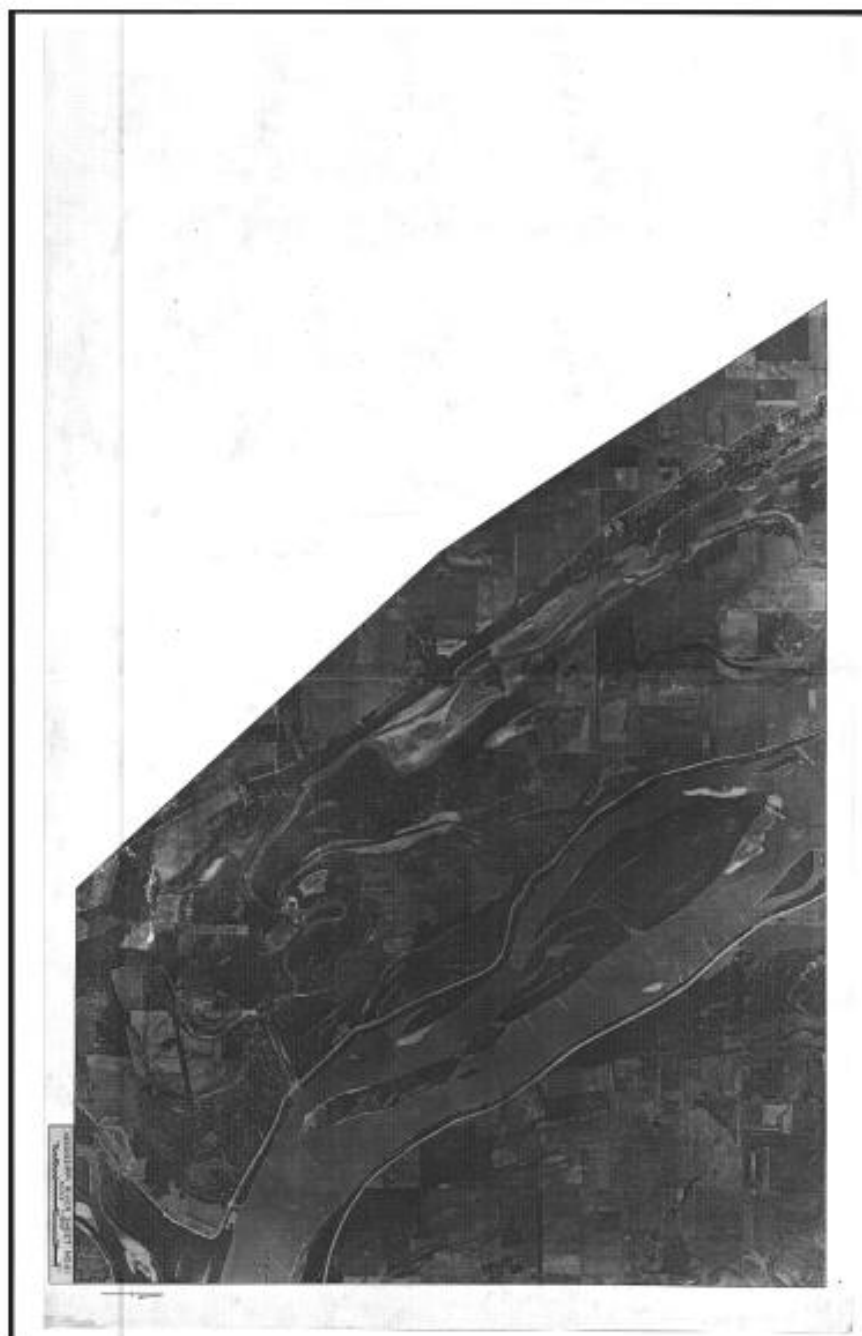


Figure C9. 1929-30 Mississippi River Brown Photo
2 of 3

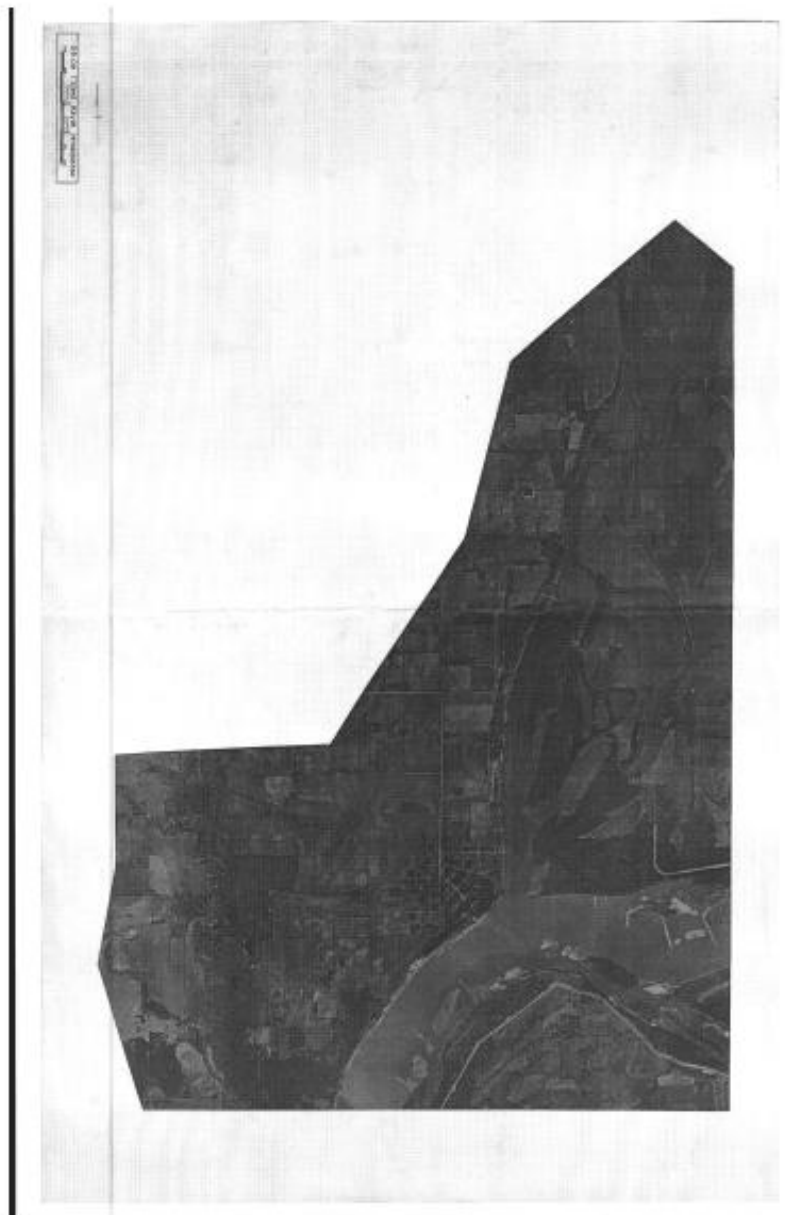


Figure C10. 1929-30 Mississippi River Brown Photo
3 of 3

APPENDIX D
SITE RECONNAISSANCE: NOTES, PHOTOGRAPHS, AND SAFETY PLAN

A site visit was conducted on 16 August 2001. Mark Anderson, Jr. (ED-DN) and Mikael Brown (ED-DN) were in attendance.

NOTES AND PHOTOGRAPHS. Site reconnaissance notes and photographs are included in this appendix following the informal Site Specific Safety and Health Plan (SSHP).

SITE SPECIFIC SAFETY AND HEALTH PLAN. A formal SSHP was prepared for this report and included in this appendix. Investigators followed all generic requirements of the Corps Safety and health Requirements Manual (EM 385-1-1) and the Safety and Occupational Health Requirements for HTRW Activities (ER 385-1-92). Site safety information was obtained from current aerial photographs and informal interviews with members of the project team. Assessment methods did not involve intrusive techniques, such as collecting and analyzing soil samples at the project sites for this report.

SITE SPECIFIC SAFETY AND HEALTH PLAN TITLE PAGE Rock Island District Corps of Engineers		This SSHP is a part of the Rock Island District HTRW Program, which includes EM 385-1-1 and ER 385-1-92.
PROJECT NAME: Environmental Management Program for Habitat Rehabilitation Upper Mississippi River Miles 434.6 – 441.7, Site Plan for Lake Odessa		REQUEST FOR SERVICES NO.:
JOBSITE ADDRESS: Wapello (Louisa County), Iowa		COST CODE:
PROJECT MANAGER: Scott Whitney		PHONE NO.: 309-794-5386
SITE CONTACT: Joe Dziuk		PHONE NO.: 309-794-5812
PHONE NO.:		
() AMENDMENT NO. _____ TO EXISTING APPROVED SSHP. DATE EXISTING APPROVED SSHP:		
OBJECTIVES OF FIELD WORK: Habitat Rehabilitation of the Lake Odessa site. A site visit of the project area will be made. Environmental concerns will be documented. No intrusive investigations (soil samples, etc.) will be conducted.	SITE TYPE: Check as many as applicable: <div style="display: flex; justify-content: space-between;"> () Active () Landfill (X) Natural </div> <div style="display: flex; justify-content: space-between;"> () Inactive () Uncontrolled () Military </div> <div style="display: flex; justify-content: space-between;"> () Secure specify: () Industrial (X) Other </div> <div style="display: flex; justify-content: space-between;"> Refuge. Wildlife </div> <div style="display: flex; justify-content: space-between;"> () Unsecure () Residential </div> <div style="display: flex; justify-content: space-between;"> () Enclosed space () Well Field </div>	
DESCRIPTION AND FEATURES: Summarize below. Include principal operations and unusual features (containers, buildings, dikes, power lines, hills, slopes, rivers, etc.). The project area is located along the Mississippi River. The only structures present on the site are the two drainage structures at either end of Lake Odessa. The project area has very little elevation change outside of the man-made levee that exists on the site.		
SURROUNDING POPULATION: () Residential () Industrial (X) Rural () Urban () Commercial: () Other:		

SITE SPECIFIC SAFETY AND HEALTH PLAN EMERGENCY CONTACTS & APPROVAL PAGE Rock Island District Corps of Engineers				This SSHP is a part of the Rock Island District HTRW Program, which includes EM 385-1-1 and ER 385-1-92.		
EMERGENCY CONTACTS			EMERGENCY CONTACTS		NAME	PHONE
Water Supply	N/A		Project Manager	Scott Whitney		309-794-5386
Site Telephone	N/A		Safety and Health Manager			
EPA Release Report No.			Industrial Hygienist			
			Environmental Agency	Iowa DNR and US Fish and Wildlife		319-524-8319 319-523-6960
			State Spill Number	Iowa Compliance & Enforcement Bureau		515-281-8694
CONTINGENCY PLANS Read and Refer to DM 385-1-2, Appendix H . Enter any additional Site Specific Information and clarifications below: 1. Evacuation Routes will be to the roads that lead away from the site and perpendicular to the alignment. 2. Personnel will evacuate if there appears to be any conditions that appear to expose any of the site visitors to an environmental or safety hazard. 3. All accidents will be reported in accordance with DM 385-1-1, Appendix B , including preparing an accident report form ENG 3394 as required by the appendix. 4. The overall plan is to evacuate the site in case of an emergency. In case of a medical emergency, the local EMS will be contacted from the nearest available phone (resident or business).			Fire Department			911
			Police Department			911
			Poison Control Center			
			Occupational Health Unit			
MEDICAL EMERGENCY						
			Hospital Name:			
			Hospital Address:			
			Name of Contact at Hospital:			
			Name of 24-Hour Ambulance:			
			Route to Hospital (Provide description below and attach map with route to hospital on the following page). A route map was not prepared since the emergency plan is to call 911 from the nearest telephone should there be an emergency.			
HEALTH AND SAFETY PLAN APPROVALS						
Prepared by: Mark Anderson, Jr.	Date: 19 July 2001					
Reviewed by: Kara Mitvalsky	Date: 29 February 2000					

**LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PLAN
PHASE I ESA - 31 JULY 2001**

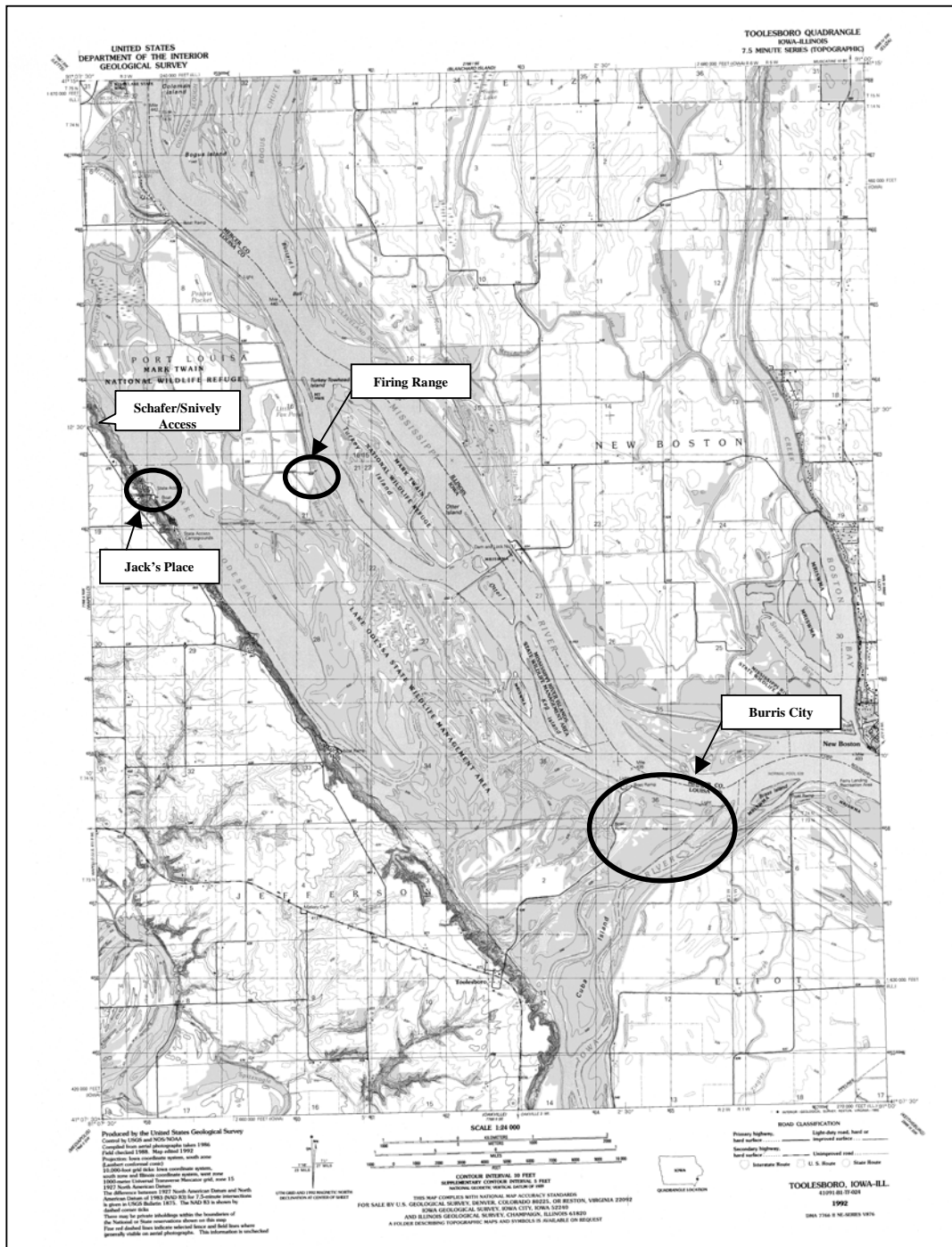


Figure D1. Lake Odessa EMP Project Area and Site Reconnaissance Finds.

Photo D001. 8/16/01. Photo from target end of firing range towards firing line.



Photo D002. 8/16/01. Photo of firing range from top of levee.



Photo D003. 8/16/01. Photo from target end of firing range towards firing line.



Photo D004. 8/16/01. Photo of firing range from firing line toward levee.



Photo D005. 8/16/01. Photo of residential buildings near Schafer Access.



Photo D006. 8/16/01. Photo of residential buildings near Schafer Access.



Photo D007. 8/16/01. Previous Location of Jack's Place.



Photo D008. 8/16/01. Previous Location of Jack's Place.



Photo D009. 8/16/01. Previous Location of Jack's Place.



Photo D010. 8/16/01. Photo of Schafer Access boat ramp.



Photo D011. 8/16/01. Photo of residential propane storage tank near Schafer Access.



Photo D012. 8/16/01. Photo of residential propane storage tank near Schafer Access.



Photo D013. 8/16/01. Photo of levee break and scour hole resulting from Spring 2001 Flood.



Photo D014. 8/16/01. Photo of scour hole from Spring 2001 Flood.



Photo D015. 8/16/01. Photo of scour hole from Spring 2001 Flood.



Photo D016. 8/16/01. Photo of Inlet Structure near the upper end of Lake Odessa.



Photo D017. 8/16/01. Photo of public fishing area behind upper end of inlet structure.



Photo D018. 8/16/01. Photo of Inlet Structure near the upper end of Lake Odessa.



Photo D019. 8/16/01. Photo of typical residence near project study area.



Photo D020. 8/16/01. Photo of typical farm building near project study area.



Photo D021. 8/16/01. Photo of typical residence near project study area.



Photo D022. 8/16/01. Photo of typical residence near project study area.



Photo D023. 8/16/01. Photo of entrance to private cabins on Lake Odessa.



Photo D024. 8/16/01. Photo of typical stoplog structure within project study area.



Photo D025. 8/16/01. Photo of typical drainage ditch within project study area.



Photo D026. 8/16/01. Photo of typical site setting.



Photo D027. 8/16/01. Photo of typical site setting.



Photo D028. 8/16/01. Photo of typical site setting.



Photo D029. 8/16/01. Photo of small boat ramp accessing some backwaters within project study area.



APPENDIX E **HISTORICAL RESEARCH DOCUMENTATION**

Table E2. Historical Use Records Coverage		
Years	Documents	
2000 2005		
1995 2000	1995 Mississippi River Orthophotos	
1990 1995	1992 Toolesboro, IA 7.5 minute USGS Quadrangle	
1985 1990		
1980 1985		
1975 1980		
1970 1975		
1965 1970		
1960 1965		
1955 1960		
1950 1955		
1945 1950		
1940 1945		
1935 1940		
1930 1935	1931 Mississippi Brown Maps	
1925 1930	1929-1930 Mississippi Brown Photos	
1920 1925		
1915 1920		
1910 1915		
1905 1910		
1900 1905		

Copies of all historical maps and photos can be found in Appendix C.

APPENDIX F

ENVIROFACTS AND ENVIROMAPPER DATABASE

The following regulatory records are documented in this appendix.

- (1) U. S. Environmental Protection Agency Envirofacts and Enviromapper.
- (2) National Response Center Database.
- (3) Iowa Department of Natural Resources.

1. Envirofacts and Enviromapper.

- a. Databases.** Envirofacts, created by the U. S. Environmental Protection Agency (USEPA), is a relational database warehouse implemented in the Oracle Relational Database Management System that is available through the Internet for public access. Enviromapper provides users with interactive Geographic Information System (GIS) functionality using USEPA spatial data for the conterminous United States. Enviromapper allows users to view spatial data at the national, state, and county levels, as well as utilize GIS functionality, such as displaying multiple spatial layers, zooming, panning, identifying features, and querying single Envirofacts points. Both systems have the ability to retrieve information from the following environmental databases:

- 1. Superfund Data.**
- 2. Safe Drinking Water Information.**
- 3. Hazardous Waste Data.**
- 4. Risk Management Plans.**
- 5. Toxics Release Inventory.**
- 6. Facility Information.**
- 7. Water Discharge Permits.**
- 8. Air Releases.**
- 9. Brownfields. Grants Information.**
- 10. Master Chemical Integrator.**
- 11. National Drinking Water Contaminant Occurrence Database.**
- 12. Drinking Water Microbial and Disinfection Byproduct Information.**

b. Search Description and Results.

Databases accessed via

<http://www.epa.gov/enviro/html/>

Search Type: A search was constructed to ensure that all potential project sites were included within the search area. Most searches were performed on a countywide basis and none of them revealed any potential environmental concerns within a reasonable distance of the project area. All results were mapped and are included in the following pages.

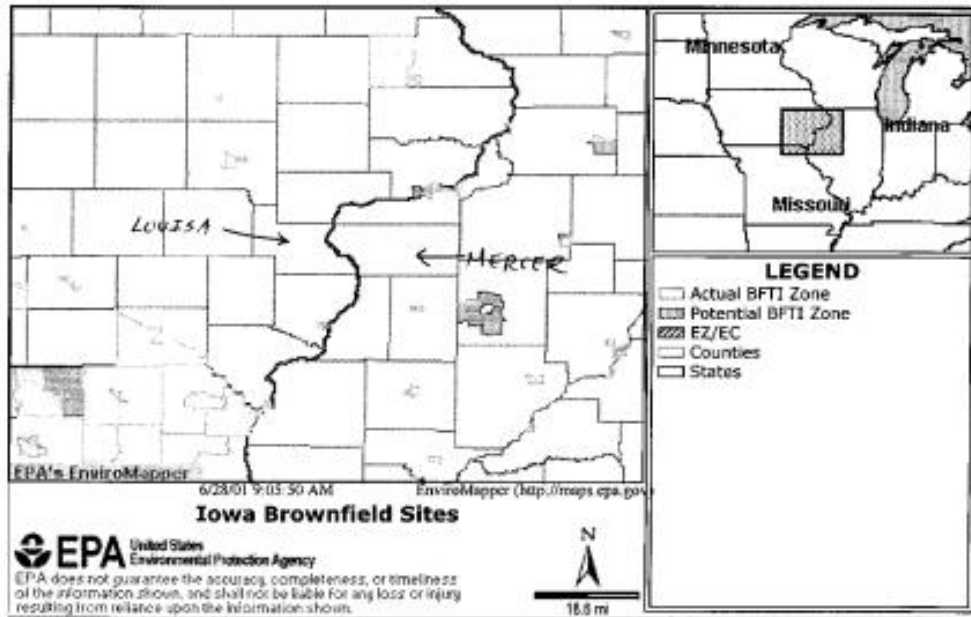


Figure F1. Surrounding Brownfield Sites

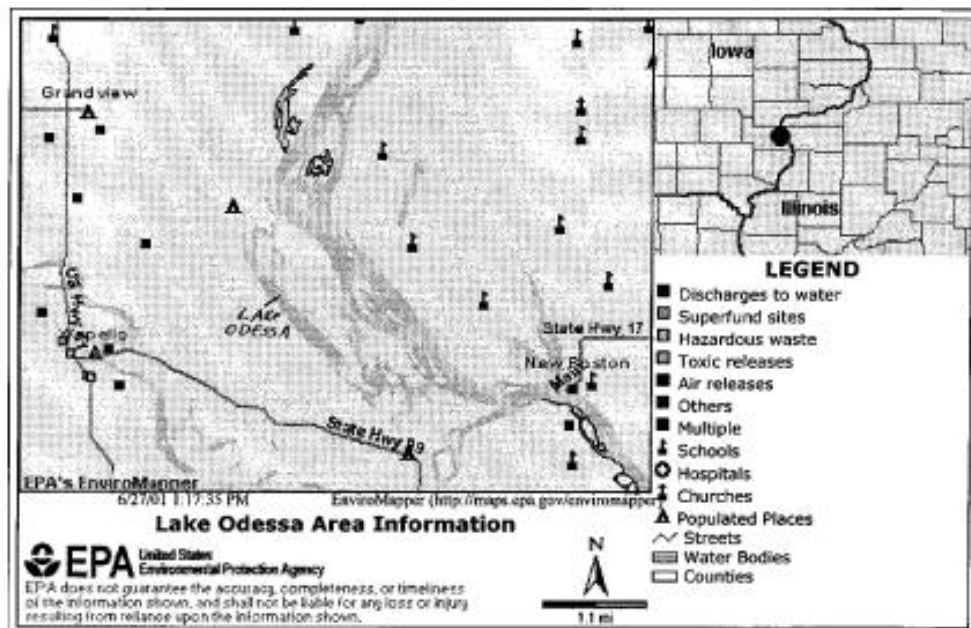


Figure F2. Lake Odessa Area Information



Figure F3. Surrounding NPL Sites

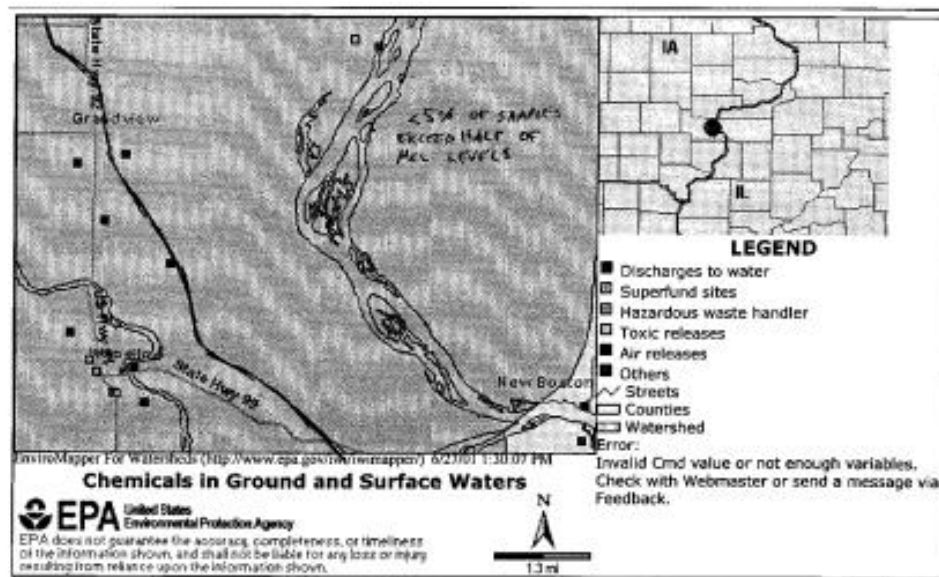


Figure F4. Chemicals in Ground and Surface Waters

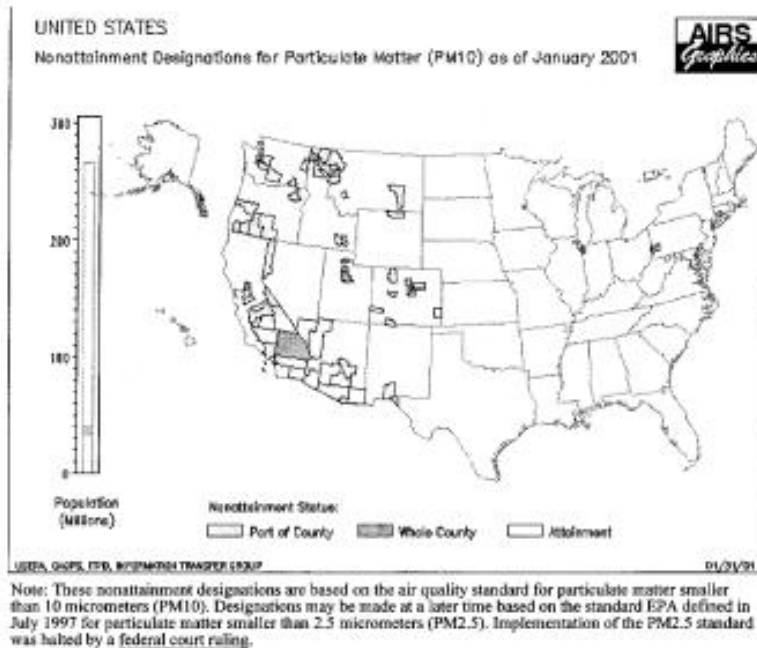


Figure F5. Particulate Matter Non-Attainment



Figure F6. Lead Non-Attainment



Figure F9. Nitrogen Dioxide Non-Attainment

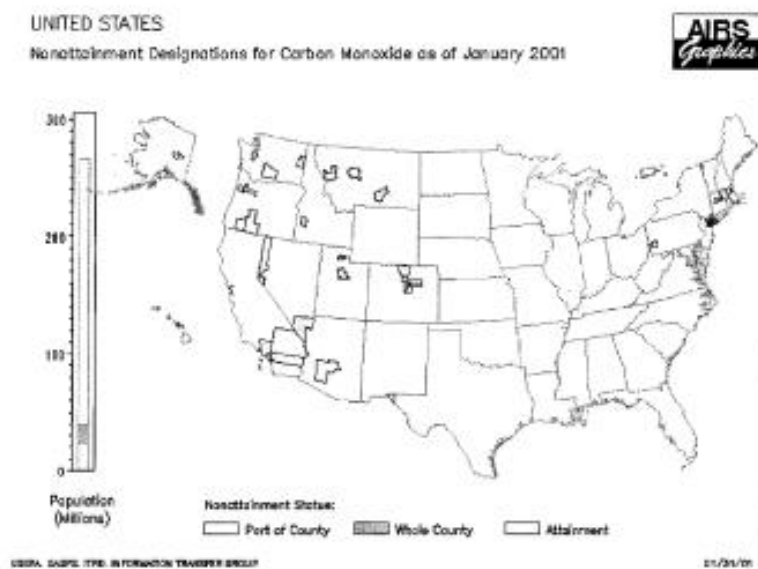


Figure F10. Carbon Monoxide Non-Attainment

LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PLAN
PHASE I ESA – 31 JULY 2001

APPENDIX G
NATIONAL RESPONSE CENTER DATABASE

National Response Center Database.

a. Database. For releases of hazardous substances, the federal government has established a reportable quantity that triggers the reporting requirements under CERCLA. If a hazardous substance is released to the environment in an amount that equals or exceeds its reportable quantity, the release must be reported to federal authorities at the National Response Center (NRC) so that emergency response personnel can evaluate whether a response action is needed.

NRC handles reporting under several federal laws:

- Clean Water Act (for oil and chemical spills in water);
- Clean Air Act, Clean Water Act, and Comprehensive Environmental Response, Compensation, & Liability Act (for releases of reportable quantities of hazardous materials);
- Federal Railroad Safety Act (for railroad incidents);
- Hazardous Liquid Pipeline Safety Act (for incidents involving pipelines other than those carrying liquid natural gas);
- Hazardous Materials Transportation Act (for any transportation incident);
- National Gas Pipeline Safety Act (for incidents involving natural gas pipelines);
- Outer Continental Shelf Lands Act (for oil spills);
- Resource Conservation & Recovery Act (for contingency plans with emergency notification procedures);
- Toxic Substances Control Act (for spills and fires involving polychlorinated biphenyls);
- Trans Alaska Pipeline Authorization Act (for incidents involving any vessel carrying oil from the Trans Alaska Pipeline).

b. Search Description and Results.

Databases accessed via

<http://www.nrc.uscg.mil/foia.htm>

Search Type: Access database information online by searching all data for the counties of Louisa, IA and Mercer, IL. Results from these searches yielded no reported responses from the NRC.

LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PLAN
PHASE I ESA – 31 JULY 2001

APPENDIX H
IOWA ENVIRONMENTAL PROTECTION DIVISION DATABASE

Iowa Environmental Protection Division.

a. Databases. The Iowa Internet Map Server allows records to be searched and mapped for a vast array of environmental information as well as other general information. Some of this environmental information includes hydrology, geology, mining, wells, groundwater vulnerability, NPL sites, USTs, wastewater treatment plants, and many other environmental conditions. The Iowa Internet Map Server also allows one to search for various municipal and political data.

b. Search Description and Results.

Databases accessed via
<http://gis.state.ia.us/>

Search Type: The databases were searched for all information relevant to this report, including Permitted Water Uses, Waste Water Treatment Plants, National Priority List Sites, Landfills, and Underground Storage Tanks. The results are shown in the following maps printed from the same location.

LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PLAN
PHASE I ESA – 31 JULY 2001

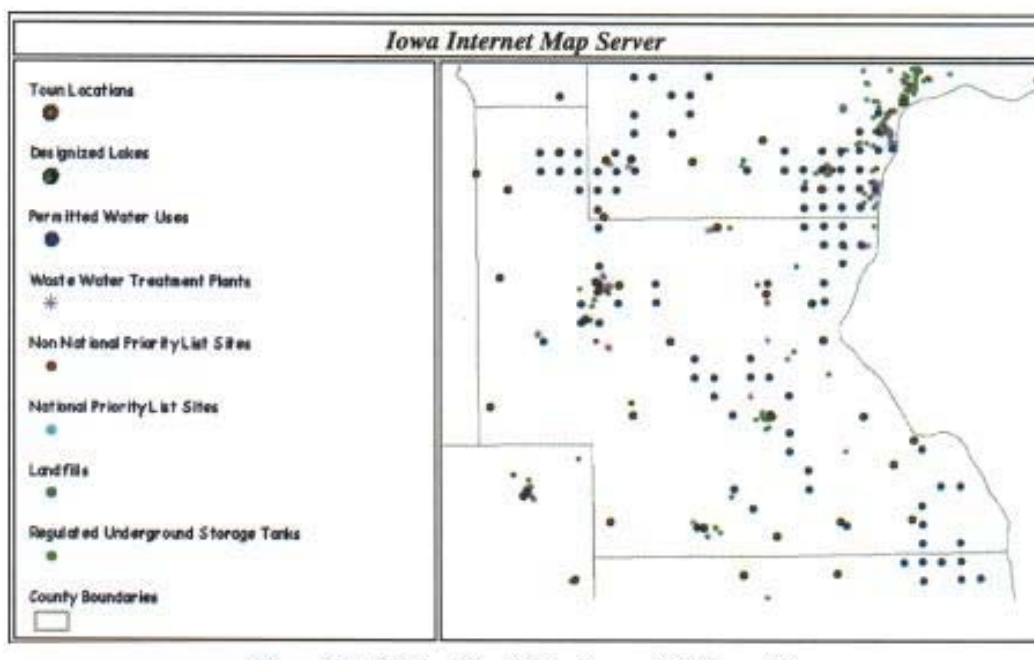


Figure H11. Louisa County Environmental Information
1 of 3

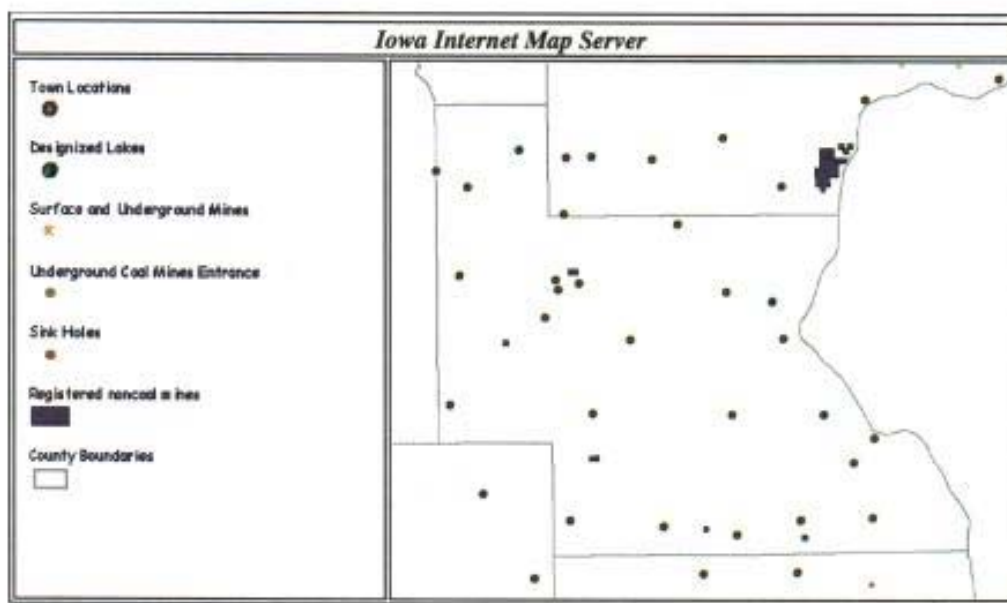


Figure H12. Louisa County Environmental Information
2 of 3

LAKE ODESSA
ENVIRONMENTAL MANAGEMENT PLAN
PHASE I ESA – 31 JULY 2001

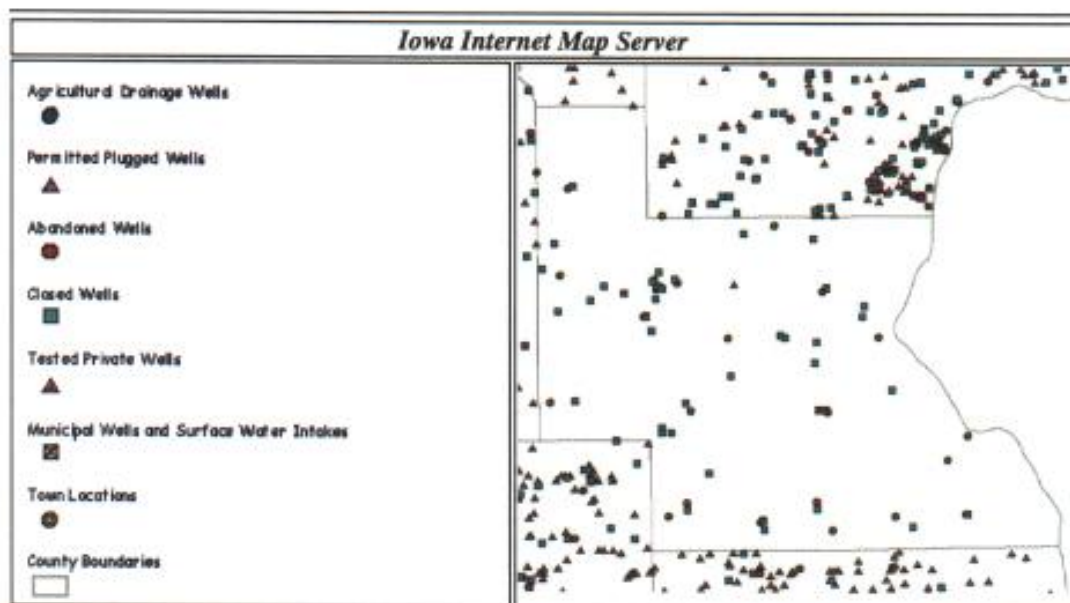


Figure H13. Louisa County Environmental Information
3 of 3

APPENDIX I
INTERVIEW DOCUMENTATION

APPENDIX F

WATER QUALITY

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX F
WATER QUALITY**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
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**APPENDIX F
WATER QUALITY**

CONTENTS

Subject	Page
1) PURPOSE.....	1
2) INTRODUCTION	1
3) METHODS	2
4) RESULTS AND DISCUSSION	3
5) CONCLUSIONS.....	5

TABLES

No.	Page
F-1 Eluriate and ambient water analysis results from samples collected at Lake Odessa on August 28, 2001	F-7
F-2 Water quality monitoring results from samples collected at site W-M438.6M	F-8
F-3 Water quality monitoring results from samples collected at site W-M436.3O	F-12
F-4 Water quality monitoring results from samples collected at site W-M439.4C	F-16
F-5 Water quality monitoring results from samples collected at site W-M435.3J	F-20

FIGURES

F-1 Pre-Project Dissolved Oxygen and pH values collected with a continuous monitor at site W-M436.3O (12/95 to 01/96)	F-24
F-2 Pre-Project Dissolved Oxygen and pH values collected with a continuous monitor at site W-M436.3O (07/96)	F-25
F-3 Pre-Project Dissolved Oxygen and pH values collected with a continuous monitor at site W-M436.3O (12/96 to 01/97)	F-26
F-4 Dissolved Oxygen Mass Balance Calculations for Yankee Chute	F-27

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX F
WATER QUALITY**

1) PURPOSE

The purpose of this appendix is to present the results of water quality related baseline monitoring performed within the Lake Odessa backwater complex, discuss the results of dissolved oxygen (D.O.) mass balance determination, and address the water quality concerns/benefits of various alternatives under consideration.

Elutriate and grain size analyses were performed in order to determine the potential water quality impacts of proposed dredging activities. Water quality monitoring was performed in an effort to define present water quality conditions and to identify potential problem areas. A D.O. mass balance was calculated for Yankee Chute in order to determine the inflow required for maintaining sufficient D.O. concentrations to support aquatic life during the winter.

2) INTRODUCTION

Sedimentation in the Lake Odessa backwater complex has resulted in a preponderance of shallow water habitat that has negatively impacted the fishery. Circulation of oxygenated water has decreased in portions of the complex that have become isolated from the main flow path. This is particularly true for Yankee Chute, where winter fish kills have been reported. Alternatives considered that would improve oxygen levels and/or circulation patterns include creation of channels, deep holes, and introduction of oxygenated Mississippi River water through the perimeter levee to Yankee Chute. An alternative that calls for restoration of the perimeter levee would require dredging of sand from the Mississippi River adjacent to Lake Odessa.

In order to address permitting issues related to dredging activities, bed sediment samples and overlying water were collected on August 28, 2001. Elutriate and grain size analyses were performed on three samples collected from potential dredge cuts within the backwater complex. Samples for chemical analysis were not collected from potential dredge cuts in the Mississippi River adjacent to the perimeter levee because sand would be utilized for levee restoration; therefore, water quality impacts would be insignificant.

A Lake Odessa water quality monitoring program was initiated in 1990 in order to define baseline water quality conditions and to identify potential problem areas. The initial monitoring station was located in Bebee Pond (site W-M438.6M). As project design features evolved, the water quality monitoring

program was modified. In 1992, a sampling station was added in Yankee Chute (site W-M436.3O) and in 1995, sampling commenced in Blackhawk Chute (site W-M435.3J) and in the main basin of the lake (site W-M439.4C). Sampling was discontinued in 1995 at site W-M438.6M and in 1998 at the remaining stations.

Plate 54 of this document shows the location of all Rock Island District pre-project water and sediment monitoring sites.

3) METHODS

In order to address water quality issues related to potential dredging activities, Rock Island District Water Quality and Sedimentation Section personnel collected bed sediment samples on August 28, 2001, at sites E-M437.5E and E-M438.8F. A duplicate sample for quality control purposes and an ambient water sample were also collected at site E-M437.5E. Sediment samples were collected with a 48-inch-long, 2-inch-wide, plastic-lined core sampler. Each sample was placed in a stainless steel basin and mixed with a stainless steel spoon. The homogeneous mixture was placed in a glass sample bottle, which was then stored in an ice chest. Water bottles were filled just below the surface, preserved if necessary, and stored in an ice chest. All samples requiring chemical analysis were shipped to EIS Analytical Services, Inc., South Bend, Indiana. Elutriate analyses were performed on three sediment samples. The elutriate test consisted of placing 50 ml of a wet, well-mixed sediment sample and 200 ml of process water collected from site E-M437.5E into a bottle. The mixture was shaken for 30 minutes, allowed to settle for 30 minutes, and the supernatant was then drawn off and analyzed. Following a 24-hour settling period, the elutriate was again drawn off and analyzed. An ambient water sample collected at site E-M437.5E was analyzed for the same constituents as the elutriate test.

Rock Island District Geotechnical Branch personnel performed grain size analyses on all sediment samples according to the U.S. Army Corps of Engineers Engineering Manual 1110-2-1906 (1970).

Baseline water quality monitoring data were collected by Corps Water Quality and Sedimentation Section personnel and by an engineering firm under contract to the Corps. Barrientos and Associates, Inc. of Iowa City, Iowa, performed the 1990 monitoring. Corps Water Quality and Sedimentation Section personnel performed the remaining water quality monitoring. At each sampling site, a water sample was collected just below the surface. In general, sampling date, time, water depth, Secchi disk depth, water velocity, wave height, air temperature, percent cloud cover, wind speed and direction, pH, water temperature, D.O. and conductivity were recorded in the field. Samples collected by Barrientos and Associates, Inc. for chlorophyll and total suspended solids analysis were placed on ice and shipped to the University Hygienic Laboratory located in Iowa City and Des Moines, Iowa. Samples collected by Rock Island District personnel for laboratory analysis were placed on ice and shipped to, ARDL, Inc., Mt. Vernon, Illinois, through March 9, 1994, and thereafter to EIS Analytical Services, Inc., South Bend, Indiana. Turbidity and total alkalinity samples collected by District personnel were analyzed in-house. Sample collection/preservation and field/laboratory analytical procedures were performed according to U.S. Environmental Protection Agency approved methods. In addition to the manually collected data, YSI 6000UPG multiparameter water quality monitoring instruments were deployed on three occasions at site W-M436.3O from December 1995 through early January 1997. These instruments were positioned 3 feet from the bottom and were programmed to record D.O., pH, temperature, depth, specific conductivity and turbidity every 2 hours.

In an effort to estimate the minimum inflow necessary for maintaining a D.O. concentration of 5 mg/l in Yankee Chute, a simplified D.O. mass balance was performed. For performing the mass balance, it was

assumed (worst-case basis) that the chute would be snow and ice-covered for a period of 100 days and there would be no reaeration or photosynthesis. Other assumptions include: the sediment oxygen demand (SOD) is $.28 \text{ g O}_2/\text{m}^2/\text{day}$ at 4°C (this rate is based on values given in Butts, 1974, personal communication with John Sullivan of the WDNR regarding Wisconsin River SOD rates, and lessons learned from a similar study at Brown's Lake); the area impacted is 36 acres (includes Yankee Chute and its access channel); the average depth of the impacted area is 3 feet; the initial and inflowing D.O. concentration is 14.2 mg/l (100 percent saturation at 1°C); and inflowing water will completely mix with the impacted area. The water column BOD was estimated to be 2.4 mg/l at 20°C . This value, temperature corrected to 1°C , is 0.7 mg/l . Literature values were used for the BOD/SOD temperature correction factor, fish respiration rate, and fish standing stock. The BOD/SOD temperature correction factor of 1.067 was suggested by Fair et al. (1941) for river mud oxygen demand rates. This correction factor is close to the 1.06 given by Bowie (1985) as a midrange of values reported in the literature. The fish respiration rate of $0.0119 \text{ m O}_2/\text{g/hr}$ is the standard respiration rate for carp according to Leidy (1977). The fish standing stock of 392 lbs./acre was the average value for 12 Upper Mississippi River backwater lakes reported by Pitlo (1987).

In order to perform the D.O. mass balance, the major sources and sinks of D.O. were first identified. The major sources of D.O. were determined to be 13.5 mg/l in the inflowing water column and a 9.2 mg/l reserve present in the chute prior to ice cover. The inflowing D.O. concentration was calculated by subtracting the inflowing BOD at 1°C (0.7 mg/l) from the inflowing D.O. at 1°C and 100 percent saturation (14.2 mg/l). The reserve D.O. concentration present in the chute was determined by subtracting the 5 mg/l minimum D.O. necessary for supporting aquatic life from the 14.2 mg/l concentration present in the chute prior to ice cover. The major D.O. sinks were determined to be SOD, water column BOD, and fish respiration.

4) RESULTS AND DISCUSSION

Grain size analysis results indicate that the bed sediments from potential dredge cuts within Lake Odessa consist primarily of fine material. Site E-M437.5E was classified as a lean clay, while the sample from site E-M438.8F was classified as a sandy lean clay. The quantity of material passing a #200 sieve was 96.4 and 83.7 percent, respectively.

Table F-1 shows elutriate (including duplicate values) and ambient water analysis results from samples collected at sites E-M437.5E and E-M438.8F. Both 30-minute and 24-hour settling periods were used in the elutriate test. Except for ammonia nitrogen and total organic carbon (TOC), noticeable concentration decreases were seen in the 24-hour versus 30-minute elutriate test results. Most metal concentrations were below their respective detection limit, and all were below their respective state standard in the 24-hour test. In the 30-minute elutriate test, copper at both sites and lead at site E-M437.5E exceeded their respective state standard. Elutriate BOD and TOC concentrations were close to ambient water values. Elutriate (30-minute) turbidity, total suspended solids and ammonia nitrogen values were considerably higher than ambient water values. Following 24 hours of settling, elutriate turbidity and total suspended solids values decreased considerably; whereas, ammonia nitrogen values did not change. The elutriate ammonia nitrogen concentrations were typical of the range seen in fine-grained Mississippi River sediments. The state standard for ammonia nitrogen is dependent upon pH and temperature. Considering the pH and temperature ranges normally expected to occur at site E-M438.8F, it is likely that the elutriate ammonia nitrogen concentration at this site (17 mg/l) exceeds the state standard. However, past experience has shown that a relatively small mixing zone can effectively reduce ammonia-nitrogen concentrations to acceptable levels.

The results from the elutriate test are typical of those seen in fine-grained Mississippi River sediments. The results indicate that if hydraulic dredging is utilized, exceedances of state water quality standards may occur. Measures taken to assure state standards are met could include prohibiting dredging during the summer when water temperatures are higher and a greater percentage of the ammonia is in the toxic un-ionized form, and/or utilizing a confined placement site which would allow for more settling. Also, a relatively small mixing zone would likely reduce ammonia-nitrogen and metal concentrations to acceptable levels.

The results from baseline water quality monitoring at four Lake Odessa sites are given in Tables F-2 through F-5. Sampling commenced at site W-M438.6M on August 18, 1990, and ended on February 14, 1995 (see Table F-2). Five D.O. concentrations at this site were below the state standard of 5 mg/l. All exceedances occurred during the summer. Two pH values exceeded the state standard of 9.0. Sampling commenced at site W-M436.3O on February 3, 1992, and ended on January 27, 1998 (see Table F-3). Eleven D.O. concentrations at this site were below the state standard. With the exception of a 2.48 mg/l D.O. concentration on January 25, 1993, all exceedances occurred during the summer. One pH value exceeded the state standard of 9.0. Sampling commenced at site W-M439.4C on April 11, 1995, and ended on January 27, 1998 (see Table F-4). Two D.O. concentrations at this site were below the state standard of 5 mg/l. These exceedances occurred during the summer. Three pH values exceeded the state standard of 9.0. Sampling commenced at site W-M435.3J on July 11, 1995, and ended on January 27, 1998 (see Table F-5). Two D.O. concentrations during the summer were below the state standard and one pH value exceeded the state standard at this site. All pH value exceedances appeared to be related to plant photosynthetic activity.

In addition to manually collected data, an YSI 6000UPG multiparameter water quality monitoring instrument (sonde) was deployed on three occasions at site W-M436.3O. D.O. and pH results from these deployments are given in Figures 1 through 3. The initial deployment was from December 20, 1995, through January 4, 1996 (see Figure F-1). The D.O. concentration fell below the state standard only on January 3, 1996. A sonde was next deployed on July 10, 1996, and retrieved on July 23, 1996. During most of the deployment, the D.O. was below the state standard (see Figure F-2). The final deployment was from December 23, 1996, through January 7, 1997. All D.O. concentrations during this period were above the state standard. All pH values during the three deployments were within the acceptable range of 6.5 - 9.0. In general, pH values tended to parallel D.O. concentrations.

According to Bill Ohde of the IDNR, fish kills have occurred during the winter in areas isolated from the main flow path, particularly Yankee Chute. These fish kills are most likely due to low D.O. concentrations. Diversion of oxygenated flow from the Mississippi River into Yankee Chute is one alternative that would help prevent winter fish kills. This could be accomplished by placing a culvert or other type of water control structure through the levee near the upper end of Yankee Chute. It is imperative that the structure include a valve/gate to prevent sediment from entering the chute when the main channel is carrying a high-suspended solids load. In order to size this structure, the volume of inflowing water necessary to maintain D.O. concentrations at a level that can sustain aquatic life was determined. The D.O. mass balance calculations are given in Figure F-4. The estimated inflow required to maintain a D.O. concentration of 5 mg/l in Yankee Chute during worst-case winter conditions was calculated to be 0.17 m³/sec (6 cfs). Dredging the entrance to Yankee Chute would allow for improved water circulation and help prevent fish kills by providing for fish egress during periods of low D.O.

The proposed creation of a deep hole and channels in other portions of the complex would also help prevent winter fish kills. The additional water volume created by dredging would allow for a larger reserve of oxygen at the onset of the critical winter period. The proposed dredging of the lateral ditch

between the main basin of the lake and Bebee Pond would allow for better circulation of oxygenated inflowing water to the lower portion of the complex.

5) CONCLUSIONS

Elutriate analyses were performed on Lake Odessa samples in order to evaluate the impacts of hydraulically placed dredged material on water quality. The analytical results suggest that ammonia-nitrogen, metal, and turbidity values could exceed state standards should hydraulic dredging occur. Measures taken to avoid state standard exceedances could include prohibiting dredging during the summer when water temperatures are higher and a greater percentage of the ammonia is in the toxic un-ionized form, and/or utilizing a confined placement facility to allow for settling of suspended solids. A relatively small mixing zone can also be effective at reducing ammonia-nitrogen and metal concentrations to acceptable levels. Mechanical dredging with side cast placement of material would result in minimal water quality impacts as long as return water is kept to a minimum.

Samples for elutriate analysis were not collected from potential dredge cuts in the Mississippi River adjacent to the perimeter levee because sand would be utilized for levee restoration; therefore, water quality impacts would be insignificant.

Baseline water quality monitoring studies performed at four Lake Odessa sites have shown that on occasion D.O. concentrations fall below 5 mg/l. Most excursions below 5 mg/l were observed during the summer months. Occasionally during the winter months, D.O. concentrations below 5 mg/l were measured, although District field personnel observed no fish kills. However, according to Bill Ohde of the IDNR, fish kills have occurred during previous winters in areas isolated from the main flow path, particularly Yankee Chute. It is likely these fish kills were caused by low D.O. concentrations. Placement of a water intake structure to allow for water exchange with the main channel is one option that would help alleviate low winter D.O. levels in Yankee Chute. A D.O. mass balance calculation estimated the inflow required to maintain a D.O. concentration of 5 mg/l in Yankee Chute during worst-case winter conditions to be 0.17 m³/sec (6 cfs). Another option for improving winter conditions in Yankee Chute is to dredge a channel leading to the entrance of the chute. This would allow for fish egress and improve the diffusion of oxygen to the area. Dredging a deep hole and channels in other portions of the complex would help prevent winter fish kills by allowing for a larger reserve of oxygen at the onset of the critical winter period and by improving water circulation patterns.

6) **LITERATURE CITED**

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Table F-1. Elutriate (0.5 and 24-hour) and ambient water analysis results from samples collected at Lake Odessa on August 28, 2001

PARAMETER	ELUTRIATE RESULTS BY SITE			
	Duplicate		Duplicate	
	1/2-Hour E-M437.5E	1/2-Hour E-M437.5E	24-Hour E-M437.5E	24-Hour E-M437.5E
BOD (mg/l)	6	3	<2	<2
Copper (mg/l)	0.10	0.09	<0.01	<0.01
Lead (mg/l)	0.081	0.069	<0.003	0.004
Mercury (mg/l)	0.00016	0.00015	<0.00005	<0.00005
Ammonia Nitrogen (mg/l)	4.7	4.5	4.7	5.1
Total Suspended Solids (mg/l)	4,320	2,200	<1	11
Total Organic Carbon (mg/l)	11	9.8	8.6	8.6
Turbidity (NTU)	3,280	4,880	287	290
pH	7.3	7.0	7.6	7.4
Temperature (°C)	22	22	22	22

PARAMETER	ELUTRIATE		AMBIENT WATER	STATE STANDARD
	1/2-Hour E-M438.8F	24-Hour E-M438.8F	E-M437.5E	Class B(LW)
BOD (mg/l)	6	2	7	-
Copper (mg/l)	0.09	<0.01	<0.01	0.020 *
Lead (mg/l)	0.055	0.004	<0.003	0.080 *
Mercury (mg/l)	0.00013	<0.00005	<0.00005	0.0025 *
Ammonia Nitrogen (mg/l)	17	17	0.091	**
Total Suspended Solids (mg/l)	2,180	17	49	-
Total Organic Carbon (mg/l)	12	11	12	-
Turbidity (NTU)	3,300	420	46	***
pH	6.9	7.3	8.8	6.5 - 9.0
Temperature (°C)	22	22	26.1	-

* Acute standard

** The ammonia nitrogen standard is temperature and pH dependent

*** The turbidity of the receiving water shall not be increased by more than 25 NTUs by any point source discharge

Table F-2. Water quality monitoring results from samples collected at site W-M438.6M

DATE	WATER DEPTH (M)	VELOCITY (CM/SEC)	WAVE HEIGHT (CM)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (KM/H)
8/18/90	1.850	<.11	3	30	-	-
9/1/90	-	-	-	29	-	-
9/15/90	1.771	<.11	3	23	-	-
9/29/90	1.539	<.11	3	16	-	-
6/25/91	2.499	0.14	6	27	20	10
7/11/91	1.600	*	3	24	100	5
7/23/91	1.189	0.09	6	23	10	10
8/6/91	0.274	0.13	6	17	100	7
8/20/91	0.558	0.07	0	21	25	1
9/10/91	0.533	0.21	6	20	10	10
9/24/91	0.518	0.15	3	12	95	3
10/10/91	0.945	0.05	0	11	40	0
10/22/91	1.097	0.21	12	23	25	15
11/5/91	1.189	0.06	0	4	100	10
11/26/91	1.433	0.09	0	-4	100	15
12/13/91	1.417	0.13	0	-1	0	2
2/3/92	1.067	0.00	**	3	75	0
4/7/92	1.372	*	9	17	80	12
5/5/92	1.646	0.17	6	14	5	10
5/19/92	1.372	0.06	0	29	5	0
7/23/92	0.823	0.04	3	26	100	7
8/13/92	0.518	0.11	0	22	65	4
8/27/92	0.549	0.09	3	23	15	13
9/17/92	0.853	0.25	3	24	50	8
10/8/92	0.884	***	9	12	100	12
10/27/92	1.052	0.00	0	15	0	0
11/24/92	1.417	0.24	0	6	100	4
1/25/93	1.372	0.00	**	-6	5	0
11/10/93	0.381	0.19	3	4	5	4
1/10/94	0.747	0.00	**	-3	100	12
2/24/94	2.164	0.00	**	-7	75	6
3/9/94	1.905	0.18	3	-1	15	7
4/19/94	1.067	0.09	9	16	5	6
5/10/94	2.515	0.09	0	18	2	0
5/24/94	0.960	0.04	0	23	85	0
6/14/94	0.351	0.12	6	31	15	8
7/7/94	0.823	0.00	3	29	20	2
7/19/94	1.143	0.14	9	25	80	5
8/9/94	0.366	*	3	19	100	4
8/30/94	0.305	0.07	3	19	100	3
10/4/94	1.158	0.00	0	15	90	2
10/25/94	0.442	0.06	6	7	60	5
12/6/94	0.427	0.15	0	-1	100	4
1/10/95	0.457	0.00	**	-5	100	1
2/14/95	0.335	0.01	**	-4	100	6
MIN	0.274	0.00	0	-7	0	0
MAX	2.515	0.25	12	31	100	15
AVC.	1.065	0.09	3	14	56	6

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-2 (Cont.). Water quality monitoring results from samples collected at site W-M438.6M

<u>DATE</u>	<u>WIND DIRECTION</u>	<u>WATER TEMP. (°C)</u>	<u>DISSOLVED OXYGEN (MG/L)</u>	<u>pH (SU)</u>	<u>TOTAL ALKALINITY (MG/L as CaCO₃)</u>
8/18/90	-	28.0	9.70	7.60	132
9/1/90	-	29.0	8.80	7.70	140
9/15/90	-	24.0	9.10	7.80	148
9/29/90	-	19.0	9.70	8.20	142
6/25/91	SE	26.4	8.56	7.82	148
7/11/91	SW	26.4	7.03	7.87	148
7/23/91	NW	29.1	5.01	7.61	167
8/6/91	E	20.7	2.99	7.53	192
8/20/91	NA	22.8	7.40	8.18	190
9/10/91	NW	24.3	3.39	7.95	180
9/24/91	S	14.9	7.34	8.03	164
10/10/91	-	14.8	11.77	8.81	146
10/22/91	S	14.5	11.28	8.29	155
11/5/91	S	2.7	15.80	8.53	153
11/26/91	SE	1.6	16.02	*	152
12/13/91	SE	3.6	10.84	7.88	142
2/3/92	-	4.3	15.59	8.46	156
4/7/92	NW	14.0	12.76	8.28	168
5/5/92	NW	18.7	12.37	8.61	174
5/19/92	-	28.0	13.15	*	178
7/23/92	NW	24.2	9.95	8.15	135
8/13/92	NW	24.8	15.52	8.87	153
8/27/92	NW	22.2	14.15	8.74	129
9/17/92	SW	25.0	8.12	*	114
10/8/92	S	15.5	8.95	8.58	132
10/27/92	-	14.2	12.33	8.82	147
11/24/92	NE	5.0	*	8.19	135
1/25/93	-	2.8	8.62	7.85	168
11/10/93	NW	6.4	11.02	8.38	204
1/10/94	SE	1.6	13.92	8.25	268
2/24/94	W	0.1	11.55	7.33	138
3/9/94	N	2.7	11.04	7.39	141
4/19/94	NW	17.0	9.16	8.47	140
5/10/94	-	17.6	10.66	8.19	140
5/24/94	-	24.1	5.33	7.59	166
6/14/94	S	28.9	9.70	8.48	189
7/7/94	SE	29.0	4.40	7.78	147
7/19/94	SE	27.2	4.57	7.62	145
8/9/94	SE	23.0	5.85	8.79	172
8/30/94	SE	20.2	1.66	8.86	166
10/4/94	E	16.7	6.60	8.17	153
10/25/94	NW	7.9	8.41	9.07	189
12/6/94	N	3.6	11.49	8.67	183
1/10/95	SE	2.3	10.30	7.64	210
2/14/95	SE	2.3	16.66	9.02	****
MIN	-	0.1	1.66	7.33	114
MAX	-	29.1	16.66	9.07	268
AVG.	-	10.2	9.74	-	160

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-2 (Cont.). Water quality monitoring results from samples collected at site W-M438.6M

<u>DATE</u>	<u>SPECIFIC CONDUCTANCE</u> <u>(µMHOS/CM @ 25°C)</u>	<u>SECCHI DISK</u> <u>DEPTH (CM)</u>	<u>TURBIDITY</u> <u>(NTU)</u>	<u>SUSPENDED</u> <u>SOLIDS (MG/L)</u>
8/18/90	342	49.1	13	22.0
9/1/90	359	-	15	22.0
9/15/90	357	36.0	19	36.0
9/29/90	342	25.9	30	40.0
6/25/91	355	70.1	7	-
7/11/91	371	42.7	14	-
7/23/91	392	24.4	22	-
8/6/91	421	9.1	70	-
8/20/91	385	13.7	39	-
9/10/91	408	9.1	62	-
9/24/91	416	12.2	55	-
10/10/91	372	26.5	24	-
10/22/91	387	27.4	25	-
11/5/91	340	33.5	12	-
11/26/91	306	47.2	11	-
12/13/91	309	45.7	7	<10
2/3/92	333	**	17	30.0
4/7/92	360	30.5	16	24.0
5/5/92	366	36.6	13	26.0
5/19/92	394	42.7	11	15.0
7/23/92	378	18.3	34	69.4
8/13/92	339	12.2	56	77.3
8/27/92	314	9.1	74	148.0
9/17/92	302	19.8	37	54.1
10/8/92	333	21.3	32	72.8
10/27/92	352	27.4	19	29.8
11/24/92	295	42.7	10	17.1
1/25/93	340	**	7	19.0
11/10/93	379	7.6	54	61.3
1/10/94	435	**	9	8.7
2/24/94	*	**	43	61.3
3/9/94	323	50.3	12	21.5
4/19/94	346	24.4	32	60.0
5/10/94	355	70.1	7	8.0
5/24/94	389	39.6	15	23.0
6/14/94	387	21.3	31	78.0
7/7/94	387	15.2	47	97.0
7/19/94	385	9.1	73	130.0
8/9/94	365	12.2	45	180.0
8/30/94	327	10.7	70	180.0
10/4/94	382	19.8	36	65.0
10/25/94	392	12.2	48	110.0
12/6/94	339	36.6	15	57.0
1/10/95	425	**	7	10.0
2/14/95	325	**	9	6.0
MIN	295	7.6	7	6.0
MAX	435	70.1	74	180.0
AVG.	362	26.0	29	56.3

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-2 (Cont.). Water quality monitoring results from samples collected at site W-M438.6M

	CHLOROPHYLL a	CHLOROPHYLL b	CHLOROPHYLL c	PHEOPHYTIN a
DATE	(MG/M ³)	(MG/M ³)	(MG/M ³)	(MG/M ³)
8/18/90	42.0	4.0	4.0	13.0
9/1/90	35.0	3.0	7.0	<1
9/15/90	61.0	9.0	8.0	16.0
9/29/90	47.0	12.0	22.0	38.0
6/25/91	-	-	-	-
7/11/91	-	-	-	-
7/23/91	-	-	-	-
8/6/91	-	-	-	-
8/20/91	-	-	-	-
9/10/91	-	-	-	-
9/24/91	-	-	-	-
10/10/91	-	-	-	-
10/22/91	-	-	-	-
11/5/91	-	-	-	-
11/26/91	-	-	-	-
12/13/91	26.0	2.3	3.1	<1
2/3/92	86.0	26.0	38.0	21.0
4/7/92	37.0	<1.3	<1.5	2.6
5/5/92	53.0	1.6	4.5	2.5
5/19/92	26.0	14.0	8.4	<1.9
7/23/92	130.0	10.0	22.0	82.0
8/13/92	201.0	<11.2	<13.0	38.4
8/27/92	406.0	63.5	25.0	502.0
9/17/92	212.0	<2.2	3.7	73.4
10/8/92	103.0	9.9	34.0	29.4
10/27/92	106.0	25.3	38.8	155.0
11/24/92	66.2	9.8	7.4	<1.9
1/25/93	33.6	5.8	15.3	33.4
11/10/93	4.3	<1.3	<1.6	2.7
1/10/94	17.0	3.4	2.8	14.6
2/24/94	4.2	3.0	6.7	2.9
3/9/94	12.5	4.5	5.4	4.0
4/19/94	83.0	<1	12.0	1.0
5/10/94	26.0	<1	<1	<1
5/24/94	12.0	2.0	<1	<1
6/14/94	88.0	<1	4.2	27.0
7/7/94	140.0	<1	15.0	25.0
7/19/94	100.0	<1	2.2	18.0
8/9/94	210.0	<1	9.1	1.6
8/30/94	230.0	<1	7.2	1.7
10/4/94	110.0	<1	4.7	20.0
10/25/94	60.0	<1	2.5	17.0
12/6/94	25.0	<1	1.1	4.9
1/10/95	15.0	<1	1.5	7.4
2/14/95	12.0	<1	<1	<1
MIN	4.2	<1	<1	<1
MAX	406.0	63.5	38.8	502.0
AVG.	82.9	-	-	-

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-3. Water quality monitoring results from samples collected at site W-M436.30

DATE	WATER DEPTH (M)	VELOCITY (CM/SEC)	WAVE HEIGHT (CM)	AIR TEMP. (°C)	CLOUD COVER (%)	WIND SPEED (KM/H)
2/3/92	1.615	0.00	**	4	75	0
4/7/92	1.920	*	6	17	75	10
5/5/92	2.164	0.15	3	14	5	7
5/19/92	1.890	0.10	0	29	5	0
7/23/92	1.372	0.27	0	26	100	5
8/13/92	1.189	0.05	0	22	70	2
8/27/92	1.143	0.09	3	23	15	13
9/17/92	1.250	0.00	3	24	40	5
10/8/92	1.448	0.17	3	12	100	7
10/27/92	1.646	0.07	0	15	0	0
11/24/92	1.966	0.27	0	6	100	4
1/25/93	1.981	0.00	**	-6	5	0
11/10/93	0.914	0.00	3	5	5	4
1/10/94	1.341	0.00	**	-3	100	10
2/24/94	2.743	0.00	**	-7	90	5
3/9/94	2.499	0.05	0	-1	20	5
4/19/94	1.646	0.09	3	16	0	7
5/10/94	3.033	0.14	0	18	2	0
5/24/94	1.539	0.00	0	23	85	0
6/14/94	1.021	0.13	0	32	15	2
7/7/94	1.417	0.00	0	30	15	1
7/19/94	1.753	0.09	6	25	75	8
8/9/94	0.975	*	3	19	100	2
8/30/94	0.610	0.00	0	19	100	0
10/4/94	1.692	0.00	0	15	85	0
10/25/94	1.067	0.07	3	7	50	4
12/6/94	1.021	0.10	0	-1	100	1
1/10/95	0.823	0.00	**	-5	100	7
2/14/95	0.884	0.00	**	-4	100	8
4/11/95	2.499	0.15	3	12	100	3
5/2/95	3.459	0.05	3	14	80	1
5/16/95	3.261	0.19	3	18	85	4
6/13/95	2.088	0.06	0	21	15	0
6/27/95	1.448	0.09	0	22	100	0
7/11/95	1.219	0.09	3	28	15	2
7/25/95	0.823	0.06	0	28	5	0
8/29/95	1.006	0.00	0	28	60	1
9/12/95	0.945	0.00	0	16	100	0
9/27/95	1.006	0.13	0	14	0	1
10/10/95	1.052	0.00	0	13	5	0
10/24/95	1.113	***	9	8	100	5
11/7/95	1.341	0.13	6	1	20	7
6/19/96	2.438	0.07	3	21	100	4
7/10/96	2.195	0.00	0	21	0	2
8/13/96	1.311	0.14	0	27	0	3
8/27/96	1.097	0.05	0	27	75	0
9/19/96	1.387	0.17	3	17	55	6
12/23/96	1.219	0.00	**	1	100	3
1/7/97	1.295	0.00	**	-10	0	2
2/11/97	1.615	0.00	**	-4	100	4
2/25/97	1.798	0.00	**	0	0	6
6/18/97	1.036	0.08	3	23	15	2
7/2/97	1.006	***	3	28	0	3
7/17/97	1.097	0.12	6	28	50	4
7/31/97	1.097	0.00	0	22	5	1
8/19/97	1.173	0.00	6	17	99	6
9/3/97	1.280	0.09	6	16	30	5
9/25/97	1.326	0.12	3	16	0	2
12/23/97	1.387	0.00	**	2	60	2
1/27/98	1.234	0.00	**	2	100	2
MIN	0.610	0.00	0	-10	0	0
MAX	3.459	0.27	9	32	100	13
AVG.	1.514	0.06	2	14	51	3

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-3 (Cont.). Water quality monitoring results from samples collected at site W-M436.30

DATE	WIND DIRECTION	WATER TEMP. (°C)	DISSOLVED OXYGEN (MG/L)	pH (SU)	TOTAL ALKALINITY (MG/L as CaCO ₃)
2/3/92	-	3.7	9.08	7.30	160
4/7/92	NW	13.6	11.13	7.52	190
5/5/92	NW	19.7	9.49	7.80	201
5/19/92	-	28.0	11.45	*	211
7/23/92	NW	25.2	11.58	8.20	180
8/13/92	NW	26.6	14.64	8.53	196
8/27/92	NW	24.0	9.50	8.05	195
9/17/92	SE	25.0	9.11	*	143
10/8/92	S	16.6	7.90	8.22	163
10/27/92	-	14.3	10.50	8.50	158
11/24/92	NE	5.2	*	7.91	138
1/25/93	-	3.9	2.48	7.55	****
11/10/93	NW	5.9	16.38	8.88	250
1/10/94	SE	0.3	13.18	8.27	211
2/24/94	W	0.1	11.32	7.39	150
3/9/94	N	3.3	9.99	7.45	141
4/19/94	NW	17.1	10.26	8.33	148
5/10/94	-	17.1	11.79	8.39	144
5/24/94	-	24.0	5.66	7.45	159
6/14/94	S	28.9	9.27	8.23	179
7/7/94	SE	29.8	8.32	8.10	158
7/19/94	SE	27.1	3.84	7.36	165
8/9/94	E	25.0	3.01	7.51	208
8/30/94	-	23.3	3.94	7.57	200
10/4/94	-	17.7	9.43	8.28	141
10/25/94	NW	10.8	9.76	8.53	193
12/6/94	NW	4.8	10.95	8.20	209
1/10/95	E	1.9	18.04	8.01	230
2/14/95	SE	2.4	32.30	8.70	232
4/11/95	SE	7.9	12.02	*	118
5/2/95	N	12.2	15.40	9.18	176
5/16/95	S	19.0	13.34	8.97	151
6/13/95	-	22.8	*	7.64	158
6/27/95	-	26.8	1.87	7.49	154
7/11/95	SE	29.0	5.44	7.78	164
7/25/95	-	28.5	3.06	7.61	202
8/29/95	SW	29.3	2.29	7.73	179
9/12/95	-	20.7	4.31	7.78	179
9/27/95	SW	16.3	7.00	*	174
10/10/95	-	15.1	7.07	7.92	233
10/24/95	W	9.6	8.14	8.20	231
11/7/95	NW	4.1	9.78	8.11	183
6/19/96	NW	23.9	1.87	7.40	179
7/10/96	SE	23.8	3.61	7.52	185
8/13/96	W	-	-	-	190
8/27/96	-	30.3	15.02	-	175
9/19/96	SE	19.3	6.19	****	157
12/23/96	N	3.6	6.09	*	186
1/7/97	W	2.9	10.28	*	188
2/11/97	W	2.0	*	*	185
2/25/97	SW	4.4	13.17	*	71
6/18/97	NW	27.5	9.92	8.29	146
7/2/97	W	30.3	7.05	7.88	169
7/17/97	SE	29.5	5.84	8.00	164
7/31/97	E	26.5	7.96	8.21	180
8/19/97	SE	23.5	3.58	7.52	185
9/3/97	E	25.3	8.00	7.92	160
9/25/97	NW	19.0	8.28	8.22	133
12/23/97	NW	3.6	9.08	*	136
1/27/98	SE	3.2	6.28	7.34	156
MIN	-	0.1	1.87	7.30	71
MAX	-	30.3	32.30	9.18	250
AVG.	-	10.7	9.04	-	176

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-3 (Cont.). Water quality monitoring results from samples collected at site W-M436.30

DATE	SPECIFIC CONDUCTANCE (µMHOS/CM @ 25°C)	SECCHI DISK DEPTH (CM)	TURBIDITY (NTU)	SUSPENDED SOLIDS (MG/L)
2/3/92	358	**	9	12.0
4/7/92	410	51.8	8	9.2
5/5/92	437	45.7	7	19.0
5/19/92	452	51.8	7	10.0
7/23/92	402	25.9	21	91.1
8/13/92	405	21.3	25	39.0
8/27/92	412	25.9	23	37.7
9/17/92	339	27.4	21	34.8
10/8/92	363	35.1	18	32.9
10/27/92	359	30.5	16	30.3
11/24/92	296	45.7	11	18.3
1/25/93	349	**	5	****
11/10/93	452	25.9	14	8.4
1/10/94	429	**	4	<2.5
2/24/94	*	**	19	29.3
3/9/94	338	79.2	7	15.0
4/19/94	360	30.5	22	42.0
5/10/94	354	97.5	6	5.0
5/24/94	385	48.8	12	18.0
6/14/94	417	16.8	33	70.0
7/7/94	414	19.8	29	60.0
7/19/94	436	29.0	20	38.0
8/9/94	477	13.7	37	72.0
8/30/94	434	10.7	58	120.0
10/4/94	364	45.7	13	21.0
10/25/94	409	29.0	17	38.0
12/6/94	369	33.5	15	20.0
1/10/95	394	**	15	32.0
2/14/95	364	**	17	29.0
4/11/95	261	48.8	11	22.0
5/2/95	367	76.2	11	18.0
5/16/95	351	64.0	9	11.0
6/13/95	357	82.3	7	9.0
6/27/95	404	42.7	14	18.0
7/11/95	400	21.3	46	80.0
7/25/95	423	12.2	72	120.0
8/29/95	430	25.9	19	47.0
9/12/95	399	22.9	35	80.0
9/27/95	399	25.9	26	45.0
10/10/95	384	29.0	18	28.0
10/24/95	392	27.4	25	47.0
11/7/95	348	61.0	19	11.0
6/19/96	381	228.6	5	<1
7/10/96	405	67.1	12	18.0
8/13/96	-	18.3	22	33.0
8/27/96	306	21.3	16	34.0
9/19/96	377	21.3	30	45.0
12/23/96	435	**	21	42.0
1/7/97	365	**	15	12.0
2/11/97	381	**	9	10.0
2/25/97	284	**	18	10.0
6/18/97	377	13.7	73	70.0
7/2/97	410	24.4	58	120.0
7/17/97	403	15.2	82	54.0
7/31/97	418	30.5	58	190.0
8/19/97	401	30.5	32	31.0
9/3/97	376	33.5	23	24.0
9/25/97	331	16.8	48	45.0
12/23/97	300	**	6	2.0
1/27/98	324	**	6	4.0

MIN	261	10.7	4	<1.0
MAX	477	228.6	82	190.0
AVG.	362	39.6	23	38

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-3 (Cont.). Water quality monitoring results from samples collected at site W-M436.30

DATE	CHLOROPHYLL a (MG/M ³)	CHLOROPHYLL b (MG/M ³)	CHLOROPHYLL c (MG/M ³)	PHEOPHYTIN a (MG/M ³)
2/3/92	29.0	18.0	26.0	1.1
4/7/92	37.0	<1.3	1.4	23.0
5/5/92	21.0	8.3	1.2	14.0
5/19/92	25.0	24.0	4.8	23.0
7/23/92	20.0	14.0	32.0	56.0
8/13/92	75.9	11.4	<7.9	82.0
8/27/92	118.0	70.8	74.8	159.0
9/17/92	19.9	7.4	13.4	396.0
10/8/92	52.2	27.6	33.7	63.6
10/27/92	78.0	17.6	34.2	62.7
11/24/92	50.9	4.2	8.1	334.0
1/25/93	****	****	****	****
11/10/93	25.8	2.3	2.1	<2.7
1/10/94	6.8	<1.3	<1.6	<2.7
2/24/94	8.0	9.9	14.4	<2.7
3/9/94	<2.3	<1.3	<1.6	<2.7
4/19/94	100.0	7.0	8.0	3.3
5/10/94	26.0	<1	<1	11.0
5/24/94	18.0	3.0	<1	1.1
6/14/94	77.0	<1	2.9	12.0
7/7/94	86.0	1.8	2.9	20.0
7/19/94	30.0	1.8	<1	<1
8/9/94	75.0	2.6	3.0	22.0
8/30/94	230.0	<1	11.0	11.0
10/4/94	57.0	2.2	2.0	2.0
10/25/94	77.0	<1	5.0	20.0
12/6/94	41.0	<1	<1	18.0
1/10/95	41.0	<1	2.0	20.0
2/14/95	120.0	<1	15.0	<1
4/11/95	86.0	<1	10.0	4.0
5/2/95	65.0	4.7	16.0	<1
5/16/95	32.0	<1	<1	<1
6/13/95	20.0	<1	<1	13.0
6/27/95	23.0	<1	<1	8.8
7/11/95	110.0	<1	4.4	15.0
7/25/95	180.0	<1	11.0	23.0
8/29/95	87.0	<1	<1	2.9
9/12/95	75.0	<1	<1	9.9
9/27/95	50.0	1.7	4.8	12.0
10/10/95	27.0	<1	<1	11.0
10/24/95	30.0	4.3	8.2	13.0
11/7/95	18.0	3.5	7.6	6.9
6/19/96	5.1	4.6	1.6	<1
7/10/96	43.0	6.4	7.1	<1
8/13/96	48.0	<1	<1	14.0
8/27/96	110.0	<1	<1	33.0
9/19/96	100.0	<1	<1	25.0
12/23/96	17.0	<1	<1	3.4
1/7/97	25.0	<1	1.8	3.2
2/11/97	18.0	<1	1.5	4.4
2/25/97	<1	<1	<1	<1
6/18/97	190.0	<1	1.5	30.0
7/2/97	150.0	7.2	7.5	23.0
7/17/97	140.0	11.0	8.4	21.0
7/31/97	120.0	<1	<1	11.0
8/19/97	68.0	2.8	3.6	6.8
9/3/97	57.0	8.5	3.8	<1
9/25/97	140.0	<1	<1	23.0
12/23/97	11.0	<1	<1	<1
1/27/98	27.0	<1	<1	3.1
MIN	<1	<1	<1	<1
MAX	230.0	70.8	74.8	396.0
AVG.	61	-	-	-

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-4. Water quality monitoring results from samples collected at site W-M439.4C

<u>DATE</u>	<u>WATER DEPTH (M)</u>	<u>VELOCITY (CM/SEC)</u>	<u>WAVE HEIGHT (CM)</u>	<u>AIR TEMP. (°C)</u>	<u>CLOUD COVER (%)</u>	<u>WIND SPEED (KM/H)</u>
4/11/95	2.438	***	15	11	100	9
5/2/95	3.429	0.07	3	13	60	1
5/16/95	3.216	0.15	6	17	85	6
6/13/95	2.179	0.06	3	20	20	5
6/27/95	1.402	0.00	0	22	100	1
7/11/95	1.219	0.09	0	28	15	3
7/25/95	0.823	0.00	0	27	0	1
8/29/95	0.914	0.04	3	28	65	3
9/12/95	0.945	*	6	16	100	6
9/27/95	1.006	0.00	3	14	0	3
10/10/95	1.036	0.00	3	12	10	4
10/24/95	1.250	***	24	8	98	6
11/7/95	1.372	***	18	1	20	13
6/19/96	2.438	0.10	6	21	100	4
7/10/96	2.134	0.00	0	21	0	0
8/13/96	0.975	0.40	8	27	0	5
8/27/96	0.732	0.09	0	27	40	0
9/19/96	1.402	0.34	9	17	40	6
12/23/96	1.265	0.00	**	1	100	6
1/7/97	1.372	0.00	**	-11	0	2
2/11/97	1.631	0.00	**	-4	100	7
2/25/97	1.798	0.00	**	0	0	6
6/18/97	0.899	0.11	3	23	15	6
7/2/97	0.991	***	18	28	0	10
7/17/97	1.158	0.10	12	28	65	6
7/31/97	1.067	0.04	3	21	2	2
8/19/97	1.158	0.13	15	17	99	5
9/3/97	1.189	0.13	9	16	30	8
9/25/97	1.280	***	18	16	0	6
12/23/97	1.387	0.00	**	2	70	5
1/27/98	1.219	0.00	**	2	100	5
MIN	0.732	0.00	0	-11	0	0
MAX	3.429	0.40	24	28	100	13
AVG	1.462	0.07	7	15	46	5

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-4 (Cont.). Water quality monitoring results from samples collected at site W-M439.4C

<u>DATE</u>	<u>WIND DIRECTION</u>	<u>WATER TEMP. (°C)</u>	<u>DISSOLVED OXYGEN (MG/L)</u>	<u>pH (SU)</u>	<u>TOTAL ALKALINITY (MG/L as CaCO₃)</u>
4/11/95	SE	8.0	11.15	9.47	119
5/2/95	N	13.3	9.26	8.70	152
5/16/95	S	18.3	10.70	8.65	149
6/13/95	NW	22.7	*	8.43	136
6/27/95	SE	26.1	3.44	7.78	157
7/11/95	SE	29.1	7.30	8.74	170
7/25/95	SE	28.3	2.90	7.80	174
8/29/95	SE	30.4	5.40	8.63	177
9/12/95	SE	20.8	9.23	8.86	187
9/27/95	SW	15.9	9.80	*	171
10/10/95	E	14.8	11.62	8.89	228
10/24/95	NW	8.3	10.09	8.50	199
11/7/95	NW	3.2	12.14	8.60	181
6/19/96	NW	24.1	6.09	7.86	136
7/10/96	-	24.1	7.95	8.16	162
8/13/96	W	-	-	-	190
8/27/96	-	28.5	16.50	8.95	151
9/19/96	SE	20.5	12.46	8.89	140
12/23/96	N	2.3	13.90	*	158
1/7/97	NW	1.2	14.38	*	141
2/11/97	W	1.2	*	*	152
2/25/97	SW	4.4	13.17	*	71
6/18/97	NW	26.7	9.29	8.64	165
7/2/97	NW	28.7	7.50	8.52	168
7/17/97	SE	28.4	8.42	8.86	155
7/31/97	SE	26.8	17.32	9.58	125
8/19/97	SE	23.3	6.48	8.88	112
9/3/97	NE	24.1	9.94	9.09	112
9/25/97	NW	18.2	9.86	8.62	134
12/23/97	NW	2.0	20.20	*	150
1/27/98	SE	0.6	15.46	8.58	191

MIN	-	0.6	2.90	7.78	71
MAX	-	30.4	20.20	9.58	228
AVG	-	17.5	10.43	-	155

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-4 (Cont.). Water quality monitoring results from samples collected at site W-M439.4C

<u>DATE</u>	<u>SPECIFIC CONDUCTANCE</u> <u>(µMHOS/CM @ 25°C)</u>	<u>SECCHI DISK</u> <u>DEPTH (CM)</u>	<u>TURBIDITY</u> <u>(NTU)</u>	<u>SUSPENDED</u> <u>SOLIDS (MG/L)</u>
4/11/95	234	36.6	16	34.0
5/2/95	279	61.0	14	25.0
5/16/95	307	57.9	13	11.0
6/13/95	326	41.1	19	27.0
6/27/95	372	30.5	22	31.0
7/11/95	342	24.4	30	50.0
7/25/95	376	16.8	44	81.0
8/29/95	389	19.8	32	55.0
9/12/95	402	22.9	41	77.0
9/27/95	381	15.2	35	70.0
10/10/95	372	25.9	26	54.0
10/24/95	379	25.9	29	57.0
11/7/95	328	45.7	14	17.0
6/19/96	337	155.4	6	<1
7/10/96	359	51.8	13	19.0
8/13/96	-	21.3	26	40.0
8/27/96	383	22.9	16	33.0
9/19/96	357	33.5	19	36.0
12/23/96	416	**	12	25.0
1/7/97	265	**	5	<1
2/11/97	327	**	11	11.0
2/25/97	284	**	18	10.0
6/18/97	383	18.3	50	44.0
7/2/97	392	27.4	40	50.0
7/17/97	355	21.3	51	46.0
7/31/97	299	15.2	92	51.0
8/19/97	290	15.2	97	68.0
9/3/97	276	12.2	101	71.0
9/25/97	338	16.8	77	58.0
12/23/97	306	**	9	9.0
1/27/98	388	**	4	<1
MIN	234	12.2	4	<1
MAX	416	155.4	101	81.0
AVG.	341	33.4	32	37

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-4 (Cont.). Water quality monitoring results from samples collected at site W-M439.4C

	CHLOROPHYLL a	CHLOROPHYLL b	CHLOROPHYLL c	PHEOPHYTIN a
DATE	(MG/M ³)	(MG/M ³)	(MG/M ³)	(MG/M ³)
4/11/95	130.0	<1	16.0	<1
5/2/95	29.0	<1	<1	<1
5/16/95	24.0	<1	<1	7.4
6/13/95	53.0	<1	<1	<1
6/27/95	93.0	<1	<1	<1
7/11/95	120.0	<1	2.6	28.0
7/25/95	120.0	<1	3.9	18.0
8/29/95	130.0	<1	<1	<1
9/12/95	110.0	<1	<1	37.0
9/27/95	52.0	4.1	9.0	28.0
10/10/95	95.0	<1	<1	25.0
10/24/95	64.0	<1	<1	18.0
11/7/95	42.0	<1	6.1	4.0
6/19/96	15.0	2.8	5.3	<1
7/10/96	49.0	4.0	3.2	<1
8/13/96	60.0	<1	1.7	19.0
8/27/96	93.0	<1	<1	24.0
9/19/96	100.0	<1	2.0	16.0
12/23/96	3.6	<1	<1	<1
1/7/97	3.3	<1	<1	<1
2/11/97	<1	<1	<1	<1
2/25/97	<1	<1	<1	<1
6/18/97	97.0	4.8	<1	26.0
7/2/97	140.0	4.2	20.0	<1
7/17/97	120.0	<1	<1	15.0
7/31/97	390.0	<1	<1	8.8
8/19/97	370.0	<1	<1	5.3
9/3/97	430.0	<1	5.0	<1
9/25/97	220.0	<1	<1	<1
12/23/97	56.0	<1	2.6	17.0
1/27/98	14.0	<1	<1	4.2
MIN	<1	<1	<1	<1
MAX	430.0	4.8	20.0	37.0
AVG.	104	-	-	-

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-5. Water quality monitoring results from samples collected at site W-M435.3J

<u>DATE</u>	<u>WATER DEPTH (M)</u>	<u>VELOCITY (CM/SEC)</u>	<u>WAVE HEIGHT (CM)</u>	<u>AIR TEMP. (°C)</u>	<u>CLOUD COVER (%)</u>	<u>WIND SPEED (KM/H)</u>
7/11/95	0.671	0.11	0	28	20	1
7/25/95	0.259	0.07	0	28	5	1
8/29/95	0.396	0.00	0	29	50	2
9/12/95	0.366	*	0	16	100	0
9/27/95	0.396	0.12	3	14	0	3
10/10/95	0.533	0.00	0	13	5	1
10/24/95	0.610	***	9	8	98	3
11/7/95	0.549	0.04	6	1	25	9
6/19/96	1.951	0.00	3	21	100	3
7/10/96	1.524	0.16	0	21	2	2
8/13/96	0.823	0.26	8	27	0	3
8/27/96	0.671	0.19	6	27	50	3
9/19/96	0.869	0.16	0	17	65	1
12/23/96	0.610	0.00	**	1	100	3
1/7/97	0.777	0.00	**	-9	0	3
2/11/97	1.082	0.00	**	-4	100	3
2/25/97	1.204	0.00	**	1	0	7
6/18/97	0.488	0.10	3	24	15	4
7/2/97	0.518	***	6	28	0	5
7/17/97	0.518	0.05	3	29	50	3
7/31/97	0.518	0.03	3	22	10	5
8/19/97	0.610	0.00	0	18	99	1
9/3/97	0.701	0.12	6	16	30	7
9/25/97	0.853	0.00	3	17	0	2
12/23/97	0.838	0.00	**	2	60	3
1/27/98	0.610	0.00	**	2	100	2
MIN	0.259	0.00	0	-9	0	0
MAX	1.951	0.26	9	29	100	9
AVG.	0.729	0.06	3	15	42	3

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-5 (Cont.). Water quality monitoring results from samples collected at site W-M435.3J

<u>DATE</u>	<u>WIND DIRECTION</u>	<u>WATER TEMP. (°C)</u>	<u>DISSOLVED OXYGEN (MG/L)</u>	<u>pH (SU)</u>	<u>TOTAL ALKALINITY (MG/L as CaCO₃)</u>
7/11/95	S	29.7	6.86	8.32	-
7/25/95	SW	26.9	5.58	8.28	-
8/29/95	SW	28.3	2.19	7.98	-
9/12/95	-	19.3	5.63	*	-
9/27/95	SW	16.8	9.31	*	-
10/10/95	SE	14.9	12.02	8.96	-
10/24/95	NW	7.8	10.08	8.40	-
11/7/95	NW	4.2	11.85	8.52	-
6/19/96	NW	23.0	2.90	7.51	160
7/10/96	N	24.2	5.96	7.78	168
8/13/96	W	-	-	-	208
8/27/96	N	28.5	10.50	8.66	165
9/19/96	S	19.3	7.12	****	156
12/23/96	N	3.4	14.07	*	230
1/7/97	W	3.1	15.05	*	195
2/11/97	W	3.2	*	*	179
2/25/97	SW	4.1	10.97	*	124
6/18/97	NW	26.9	9.31	8.18	211
7/2/97	W	29.1	8.32	8.26	193
7/17/97	SE	29.5	7.59	8.48	165
7/31/97	SW	25.8	7.99	8.89	150
8/19/97	SE	22.9	7.12	8.46	134
9/3/97	NE	23.3	8.14	8.37	118
9/25/97	N	19.4	13.55	9.41	115
12/23/97	NW	3.0	8.17	*	164
1/27/98	SE	4.0	8.38	7.49	187
MIN	-	3.0	2.19	7.49	115
MAX	-	29.7	15.05	9.41	230
AVG.	-	17.6	8.69	-	168

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-5 (Cont.). Water quality monitoring results from samples collected at site W-M435.3J

<u>DATE</u>	<u>SPECIFIC CONDUCTANCE</u> <u>(µMHOS/CM @ 25°C)</u>	<u>SECCHI DISK</u> <u>DEPTH (CM)</u>	<u>TURBIDITY</u> <u>(NTU)</u>	<u>SUSPENDED</u> <u>SOLIDS (MG/L)</u>
7/11/95	435	12.2	-	-
7/25/95	496	10.7	-	-
8/29/95	429	9.1	-	-
9/12/95	437	10.7	-	-
9/27/95	396	12.2	-	-
10/10/95	384	24.4	-	-
10/24/95	387	13.7	-	-
11/7/95	325	39.6	-	20.0
6/19/96	390	185.9	5	<1
7/10/96	381	30.5	12	29.0
8/13/96	-	7.6	53	93.0
8/27/96	327	15.2	37	76.0
9/19/96	373	18.3	42	86.0
12/23/96	528	**	14	9.0
1/7/97	371	**	21	22.0
2/11/97	409	**	15	17.0
2/25/97	292	**	23	11.0
6/18/97	473	12.2	137	134.0
7/2/97	435	24.4	38	50.0
7/17/97	418	9.1	106	151.0
7/31/97	393	12.2	234	190.0
8/19/97	338	12.2	103	110.0
9/3/97	311	13.7	94	98.0
9/25/97	292	13.7	70	61.0
12/23/97	308	**	12	9.0
1/27/98	386	**	6	3.0
MIN	292	7.6	5	<1
MAX	528	185.9	234	190.0
AVG.	389	24.4	57	62

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

Table F-5 (Cont.). Water quality monitoring results from samples collected at site W-M435.3J

<u>DATE</u>	<u>CHLOROPHYLL a</u> <u>(MG/M³)</u>	<u>CHLOROPHYLL b</u> <u>(MG/M³)</u>	<u>CHLOROPHYLL c</u> <u>(MG/M³)</u>	<u>PHEOPHYTIN a</u> <u>(MG/M³)</u>
7/11/95	-	-	-	-
7/25/95	-	-	-	-
8/29/95	-	-	-	-
9/12/95	-	-	-	-
9/27/95	-	-	-	-
10/10/95	-	-	-	-
10/24/95	-	-	-	-
11/7/95	36.0	<1	<1	15.0
6/19/96	2.3	<1	<1	<1
7/10/96	28.0	7.8	7.6	<1
8/13/96	74.0	<1	<1	12.0
8/27/96	73.0	<1	<1	13.0
9/19/96	110.0	<1	6.3	27.0
12/23/96	15.0	<1	<1	3.8
1/7/97	26.0	1.3	1.2	4.8
2/11/97	27.0	<1	<1	7.1
2/25/97	6.3	<1	<1	<1
6/18/97	170.0	<1	<1	53.0
7/2/97	110.0	<1	<1	1.1
7/17/97	160.0	4.4	10.0	15.0
7/31/97	190.0	<1	<1	11.0
8/19/97	250.0	<1	13.0	4.3
9/3/97	250.0	<1	16.0	17.0
9/25/97	200.0	<1	<1	18.0
12/23/97	21.0	<1	1.2	2.1
1/27/98	20.0	<1	1.6	<1
MIN	2.3	<1	<1	<1
MAX	250.0	7.8	16.0	53.0
AVG.	93.1	-	-	-

* Meter malfunction.

** Not applicable, ice cover.

*** Too windy to take measurement.

**** Field/Laboratory accident.

FIGURE F-1. PRE-PROJECT DISSOLVED OXYGEN AND pH VALUES COLLECTED WITH A
CONTINUOUS MONITOR AT SITE W-M436.30

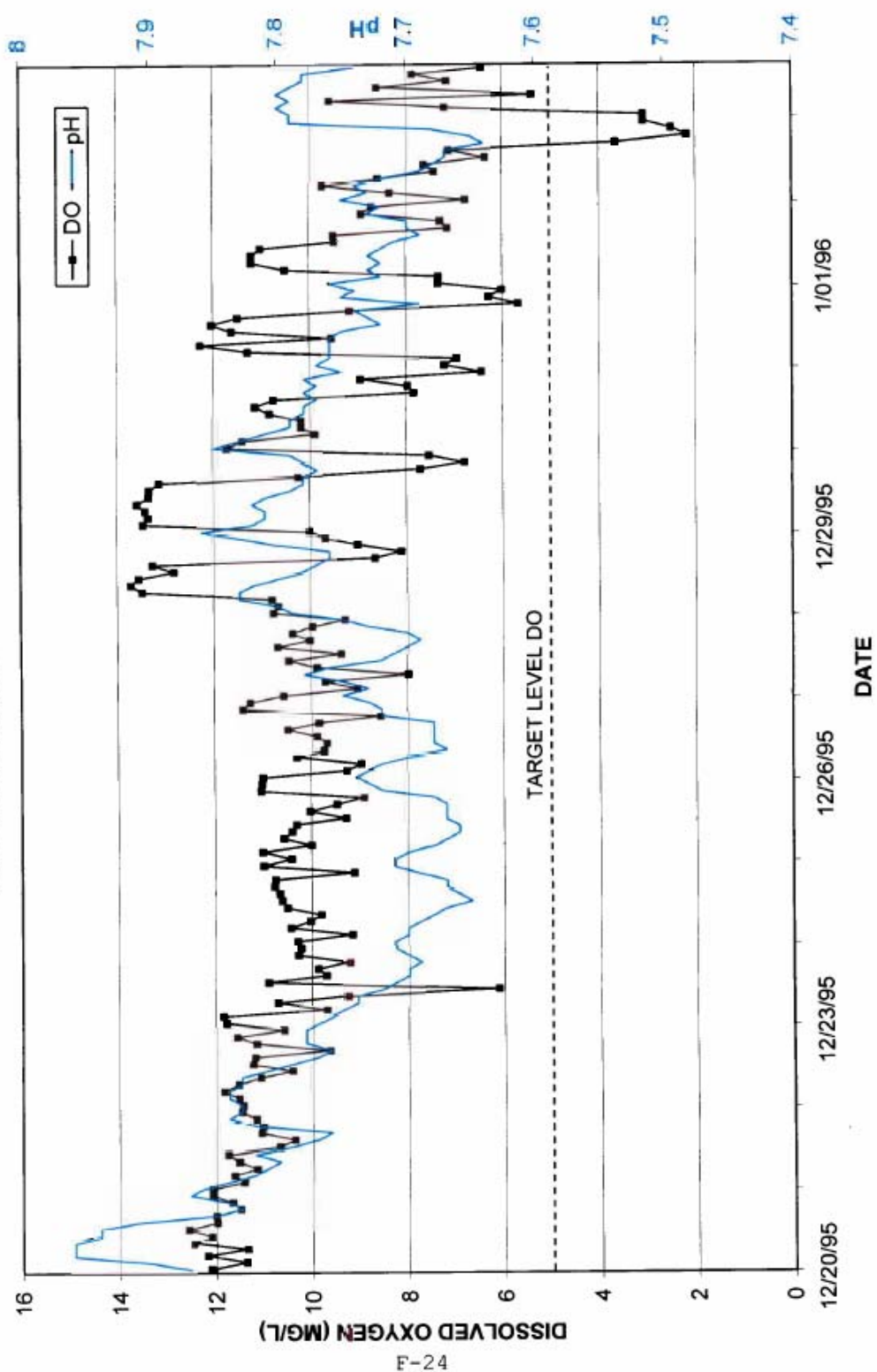


FIGURE F-2. PRE-PROJECT DISSOLVED OXYGEN AND pH VALUES COLLECTED WITH A
CONTINUOUS MONITOR AT SITE W-M436.30

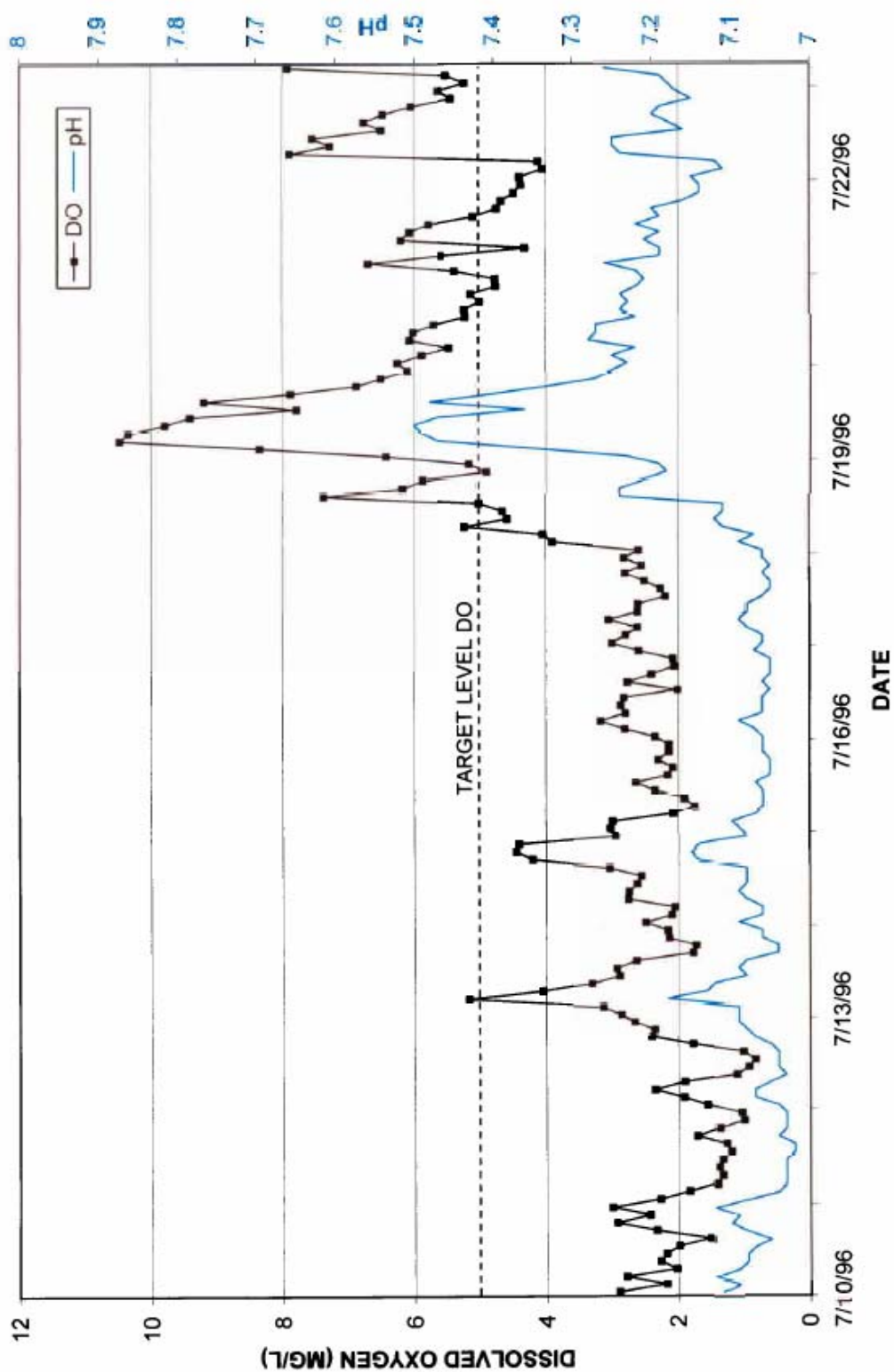


FIGURE F-3. PRE-PROJECT DISSOLVED OXYGEN AND pH VALUES COLLECTED WITH A
CONTINUOUS MONITOR AT SITE W-M436.30

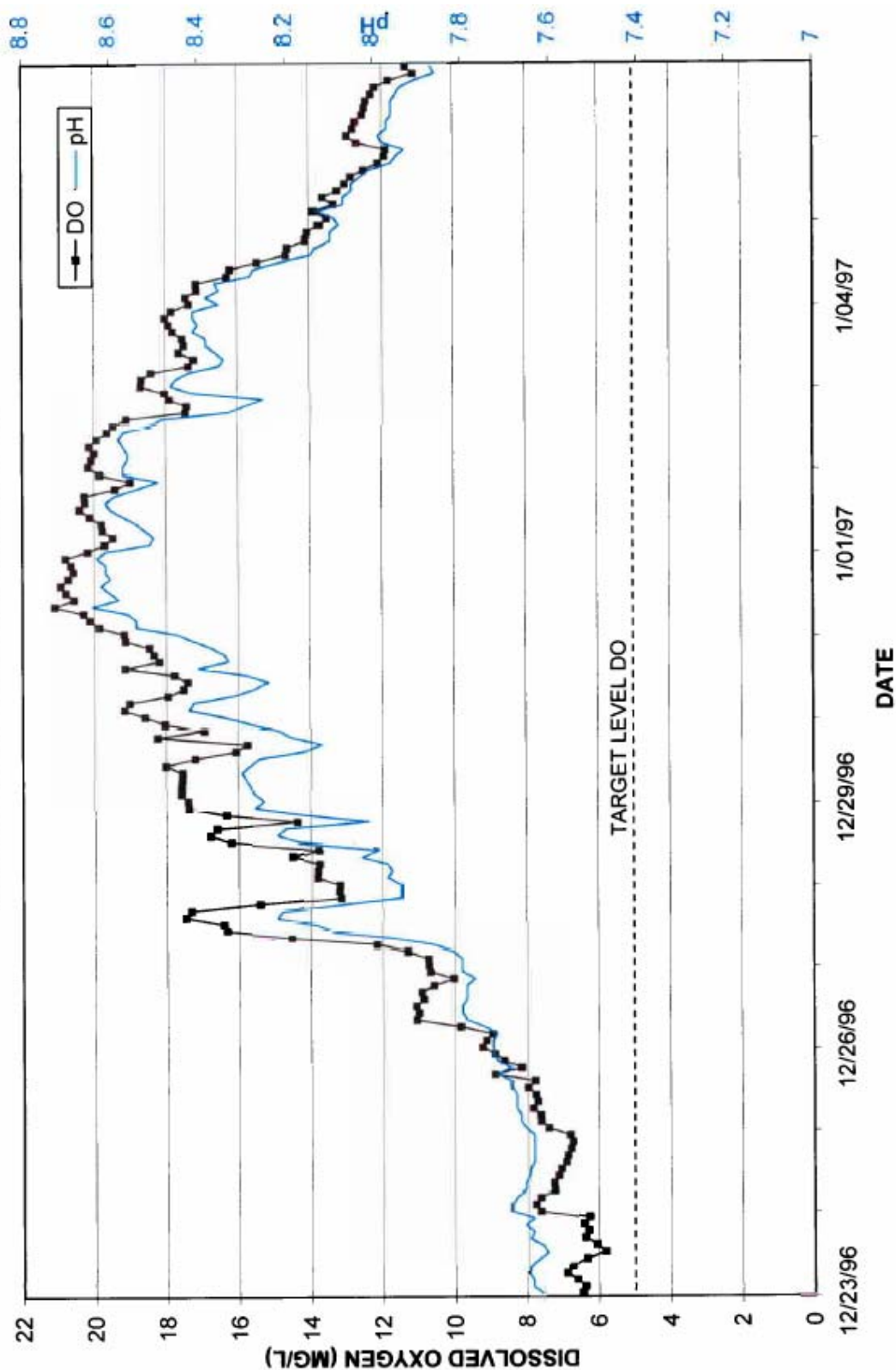


FIGURE F-4. DISSOLVED OXYGEN MASS BALANCE CALCULATIONS FOR YANKEE CHUTE

DISSOLVED OXYGEN SOURCES

D.O. IN INFLOW	(D.O. at Saturation at 1°C) - (BOD at 1°C) = Net D.O. in inflow 14.2 mg/l - 0.7 mg/l = 13.5 mg/l
D.O. RESERVE IN CHUTE	(D.O. at saturation at 1°C) - (Minimum Required D.O.) = D.O. Reserve in Chute 14.2 mg/l - 5.0 mg/l = 9.2 mg/l $9.2 \text{ mg/l} \cdot \frac{28.32 \text{ l}}{\text{ft}^3} \cdot 36 \text{ acres} \cdot 3 \text{ ft} \cdot \frac{43,560 \text{ ft}^2}{\text{acre}} \cdot \frac{1 \text{ g}}{1,000 \text{ mg}} = 1.23 \cdot 10^6 \text{ g O}_2$

DISSOLVED OXYGEN SINKS

SOD	$\frac{28 \text{ g O}_2}{\text{m}^2/\text{day}} \cdot 36 \text{ acres} \cdot \frac{43,560 \text{ ft}^2}{\text{acre}} \cdot \frac{.3048 \text{ m}^2}{\text{ft}^2} \cdot 100 \text{ days} = 1.34 \cdot 10^7 \text{ g O}_2$
BOD	2.4 mg/l at 20°C in the water column BOD at 1°C = 2.4 mg/l · (1.067) ¹⁻²⁰ BOD at 1°C = 0.7 mg/l $0.7 \text{ mg/l} \cdot \frac{28.32 \text{ l}}{\text{ft}^3} \cdot 36 \text{ acres} \cdot 3 \text{ ft} \cdot \frac{43,560 \text{ ft}^2}{\text{acre}} \cdot \frac{1 \text{ g}}{1,000 \text{ mg}} = 9.33 \cdot 10^4 \text{ g O}_2$
FISH RESPIRATION	$\frac{392 \text{ lbs}}{\text{acre}} \cdot 36 \text{ acres} \cdot \frac{0.0119 \text{ ml O}_2}{\text{g/hr}} \cdot \frac{24 \text{ hr}}{\text{day}} \cdot \frac{1.6 \cdot 10^{-7} \text{ moles O}_2}{\text{ml O}_2} \cdot \frac{32 \text{ g O}_2}{\text{mole O}_2} \cdot 100 \text{ days} \cdot \frac{454 \text{ g}}{\text{lb}} = 9.37 \cdot 10^4 \text{ g O}_2$
TOTAL SINKS	$(1.34 \cdot 10^7 \text{ g O}_2) + (9.33 \cdot 10^4 \text{ g O}_2) + (9.37 \cdot 10^4 \text{ g O}_2) = 1.35 \cdot 10^7 \text{ g O}_2$

D.O. MASS BALANCE EQUATION

Inflowing D.O. + D.O. Reserve = SOD + Fish Respiration + BOD + Outflowing D.O.

$$(8,640,000 \text{ sec} \cdot \frac{13.5 \text{ mg}}{\text{l}} \cdot \frac{1,000 \text{ l}}{\text{m}^3} \cdot \frac{1 \text{ g}}{1,000 \text{ mg}} \cdot Q) + 1.23 \cdot 10^6 \text{ g O}_2 = (8,640,000 \text{ sec} \cdot \frac{5 \text{ mg}}{\text{l}} \cdot \frac{1,000 \text{ l}}{\text{m}^3} \cdot \frac{1 \text{ g}}{1,000 \text{ mg}} \cdot Q) + 1.35 \cdot 10^7 \text{ g O}_2$$

$$(1.17 \cdot 10^8 \text{ sec} \cdot 1 \text{ g/m}^3 \cdot Q) + 1.23 \cdot 10^6 \text{ g O}_2 = (4.32 \cdot 10^7 \text{ sec} \cdot 1 \text{ g/m}^3 \cdot Q) + 1.35 \cdot 10^7 \text{ g O}_2$$

$$7.38 \cdot 10^7 \text{ sec} \cdot 1 \text{ g/m}^3 \cdot Q = 1.23 \cdot 10^7 \text{ g O}_2$$

$$Q = \frac{1.23 \cdot 10^7 \text{ g O}_2}{7.38 \cdot 10^7 \text{ sec} \cdot 1 \text{ g/m}^3}$$

$$Q = 0.17 \text{ m}^3/\text{sec} \text{ or } 6 \text{ cfs}$$

APPENDIX G

GEOTECHNICAL CONSIDERATIONS

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

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**APPENDIX G
GEOTECHNICAL CONSIDERATIONS**

Subject	Page
1) Purpose	1
2) Background.....	1
3) Site Geology	2
a) Location.....	2
b) Physiography	2
c) Stratigraphy	2
4) Exploration Methods and Laboratory Testing	2
a) Field Exploration.....	2
b) River Samples.....	3
c) Laboratory Testing	3
5) Project Features.....	3
6) Discussion of Specific Project Features.....	4
a) Perimeter Levee.....	4
b) Moist Soil Units (MSUs).....	5
c) Fisheries Enhancement.....	7
7) Seepage Analysis	7
8) Slope Stability.....	9
9) Groundwater	10
10) Structures.....	10
11) Dredging.....	10
12) Recommendations	11
a) Perimeter Levee.....	11
b) Moist Soil Units (MSUs).....	12
c) Fisheries Dredging and Shoreline Protection	13
13) References	14

APPENDIX G
GEOTECHNICAL CONSIDERATIONS

CONTENTS (continued)

Subject	Page
----------------	-------------

Tables

G-1	Assumed soil permeability.....	G-8
G-2	Slope stability summary.....	G-9

Figures

G-1	Estimated moist soil unit seepage rates.....	G-8
-----	--	-----

Plates

G-1	Moist Soil Management Unit – Seepage Analysis – GMS Model
G-2	Perimeter Levee – Seepage Analysis – GMS Model
G-3	Perimeter Levee – Slope Stability Analysis

**UPPER MISSISSIPPI RIVER SYSTEM
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**APPENDIX G
GEOTECHNICAL CONSIDERATIONS**

1) PURPOSE

Lake Odessa is a large backwater complex with excellent wetland and aquatic habitat opportunities. The main goals of the project include enhancing wetland and terrestrial habitat, enhancing aquatic habitat, and protecting habitat features.

2) BACKGROUND

Lake Odessa is part of the U.S. Fish and Wildlife Service (USFWS) Mark Twain National Wildlife Refuge. The 6,788-acre area is comprised of a large lake and other backwater bodies of water, wooded areas, and grassy fields. The area is separated from the Mississippi River by a perimeter levee. The perimeter levee ties into Lock and Dam 17 at about the midpoint of the Lake Odessa complex. The northern half of the complex is managed by USFWS and the Iowa Department of Natural Resources (IDNR) manages the southern half.

Numerous flood events have damaged the perimeter levee and caused tree kills and sedimentation of the lake. This sedimentation has resulted in a shallowing of the lake and subsequent poor overwintering conditions for fish. The Flood of 2001 caused several large breaches of the levee.

The standard practice for water management at Lake Odessa is to encourage waterfowl habitat. The Lake Odessa complex is unique in that it straddles two navigation pools, which provides unusual water management opportunities. Due to the presence of Lock and Dam 17 at the midpoint of the complex, the river surface elevation can vary several feet from the inlet structure at the upper end and the outlet structure at the lower end. During the summer months (June-August), the inlet structure is closed and the outlet structure is opened. This draws down the water level within the complex towards that at the lower pool. The outlet structure is closed and the inlet structure is opened for the fall months (September-November). This raises the water level within the complex towards that at the upper pool.

3) SITE GEOLOGY

a) Location

Lake Odessa lies 15 miles south of Muscatine, Iowa. This site is along the west valley wall of the Mississippi River valley from approximately River Mile (RM) 441.5 to 434.5 in the vicinity of Lock and Dam 17. The northern portion lies in the Mark Twain National Wildlife Refuge, Port Louisa Township, Louisa County, Iowa. The southern portion is within the State Wildlife Management Area, managed by the IDNR.

b) Physiography

Lake Odessa, at the base of steep bluffs along the western valley wall, outlines a former position of the braided river channel. This area is adjacent to the Southern Iowa Drift Plain and lies entirely within the Mississippi River floodplain as an old, low-level cutoff channel of the Mississippi River, abandoned as the present channel moved to the east. The landscape of the floodplain is elongated and relatively flat, with elevations between 527-603 feet Mean Sea Level (MSL, 1912). These floodplains have characteristic meanders or migrations of the river channel. The area is covered with alluvial soils at and near the surface and glacial deposits at depths. The surface stratum is usually clayey, varying in thickness from 3 to 20 feet. This is underlain by sand and gravel stratum which extends to an intermittent glacial till clay at a depth of 40 to 80 feet or to bedrock at a depth of 120 to 160 feet.

c) Stratigraphy

The upland areas are capped by varying thicknesses of Wisconsin stage loess, underlain by unconsolidated glacial tills of the pre-Illinoian stages. Within the river valley are Holocene and Pleistocene age deposits, underlain by Devonian age bedrock. The Holocene-Pleistocene deposits, called the Cahokia alluvium, form a broad, level terrace consisting of poorly sorted silt, clay, and silty sand, but locally contain lenses of sand and gravel. The Cahokia Alluvium generally rests on glacial valley train deposits of the Mackinaw Member of the Henry formation. These valley train deposits consist of well graded coarse to fine sands and gravels deposited by the retreating Wisconsin glaciers. The deposits are usually evenly bedded and are more uniform in texture.

The Upper Devonian age (Yellow Spring Group) shales, argillaceous dolomites, limestones, and siltstones underlie the Henry formation. Across from the project site at Lock and Dam 17, New Boston, Illinois, the bedrock consists of Grassy Creek and Sweetland Creek formations of the Upper Devonian age. These rocks are thinly bedded shales and lie deeper under the valley deposits than they do at Lock and Dam 16, which is 14 miles upstream. At Lock and Dam 17, borings down to 460 MSL have not encountered bedrock.

4) EXPLORATION METHODS AND LABORATORY TESTING

a) Field Exploration

The subsurface exploration program was conducted in general accordance with U.S. Army Corps of Engineers (USACE) and the American Society of Testing and Materials (ASTM) standards, as follows:

1. EM 1110-1-1804, "Geotechnical Investigation"
2. EM 1110-2-1907, "Soil Sampling"
3. ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils"

The borings were advanced using an all-terrain vehicle (ATV) track-mounted rotary drilling rig, Central Mine Equipment (CME) Model 850. The borings were advanced using hollow stem augers (3-1/4-inch inside diameter and 6-3/4-inch outside diameter) and 4-inch-diameter flight augers. The borings were drilled to depths varying from 5 to 50 feet below the ground surface. 32 borings were performed in the perimeter levee, 17 borings were performed at potential structure locations and around the original proposed upper MSU, and 10 borings were performed in the proposed MSU. Levee borings were backfilled with bentonite hole plug. Borings for proposed structures were advanced by mud rotary drilling methods. Boring locations are shown on plates 9 and 10 of the main report.

Borings performed with hollow stem augers were sampled at 2.5-foot intervals by standard penetration method using an automatic hammer, and borings performed by flight auger were sampled selectively from the augers. Representative samples obtained were sealed in 16-ounce jars and returned to the lab for testing.

b) River Samples

River samples were performed to determine possible sources to supply clean sand for the levee improvements. The river samples were taken in Turkey Chute above and below Lock and Dam 17. The borings on the river bottom varied in depth from 4.5 to 10 feet. Water depths varied from 2 to 15 feet and ice varied from 0 to 1 foot. Five borings were performed above and 6 were performed below Lock and Dam 17. Borings were performed using a thin wall sampling tube. Composite samples were collected and sealed in 16-ounce jars and returned to the lab for analyzing.

c) Laboratory Testing

Laboratory testing included visual classification and moisture content testing for all samples. Selected fine-grained samples were tested for Atterberg limits, and selected coarse-grained samples were tested for gradation by a washed sieve analysis. River samples were tested for fines content (percent finer than 0.003 inches) and moisture contents were performed on the clay samples. Complete graphical boring logs incorporating laboratory test data are shown on plates 11 through 18 of the main report. Individual grain size analyses are available but were not included with this report.

5) PROJECT FEATURES

The recommended project features are shown on plates 3 and 4 of the main report. The features involving geotechnical aspects may be divided into the following categories:

Perimeter Levee System - The perimeter levee, as noted earlier, has been damaged and breached by past high water events. Repair of these breached sections will be performed as an emergency repair and not as part of this project. This project will, however, consider improvement of the entire perimeter levee. Providing a consistent minimum elevation as well as levee section

improvements was considered. In addition, rock spillways would be incorporated to help reduce damages induced by high water events. A rock wing dike is also proposed near the mouth of Michael Creek.

Moist Soil Units (MSUs) - Proposed units include: Field 4 & 5, Field 21, Fox Pond, Unit 2, and the lower IDNR MSU. Field 6 is a proposed sand prairie planting area. Also proposed is a dedicated water bay and channel to allow gravity water flow to Field 4 & 5, Field 21, and MSU 20.

Fish Habitat - There are several features proposed to enhance fish habitat within the Lake Odessa Complex. A fish nursery is proposed at the upper end, west of the proposed upper MSUs. Several channel and deep-hole excavations are proposed within Lake Odessa and between Goose Pond and Big Mallard Pond to improve fish overwintering. Several channel cuts are also proposed to improve access to backwater lakes.

6) DISCUSSION OF SPECIFIC PROJECT FEATURES

a) Perimeter Levee

Improving the existing levee would provide a consistent minimum levee elevation, corresponding to a sloping design that ranges from the 25-year flood event at the lower end, to the 50-year event in the upper end. There are two main options for improving this type of levee. The first would be placing a compacted clay blanket on the riverside of the existing levee. This would require stripping the crown and riverside slope, as well as benching the slope to receive the new fill. The other option would be improvement by hydraulic sand fill on the landside slope. This would require stripping and grubbing of the crown and landside slope and foundation prior to fill placement. All roots and other projections over 2-inches in diameter within the improved area should be removed to a depth of 3 feet below the natural ground surface. Due to the relative unavailability of suitable clay in the Lake Odessa area, the clay blanket option could be very costly. The Rock Island District has widely used the hydraulic sand method. Material is discharged directly on the slope and shaped by bulldozer while in a nearly saturated condition.

The existing levee crest elevation appears to be at or near the 25-year flood profile. This is based on existing survey information, which was obtained before the Flood of 2001. The perimeter levee was breached in several locations during that event. The repair of these areas is ongoing and is not a part of this project. It is unknown whether the current levee breaches occurred before or during overtopping during 2001. The average height of the levee is estimated at about 15 feet (measured from the landside ground). The cross section of the existing levee varies along the length, but averages about 3H: 1V on both land and riversides.

In addition to improving the levee section, two spillways are proposed. The spillway elevations will correspond to the 17-year and 10-year events at the upper and lower spillways, respectively. The incorporation of these spillways would greatly reduce differential head across the levee prior to overtopping for future events. The spillways would be constructed of riprap and articulated concrete matting overlying bedding stone. The upper spillway is being constructed independent of this project, as part of the levee repairs from the 2001 flood event. In order to construct the spillway, material will have to be excavated from the area and relocated. It is anticipated that the material is clay, and is similar to the material in the adjacent levee sections (both up and down station), and thus can be utilized to enhance adjacent levee sections. This information was obtained from the borings that were discussed in the field exploration section above. It is

recommended that additional borings be taken in the area to verify that the material can be used for levee repair, as the existing borings were taken in long intervals (~1100 feet).

The borings within the perimeter levee indicate a wide variety of fill material and foundation conditions. Some areas are comprised completely of sand, others of clay, and others of sand overlying a clay core. The upper foundation stratum appears to vary from about 8 feet of clay overlying sand to no clay top stratum whatsoever. The improvement of the levee section and incorporation of spillways should significantly reduce stress on the levee during high water events. Slope stability of an improved levee section is discussed later in this appendix.

A low wing dike is proposed near the mouth of Michael Creek at the upper end near the inlet structure. The proposed structure will be approximately 2.5 to 3 feet high and constructed of riprap. No soil borings have been performed for this proposed feature.

b) Moist Soil Units (MSUs)

Proposed Units

It should be noted that in the previous draft of the report (draft report), it was proposed to enhance existing berms around the MSUs. Since the first draft of this report, it was determined that the existing berms are adequate to carry out the management strategies for the units. The soils information in this appendix has been left intact to show what was explored for this report, and to maintain a general knowledge base for the areas. Pumps and pump pads are proposed as a part of this project in order to supply the required water to these units. The pumps were sized using a combination of seepage analysis and actual pumping tests at the MSUs. In addition, one of the bays of the inlet structure will be dedicated to take advantage of high water levels in the river (see dedicated water bay below).

It should be noted that the soils within the Lake Odessa complex are derived from alluvial deposits. Alluvial deposits are well known for their variability within even very small areas. Therefore, attempting to characterize large areas for suitability as a MSU is extremely difficult. Although a majority of the soils present at the Lake Odessa complex is sandy in nature, there are surficial clays that would be capable of impounding water. Information on soil types present was obtained by review of the *Soil Survey of Louisa County, Iowa* and the soil borings. In general, the borings are in agreement with the *Soil Survey*. The potential seepage rates of these units are discussed later in this appendix.

MSU 20, approximately 72 acres in area, appears to consist of predominantly clayey soils to a depth of at least 5 feet, exhibiting moderate to low permeability. There are some minor areas of Shaffton and Ambraw loam, which have a thinner clay cover and higher permeability. Based on available survey data, a majority of this proposed MSU appears to lie near elevation 536 MSL.

Field 21, approximately 83 acres in area, appears to consist of predominantly Shaffton and Ambraw loam, which has a surficial clayey layer about 2 to 2.5 feet deep. There is also a large unit of Elrick sandy loam, which is comprised of clayey sand and is highly permeable, within this area. It appears that the Elrick sandy loam covers about 25% of Field 21, and is located in the central portion. Southern and perimeter portions of this field appear to be between elevations 536-537 MSL, with some areas in the central portion as high as almost 540 MSL.

Field 4 & 5, approximately 83 acres in area, appears to consist of about 60% Shaffton and Ambraw loam and about 40% Toolesboro loam. Toolesboro loam has a surficial clayey layer of only about 1 foot. The most southern portion of this field lies at about elevation 536 MSL, with the central and northern areas at about 538 MSL.

Fox Pond, approximately 336 acres in size, appears to consist mainly of soils of the Coland-Perks-Lawson complex. These three soil types are intricately mixed on the landscape. The Perks soil, typically comprising about 30% of these areas, would be expected to be fairly permeable. This area appears to lay at about elevation 536 MSL.

Unit 2, approximately 92 acres in area, appears to consist of Colo silty clay loam and Ambraw loam in the lower, southern portion. The upper, northern portion is comprised mostly of Ackmore silty loam and Klum fine sandy loam. These upper portions have little clay cover and would be expected to be very permeable. There is a cross dike separating the unit into two cells at the lower end. The cross dike terminates in the central portion of Unit 2. Specific topographic survey is not available at this time for Unit 2.

The IDNR MSU, approximately 49 acres in area, appears to consist predominantly of Shaffton loam. There is an existing impoundment berm around this unit, approximately 4 to 5 feet in height. The sponsor has noted that this unit typically can only be partially flooded before seepage losses exceed current pumping capacities. For that reason, fine material obtained from the fisheries enhancement dredging will be discharged into this MSU to reduce seepage losses.

The original proposed upper sand field MSU, located to the south of the other upper units, is predominantly comprised of Elrick sandy loam and Toolesboro loam. Due to the sandy nature of the area and its elevation relative to the anticipated groundwater table, preliminary estimates of seepage losses were very large. This area was subsequently dismissed as a potential MSU and a portion is now a proposed sand prairie planting.

As noted above, all the MSUs mentioned in this section have adequate berms around the perimeters. Thus, no berm work will be required.

Dedicated Water Bay

There is a proposed dedicated water bay to gravity feed water to MSU 20, Field 4 & 5, and Field 21. However, available survey indicates that a majority of the unit areas are at or above elevation 536 MSL, which is the typical river elevation when unit flooding would be desired. It is therefore assumed that flooding of large portions of the units by gravity flow on a regular basis would not be effective. Any significant flooding of the units would therefore be achieved by pumping. The purpose this feature would serve would be to take advantage of small increases in river elevation that occasionally occur late in the year. Another possible function would be to possibly recharge the groundwater table in the vicinity of the proposed MSU faster than it normally would after the summer drawdown.

The water bay would consist of a diversion structure connected to the existing inlet structure. The existing inlet has 4 bays with control gates to allow water into the complex. The diversion structure would consist of a sheet pile wall directing the southernmost bay towards the proposed MSUs. This wall would terminate in a new ditch excavated to connect with an existing water supply ditch that runs alongside the road between Field 21 and Field 4 & 5.

c) **Fisheries Enhancement**

There are several proposed features to enhance fish habitat. One of these is a proposed fish nursery at the upper end of the complex, west of the proposed MSU. An existing control structure needs to be either repaired or replaced at this location.

There are several proposed dredging features to improve deepwater fish habitat. Deeper water habitat is proposed in Lake Odessa, Goose Pond, and the Yankee to Blackhawk Chutes area. Channel cuts are also proposed to restore or enhance connectivity with Bebee and Swarms Ponds. Preliminary investigation for water quality indicates that in most locations the bed is comprised predominantly of silt and clay deposits. Since the Lake Odessa complex would not typically experience high flows, these types of overbank deposits are not surprising. This significantly impacts dredging considerations, as these materials have a deleterious effect on water quality during dredging operations, and disposal options are more limited than they would be for a clean sand material. Specific dredging options are discussed later in this appendix.

7) **SEEPAGE ANALYSIS**

A seepage analysis of the proposed MSUs was conducted using the Groundwater Modeling System (GMS) software package version 3.1. The proposed MSUs were modeled using the SEEP2D module. Due to the shape of the proposed units in cross section (very wide and short, relatively), one-half of a typical cross section was modeled. The proposed MSUs have an average short dimension of about 1,200 feet, so a half section of width 600 feet was constructed. For ease of modeling, the units were constructed flat. The same general model was used for each proposed MSU. The GMS model is shown on plate G-1. Material properties were varied to estimate in-situ conditions at each location.

The inherent difficulty in estimating the potential seepage losses over a large area with these types of soil deposits should be kept in mind. Even if a vast majority of an area has significant clay cover, a relatively small area of exposed sand could make a large difference in the seepage rate. Also, consider the fact that the surficial clay materials, which are being relied upon to impound water, are affected by weathering mechanisms and disruption by vegetation. The simple fact is that no number of soil borings would be sufficient to model these areas accurately. The analysis performed, therefore, represents a best estimate, incorporating information from soil borings, soil surveys, and engineering judgment. The actual seepage rate could prove to be significantly higher or lower. The only way to really know would be to attempt impoundment of water in the fields and measure losses. This was performed in the late fall of 2001 for Field 4 & 5, MSU 20, and Field 21. Although the pumping and stage records were not complete, it appears that the estimates contained herein are modestly conservative.

The floor of each unit was modeled to reflect the type of soil present, based on the *Soil Survey* and borings. For the IDNR MSU, the analysis assumed a 1.5-foot-thick compacted clay liner at the surface. The deepest borings at the site were 50 feet deep, and no bedrock was encountered within that depth. A sand aquifer depth of 100 feet was assumed for the analysis. The upper 6 feet of the units varied between clay, clayey sand, and clean sand, as appropriate. Below that, the model assumed clean sand. Table G-1 shows assumed values for permeability, based on laboratory test results and typical values from the literature. One value was chosen to represent both horizontal and vertical permeability for each material. The permeability values for the clay and clayey sand may seem higher than normal for these types of materials. This is to compensate for the interspersed sandy soils within these materials over the large areas modeled. In

addition, these surficial clays are exposed to weathering processes and vegetation that can greatly increase permeability.

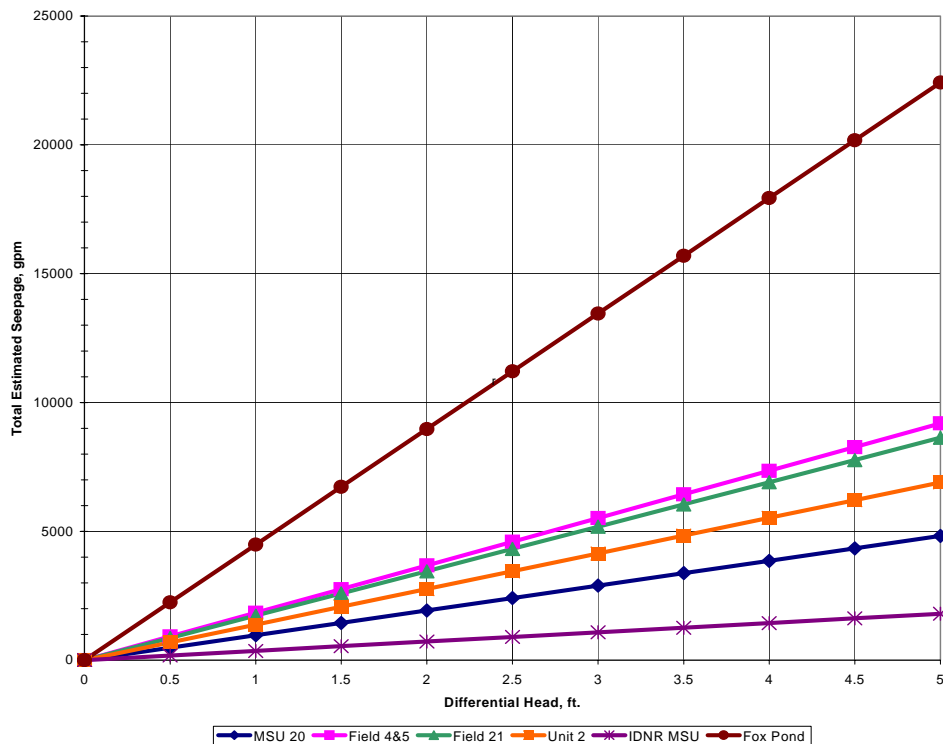
Table G-1. Assumed soil permeability

Material	Permeability (cm/sec)	Permeability (ft/day)
Clay Liner (compacted)	0.00001	0.03
Clay Berm (uncompacted)	0.0002	0.6
Clay	0.0004	1.2
Clayey Sand	0.0021	6
Clean Sand	0.0700	200

Many cases were investigated for each unit by varying water levels within the unit and varying the groundwater level. A series of seepage rates were determined based on the relative difference between the unit water elevation and the groundwater elevation (differential head). This was calculated for a differential head of up to 5 feet. The groundwater elevation in this area would be expected to generally follow the level of the Mississippi River. A discussion of the groundwater conditions can be found later in this appendix.

The seepage rate obtained for each case was doubled to represent a whole cross section width of 1,200 feet. The total area of each unit was then divided by 1,200 feet, giving a length assuming a rectangular area. This length was then multiplied by the seepage rate for the whole cross section, giving an estimate of the seepage for the total area. Figure G-1 shows an estimate of the total seepage rates for each unit. The estimate shows a linear relationship between seepage rate and differential head.

Figure G-1. Estimated moist soil unit seepage rates



There are issues that will have a bearing on the potential seepage rates of these sites. Scraping borrow from the unit areas to construct impoundment berms could likely increase the seepage rate. This should be evaluated as the project progresses. There are also some limitations of the model that should be kept in mind. The units were modeled flat, even though they are not flat in actuality, due to limitations of time and the software. Greater clay thicknesses generally exist in the lower-lying areas, with the higher ground composed of more sandy soils. Therefore, at lower water impoundment elevations, when the entire unit is not submerged, the unit would effectively have a smaller area and higher clay cover proportion. The net effect of this situation is potential over-estimation of seepage at lower water impoundment elevations. At elevations high enough to submerge the entire unit, this effect would disappear.

A seepage analysis was also performed on the perimeter levee using the GMS software to check the factor of safety against boiling. Since the borings in the perimeter levee indicate great variability, an all-sand section was assumed for the critical case. The crown of the levee elevation was established as a slope between 548 and 551 MSL in the lower and upper ends respectively. The landside elevation was established at elevation 536 MSL. Landside slope was modeled at 5H: 1V, and riverside at 4H: 1V. The maximum differential head was applied, which is more critical than the actual worst case if spillways are incorporated into the levee. The modeled section indicates a factor of safety against boiling of 3.4, which is adequate for this type of structure. Plate G-2 shows the GMS model and the calculations.

8) SLOPE STABILITY

Slope stability analysis was performed for critical sections of the perimeter levee using the software package UTEXAS4. UTEXAS4 is capable of performing limit equilibrium slope stability computations by a variety of procedures. The method outlined by Spencer was utilized for this analysis.

Based on height of additional fill and thickness of clay top stratum, the critical section chosen for analysis was a lower area of the levee near Station 220+00. Two borings were performed in this vicinity, LO-00-39 and LO-00-40. Both of these borings indicate an apparent sand fill overlying the original clay levee, impervious clay top stratum, and alluvial sand. The modeled section consisted of an improved levee, raised by 2 feet and with a landside slope of 5H: 1V. This slope was chosen because Rock Island District experience has proven it to be sufficient for sand levees. Table G-2 summarizes the results of the analysis. Plate G-3 shows sample output. This analysis would indicate that the 5H: 1V landside slope is adequate for slope stability.

Table G-2. Slope stability summary

Case	Slope	Calculated F.S.	Minimum F.S.*
End of Construction	River side	2.64	1.3
End of Construction	Land side	2.14	1.3
Steady Seepage	Land side	1.46	1.4

*Values from EM 1110-2-1913, April 2000

The existing perimeter levee appears to be in fair condition, with the exception of the breaches developed during the flood of 2001. There are no apparent rotational failures, although heavy brush cover in some locations makes assessment difficult. It is believed that any failures of the perimeter levee have occurred because of erosional phenomena, most likely overtopping.

The impoundment berms for the MSUs and the dredged material containment berm were not analyzed in detail. A visual inspection indicates that there should be no slope stability problems with these minor height embankments.

9) GROUNDWATER

The groundwater elevation within the Lake Odessa complex would be expected to closely follow the elevation of the adjacent Mississippi River. At the dam at low water, there is a water elevation difference of about 4 feet between Lock and Dam 17 pool and tail. The presence of the perimeter levee and water control structures allows for the manipulation of water levels (surface and ground water) between the pool and tail elevations. There would be some amount of lag time between changes in water surface elevation and groundwater elevation. The ground water table would probably not be as high as the pool elevation at the inlet structure due to losses at the lower end, and conversely would not be as low as the tail elevation at the outlet structure due to infiltration at the upper end. The typical fall months water surface elevation at the inlet and outlet structures would be approximately 536 and 531 MSL, respectively.

10) STRUCTURES

There are several proposed structures associated with the MSUs and Fish Nursery. Most of these are either stoplog structures or shallow pump housings. These structures should not require extensive deep soil exploration. The soils at these sites should be sufficient to adequately support the proposed structures. Some over-excavation and placement of crushed stone base material may be required to limit differential settlement. Borings at specific structure locations may be performed when locations are finalized. Based on the relatively high groundwater table throughout the complex, dewatering measures should be anticipated at any in-ground structure.

There is a proposed replacement of the large pump at Fox Pond. One of the borings, LO-00-7, was performed near this location. This boring shows about 15 feet of clayey sand and sandy lean clay overlying clean sand. It is anticipated that this structure would be supported by a pile foundation. An analysis of the foundation for this structure can be performed when estimated footing type, size, and elevation are known.

The diversion structure for the dedicated water bay would consist of a sheet pile wall tied into the existing inlet structure. This would divert one bay of the existing inlet structure to the supply ditch for the proposed MSU. Soil borings can be performed to determine actual soil properties prior to design.

11) DREDGING

Dredging would be required to produce deeper fish habitat and to restore connectivity between backwater lakes. Preliminary sampling indicates the lake bottom materials to be predominantly silt and clay materials. Various methods of hydraulic and mechanical dredging were considered.

Various methods of dredged material placement were also considered. The proposed best alternatives are outlined below.

Hydraulic dredging is the preference for the deeper water features on this project. A small floating plant that could be brought over land and then launched into Lake Odessa would be required. The majority of the lakebed appears to be fine-grained soil (silt and clay), so confined placement areas would be required. Smaller proposed dredge cuts, such as the channel cuts, might employ an alternative dredging method, such as the use of amphibious excavators. These specially designed excavators are equipped with pontoons that allow them to perform offshore excavation. These excavators are proposed for use in areas where material must be placed to protect potentially eroding shoreline.

It is proposed that a portion of the hydraulic dredged material be placed in the IDNR MSU, enough to cover the area approximately 1 foot deep. The balance of the material would be placed in a containment area south of Lake Odessa. The total storage volume of the containment should be approximated at 1.5 to 2 times the anticipated volume of dredged material to reduce staging delays. Otherwise, a Confined Disposal Facility (CDF) design would likely be required for final project design. The raised containment area would be planted with mast trees, although significant delay (several months to a year or more, depending on depth of placement) to allow for dewatering and settlement should be anticipated.

12) RECOMMENDATIONS

a) Perimeter Levee

The existing levee is inconsistent in both elevation and cross section. Improvement of the levee would include raising low reaches to a consistent profile elevation sloping from the 25-year to 50-year flood event in the lower and upper ends respectively, and corresponding improvements to the cross section. Based on existing profile information, maximum levee raises of about 2 feet would be expected. It is anticipated that the perimeter levee would be improved using hydraulic sand fill dredged from the river bottom.

While sand can be obtained from the main channel of the Mississippi River, borings indicated that sands with less than 5 percent fines content could be obtained from Turkey Chute. The borings also indicated some thin clay layering was present. These thin clay layers varied from a few inches to a foot or more. Some borings indicated thick silt layers up to 4.5 feet before sands were found. Due to the possible clay layering, specific dredge cut locations will need to be confirmed by a more thorough investigation of the chute before construction begins. It is recommended that the material placed on the levee have a combined fines content of less than 5 percent.

The improved section would consist of no steeper than 5H: 1V landside slopes and a minimum crown width of 12 feet. The existing levee should be cleared of vegetation and stripped to a depth of at least 6 inches on the crown and landside slope prior to new fill placement. Wherever possible, the existing riverside slope should be left undisturbed, with material placement on the landside. This would help retain any benefit from existing vegetation for erosion protection, as well as minimize upward gradient on the landside in sections with a clay core. Areas of active erosion or instability should be rebuilt and seeded. Any woody growth on the existing levee, however, should be cleared. As discussed earlier, slope stability of the improved levee should not be a concern.

A 1,100-foot-long rock and articulated concrete mat spillway at an elevation corresponding to the 10-year flood event would be incorporated at the lower end of the complex. A 700-foot-long rock spillway at an elevation corresponding to the 17-year flood event would be incorporated at the upper end. The upper spillway will be designed with input from the project team, but will be constructed separately from this project. Rock sizing for the spillways will depend on anticipated velocity from the Hydraulic Analysis. The rock spillways would consist of articulated concrete matting overlaying 6 inches of bedding stone on the landside of the spillway, and 24 inches of riprap overlaying 9 inches of bedding stone on the riverside of the levee. Landside and riverside slopes should be no steeper than 5H: 1V and 4H: 1V, respectively. The crown section should be at least 12 feet wide. The landside apron should extend 20 feet beyond the toe, with the first 10 feet being the matting, and the last 10 feet being rip rap that is keyed into the ground 3 feet. A concrete or driven sheetpile cutoff wall should be incorporated in the crest. This cutoff wall should extend a minimum of 6 feet below the bedding stone on the spillway. The spillways should be tied into the levee at either end to prevent flanking.

The proposed wing dike at Michael Creek would consist of riprap placed directly on the streambed. Maximum side slopes should not exceed 3H: 1V, and crest width should be at least 8 feet. Borings have not been performed for this feature, but this could be done prior to construction. Overbuilding by 1 foot should conservatively compensate for any potential settlement.

b) Moist Soil Units (MSUs)

The impoundment berms for the proposed MSUs already exist. Since the first draft of this report (draft copy), it was determined that the existing berms around the MSUs are adequate to carry out the management strategies for the units. The soils information in this appendix has been left intact to show what was explored for this report, and to maintain a general knowledge base for the areas. Pumps and pump pads should be provided as a part of this project in order to supply the required water to these units. As previously mentioned, the proposed dedicated water bay will only be able to take advantage of high water levels in the river, so the pumps would help supply more consistent water to the MSUs. The pumps were sized by a combination of seepage analysis and actual pump trials at the MSUs.

Although the IDNR MSU does not require berm improvements, it is susceptible to high seepage loss. In order to reduce observed seepage losses, it is recommended that approximately 1 foot of dredged material be discharged onto the floor of the unit. Prior to dredged material placement, the unit should be cleared and grubbed. After placement, the dredged material should be allowed to dry to a workable state and then mixed into the upper 6-12 inches of the unit. This mixture should then be surficially rolled before the stripped topsoil is redistributed.

Some of the soils present within the Lake Odessa complex are not well suited to impounding water. The seepage problems experienced at the IDNR MSU in the past could also be anticipated to some extent at the other units. The seepage estimates contained within this document are intended to compensate for this possibility.

Each of the small pump installations at the MSU would require a discharge apron to prevent erosion. This apron could consist of approximately 12 inches of riprap overlying 6 inches of bedding, or any other suitable revetment. The apron should extend longitudinally and transversely to adequately dissipate the energy of the discharged water and prevent erosion.

The diversion structure for the dedicated water bay would consist of a sheetpile wall tied into the existing inlet structure. The design should provide a flexible, watertight connection to the existing inlet structure, although settlement of the proposed wall should be negligible. Embedment depth of the sheets would be estimated between 1.0 and 1.5 times the height of the wall above grade, depending on loading and potential scouring conditions, with a minimum embedment of 6 feet. Soil borings could be performed to determine actual soil properties prior to design.

Part of the proposed dedicated water bay involves excavating a ditch from the proposed diversion structure to the existing supply ditch. This ditch should be sized to allow anticipated flows without excessive velocity. Ditch slopes no steeper than 3H: 1V should be sufficiently stable.

c) Fisheries Dredging and Shoreline Protection

The fish nursery at the upper end would require repair to the existing stoplog structure or a new structure. Boring LO-00-51 was performed at this site in order to make foundation recommendations if a new structure is required.

Dredging would be performed to provide deeper water habitat and restore connectivity between backwater lakes. Since the majority of the anticipated dredged material appears to be fine-grained, assume dredge cut slopes to be 6H: 1V. Hydraulically dredged material would need to be placed in either the IDNR MSU or the proposed containment area, as discussed earlier. The proposed containment berm for the dredged material area consists of 2.5H: 1V side slopes with a 10-foot crown width. These are anticipated to be on the order of 4 feet high. This berm can essentially be “pushed up” from the local surficial material, without any stripping required.

There are areas where the shoreline of these various backwater lakes is believed to be eroding. These areas would be protected by placing riprap. Placement slopes should be no steeper than 2H: 1V.

13) REFERENCES

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US Army Corps
of Engineers
Rock Island
District

For sand, assume:
 $e = 0.50$
 $G = 2.70$

$$H_u = [(G + e)(1 + e) - 1] \cdot H_w$$
$$= [(2.7 + 0.5)/(1 + 0.5) - 1] \cdot 62.4 = 70.7 \text{ psf}$$

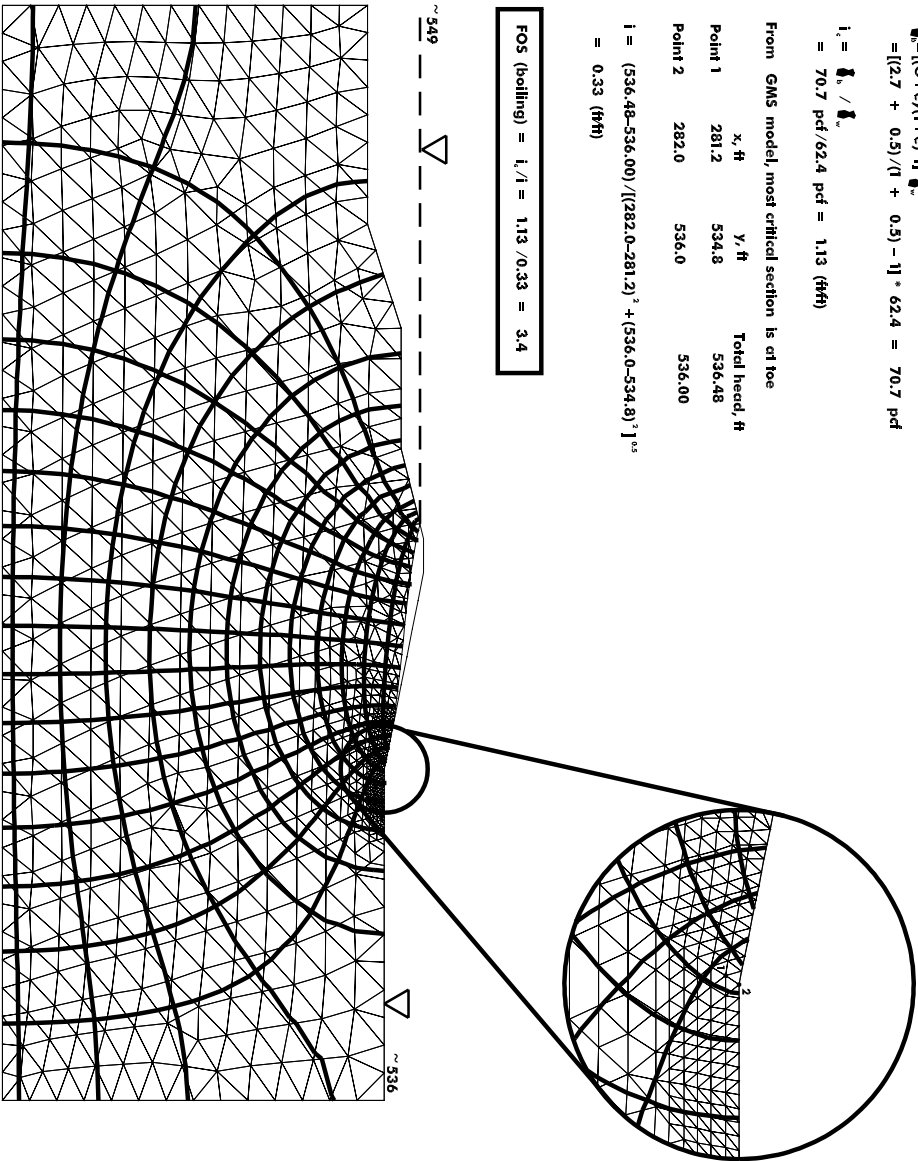
$$i_c = H_u / H_w$$
$$= 70.7 \text{ psf} / 62.4 \text{ psf} = 1.13 \text{ (ft/ft)}$$

From GMS model, most critical section is at toe

	x, ft	y, ft	Total head, ft
Point 1	281.2	534.8	536.48
Point 2	282.0	536.0	536.00

$$i = (536.48 - 536.00) / [(282.0 - 281.2)^2 + (536.0 - 534.8)^2]^{0.5}$$
$$= 0.33 \text{ (ft/ft)}$$

$$\text{FOS (boiling)} = i_c / i = 1.13 / 0.33 = 3.4$$



Perimeter Levee - Factor of Safety Against Boiling

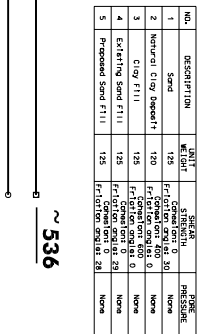


Design By:	Drawn By:	Checked By:	Reviewed By:	Date:	Approved:
XX XXX 2002	AS SHOWN	XXXXX	XXXXX		
Soil Test Log Number: XXXXX-XX-9-XXXX				Revised To:	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

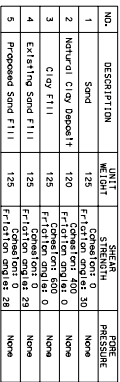
RIVER, STATE
PROJECT TITLE

Sheet
Reference
Plate G-2
Scale of 1/2"



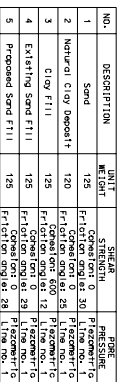
Land Side

Factor of safety: 2.641



Factor of safety: 2.141

Case 2: Low Water, End of Construction, Land Side



Factor of safety: 1.456

Case 3: High Water, Steady State Seepage, Land Side

Sheet
Reference
Number:
Plate G-3
Sheet of XX

APPENDIX H

SEDIMENTATION

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX H
SEDIMENTATION**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX H
SEDIMENTATION**

CONTENTS

Subject	Page
1) Introduction	H-1
2) Estimated Sedimentation for Lake Odessa.....	H-1
3) Fish Holes.....	H-3
4) Michael Creek Wingdam	H-3
5) Archeological Site Protection.....	H-3

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX H
SEDIMENTATION**

1) INTRODUCTION

Sedimentation in the backwater areas of the Lake Odessa Wildlife Refuge, including Yankee Chute, Little Goose Pond, Fox Pond, Bebee Pond, Prairie Pocket, and Turkey Chute has not been measured. Bathymetric measurements were taken in 1992 and in 2000, but drawing long-term conclusions from an 8-year span is problematic, especially considering that there have been several overtopping flood events and levee breaches during this period. The Lake Odessa Wildlife Refuge has experienced continual sedimentation from the time that Lock and Dam 17 went into operation in 1939. Originally, the refuge area was located in a braided portion of the Mississippi River side channel. The islands in the braided channel consisted of sand bar deposits that exist in the refuge today. Early agricultural levees were built in 1913, but these levees were frequently overtopped and did little to prevent incoming sediments. Much of the coarse-grained sediment was stopped from entering the refuge by the construction of a perimeter levee and inlet and outlet structures in 1954.

The flood of 1993 seriously impacted the refuge, including a half mile in total levee breaks, inlet and outlet structures damaged beyond repair, and the complete filling in of feeder channels to Lake Odessa. The Flood of 2001 caused levee failures and pushed sediments into the refuge and into Lake Odessa. Spillways have been designed to reduce levee damage from future overtopping events. Details of the spillway design are located in Appendix I – Hydrology and Hydraulics.

During non-flood conditions, water enters the refuge through the northern inlet structure in Pool 17, flows through Lake Odessa, and exits through the outlet structure downstream of Lock and Dam 17. The inflow carries fine-grained sediments that are deposited into Lake Odessa. Sediment sampling in 2001 (USACE ED-HQ Bierl et al., see Appendix F) verify that the Lake Odessa bottom consists almost entirely of fine silt deposits.

2) ESTIMATED SEDIMENTATION FOR LAKE ODESSA

The rate of sediment accumulation entering Lake Odessa from the Mississippi River was estimated using the findings of the *Upper Mississippi River and Illinois Waterway Cumulative Effects Study*¹.

¹ WEST Consultants, *Upper Mississippi River and Illinois Waterway Cumulative Effects Study, Volume 1: Geomorphic Assessment* (Bellevue, WA, submitted to U.S. Army Corps of Engineers, Rock Island District, June 2000).

This study examined sedimentation rates in many backwater locations of the Upper Mississippi River. A typical lower sedimentation rate is approximately 1 centimeter per year, where higher sedimentation rates are about 3 centimeters per year. Sedimentation rates for specific locations appear on Table 6.5 of the WEST study (see below). While larger sedimentation rates have been observed and measured elsewhere on the Upper Mississippi River, these locations tend to occur closer to the main channel where abrupt velocity changes occur and bedload deposits are significant. For Lake Odessa, suspended load accumulation is more appropriate because it is a leveed system, and the lower half of the range of sedimentation rates (1-2 cm/year) is reasonable. The average suspended load for Pool 17 from 1954 through 1995 was 10,624,064 tons per water year.² Flow measurements show that less than a tenth of 1 percent of the total discharge enters Lake Odessa.

Table 6-5: Summary of UMR sedimentation rate estimates.

Source Reference	Location	Estimated Sedimentation Rate (cm/year)	Applicable Time Period	Comments
Current Study	Lower Pool 11	1.56	1938 - 1951	Average of 13 cross sections (RM 584 - 597) for backwater areas
		0.34	1951 - 1995	
	RM 403 to 580 Pools 12 - 19	0.05 (0.04)*	Primarily ~mid-1940s to 1995	Average for backwater areas derived from sediment budget, assuming dredged material left in *(dredged material taken out).
	RM 364 to 403 Pools 19 - 20	0.23 (0.22)*	Primarily ~1950 to 1995	
	RM 218 to 364 Pools 20 - 26	0.31 (0.20)*	Primarily ~mid-1960s to 1995	
Rogala and James (1997)	Pool 8	0.46	1989 - 1996	Mean rate for 25 backwater transects
Rogala and Boma (1996)	Pools 4, 8, 13	0.25	1989 - 1996	Average based on 42 backwater transects, excluding dredge cuts
Knox and Faulkner(1994) (upstream from the confluence with MR along Buffalo River)	Pool 4: Lower Buffalo River (Silt Range 163)	2.0	1935 - 1954	Cesium-137 dating, Based on two core holes (about 1000 m upstream)
		0.9	1954 - 1992	
	Pool 4: Lower Buffalo River (Silt Range 158)	3.3	1935 - 1945	Cesium-137 dating, Based on entire transect (about 200 m upstream)
		1.4	1945 - 1954	
McHenry et al. (1984)	Pools 4, 5, 5A, 6, 7, 8, 9, 10	3.4	1954 - 1964	Cesium-137 dating, Average based on 47 profiles
	Pools 4, 5, 5A, 6, 7, 8, 9, 10	1.8	1965 - 1975	
Nakato (1981a)	Pools 11,12,14,16,17, 20, 21, 22	1.62	Primarily 1930s - 1950s	Average rate based on 19 cross sections for selected backwater areas

² Ibid.

3) FISH HOLES

Various locations are proposed to create fish holes for the Lake Odessa EMP project. The design goal of the fish holes is to provide 6 feet of depth at the end of the 50-year project life. According to the range of reasonable sedimentation rates (1-2 cm/year), the fish holes should be dredged to a total depth between 7.6 feet and 9.3 feet in order to provide 6 feet of depth after 50 years; however, some consolidation of sediments will occur, so a final depth of 8 feet should be adequate. It is recommended that fish holes be located away from areas of through-flow such as the western portion of Lake Odessa or in the water supply ditches. These areas can deposit bedload material into the fish holes and would decrease their expected life.

Turkey Chute is located outside the perimeter levee in the backwater areas of the Mississippi River. This area has potential for overwintering fish habitat. By dredging to a depth of 10 ft in Turkey Chute downstream of Lock and Dam 17, a depth of 6 ft over the life of the project (50 years). This assumes the sedimentation rate of 1.62 cm/year from the 1981 study by Prof. Nakato. A depth of 10 ft below the minimum winter water surface implies a riverbed elevation of approximately 519 ft MSL.

4) MICHAEL CREEK WINGDAM

A wingdam is proposed to be built at the mouth of the access channel to the inlet structure in order to reduce the amount of sediment entering the Lake Odessa refuge (see plate 3 of the DPR). The wingdam should be built of piled riprap stones extending perpendicular from the bankline and tying into the northern shore of the access channel to the inlet structure. A wingdam with an 8-foot crown width that is 3 feet higher than the river bottom and extending approximately 25 feet from the shoreline and keyed 10 feet into the bankline. The crown elevation of the wingdam varies with the bankline elevation being 536.4 ft to a tip elevation of 533.9 ft; Flat pool elevation is 535.87 ft. This wingdam would deflect most of the accumulating bedload from Michael Creek into the main currents of the Mississippi, thus protecting the access channel from accumulating sediments. This wingdam design would also let the majority of the flow pass over the structure, which would ensure no impacts to navigation and a minimal amount of land development upstream of the structure. Such land development would occur near the shoreline where normal pool depths are currently less than 3 feet. In terms of rock quantity, extra rock is necessary to account for settlement of riprap stones into the river bottom materials. Since the bottom material is sand, little settling (less than 1 foot) is expected.

5) ARCHEOLOGICAL SITE PROTECTION

There are many archeological sites within the Lake Odessa Wildlife Refuge. As part of this project, it is proposed that the shoreline sites be protected by riprap (see plates 3 and 4 of the DPR). The two main factors that cause erosion in the area are wave erosion from recreational boats and periodic drawdowns of Lake Odessa that expose unvegetated shoreline. The Rock Island District's Hydraulics Branch believes that these factors are minimal and that shoreline protection may not be necessary for the following four reasons: (1) the refuge is located in a backwater area that experiences deposition during normal years and heavier deposition during flood years, (2) the well-vegetated banklines resist erosion and will rapidly revegetate any exposed areas due to the rich, silty soils deposited in the area, (3) the eastern portion of Lake Odessa where many of the archeological sites are located does not carry significant flow compared to the western portion of the lake, and (4) the lake is narrow and oriented north to south; thus, wind-generated wave wash from prevailing westerly winds is minimal.

APPENDIX I

HYDROLOGY AND HYDRAULICS

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX I
HYDROLOGY AND HYDRAULICS**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX I
HYDROLOGY AND HYDRAULICS**

CONTENTS

Subject	Page
1) Introduction and Location of Site.....	I-1
2) Climate	I-1
3) Mississippi River.....	I-2
a) Flood Conditions	I-2
b) Normal Pool and Water Table.....	I-3
4) Project Features	I-3
a) Sand Prairie Planting	I-3
b) IDNR Moist Soil Unit	I-3
c) Michael Creek Wing Dam.....	I-4
d) Dedicated Water Bay Culvert.....	I-4
e) Archeological Site Protection	I-5
f) USFWS Moist Soil Units	I-5
g) Levee Enhancements	I-7
h) Spillway Summary	I-9
i) Historical Analysis	I-9
j) Gate Operation and Interior Water Levels	I-11

Tables

No.	Title	Page
I-1	Summary of monthly precipitation and snowfall	I-2
I-2	Discharges and elevations for various flood frequencies on the Mississippi River	I-2
I-3	Minimum pump capacities for proposed moist soil units.....	I-6
I-4	Sloping Perimeter Levee Elevations, Lake Odessa.....	I-7
I-5	10-year to 25-year elevations for two spillway locations on the perimeter levee at the Lake Odessa Wildlife Refuge	I-8
I-6	Evaluation of historical flood events using the two spillway design hydraulic spreadsheet	I-10

CONTENTS (Continued)

Plates

No.	Title
I-1	Iowa River Flood Profiles
I-2	Stage Hydrographs, Pool 17, 1994-2001
I-3	Stage Hydrographs, Pool 17, 1986-1993
I-4	Stage Hydrographs, Pool 17, 1978-1985
I-5	Stage Hydrographs, Pool 17, 1970-1977
I-6	Stage Hydrographs, Pool 17, 1965-1969
I-7	Perimeter Spillway Design
I-8	One-Foot Elevation Contour Map: Lake Odessa
I-9	Elevation - Surface Area - Storage Relationship
I-10	Perimeter Spillway Case Scenarios
I-11	MSU Pump Capacities
I-12	Detailed Water Level Scenario 1
I-13	Detailed Water Level Scenario 2
I-14	Detailed Water Level Scenario 3

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX I
HYDROLOGY AND HYDRAULICS**

1) INTRODUCTION AND LOCATION OF SITE

The Lake Odessa Wildlife Refuge is located on the Iowa side of the Mississippi River between River Miles (RM) 434.5 and 441.5 (see plates 1 and 2 of the DPR). It is surrounded by a perimeter levee that was built in 1913 for flood protection of agricultural land and later enhanced in 1954. Inlet and outlet structures were rebuilt after the flood of 1993 (originally built in 1954) to allow flow into and out of the refuge, offering a degree of water level control within Lake Odessa. Lock and Dam 17 is located at RM 437.1 and ties into the perimeter levee. The U.S. Fish and Wildlife Service (USFWS) manages the levee upstream of RM 438, while the Iowa Department of Natural Resources (IDNR) manages the downstream portion of the levee. Management of the interior is similarly divided by the two agencies. The Iowa River enters the Mississippi River at RM 434.5, which is just downstream of the refuge. The City of Keithsburg, Illinois, is roughly 8 miles downstream of the refuge and formerly served as the official flood forecasting location of the National Weather Service (NWS). Recently, the NWS has begun forecasting flood levels at Lock and Dam 17. Plate I-1 shows flood profiles for various frequency events and several historical flood events, as well as the crest elevation of the perimeter levee as surveyed in 1999.

This appendix provides a hydrologic assessment of the area and summarizes the hydrologic and hydraulic evaluation of various project features considered as part of this project. This includes all features considered throughout the feasibility phase of the environmental management project. All MSL references to elevation in this appendix refer to the 4th General (Survey) Adjustment of 1912.

2) CLIMATE

Climatological data for this site are collected at the New Boston gage at Lock and Dam 17. The nearest gaging stations to the wildlife refuge are located upstream and downstream of Lock and Dam 17 at RM 437.1. The U.S. Army Corps of Engineers owns and maintains these gages, and data recorded from these gages can be accessed at <http://water.mvr.usace.army.mil>, station MI17. Temperature data was recorded over a 32-year period from 1968 through 1999, and precipitation data was recorded over a 52-year period from 1948 through 1999.

The climate of this area is typical of the Midwestern United States, with warm, wet summers and cold, dry winters. The maximum average temperature of 89 degrees Fahrenheit occurs in July,

while the minimum average temperature of 10.5 degrees Fahrenheit occurs in January. The average annual precipitation is 33.97 inches with a standard deviation of 7.4. The average annual snowfall is 19.94 inches with a standard deviation of 13.3. Monthly mean values appear in Table I-1.

Table I-1. Summary of monthly precipitation and snowfall

Month	Rain (inches)	Snow (inches)	Month	Rain (inches)	Snow (inches)
January	1.55	6.34	July	4.23	0.00
February	1.31	3.44	August	3.60	0.00
March	2.38	2.66	September	3.24	0.00
April	3.51	0.34	October	2.64	0.06
May	3.77	0.002	November	2.10	0.98
June	3.84	0.00	December	1.65	4.13

3) MISSISSIPPI RIVER

a) Flood Conditions

The nearest Mississippi River gage to Lake Odessa is at Lock and Dam 17 at New Boston, Illinois. This gage is near the midpoint of the project at RM 437.1. Plates I-2 through I-6 show the stage hydrographs of Pool 17 for every year from the 1965 flood to the 2001 flood. Plate I-1 shows the flood flow frequency profiles for this reach of the river, along with five historical flood profiles, and the perimeter levee crest survey taken in 1999. The perimeter levee was overtopped in several locations in the spring of 2001, so the current levee crests will vary slightly from what is shown. It is proposed as part of this EMP project that the levee be enhanced, including a spillway located at the downstream end of the project. The spillway is designed to overtop at approximately the 10-year elevation in order to fill the interior before the perimeter levee is overtopped, thus reducing the probability of future levee breaks. See the "Emergency Spillway" section for details of the spillway design.

Flood flow frequency profiles on plate I-1 come from the *Upper Mississippi River Water Surface Profiles River Mile 0.0 to River Mile 847.5*, published in 1979 by the Technical Flood Plain Management Task Force. Newer profiles were published in 2003 but were unavailable at the time of this study. A summary of the flows and elevations at RM 437.1 near the middle of the Lake Odessa Wildlife Refuge are shown in Table I-2.

Table I-2. Discharges and elevations for various flood frequencies on the Mississippi River

Frequency (%)	Recurrence Interval (years)	Discharge (cfs)	Lock and Dam 17 Elevation (ft MSL) RM 437.15	Keithsburg Elevation (ft MSL) RM 428.0 (pre-1997 gage location)
0.2%	500	402,500	554.2	547.8
0.5%	200	367,000	552.6	546.3
1.0%	100	340,000	551.2	545.1
2.0%	50	311,000	550.1	543.9
10.0%	10	240,000	546.2	540.2
20.0%	5	206,000	544.6	538.4

Representative frequency curves of elevation-duration at RM 434.8 are shown on plate I-7. This location was chosen as it is on the most downstream portion of the perimeter levee, the preferred location of an emergency overflow spillway.

b) Normal Pool and Water Table

The water surface of Pool 17 is regulated to a stage of 9.3 feet during non-flood conditions. The pool stage fluctuates from 9.1 to 9.7 feet operationally due to varying river and weather conditions. A stage of 9.3 corresponds to an elevation of 535.87 feet MSL (1912 datum). This elevation is the predominant water table elevation in the northern portion of the refuge near the inlet structure. Gravity drainage is not possible to any portion of the wildlife refuge that is higher in elevation than 536.27 feet MSL (highest regulated pool), except during times of flood. Plate I-8 is a topographic map showing 1-foot contours.

The tailwater of Lock and Dam 17 fluctuates greatly due to the natural flow changes that occur in the Mississippi River. It is not uncommon for the tailwater to fluctuate more than 6 feet during non-flood conditions. Because of this, the water table in the southern portion of the wildlife refuge fluctuates in response to the river. The higher water table in the northern section of the refuge implies that a groundwater gradient exists throughout the refuge. Flowing water in the various channels within the refuge originates from several sources: inflow from the inlet structure, seepage of water through the perimeter levee, rainfall-runoff within the refuge, the managed lowering of Lake Odessa, and groundwater baseflow due to the existing groundwater gradient.

4) PROJECT FEATURES

a) Sand Prairie Planting

The sand prairie is located within the northern portion of the refuge, directly southeast of Little Goose Pond. The area will be planted with sand prairie plant species. Originally, the area was to be converted to a moist soil unit, but ground survey indicated that the site is up to 4 feet higher in elevation than 536 feet, which is approximately the normal regulated water level of Pool 17. Locating an MSU in this area would be a poor choice because of the raised elevation leading to greater pore pressures and seepage, and the further seepage associated from the underlying sand layer. Adding a clay liner can control seepage, but this was found to be cost prohibitive. For these reasons, the upper MSU was dropped from further consideration, in preference for other MSU locations. See plate 3.

b) IDNR Moist Soil Unit

The IDNR MSU was located within a smaller area encircled by an access road in the southern portion of the refuge. Refuge managers have flooded this area using a Crisafulli pump, but desired water elevations could never be achieved due to excessive seepage. Adding a clay liner to control seepage was explored and was found to be cost prohibitive and was dropped from further consideration.

Upon revisiting the IDNR MSU, it was proposed that dredged silt material be allowed to consolidate within the IDNR MSU to help control seepage. In order to raise the water level 4 feet in 14 days, a pump size of 11,360 gpm would be needed. The water surface elevation would be raised from 537.5 to 541.5 feet MSL. Seepage assumptions are documented in Appendix G - Geotechnical Considerations (see Figure G-1).

c) Michael Creek Wingdam

Along the shoreline of the Mississippi River are numerous rock dikes called wingdams that protrude perpendicular to the flow of the main channel. They are built to cut off flow conveyance in the shallow off-channel areas and concentrate flow into the main channel. This tends to reduce sedimentation in the main channel, lowering the cost of maintaining a navigable depth of 9 feet. Experience at the Rock Island and St. Paul Districts indicates that these increased velocities result in scour holes immediately downstream of the wingdams and off the tips, and provide good habitat for fish.

Sediment accumulation in front of the inlet structure limits the amount of inflow to Lake Odessa and is a concern for refuge managers. The primary source of the sediment is from Michael Creek, which enters the Mississippi River directly upstream of the access channel at River Mile 441.3. Sediment is also deposited in the access channel because it is located at an outer bend of the Mississippi River. Placing a submerged wingdam just upstream of the mouth of the access channel will help eliminate sediment accumulation in front of the inlet structure. The wingdam should be constructed of riprap stone having an 8-foot crown width, extending 25 feet into the Mississippi River from the shoreline, and keyed 10 feet into the bank. The height of the riprap should be 3 feet above the existing river bottom along the entire 25-foot length. This low crest height was chosen to avoid impacts to navigation, as most of the flow will continue to pass over the wingdam. The 3-foot height is high enough to deflect bedload sediments into the faster river currents where they are transported downstream and away from the access channel. The predicted scour holes would be located at the tip of the wing dam and behind the wingdam and will further limit the ability of suspended sediments to accumulate in front of the access channel. The base material under the proposed wingdam is sand; therefore, minimal settling of riprap is anticipated.

d) Dedicated Water Bay Culvert

The inlet structure is located at RM 440.8. This structure contains four sluice gates that are each 5 feet by 5 feet with sill elevations of 532.25 feet MSL. To provide more water to the southernmost gate would be walled off so that flow would be channeled directly to the MSUs (while the flow through the other gates will enter Lake Odessa as they currently do). The channel downstream of the dedicated water bay cuts through a gravel road that is used as a low water crossing by construction vehicles and other equipment; therefore, a culvert will be needed to pass the flow under the road to the MSUs. The size of the culvert should be large enough to avoid backwater effects that significantly reduce inflow. The recommended pipe-arch size is a 64-inch by 43-inch culvert, which has a cross-sectional area of 14.7 square feet. The desirable range for slope for full-flow capacity is 0.005 - 0.02 ft/ft. The roughness coefficient (Manning "n" value) for a corrugated metal 3-inch by 1-inch annular pipe-arch (64" x 43") is 0.027 if the interior is unpaved and 0.022 if the interior is paved. A paved interior is recommended to increase the flow capacity as well as the life of the culvert. More details can be found in Appendix K - Structural Analysis.

e) Archeological Site Protection

This project includes shoreline protection at several locations shown on plates 3 and 4 of the main report. As noted in Appendix H, Lake Odessa is in a depositional area, thus, velocities are minimal and would not cause erosion. Wave erosion may be a factor, but it was judged that these areas could be stabilized without riprap protection designed by EM 1110-2-1601. Although riprap isn't required, riprap will be used to ensure a 50-year life on the protection of some archeological sites. More details are given in Appendix H and Section 9 of the main report.

f) USFWS Moist Soil Units

As part of the Lake Odessa Refuge water level management strategy, several MSUs are planned to be sectioned off and periodically flooded. This is done at the discretion of refuge managers to maximize habitat during key periods of the year, such as waterfowl migration in the fall. Several areas have been identified (see plates 3 and 4 of the main report) as being most beneficial to serve as MSUs: Field 21, Field 4 & 5, Unit 2, MSU 20, and the Fox Pond area south of MSU 20.

The majority of the MSUs have ground elevations averaging 537 feet MSL, which is 1 foot above flat pool (and the approximate water table) in the northern portions of the refuge. Due to the elevation difference between the river and the MSUs, gravity fed water could only be utilized during high water events such as flooding. To better facilitate bringing water to the units, pumps should be utilized.

At Fox Pond, wildlife managers would raise water levels from 536.0 to 537.0 in two 0.5-foot increments using an in-place pump station. Each increment would be raised 0.5 foot in 7 days and held for 2 months. For the other MSUs, wildlife managers would utilize portable pumps to raise water levels from 537.0 to 538.5 in three 0.5-foot increments. Each increment would be raised 0.5 foot in 7 days and held for 21 days. Rate of rise variations were tested to provide a range of minimum pumping rates necessary to fill the various MSUs (see plate I-11). The minimum required pump capacity is located under the “7 days” column for various increases in water level. The values listed on plate I-11 do not include seepage losses, which must be added to these minimum pump capacity requirements. Seepage losses are discussed in the following paragraph, and pump capacity requirements are summarized on Table I-3.

Soil borings in the area indicate large areas of underlying sand. Holding a water level of 2.5 feet higher than the water table will require maintenance pumping to overcome induced seepage. Seepage loss rates have been analyzed for the various MSUs considered (see Figure G-1 in Appendix G), and verified by field measurements. More details of the analysis and seepage losses are located in Appendix G - Geotechnical Considerations. Requirements for pump capacity to the various MSUs are summarized on Table I-3 on the following page for each of three pumping plans: 8 hours pumping per day, 12 hours pumping per day, and 24-hour continuous pumping. A 12-hour pumping schedule was selected to match available on-site management resources. On a 12-hour pumping schedule, single portable Crisafulli pumps can meet the management plan for all MSU units except for Fox Pond, which requires a larger pump with a portable power generation set. More details on the required pumps can be found in section 6 of the main report.

Table I-3. Minimum pump capacities for proposed moist soil units

8-Hour Pumping per Day			Assumed Head for Seepage Calculation (ft)	Seepage Loss (gpm) in first 0.5 ft Water Level Rise	Total Pump Capacity Needed Minimum (gpm)
Moist Soil Unit Location	Water Level Elevation Plan (ft MSL)	Minimum Pump Capacity (gpm)			
Unit 2 (FWS)	537.0 to 537.5 in 7 days	5,640	1.25	1,700	7,340
	537.5 to 538.0 in 7 days	5,640	1.75	2,400	8,040
	538.0 to 538.5 in 7 days	5,640	2.25	3,000	8,640
Field 4&5 (FWS)	537.0 to 537.5 in 7 days	4,020	1.25	2,400	6,420
	537.5 to 538.0 in 7 days	4,020	1.75	3,300	7,320
	538.0 to 538.5 in 7 days	4,020	2.25	4,200	8,220
Field 21 (FWS)	537.0 to 537.5 in 7 days	4,050	1.25	2,300	6,350
	537.5 to 538.0 in 7 days	4,050	1.75	3,000	7,050
	538.0 to 538.5 in 7 days	4,050	2.25	3,800	7,850
Fox Pond (FWS)	536.0 to 536.5 in 7 days	32,610	0.25	1,200	33,810
	536.5 to 537.0 in 7 days	32,610	0.75	3,400	36,010
Lower MSU (DNR)	537.5 to 541.5 in 14 days	14,040	5.50	2,000	16,040

12-Hour Pumping per Day			Assumed Head for Seepage Calculation (ft)	Seepage Loss (gpm) in first 0.5 ft Water Level Rise	Total Pump Capacity Needed Minimum (gpm)
Moist Soil Unit Location	Water Level Elevation Plan (ft MSL)	Minimum Pump Capacity (gpm)			
Unit 2 (FWS)	537.0 to 537.5 in 7 days	3,760	1.25	1,700	5,460
	537.5 to 538.0 in 7 days	3,760	1.75	2,400	6,160
	538.0 to 538.5 in 7 days	3,760	2.25	3,000	6,760
Field 4&5 (FWS)	537.0 to 537.5 in 7 days	2,680	1.25	2,400	5,080
	537.5 to 538.0 in 7 days	2,680	1.75	3,300	5,980
	538.0 to 538.5 in 7 days	2,680	2.25	4,200	6,880
Field 21 (FWS)	537.0 to 537.5 in 7 days	2,700	1.25	2,300	5,000
	537.5 to 538.0 in 7 days	2,700	1.75	3,000	5,700
	538.0 to 538.5 in 7 days	2,700	2.25	3,800	6,500
Fox Pond (FWS)	536.0 to 536.5 in 7 days	21,740	0.25	1,200	22,940
	536.5 to 537.0 in 7 days	21,740	0.75	3,400	25,140
Lower MSU (DNR)	537.5 to 541.5 in 14 days	9,360	5.50	2,000	11,360

24-Hour Continuous Pumping			Assumed Head for Seepage Calculation (ft)	Seepage Loss (gpm) in first 0.5 ft Water Level Rise	Total Pump Capacity Needed Minimum (gpm)
Moist Soil Unit Location	Water Level Elevation Plan (ft MSL)	Minimum Pump Capacity (gpm)			
Unit 2 (FWS)	537.0 to 537.5 in 7 days	1,880	1.25	1,700	3,580
	537.5 to 538.0 in 7 days	1,880	1.75	2,400	4,280
	538.0 to 538.5 in 7 days	1,880	2.25	3,000	4,880
Field 4&5 (FWS)	537.0 to 537.5 in 7 days	1,340	1.25	2,400	3,740
	537.5 to 538.0 in 7 days	1,340	1.75	3,300	4,640
	538.0 to 538.5 in 7 days	1,340	2.25	4,200	5,540
Field 21 (FWS)	537.0 to 537.5 in 7 days	1,350	1.25	2,300	3,650
	537.5 to 538.0 in 7 days	1,350	1.75	3,000	4,350
	538.0 to 538.5 in 7 days	1,350	2.25	3,800	5,150
Fox Pond (FWS)	536.0 to 536.5 in 7 days	10,870	0.25	1,200	12,070
	536.5 to 537.0 in 7 days	10,870	0.75	3,400	14,270
Lower MSU (DNR)	537.5 to 541.5 in 14 days	4,680	5.50	2,000	6,680

g) Levee Enhancement

It is proposed as part of this EMP project that the perimeter levee be restored to approximately the 25-year elevation at the downstream location and transitioning to approximately the 50-year elevation at the upstream location. Also, two emergency overflow spillways are proposed to be constructed to minimize levee damage due to overtopping. One spillway is located at the downstream end of the project along the Iowa River levee (RM 434.8), and the second spillway is located in the upstream portion of the levee near the prairie pocket area (RM 440.4). The downstream spillway was designed to have a 10% chance per year of overtopping; the upstream spillway was designed to have a 6% chance per year of overtopping. In this configuration, the downstream levee will overtop first allowing water to fill the interior from the downstream portion of the project. By the time the upper spillway overtops, water is ponded on the spillway apron, which reduces the chance for scour downstream. Scour can be further reduced if the gated structures are opened prior to the overtopping of the upstream spillway crest. The two spillways work together to fill the interior of the refuge before the perimeter levee is overtopped from Mississippi River flooding. Future levee breaks can be prevented and damage minimized if the interior water level is no more than a foot lower than the Mississippi River water level at the time that the perimeter levee is overtopped. The sloping protection level of the perimeter levee was designed so that levee overtopping first occurs at the downstream location of the perimeter levee, and slowly progresses upstream as the Mississippi River rises. See Table I-4 for design elevations along the perimeter levee.

Table I-4 Sloping Perimeter Levee Elevations, Lake Odessa

River Mile	Minimum* Crest Elevation ft MSL (1912 Datum)	Feature near Location
441.1	551.0	Upstream Extent of Project
440.8	550.9	Upper Gated Structure
440.4	550.7	Prairie Pocket (FWS Spillway)
437.2	549.3	Upstream of Lock and Dam 17
437.15	549.0	Downstream of Lock and Dam 17
435.4	548.3	Lower Gated Structure
434.8	548.0	Downstream Extent of Project (DNR Spillway)

* The elevations listed above are elevations that existing low spots would be raised to. Existing high spots in the perimeter levee would not be lowered.

To reduce sedimentation, it is preferable to fill the interior from the downstream end of the refuge. Because of the long distance of levee along the Mississippi River and the natural water surface slope of the river during flood events, the upper spillway is needed to prevent levee damage at the upstream end of the project. Due to the slope of the river, the crest elevations of the two proposed spillways are not equal for a given overtopping frequency. The 10-year elevation at the lower location is 545.4 ft MSL, while the 10-year elevation at the upper location is 547.6 feet MSL. Other frequency elevations (shown on plate I-7) have been considered as part of the spillway design process, and are summarized in Table I-5.

Table I-5. 10-year to 25-year elevations for two spillway locations on the perimeter levee at the Lake Odessa Wildlife Refuge

Frequency (%)	Recurrence Interval (years)	Spillway Elevation at Lower Location on Perimeter Levee Elevation (ft MSL) RM 434.8	Spillway Elevation at Upper Location on Perimeter Levee Elevation (ft MSL) RM 440.4
4%	25	548.05	550.25
5%	20	547.6	549.8
6%	16.7	547.0	549.2
6.67%	15.0	546.65	548.85
7%	14.3	546.5	548.7
8%	12.5	546.1	548.3
9%	11.1	545.75	547.95
10%	10	545.4	547.6

The frequencies above are based off of the *Upper Mississippi River Water Surface Profiles River Mile 0.0 to River Mile 847.5*, published in 1979 by the Technical Flood Plain Management Task Force. Newer profiles were published in 2003 resulting from the *Upper Mississippi River System, Flood Frequency Study*, but were unavailable at the time of this study. Even though the protection level has changed due to a more current set of statistics, the function and result of the levee and spillway design has been tested and has not changed. The design will still function to reduce future levee blowouts.

Various parameters were used in a spreadsheet model to compute hourly interior and exterior water surface elevations. Hourly inflow volumes into the interior were calculated using hydraulic coefficients and equations over the spillways and added to the total interior volume. The volume was converted into elevation using the storage curve on plate I-9. The interior volume was calculated from surveyed topography (see plate 3 of the main report) for every foot of elevation from 528-556 feet MSL using ArcView 3.2's Spatial Analyst module. Coefficients and parameter values are shown on the sample calculations sheet on plate I-10. Variable parameters include: spillway crest elevation, starting interior water elevation, rate of rise of the Mississippi river, coefficients of discharge, spillway lengths, and gate openings. Inflow was assumed to be zero through the gates throughout the filling process in order to simulate the worst-case scenario for levee damage due to flooding.

Spreadsheet calculations were made for many combinations of these parameters, but certain parameters were chosen based on experience. A starting interior water elevation of 538 feet was used based on recommendations of wildlife refuge managers who experienced the 1993 and other floods. A rate of rise of 0.75 foot per day was chosen for the Mississippi River based on past flood events rising from the 10-year elevation to the 25-year elevation. Discharge coefficients were chosen from the Handbook of Hydraulics (7th Edition) based on a broad-crested weir spillway design with a 1:5 (v:h) downslope. Various combinations of spillway length and spillway crest were chosen such that the interior water surface elevation was no more than 1 foot lower than the Mississippi River water surface elevation at the time of perimeter levee overtopping. This analysis used a one-hour computational time step, and assumed that the perimeter levee would be restored to at least the water surface profile of the 4% event (25-year recurrence interval) along the length of the levee. No low spots in the levee exist other than at the two spillway locations that are designed to overtop.

h) Spillway Summary

After analyzing the results of many possible spillway combinations, a 1,100-foot long spillway at the lower end (RM 434.8) was chosen in conjunction with a 700-foot long spillway at the upper end (RM 440.4) of the perimeter levee. Crest elevations are 545.2 ft MSL for the downstream spillway and 545.8 ft MSL for the upstream spillway. These crest elevations have a corresponding risk of overtopping per year of 10% for the downstream spillway (overtops first) and 6% for the upstream spillway. Below are the final spillway design parameters:

Downstream Spillway (DNR)

Location: River Mile 434.8, along Iowa River
Length: 1100 ft
Crest: 545.2 ft (10% chance per year of overtopping, overtops first)
Interior Water Elevation at Time of Spillway Overtopping: 538 ft

Upstream Spillway (FWS)

Location: River Mile 440.4, near Prairie Pocket
Length: 700 ft
Crest: 548.8 ft (6% chance per year of overtopping, overtops second)
Interior Water Elevation at Time of Spillway Overtopping: 541.2 - 542.2 ft

i) Historical Analysis

A historical analysis was performed to characterize the performance of the proposal of two spillways (one 1,100-foot and one 700-foot spillway) in the perimeter levee. In the past 70 years of recorded stage at Lock and Dam 17, five events would have overtopped the proposed spillway crest (see Table I-6). Two of the events (June 1993 and April 1965) would have flooded the interior of the refuge and overtopped the enhanced perimeter levee. If the perimeter levee would be restored to the 20-year elevation instead of the 25-year elevation, six more flood events (a total of 11) would have filled the interior during the period of record. The two simulated historical flood events on a 25-year to 50-year perimeter levee resulted in a computed head differential greater than one foot, indicating the possibility of minor levee damage. Because of this, crest elevations of the two spillways were slightly altered (to the values listed in the "Spillway Summary" section) and the recommendation was made to utilize the gated structures (see "Gate Operation and Interior Water Levels" Section). Results of the historical analysis appear in Table I-6.

As part of the historical flood analysis, flooding on the Iowa River was investigated to determine if there is a possibility of overtopping the lower spillway without a flood occurring on the Mississippi River. The lower spillway can be positioned either on the perimeter levee adjacent to the Iowa River or just upstream of the outlet structure. Iowa River flooding is not a concern of overtopping the lower spillway without a backwater effect from a Mississippi River flood; such large flows on the Iowa River would require prior overtopping of the Coralville Dam emergency spillway, which has only occurred once (1993). Large flows on the Iowa River typically happen when the Mississippi River stages are also high. If the Mississippi River stage were normal, and a very large flood occurred on the Iowa River, there would be adequate flood storage available at the mouth of the Iowa River to reduce flood peaks and avoid overtopping the 545.2 feet MSL lower spillway crest.

Comment [B1]: What exactly does this mean? The way it reads, it sounds as though our current design isn't adequate. Good catch. The old paragraph should have been updated, so now it is (TRG)

Table I-6. Evaluation of Historical Flood Events

Proposed Spillway Design

- 1) The flood damage reduction plan is to restore the existing perimeter levee to the 25-year elevation and construct two spillways, which would allow the interior to fill before the perimeter levee is overtopped.
- 2) The main spillway is located at RM 434.8 on the perimeter levee (bordering the Iowa River); it is 1,100 ft long and has a crest elevation at the 10-year elevation of 545.4 ft (10% chance per year of overtopping).

The upper spillway is located at RM 440.4 on the perimeter levee (near Prairie Pocket); it is 700 ft long and has a crest elevation at the 11.1-year elevation of 548.0 ft (9% chance per year of overtopping).

- 3) In the past **70 years** of recorded stage at Lock & Dam 17, **five events** would have overtopped the proposed spillway crest. **Three events** (*April 2001, April 1973, April 1993*) had peak stages between the 10- and 25-year elevations; the interior would have been flooded and the perimeter levee not overtopped, assuming the perimeter levee was restored to the 25-year elevation.
- 4) The interior of the Lake Odessa Wildlife Refuge is filled within roughly 3.5 days with this spillway design. The entire perimeter levee is submerged within a 7-day period from the start of spillway overtopping.
- 5) The water level of the interior at the start of overtopping was assumed to be 538 ft MSL. The head difference (river to interior) at time of overtop of the lower spillway is 7.4 ft for all events. The head difference (river to interior) at time of overtop of the upper spillway is 10.0 ft for all events.

Historical Functionality of Proposed Spillways

	Average Rate of Rise from 545 ft MSL to 550 ft MSL (ft/day)	Head Differential (river to interior) at time of:		
Flood Event		lower end perimeter levee overtop	upper end perimeter levee overtop	Notes:
Design Flood	0.75	0.66 ft	1.22 ft	Spillway Design Case
June 1993	0.47	< 0.1 ft	< 0.1 ft	actual hydrograph used
April 1965	0.80	1.43 ft	1.67 ft	would be < 0.1 ft and 0.87 ft if half of the gates are opened during event
April 2001	1.12	Actual hydrograph used, if perimeter levee was restored to 25-year level, this event would not have overtopped perimeter levee, but would have overtopped the spillway for a duration of 14 days & 7 hours. Complete Filling		
April 1973	0.96	Overtopping would have occurred for a period of 5 days and 9 hours, Completely filling the interior without having overtopped the perimeter levee.		
April 1993	Overtopping would have occurred for a period of 11 days and 8 hours, but would not have exceeded the restored 25-year elevation of the perimeter levee. Complete Filling of Interior			

Table I-6, continued

The events below would **not** have overtopped the proposed lower spillway at RM 434.8, but came close.

April 1969	Stage 19.76 on the 26th of April, cresting 0.07 ft below proposed main spillway crest.
May 1975	Stage 19.70 on the 8th of May, cresting 0.13 ft below proposed main spillway crest.
April 1997	Stage 19.67 on the 21st of April, cresting 0.16 ft below proposed main spillway crest.
April 1951	Stage 19.61 on the 28th of April, cresting 0.22 ft below proposed main spillway crest.
October 1986	Stage 19.50 on the 7th of October, cresting 0.33 ft below proposed main spillway crest.
April 1952	Stage 19.76 on the 28th of April, cresting 0.39 ft below proposed main spillway crest.

j) Gate Operation and Interior Water Levels

Not all levee failures are due to overtopping. High pore pressures can lead to piping failures, which is one reason it is recommended to restore the interior slopes of the perimeter levee to 1:5 (v:h) (see Appendix G - Geotechnical Considerations for more details). During the rising water levels of a flood, pore pressures in the levee are lower when water levels in the interior refuge are higher. The two recommended spillways have been designed to fill the interior before the perimeter levee overtops; however, opening the gates of the inlet and outlet structures during a flood event will aid in filling the interior of the Lake Odessa Wildlife Refuge and will reduce the risk of incurring levee damage or excessive scour to the interior.

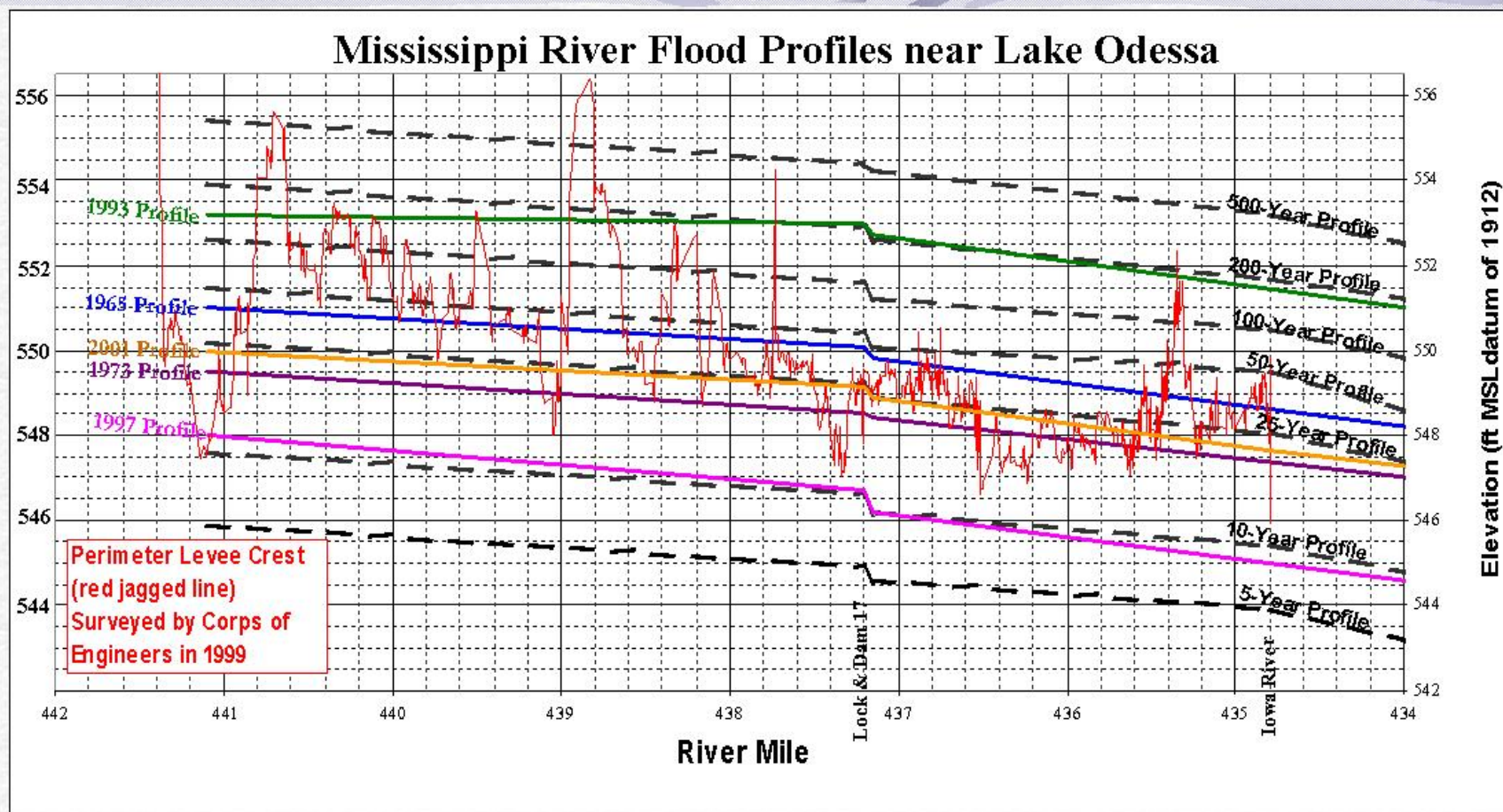
The Mississippi River is forecasted at the tailwater of Lock and Dam 17. The gates do not need to be opened prior to flood stage. (The flood stage is 14.0 ft, corresponding to a 540.57 ft water surface elevation at the tailwater of the dam and approximately 539.5 ft at the downstream spillway.) In order to overtop the downstream spillway crest (545.2 ft), the stage at the tailwater of Lock and Dam 17 would have to exceed approximately 19.6 ft. The gates of the inlet & outlet structures should be opened prior to this stage as follows:

The gates of the outlet structure should be opened no later than when the Mississippi River is 1 ft below the crest of the downstream spillway and is predicted to rise more than 1 ft. This occurs at an approximate stage of 18.6 ft at the tailwater of Lock and Dam 17. The gates of the inlet structure are opened 24 hours after the gates of the outlet structure are opened. This will give an interior water elevation of 542.2 ft at the time of initial overtopping of the FWS spillway. See Plate I-12 for details of the interior water levels.

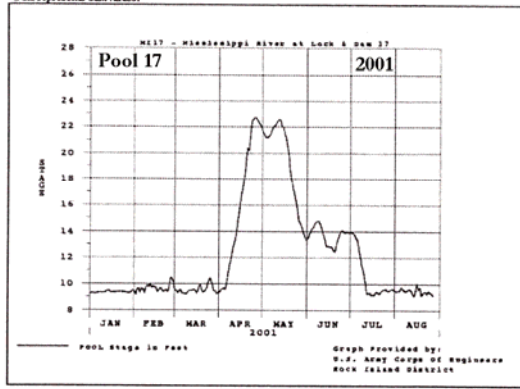
If the gates of the inlet structure are inaccessible and cannot be opened, the interior water elevation would be 541.2 ft at the time of initial overtopping of the FWS spillway. See Plate I-13 for details of the interior water levels.

If neither set of gates can be opened, the interior water elevation would be 539.4 ft at the time of initial overtopping of the FWS spillway. This represents a worst-case scenario. See Plate I-14 for details of the interior water levels.

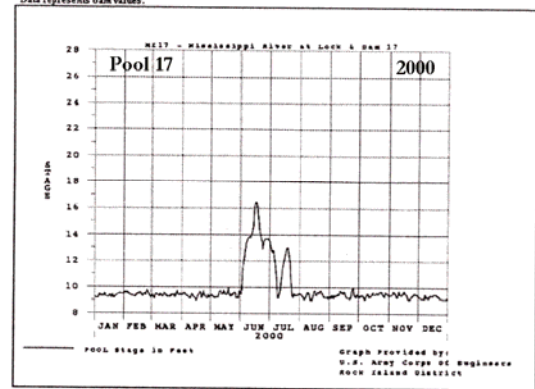
The recommended plan is to utilize both gated structures if possible (Plate I-12). This yields the highest interior water level at the time the FWS spillway is overtopped, and gives the highest degree of protection to the interior features (MSU berms, Roadways, etc.) of the project area. In the case of a fast rising river as was seen in 2001, the gates may be opened days in advance of the predicted overtop of the downstream levee. When the river rises above flood stage, project managers should keep a vigilant watch on the stage predictions at the tailwater of Lock and Dam 17. The National Weather Service issues official stage forecasts.



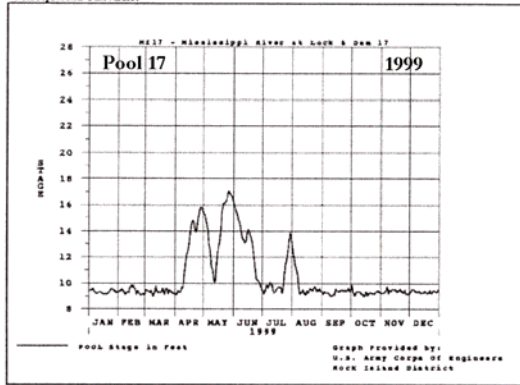
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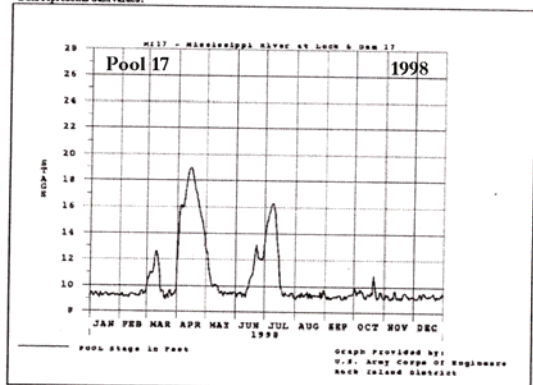
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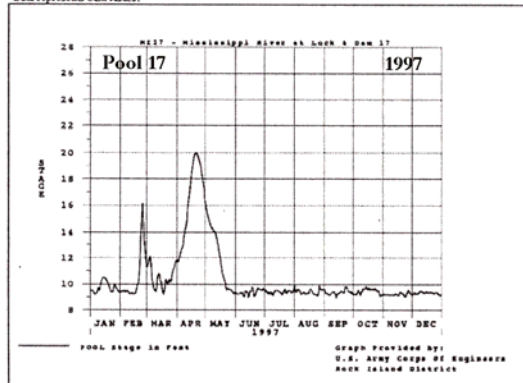
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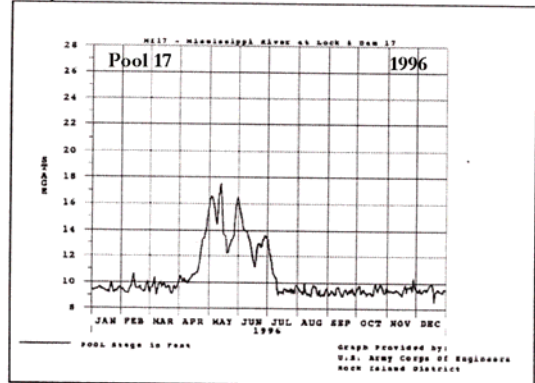
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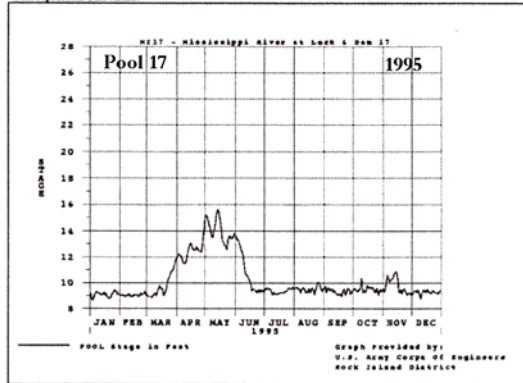
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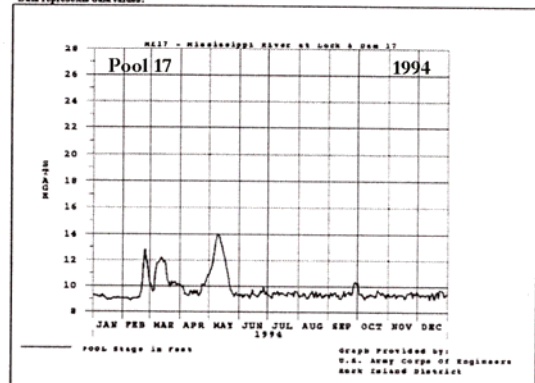
*Data represents dam values.



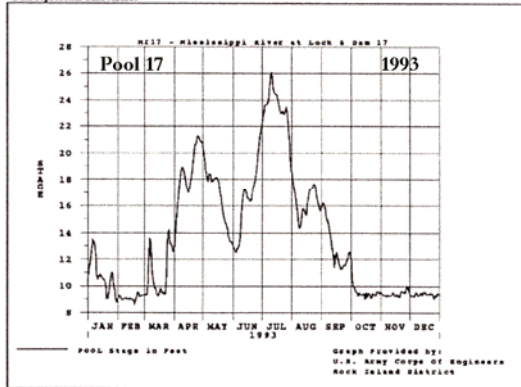
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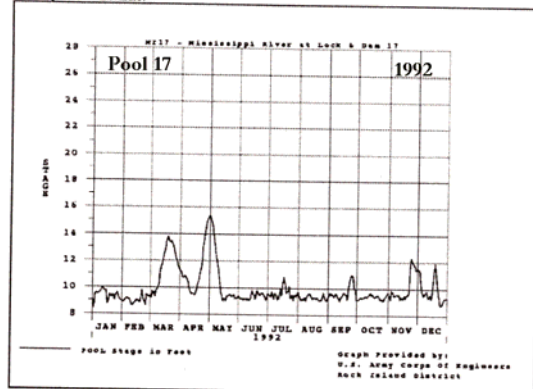
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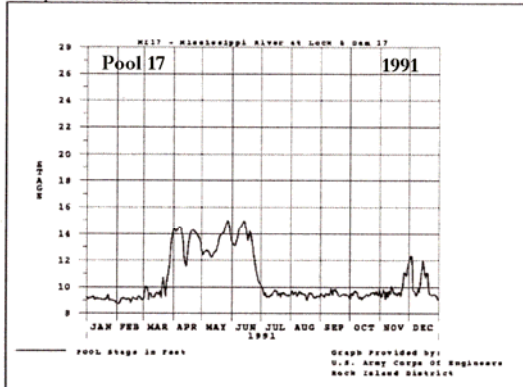
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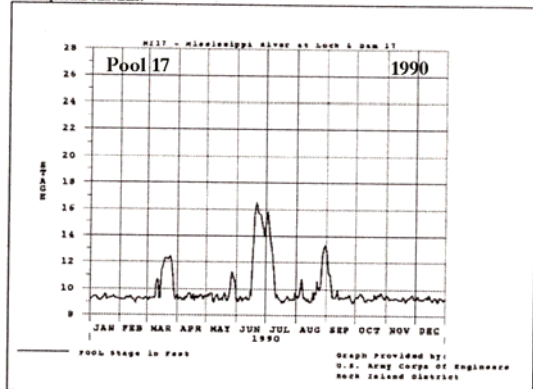
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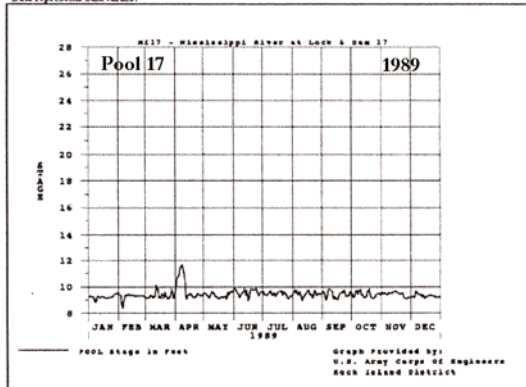
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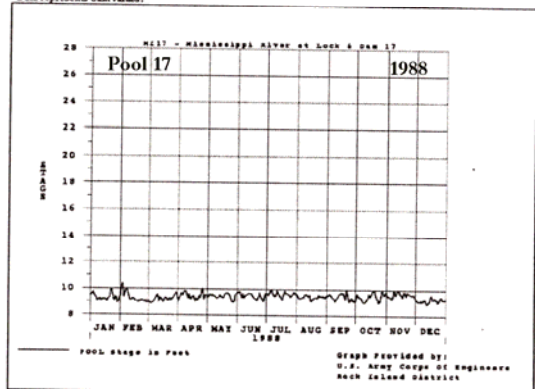
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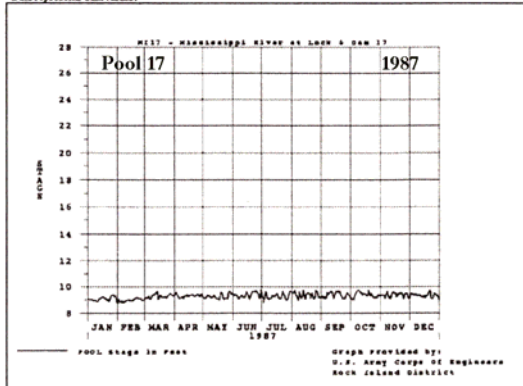
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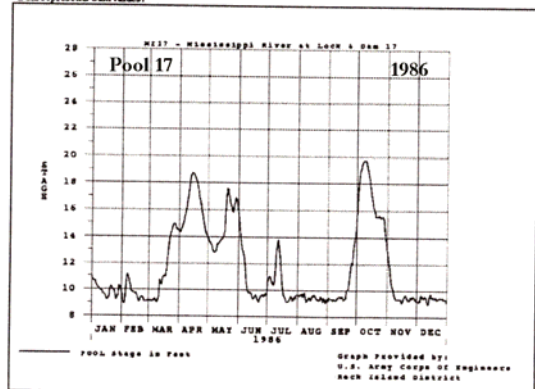
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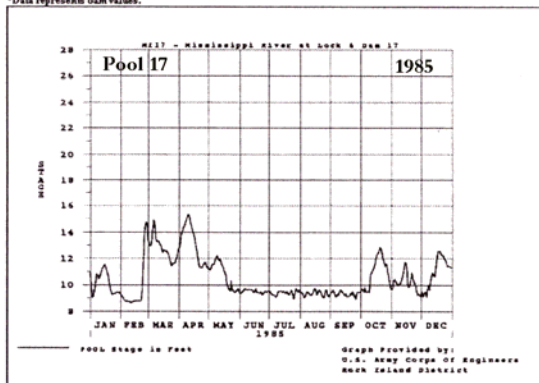
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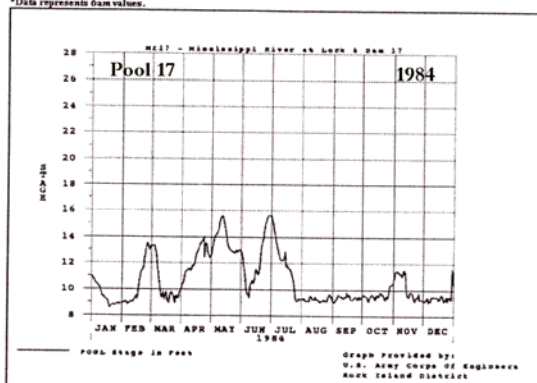
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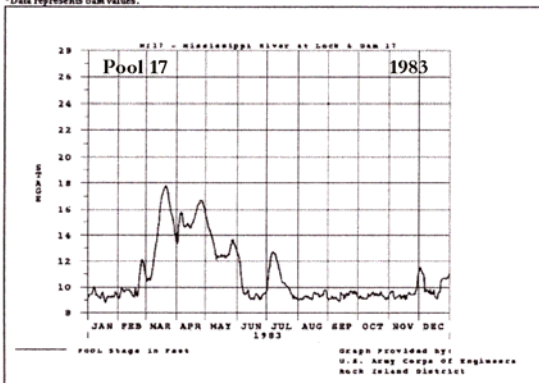
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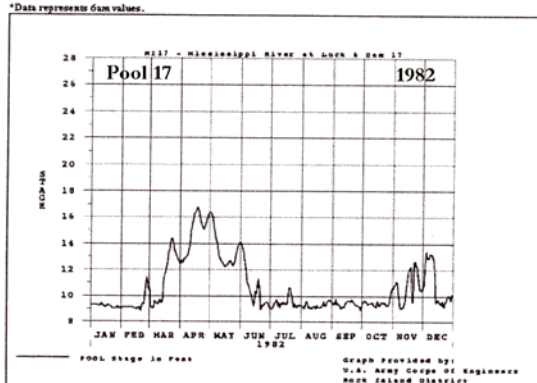
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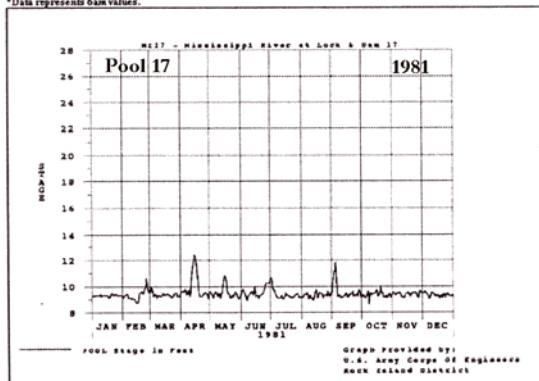
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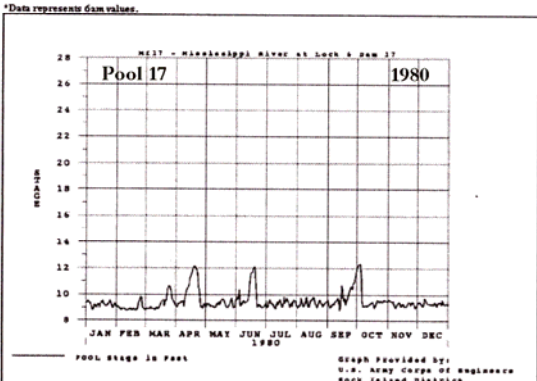
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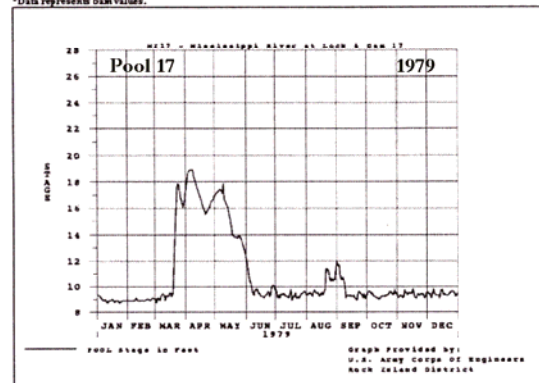
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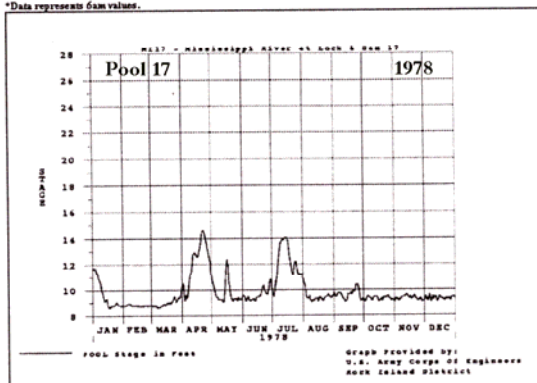
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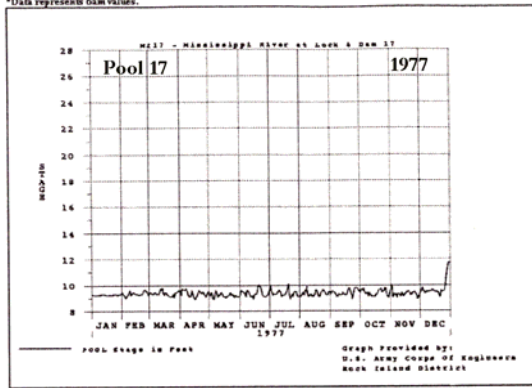
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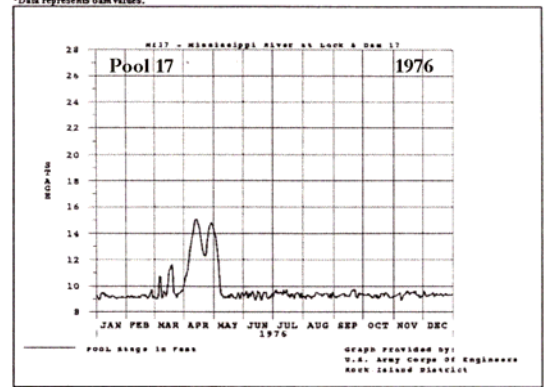
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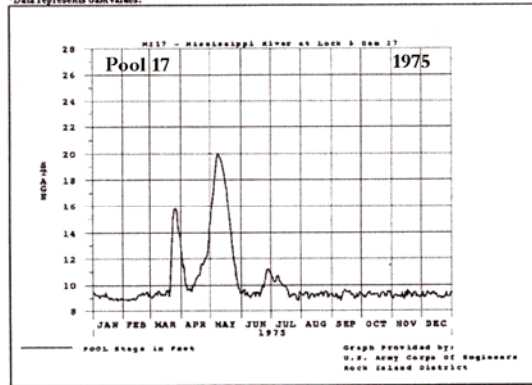
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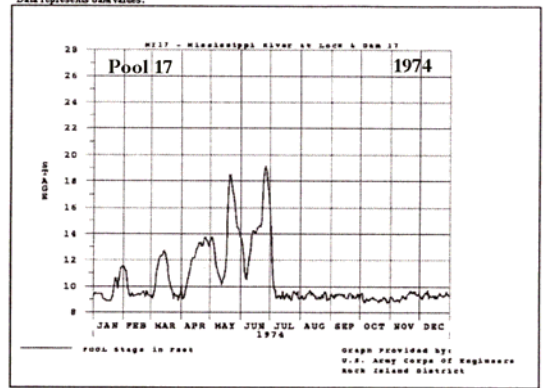
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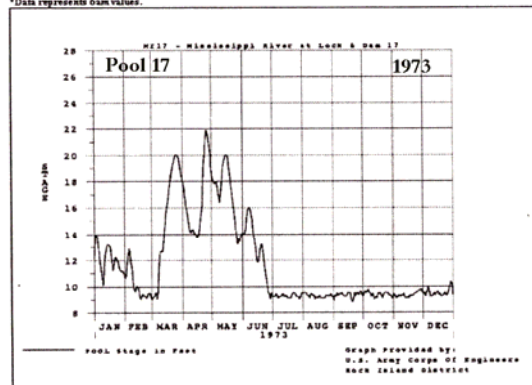
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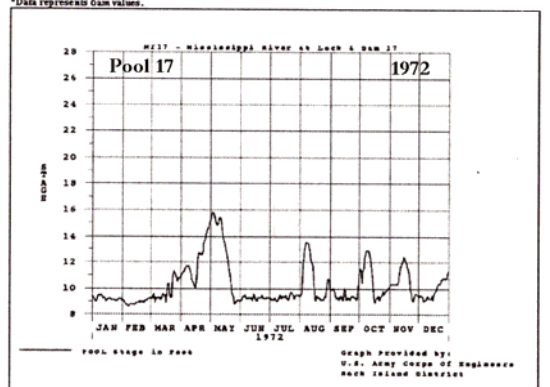
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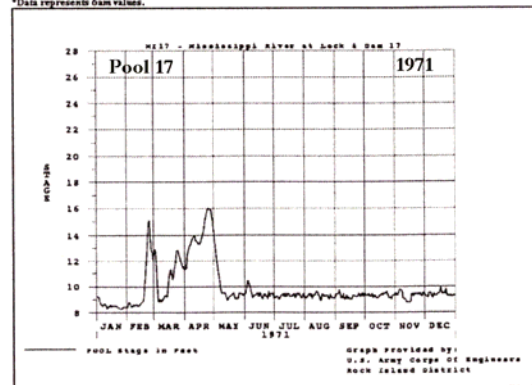
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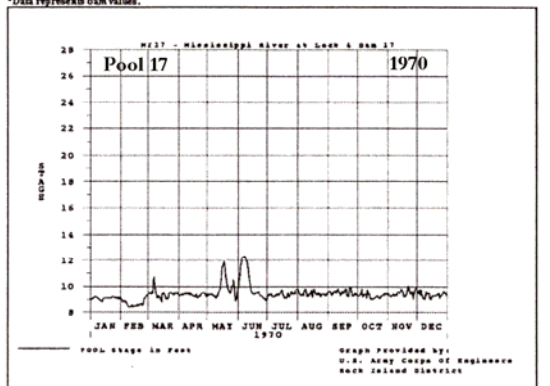
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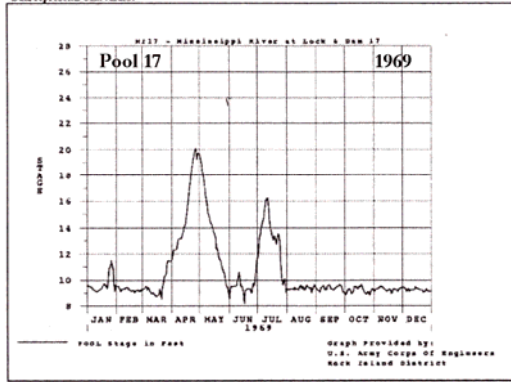
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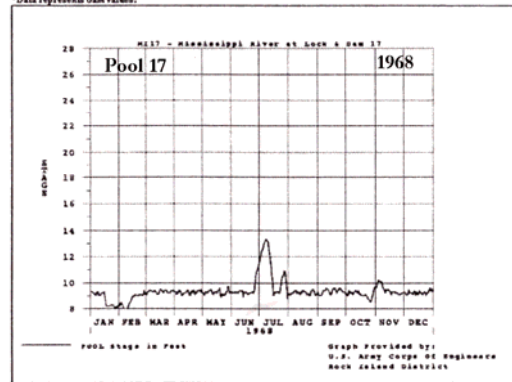
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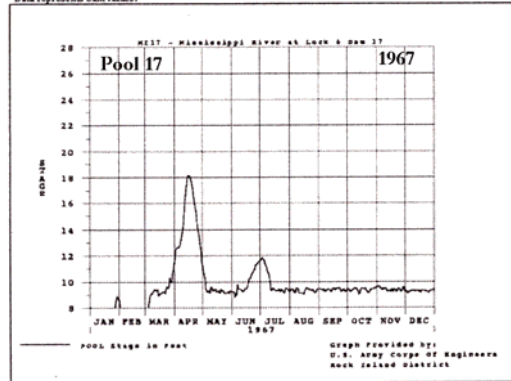
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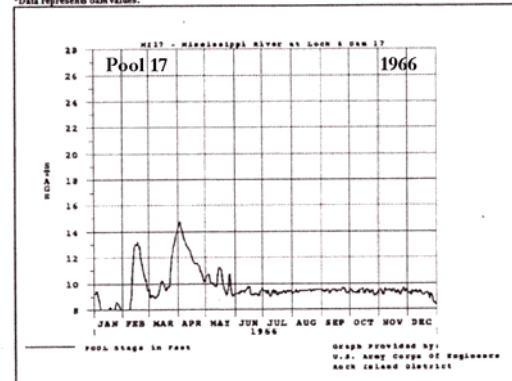
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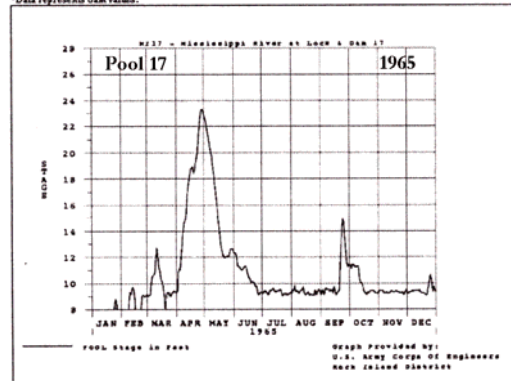
*Data represents dam values.



*Data represents dam values.



*Data represents dam values.



Perimeter Spillway Design

Using volume-elevation lookup tables, which was calculated using ArcView's Spatial Analyst on TIN coverage "Odessa3" Storage & Surface Area values were linearly interpolated to the nearest 0.2 ft, based off of 1 ft calculations.

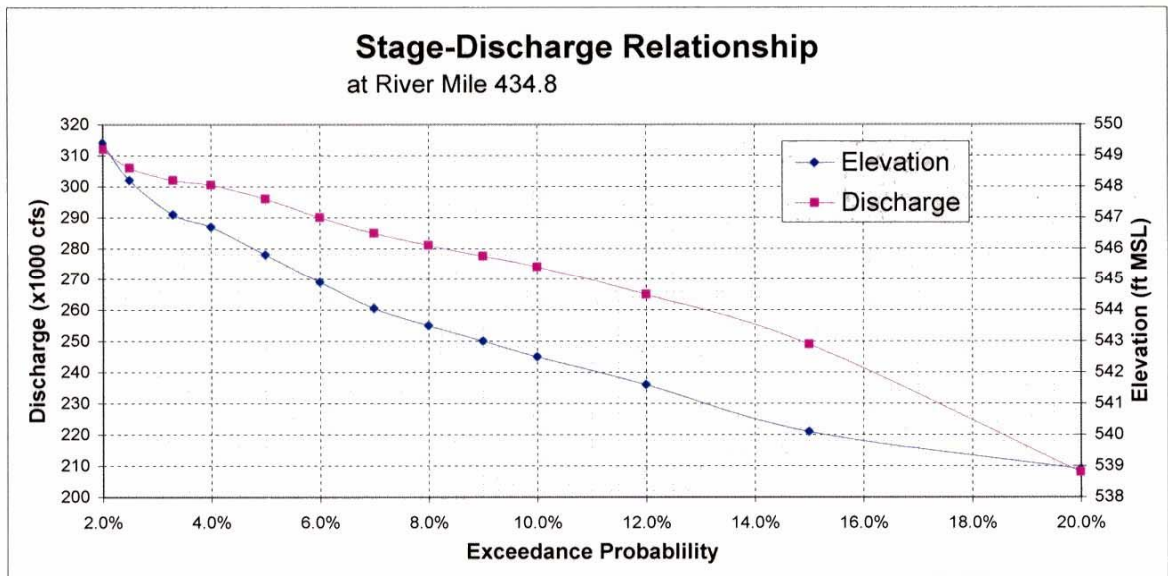
Elevation Range of Lake Odessa Refuge Lookup Table:

528 ft MSL (low)

556 ft MSL (high) (0.5 ft above the 500-year flood - covers the full range)

Spillway is located at River Mile 434.8, oriented perpendicular to Mississippi River

Elevation (ft MSL)	Mississippi River	
	Discharge (x1000 cfs)	Exceedance Frequency
538.8	209	20.0%
542.9	221	15.0%
544.5	236	12.0%
545.4	245	10.0%
545.75	250	9.0%
546.1	255	8.0%
546.5	260.5	7.0%
547.0	269	6.0%
547.6	278	5.0%
548.05	287	4.0%
548.2	291	3.3%
548.6	302	2.5%
549.2	314	2.0%

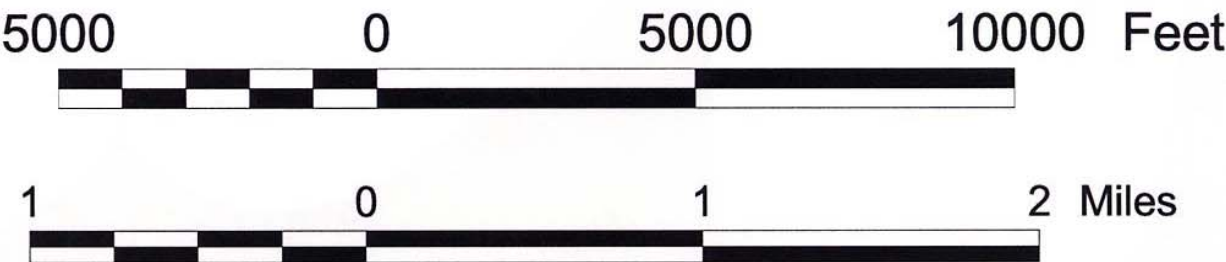
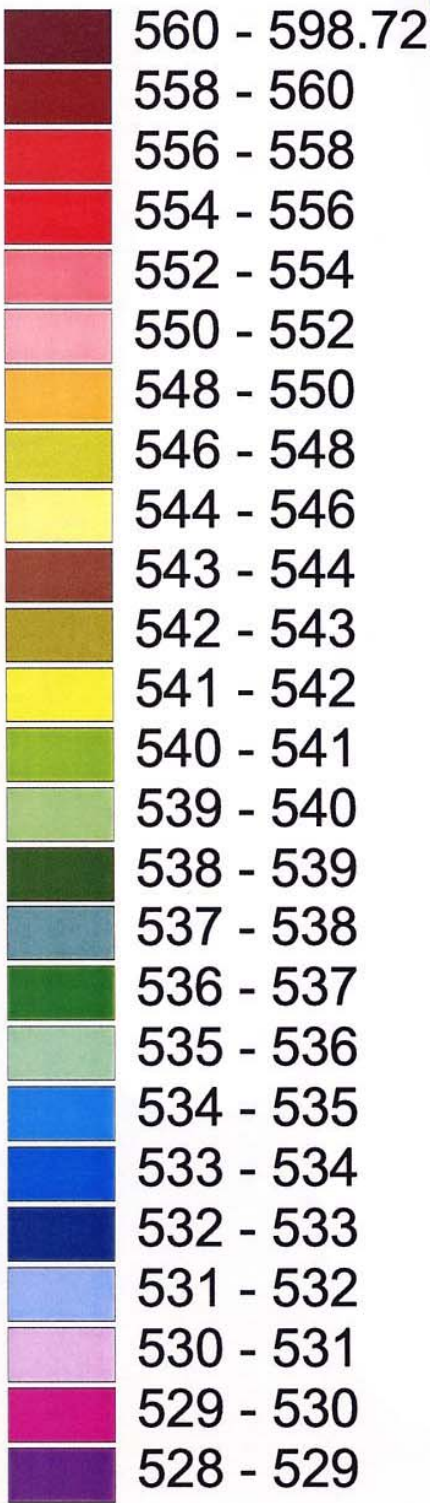


Lake Odessa

Inlet

Outlet

Elevation Range
(ft MSL 1912)



Pump Capacity

Lake Odessa Project Features

The purpose of these project features is to provide manageable moist soil units for the refuge. We have 2-7 days to increase water depths 6" at four project feature locations; the water level is held for a month and is then raised another 6". The tables below have been expanded to provide extra information that may be useful if there are any changes in operation of the moist soil units. This analysis assumes areas to be contained by clay berms – negligible seepage.

UNIT 2 - Located in Northeast Section of Refuge, North of Inlet Structure

Area = 5,066,355 ft²

Depth (ft) of water rise	Area ft ²	Volume ft ³	Flow Rate (GPM) Required to Fill in Time Period						
			2 days	3 days	4 days	5 days	6 days	7 days	14 days
0.5	5066354	2533177	6580	4386	3290	2632	2193	1880	940
1.0	5066354	5066354	13159	8773	6580	5264	4386	3760	1880
1.5	5066354	7599532	19739	13159	9870	7896	6580	5640	2820
2.0	5066354	10132709	26319	17546	13159	10527	8773	7520	3760

FIELD 4 & 5 - Located in Northeast Section of Refuge, Southwest of the Inlet Structure and West of an excavated channel

Area = 3,612,939 ft²

Depth (ft) of water rise	Area ft ²	Volume ft ³	Flow Rate (GPM) Required to Fill "Depth of Water Rise" in Time Period						
			2 days	3 days	4 days	5 days	6 days	7 days	14 days
0.5	3612939	1806469	4692	3128	2346	1877	1564	1341	670
1.0	3612939	3612939	9384	6256	4692	3754	3128	2681	1341
1.5	3612939	5419408	14076	9384	7038	5631	4692	4022	2011
2.0	3612939	7225878	18769	12512	9384	7507	6256	5362	2681

FIELD 21 & MSU 20 - Located in Northeast Section of Refuge, South of the Inlet Structure and East of an excavated channel

Area = 6,776,782 ft²

Depth (ft) of water rise	Area ft ²	Volume ft ³	Flow Rate (GPM) Required to Fill "Depth of Water Rise" in Time Period						
			2 days	3 days	4 days	5 days	6 days	7 days	14 days
0.5	6776782	3388391	8801	5867	4401	3520	2934	2515	1257
1.0	6776782	6776782	17602	11735	8801	7041	5867	5029	2515
1.5	6776782	10165173	26403	17602	13202	10561	8801	7544	3772
2.0	6776782	13553564	35204	23469	17602	14082	11735	10058	5029

FIELD 21 & MSU 20 & Large Area w/ Drainage Ditches - Located in Northeast Section of Refuge, South of the Inlet Structure and East of an upland sand prairie. Proposed bi-directional pump to be located south of the upland sand prairie.

Area = approx 450 acres = 19,602,000 ft²

Depth (ft) of water rise	Area ft ²	Volume ft ³	Flow Rate (GPM) Required to Fill "Depth of Water Rise" in Time Period						
			2 days	3 days	4 days	5 days	6 days	7 days	14 days
0.5	19602000	9801000	25457	16971	12729	10183	8486	7273	3637
1.0	19602000	19602000	50914	33943	25457	20366	16971	14547	7273
1.5	19602000	29403000	76371	50914	38186	30549	25457	21820	10910
2.0	19602000	39204000	101829	67886	50914	40731	33943	29094	14547

Detailed Water Level Scenario 1 (operating plan)							
Lower Gates (outlet structure) are opened when the rising Mississippi River is 1 ft below the crest of the lower spillway. Upper Gates (inlet structure) are opened 24 hours later							
0 ft Head Differential at time of RM 434.8 perimeter levee overtop (difference between river level and interior level)							
0.82 ft Head Differential at time of RM 440.4 perimeter levee overtop (difference between river level and interior level)							
					RM 440.8	RM 435.4	Lower End
	RM 434.8	RM 440.4	RM 434.8	RM 440.4	# sluice gates	# sluice gates	Interior
	Head over	Head over	DNR Spillway	FWS Spillway	Gates U	Gates L	Water Surface
Time	DNR Spillway	FWS Spillway	Inflow	Inflow	Inflow	Inflow	Elevation
hours	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(cfs)	(ft, MSL)
0	-1.0	-2.4	0	0	0	1625	538.0
2	-0.9	-2.3	0	0	0	1628	538.0
20	-0.4	-1.8	0	0	0	1656	538.4
22	-0.3	-1.7	0	0	0	1659	538.4
24	-0.3	-1.6	0	0	1239	1662	538.4
30	-0.1	-1.5	0	0	1247	1671	538.8
31	0.0	-1.4	0	0	1248	1672	538.8
32	0.0	-1.4	0	0	1249	1674	538.8
33	0.0	-1.4	17	0	1251	1675	538.8
34	0.1	-1.3	49	0	1252	1677	538.8
35	0.1	-1.3	90	0	1253	1678	539.0
36	0.1	-1.3	142	0	1255	1680	539.0
48	0.5	-0.9	1178	0	1270	1698	539.6
54	0.7	-0.7	1906	0	1277	1706	540.0
60	0.9	-0.5	2782	0	1285	1715	540.4
66	1.1	-0.3	3723	0	1292	1724	540.8
72	1.3	-0.1	4750	0	1300	1733	541.4
73	1.3	-0.1	4929	0	1301	1734	541.6
74	1.3	-0.1	5111	0	1302	1736	541.6
75	1.3	-0.1	5295	0	1304	1737	541.8
76	1.4	0.0	5480	0	1305	1739	542.0
77	1.4	0.0	5668	0	1306	1740	542.0
78	1.4	0.0	5858	14	1307	1742	542.2
79	1.5	0.1	6050	36	1309	1743	542.2
80	1.5	0.1	6244	65	1310	1744	542.4
81	1.5	0.1	6441	98	1311	1746	542.6
82	1.6	0.2	6639	134	1312	1747	542.6
83	1.6	0.2	6839	175	1313	1749	542.8
84	1.6	0.2	7041	222	1315	1750	543.0
85	1.7	0.3	7245	270	1316	1752	543.0
86	1.7	0.3	7451	320	1317	1753	543.2
87	1.7	0.3	7659	378	1318	1754	543.4
88	1.8	0.4	7869	435	1320	1756	543.4
89	1.8	0.4	8081	494	1321	1757	543.6
90	1.8	0.4	8294	560	1322	1759	543.8
91	1.8	0.4	8510	625	1323	1760	544.0
92	1.9	0.5	8727	692	1324	1762	544.2
93	1.9	0.5	8946	764	1326	1763	544.2
94	1.9	0.5	9167	836	1327	1764	544.4
95	2.0	0.6	9389	910	1328	1766	544.6
96	2.0	0.6	9614	989	1329	1767	544.8
98	2.1	0.7	9938	1147	999	885	545.2
100	2.1	0.7	10393	1322	563	222	545.6
101	2.2	0.8	10623	1423	423	111	545.6
102	2.2	0.8	10855	1512	317	55	545.8
103	2.2	0.8	11088	1602	238	28	546.0
104	2.3	0.9	11323	1695	179	14	546.2
105	2.3	0.9	11560	1789	134	7	546.4
106	2.3	0.9	11798	1885	101	3	546.6
107	2.3	0.9	12038	1983	76	2	546.8
108	2.4	1.0	12280	2082	57	1	547.0
109	2.4	1.0	12400	2183	43	0	547.2
110	2.4	1.0	11386	2286	32	0	547.4
122*	2.8	1.4	0	3631	1	0	548.0
131	3.1	1.7	0	4706	0	0	548.3
132	3.1	1.7	0	4837	0	0	548.3
133	3.2	1.8	0	4969	0	0	548.4
134	3.2	1.8	0	5102	0	0	548.4
135	3.2	1.8	0	5237	0	0	548.4
136	3.3	1.9	0	5372	0	0	548.5
137	3.3	1.9	0	5509	0	0	548.5
138**	3.3	1.9	0	5647	0	0	548.5
139	3.3	1.9	0	5786	0	0	548.5
140	3.4	2.0	0	5926	0	0	548.6

* perimeter levee is
overtopped at
River Mile 434.8

** perimeter levee is
overtopped at
River Mile 440.4

APPENDIX J

COST ESTIMATE

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT
PUBLIC REVIEW DRAFT**

**LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT
POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX J
COST ENGINEERING**

CONTENTS

Subject	Page
1. General	J-1
2. Price Level.....	J-1
3. Contingency Discussion	J-1
4. Recommended Plan.....	J-1

MCACES ESTIMATE

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT
POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

APPENDIX J
COST ENGINEERING

1. GENERAL

A detailed estimate was developed for the recommended plan using the Micro Computer Aided Cost Estimating System (MCACES). The level of detail for the estimate is consistent with the level of design. This detailed estimate was prepared using preliminary project plans, information gathered from site visits and discussions with design team members and the local sponsor, and review of similar construction projects.

2. PRICE LEVEL

The estimates are prepared to a May 2004 price level. These costs are considered to be fair and reasonable to a well-equipped and capable contractor and include overhead and profit. Calculation of the Fully Funded Estimate (FFE) was done in accordance with guidance from EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS), updated September 2003. The midpoint of construction (September 2006) was used to determine the FFE.

3. CONTINGENCY DISCUSSION

After review of project documents and discussion with engineering and construction personnel involved in the project, cost contingencies were developed which reflect the uncertainty associated with the construction work. These contingencies are based on qualified cost engineering judgment of the available design data, type of work involved, and uncertainties associated with the work and schedule. The contingency for the cost estimate is 20%. The basis for the selection of the contingency factor is primarily due to the level of design of a project feature, unknown quantities, and unknown site conditions. Many of the project features can be constructed using conventional methods and are similar to previous Rock Island District projects.

4. RECOMMENDED PLAN

The MCACES estimate incorporated local wage and equipment rates. Costs, including appropriate contingencies are presented in accordance with ER 1110-2-1302, Civil Works Cost Engineering and EC 1110-2-538, Civil Works Project Cost Estimating – Code of Accounts. The attached MCACES sheets, show the Current Working Estimate (CWE), (contract amount plus contingency) and the FFE amount (CWE plus escalation).

Tue 10 Aug 2004
Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
Rock Island District

TIME 16:23:56
TITLE PAGE 1

Lake Odessa Habitat
Rehabilitation and Enhancement
Project, Mississippi River EMP,
Louisa County, Iowa

Designed By: CEMVR-ED-D
Estimated By: D.Bequeaith, A.Ensey, J.Traicoff

Prepared By: CEMVR-ED-C

Preparation Date: 05/13/04
Effective Date of Pricing: 05/13/04

Sales Tax: 7.00%

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Release 1.2

LABOR ID: ODESSA EQUIP ID: RG0599

Currency in DOLLARS

CREW ID: NAT01A UPB ID: UP01EA

		QUANTITY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT	NOTES
06	Fish & Wildlife Facilities			9,188,454	1837691	540,281	11,566,426		
30	Planning, Engineering, & Design			2,039,000	0	4,445	2,043,445		
31	Construction Management			665,400	0	32,605	698,005		
TOTAL Lake Odessa Habitat		1.00	EA	11,892,854	1837691	577,331	14,307,875	14307875	

Tue 10 Aug 2004
Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
Rock Island District
** PROJECT OWNER SUMMARY - Feature **

TIME 16:23:56
SUMMARY PAGE 2

				QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT	NOTES

02	Relocations										
06	Fish & Wildlife Facilities										
06_10	M.S.M.U.'s					877,887	175,577	51,620	1,105,084		
06_20	Sand Prairie Planting		36.00	AC		24,605	4,921	1,447	30,973	860.36	
06_30	Fish Nursery					36,995	7,399	2,175	46,570		
06_40	Channel/Deep Hole Dredging		244440	CY		2,391,874	478,375	140,642	3,010,891	12.32	
06_50	Mast Trees		3694.00	EA		251,512	50,302	14,789	316,603	85.71	
06_60	Mainstem Levee Work		50396	LF		5,605,581	1121116	329,608	7,056,306	140.02	
TOTAL Fish & Wildlife Facilities						9,188,454	1837691	540,281	11,566,426		

30	Planning, Engineering, & Design										
30_ 5	Definite Project Report					1,809,000	0	0	1,809,000		
30_ 10	Plans and Specifications					175,000	0	1,750	176,750		
30_ 15	Engineering During Construction					55,000	0	2,695	57,695		
TOTAL Planning, Engineering, & Design						2,039,000	0	4,445	2,043,445		

31	Construction Management										
31_ 5	Contract Administration					99,900	0	4,895	104,795		
31_ 15	Shop Drawing Review					66,600	0	3,263	69,863		
31_ 20	Inspection and Qual Assurance					498,900	0	24,446	523,346		
TOTAL Construction Management						665,400	0	32,605	698,005		

TOTAL Lake Odessa Habitat				1.00	EA	11,892,854	1837691	577,331	14,307,875	14307875	

LABOR ID: ODESSA EQUIP ID: RG0599

Currency in DOLLARS

CREW ID: NAT01A UPB ID: UP01EA

Tue 10 Aug 2004
Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
Rock Island District
** PROJECT OWNER SUMMARY - Level 6 **

TIME 16:23:56
SUMMARY PAGE 14

			QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT NOTES

02	Relocations								
06	Fish & Wildlife Facilities								
06_10	M.S.M.U.'s								
06_10	.	Unit 2							
06_10	.	.10	Muscatine Slough Water Cont Pipe	1.00	EA	13,576	2,715	798	17,089 17089
06_10	.	.50	Crisafulli Pump	1.00	EA	41,308	8,262	2,429	51,999 51999
TOTAL Unit 2						54,884	10,977	3,227	69,088
06_10	.	.10	Field 21 M.S.M.U.						
06_10	.	.10.20	Pump						
06_10	.	.10.20.05	Crisafulli Pump	1.00	EA	77,434	15,487	4,553	97,473 97473
06_10	.	.10.20.15	Concrete Mats for Pump Pad	1.00	EA	29,009	5,802	1,706	36,517 36517
TOTAL Pump						106,443	21,289	6,259	133,990 133990
TOTAL Field 21 M.S.M.U.						106,443	21,289	6,259	133,990
06_10	.	.15	Fields 4 & 5						
06_10	.	.15.20	Pump						
06_10	.	.15.20.05	Crisafulli Pump	1.00	EA	77,434	15,487	4,553	97,473 97473
06_10	.	.15.20.15	Concrete Mats for Pump Pad	1.00	EA	29,009	5,802	1,706	36,517 36517
TOTAL Pump						106,443	21,289	6,259	133,990 133990
TOTAL Fields 4 & 5						106,443	21,289	6,259	133,990
06_10	.	.25	Fox Pond						
06_10	.	.25.	Pump Pad						
06_10	.	.25. _05	Pump Pad and Piping	1.00	EA	27,579	5,516	1,622	34,716 34716
06_10	.	.25. _15	Concrete Mats for Pump Pad	1.00	EA	29,009	5,802	1,706	36,517 36517
TOTAL Pump Pad						56,588	11,318	3,327	71,233 71233
06_10	.	.25.10	Fox Pond Water Control Structure						
06_10	.	.25.20	Pump Station	1.00	EA	22,385	4,477	1,316	28,178
						189,948	37,990	11,169	239,107 239107

LABOR ID: ODESSA EQUIP ID: RG0599

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CREW ID: NAT01A UPB ID: UP01EA

Tue 10 Aug 2004
 Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
 PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
 Rock Island District
 ** PROJECT OWNER SUMMARY - Level 6 **

TIME 16:23:56
 SUMMARY PAGE 15

				QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT	NOTES
06_10	.25.25	Pump Station Sump Channel		1.00	EA	5,733	1,147	337	7,217	7217.02	
		TOTAL Fox Pond				274,655	54,931	16,150	345,735		
06_10	.30	Iowa DNR M.S.M.U.									
06_10	.30.10	Stripping/Clearing/Grubbing				112,216	22,443	6,598	141,258		
		TOTAL Stripping/Clearing/Grubbing				112,216	22,443	6,598	141,258		
06_10	.30.15	Water Control Structure-1									
06_10	.30.15_ 2	Horizontal Pipe				23,576	4,715	1,386	29,678		
		TOTAL Water Control Structure-1				23,576	4,715	1,386	29,678		
06_10	.30.20	Pump									
06_10	.30.20_05	Crisafulli Pump		1.00	EA	77,434	15,487	4,553	97,473	97473	
06_10	.30.20_15	Concrete Mats for Pump Pad		1.00	EA	29,009	5,802	1,706	36,517	36517	
		TOTAL Pump		1.00	EA	106,443	21,289	6,259	133,990	133990	
		TOTAL Iowa DNR M.S.M.U.				242,235	48,447	14,243	304,926		
06_10	.35	Dedicated Bay									
06_10	.35.	Supply Ditch		1.00	EA	50,500	10,100	2,969	63,569	63569	
06_10	.35.10	Structure Construction		1.00	EA	16,840	3,368	990	21,198	21198	
06_10	.35.20	Road X-ing Pipe		1.00	EA	15,849	3,170	932	19,951	19951	
06_10	.35.25	Dewatering				10,038	2,008	590	12,636		
		TOTAL Dedicated Bay				93,227	18,645	5,482	117,354		
		TOTAL M.S.M.U.'s				877,887	175,577	51,620	1,105,084		
06_20		Sand Prairie Planting									
06_20	.10	Field 6		36.00	AC	24,605	4,921	1,447	30,973	860.36	
		TOTAL Sand Prairie Planting		36.00	AC	24,605	4,921	1,447	30,973	860.36	
06_30		Fish Nursery									
06_30	. 5	Stoplog Structure and Pipe									

LABOR ID: ODESSA EQUIP ID: RG0599

Currency in DOLLARS

CREW ID: NAT01A UPB ID: UP01EA

Tue 10 Aug 2004
 Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
 PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
 Rock Island District
 ** PROJECT OWNER SUMMARY - Level 6 **

TIME 16:23:56
 SUMMARY PAGE 16

				QUANTY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT	NOTES
06_30	. 5. 2	Base Slab for Manhole				1,297	259	76	1,633		
06_30	. 5. 3	Excavation Pipe/Manhl Trench				645	129	38	812		
06_30	. 5. 4	Backfill Pipe Trench				1,021	204	60	1,285		
06_30	. 5. 6	Grill Structure				5,358	1,072	315	6,745		
06_30	. 5. 7	Stop Log				12,121	2,424	713	15,258		
06_30	. 5. 8	Scour Protection				1,694	339	100	2,133		
06_30	. 5.14	Pipe-RCP				9,670	1,934	569	12,173		
06_30	. 5.16	Precast Concrete MH				3,096	619	182	3,897		
06_30	. 5.20	Crew Relocation				2,093	419	123	2,635		
TOTAL Stoplog Structure and Pipe						36,995	7,399	2,175	46,570		
TOTAL Fish Nursery						36,995	7,399	2,175	46,570		
06_40	Channel/Deep Hole Dredging										
06_40	.10	Main Lake Dredging		81555	CY	774,127	154,825	45,519	974,471	11.95	
06_40	.20	Goose Pond Dredging		90170	CY	838,776	167,755	49,320	1,055,852	11.71	
06_40	.30	Blackhawk/Yankee Dredging		63530	CY	592,444	118,489	34,836	745,769	11.74	
06_40	.40	Swarms/Bebee Dredging		9185.00	CY	76,719	15,344	4,511	96,574	10.51	
06_40	.50	Containment Berm		21798	CY	109,807	21,961	6,457	138,225	6.34	
TOTAL Channel/Deep Hole Dredging						244440	CY	2,391,874	478,375	140,642	3,010,891 12.32
06_50	Mast Trees										
06_50	. 5	Area A									
06_50	. 5.20	Tree		530.00	EA	13,053	2,611	767	16,431	31.00	
06_50	. 5.30	Herbicide Treatment		530.00	EA	1,676	335	99	2,109	3.98	
06_50	. 5.50	Weed Barrier Mats		530.00	EA	6,554	1,311	385	8,251	15.57	
06_50	. 5.55	Seeding		13.00	AC	14,051	2,810	826	17,687	1360.53	
TOTAL Area A						530.00	EA	35,333	7,067	2,078	44,478 83.92
06_50	.10	Area B									
06_50	.10.20	Tree		560.00	EA	13,739	2,748	808	17,295	30.88	
06_50	.10.30	Herbicide Treatment		560.00	EA	1,761	352	104	2,216	3.96	
06_50	.10.50	Weed Barrier Mats		560.00	EA	6,930	1,386	407	8,724	15.58	
06_50	.10.55	Seeding		14.00	AC	15,131	3,026	890	19,047	1360.53	
TOTAL Area B						560.00	EA	37,562	7,512	2,209	47,282 84.43
06_50	.15	Area C									
06_50	.15.10	Access				1,169	234	69	1,472		

LABOR ID: ODESSA EQUIP ID: RG0599

Currency in DOLLARS

CREW ID: NAT01A UPB ID: UP01EA

Tue 10 Aug 2004
Eff. Date 05/13/04

Tri-Service Automated Cost Engineering System (TRACES)
PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
Rock Island District
** PROJECT OWNER SUMMARY - Level 6 **

TIME 16:23:56
SUMMARY PAGE 17

				QUANTITY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST	UNIT	NOTES
06_50	.15.20	Tree		1020.00	EA	25,036	5,007	1,472	31,516	30.90	
06_50	.15.30	Herbicide Treatment		1020.00	EA	3,207	641	189	4,037	3.96	
06_50	.15.50	Weed Barrier Mats		1020.00	EA	12,615	2,523	742	15,879	15.57	
06_50	.15.55	Seeding		26.00	AC	28,101	5,620	1,652	35,374	1360.53	
TOTAL Area C				1020.00	EA	70,128	14,026	4,124	88,277	86.55	
06_50	.20	Area D									
06_50	.20.10	Access				1,815	363	107	2,285		
06_50	.20.20	Tree		1584.00	EA	38,867	7,773	2,285	48,926	30.89	
06_50	.20.30	Herbicide Treatment		1584.00	EA	4,980	996	293	6,269	3.96	
06_50	.20.50	Weed Barrier Mats		1584.00	EA	19,593	3,919	1,152	24,664	15.57	
06_50	.20.55	Seeding		40.00	AC	43,233	8,647	2,542	54,421	1360.53	
TOTAL Area D				1584.00	EA	108,489	21,698	6,379	136,566	86.22	
TOTAL Mast Trees				3694.00	EA	251,512	50,302	14,789	316,603	85.71	
06_60		Mainstem Levee Work									
06_60	.20	25-50 Yr Level Mainstem Levee									
06_60	.20.	Main Stem Levee									
06_60	.20.	- Dredging		279987	CY	3,303,281	660,656	194,233	4,158,170	14.85	
06_60	.20.	- 10 Stripping/Clearing/Grubbing		75.00	ACR	210,067	42,013	12,352	264,432	3525.76	
06_60	.20.	- 12 Haul to Areas by Scraper		10149	CY	15,244	3,049	896	19,190	1.89	
06_60	.20.	- 17 Surveying Costs				59,906	11,981	3,522	75,409		
06_60	.20.	- 22 Mob and Demob				200,004	40,001	11,760	251,765		
TOTAL Main Stem Levee				279987	CY	3,788,503	757,701	222,764	4,768,967	17.03	
06_60	.20.20	Wing Dam (Michael Crk)									
06_60	.20.20_ 3	Mobilize				15,485	3,097	911	19,492		
06_60	.20.20_ 10	Placement from Barge		55.00	CY	1,338	268	79	1,684	30.62	
06_60	.20.20_ 15	Riprap		90.00	TN	2,442	488	144	3,074	34.16	
06_60	.20.20_ 20	Demobilize				15,485	3,097	911	19,492		
TOTAL Wing Dam (Michael Crk)				109.10	TN	34,750	6,950	2,043	43,743	400.94	
06_60	.20.30	1100ft Spillway		1100.00	LF	1,311,905	262,381	77,140	1,651,426	1501.30	
06_60	.20.32	Tie Spillway in to Levee		734.00	SY	55,277	11,055	3,250	69,583	94.80	
06_60	.20.40	Protection of Arch Sites									
06_60	.20.40_ 5	Mobilize									

LABOR ID: ODESSA EQUIP ID: RG0599

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Tri-Service Automated Cost Engineering System (TRACES)
PROJECT ODSSA4: Lake Odessa Habitat - Rehabilitation and Enhancement
Rock Island District
** PROJECT OWNER SUMMARY - Level 6 **

TIME 16:23:56
SUMMARY PAGE 18

				QUANTITY	UOM	CONTRACT	CONTINGN	ESCALATN	TOTAL COST

									UNIT

									NOTES

06_60	.20.40_	5_ 5	Mobilize Crane			6,399	1,280	376	8,055
06_60	.20.40_	5_ 10	Mobilize Segmented Barge			15,866	3,173	933	19,972
			TOTAL Mobilize			22,265	4,453	1,309	28,027
06_60	.20.40_	10	Riprap	8619.00	TN	352,536	70,507	20,729	443,773
06_60	.20.40_	12	Reconfigurations	4.00	EA	18,081	3,616	1,063	22,760
									5689.95
06_60	.20.40_	15	Demobilize						
06_60	.20.40_	15_ 5	Demobilize Crane			6,399	1,280	376	8,055
06_60	.20.40_	15_ 10	Demobilize Segmented Barge			15,866	3,173	933	19,972
			TOTAL Demobilize			22,265	4,453	1,309	28,027
			TOTAL Protection of Arch Sites	8619.00	TN	415,146	83,029	24,411	522,586
			TOTAL 25-50 Yr Level Mainstem Levee	279987	CY	5,605,581	1121116	329,608	7,056,306
			TOTAL Mainstem Levee Work	50396	LF	5,605,581	1121116	329,608	7,056,306
			TOTAL Fish & Wildlife Facilities			9,188,454	1837691	540,281	11,566,426
30 Planning, Engineering, & Design									
30_ 5			Definite Project Report			1,809,000	0	0	1,809,000
30_ 10			Plans and Specifications			175,000	0	1,750	176,750
30_ 15			Engineering During Construction			55,000	0	2,695	57,695
			TOTAL Planning, Engineering, & Design			2,039,000	0	4,445	2,043,445
31 Construction Management									
31_ 5			Contract Administration			99,900	0	4,895	104,795
31_ 15			Shop Drawing Review			66,600	0	3,263	69,863
31_ 20			Inspection and Qual Assurance			498,900	0	24,446	523,346
			TOTAL Construction Management			665,400	0	32,605	698,005
			TOTAL Lake Odessa Habitat	1.00	EA	11,892,854	1837691	577,331	14,307,875

LABOR ID: ODESSA EQUIP ID: RG0599

Currency in DOLLARS

CREW ID: NAT01A UPB ID: UP01EA

APPENDIX K

STRUCTURAL ANALYSIS

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14D)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX K
STRUCTURAL ANALYSIS**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14D)
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**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX K
STRUCTURAL ANALYSIS**

CONTENTS

Section	Page
1) Purpose	K-1
2) Background	K-1
3) Dedicated Water Bay	K-2
4) Fox Pond Pump Station.....	K-2
5) Pump Pads.....	K-2
6) CMP Culvert Structures	K-3
7) Fish Nursery Stoplog Structure	K-4
8) Conclusions	K-4
9) Calculations.....	K-4
10) References	K-4

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14D)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX K
STRUCTURAL ANALYSIS**

1) PURPOSE

This appendix to the Definite Project Report describes the preliminary design of all structures proposed for the Lake Odessa Habitat Rehabilitation and Enhancement Project (Lake Odessa HREP). The preliminary designs described here were utilized to estimate costs for the project economic analyses.

2) BACKGROUND

The Lake Odessa Habitat Rehabilitation and Enhancement Project (HREP) is located 15 miles south of Muscatine, Iowa, on the right descending bank of the Mississippi River between river miles (RM) 434.5 and 441.5. The project lies in Louisa County and encompasses the federally owned lands between the Iowa River on the south and Michael Creek on the north. All project lands are in Federal ownership and the management responsibility of the U.S. Fish and Wildlife Service (USFWS). The USFWS manages the upper portion of the project area as part of the Mark Twain National Wildlife Refuge, and the USFWS has granted management of the project's lower half to the Iowa Department of Natural Resources (IDNR) through a cooperative agreement. The Rock Island District, along with the USFWS and IDNR, propose constructing several new features at the refuge to enhance wildlife habitat quality.

The proposed features involving structures are the enhancement of six existing moist soil units (MSUs), a new fish nursery, and improved water control for the refuge. The MSUs are Unit 2 at the north end of the refuge, Field 4 and 5, Field 21, MSU 20, Fox Pond, and the IDNR unit at the south end of the refuge (see DPR plates 3 and 4). The proposed fish nursery would be located at the northwest corner of the refuge. The improvement to water control would be at the inlet structure on the north end of the perimeter levee.

The proposed structures are a dedicated bay on the existing inlet structure, a replacement pump station at Fox Pond, pump pads for the MSUs and Fox Pond, several corrugated metal pipe (CMP) structures located throughout the refuge, and a stoplog structure for the fish nursery.

3) DEDICATED WATER BAY

The preliminary design of the dedicated water bay is shown on DPR plate 33.

The dedicated water bay is an addition to the inlet structure at the north end of the refuge that would provide improved water control. It would divert part of the inflow from the inlet structure directly to Field 21, Field 4 & 5, MSU 20, and the Prairie Pocket area. Currently, the USFWS must operate controls at two points to divert flow to these fields. There is a stoplog structure, and a sluice gate at a CMP culvert, approximately 500 feet downstream of the inlet structure in the inlet channel. They must close the stoplog structure to raise the water in the forebay high enough to flow through the culvert. The culvert supplies water to the ditches which feed the areas mentioned above. However, closing the stoplog structure cuts off flow to Lake Odessa. If the USFWS needs to reestablish flow to Lake Odessa, they must open the stoplog structure, which would stop the flow to the supply ditches.

The proposed dedicated bay is a 40-foot-long sheet pile wall that dedicates the flow from the first bay of the inlet structure into a new ditch. The new ditch then ties directly into the supply ditches for the fields, MSU 20, and Prairie Pocket, bypassing the original stoplog structure and CMP culvert. With this dedicated bay, the USFWS can supply water to the fields without cutting off flow to Lake Odessa.

4) FOX POND PUMP STATION

The preliminary design for the Fox Pond Pump Station is shown on DPR plate 40.

Currently, the USFWS has a pump station to utilize the Fox Pond area as a MSU (see DPR plate 3). This pump station is old, prone to breakdowns, and is no longer reliable. The Rock Island District and the USFWS propose constructing a new pump station near the existing one, drawing water from the channel leading to Swarms Pond (see DPR plate 3).

The new Fox Pond pump station will be a concrete-lined sheet pile sump housing a vertical pump. The bottom of the sump will be 6 feet 2 inches below low water. The proposed pump would be belt-driven and powered by a trailer-mounted generator set. There would be an 8-inch-thick concrete pad immediately adjacent to the station for the generator set to sit while driving the pump. Water would be pumped through a steel pipe running through the berm separating Fox Pond and the channel leading to Swarms Pond. A flap gate would prevent backflow through the pipe.

5) PUMP PADS

The details of the pump pads are shown on DPR plate 39.

The demand for water by the Unit 2, Field 4 & 5, Field 21, and the IDNR MSU is significantly less than that for Fox Pond. Therefore, a smaller pump can be used. The Rock Island District and the USFWS propose using portable pumps with portable diesel engines (e.g., Crisafulli brand pumps) for filling these units. The pump pads are improved surfaces for the portable pumps to operate from at the selected MSUs.

The proposed design would use a 6-inch-thick concrete mat surface on the side of the berm. Some reshaping of the side of the slope and a small amount of fill would be required to provide a flat spot for the pump. If the dredging option for the Lake Odessa HREP proves to be feasible, the dredged material from that operation should be suitable for the reshaping work. In addition, since the

USFWS would need to make use of the roads during the time of filling, the pump pads would have a pipe embedded into the berm, to which the pumps can be hooked up to (instead of running a hose over the berm). Because most of the pipes for these pump pads would be in the splash zone, the pipes through the berm would be made of high-density polyethylene instead of steel.

A pad is also proposed for the Fox Pond area. There will be times when the USFWS will need to drain Fox Pond when Lake Odessa is higher than the pond. A pump pad is required to make use of one of the portable pumps from the other MSU's, and to allow the USFWS to pump *out* of Fox Pond. This pad would have all the same features as those for the other MSUs and would be located adjacent to the new Fox Pond pump station.

6) CMP CULVERT STRUCTURES

The corrugated metal pipe culvert structures are shown on DPR plates 35, 37, and 38.

There would be four corrugated metal culvert structures—two are drains and two are simple culverts. The two drains would be installed at the Fox Pond and IDNR MSUs. These are simple 36-inch CMP culvert pipes with slide gates.

The remaining two structures would be designed simply to allow water to pass under an embankment or berm. Water supply for Unit 2 would come from the head of Muscatine Slough (see DPR plate 3). This area is a marshy area immediately east of Unit 2. The water supply from the slough would have to pass under a roadway embankment through an existing 24-inch culvert under the roadway embankment. This existing culvert does not have the capacity for the Unit 2 pump to pump from the Muscatine Slough. A larger culvert in the embankment would be required. The Muscatine Slough CMP would be a simple 36-inch CMP. It would have a slide gate on the upstream end to prevent backflow.

The last CMP structure would be a simple culvert under an access road. The roadway leading to the inlet structure provides the main access for the perimeter levee around the refuge. USFWS must occasionally pass heavy construction equipment on this roadway but the inlet structure is not wide enough. There is a filled section with culverts, on the inlet canal, that allows heavy construction equipment to pass. This fill with the culverts is called the low water crossing. If the dedicated bay is constructed, the District must extend this low water crossing across the new ditch for the dedicated bay (see *Dedicated Bay* section above). The low water crossing extension CMP would be the culvert under the low water crossing extension. It is a 64-inch by 43-inch CMP pipe-arch.

All CMPs would be 0.064 inch thick and assumed to have a bituminous paved invert. The Rock Island District may want to consider using aluminized CMPs for additional service life.

7) FISH NURSERY STOPLOG STRUCTURE

The fish nursery stoplog structure is shown on DPR plate 34.

This structure would be a pre-cast 36-inch diameter reinforced concrete pipe (RCP) structure with a pre-cast 48-inch diameter manhole. The RCP would cut through the berm surrounding the proposed fish nursery at the north end of the project. The structure will allow for HS20 highway loading conditions, to allow farm equipment and trucks to pass. The manhole would have a concrete slab under it, while the entire RCP structure would have a 6 inch compacted granular base. Steel slots would be placed in the manhole to accommodate wooden stoplogs. Steel channels and grating will allow for secure access to the stoplogs.

8) CONCLUSIONS

The details shown on DPR plates 33 through 40 provide sufficient detail to produce a feasibility level construction cost estimate. When the project gets to the plans and specifications stage, more detailed survey information will be required. Data that was used to develop the cross sections shown in the plates was obtained from a digital terrain model assembled from a photogrammetric survey of the refuge. The photogrammetric survey doesn't deliver the level of detail required to develop plans and specifications. If the Lake Odessa HREP is approved for construction, a more detailed survey of the individual sites will be required.

9) CALCULATIONS

The calculations for the dedicated bay, the Fox Pond pump station, the CMPs, and HDPE pipes are included in this appendix.

10) REFERENCES

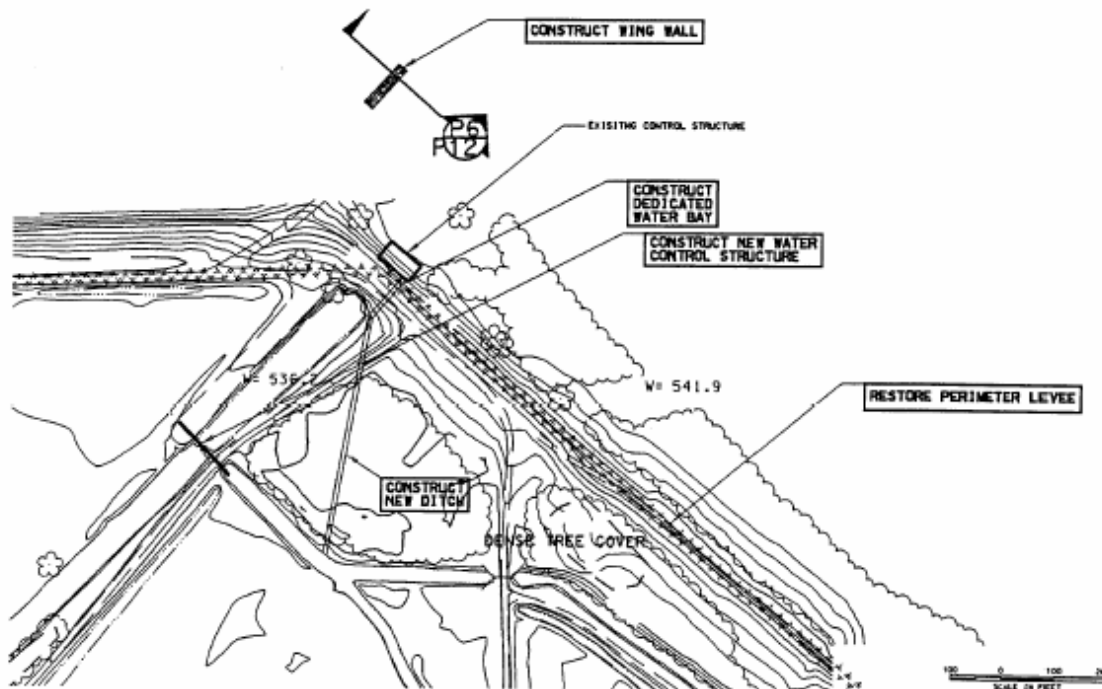
1. EM 1110-2-2902, Change 1. Conduits, Culverts, and Pipes. 31 March 1998.
2. American Institute of Steel Construction, Inc. 1989. *Manual of Steel Construction, Allowable Stress Design*. 9th Ed. Chicago: AISC.
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8. Bethlehem Steel Corporation. 1990. Product Brochure. *Bethlehem Steel Sheet Piling*. Bethlehem, PA.
9. Cox, T.A., U.S. Fish and Wildlife Service. Interview with Author. August 2001.
10. Dzuik, K. J., P.E.; J. Behrens; Barnes, A. G., P.E.; and T. Gambucci, P.E. Interviews with author. Rock Island, IL. August 2001 – February 2002.
11. Merrick & Co. Construction drawings. *Inlet and Outlet Structures. Mark Twain N.W.R. - Wapello District*. Denver. 1995.
12. M. J. Hardin Assoc., & Co. 1992. Photogrammetric survey data and digital terrain model of the Mark Twain National Wildlife Refuge. Kansas City, MO.
13. Odhe, W., Iowa Dept. of Natural Resources. Interview with Author. December 2001.
14. U.S. Army Engineer District, Rock Island. Civil drawings of Lake Odessa. Rock Island, IL. July 2000.
15. U.S. Army Engineer District, Rock Island. 1990. Construction Drawings Revised As Constructed. *Upper Mississippi River System, Environmental Management Program, Pool 22, River Mile 311, Bay Island, Missouri*. DACW25-91-R-0009. Rock Island, IL: CEMVR.
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Objective

To produce a cost estimate for a dedicated bay for the Lake Odessa Habitat Rehabilitation and Evaluation Project.

One of the proposed features of the Lake Odessa Habitat Rehabilitation and Evaluation Project (HREP) is a dedicated bay. This feature is a proposed improvement to the inlet structure at the north end of the site (see figure below). Its purpose is to dedicate the flow from the one bay of the inlet structure to the ditches that supply field 21, field 4 & 5, MSU 20, and Prairie Pocket (see plate 3).



Currently the USFWS must operate controls at two points *and* shut off flow to Lake Odessa to supply water to the ditches. They open the inlet structure bays and close the stoplogs approximately 500' downstream of the inlet structure. This raises the water elevation in the stoplog forebay high enough for it to flow through a culvert into the supply ditches. However, this shuts off flow to the lake. If they need a large supply of water to the fields, they must either allow Lake Odessa to go down or alternate the flow between the lake and the supply ditches.

USFWS and CEMVR propose dedicating the flow from the left bay of the inlet structure to the supply ditches. This will allow USFWS to supply water to the fields without shutting off the flow to Lake Odessa completely.

The purpose of this analysis is to estimate the quantity of work and materials required to construct a dedicated bay. All that is required is sufficient detail for CEMVR-ED-C to produce a reasonably accurate cost estimate. As this only a preliminary design, the designer does not need to produce details sufficient for plans and specifications. Rebar layouts, connection details, and a design for all possible load cases are not necessary.

References

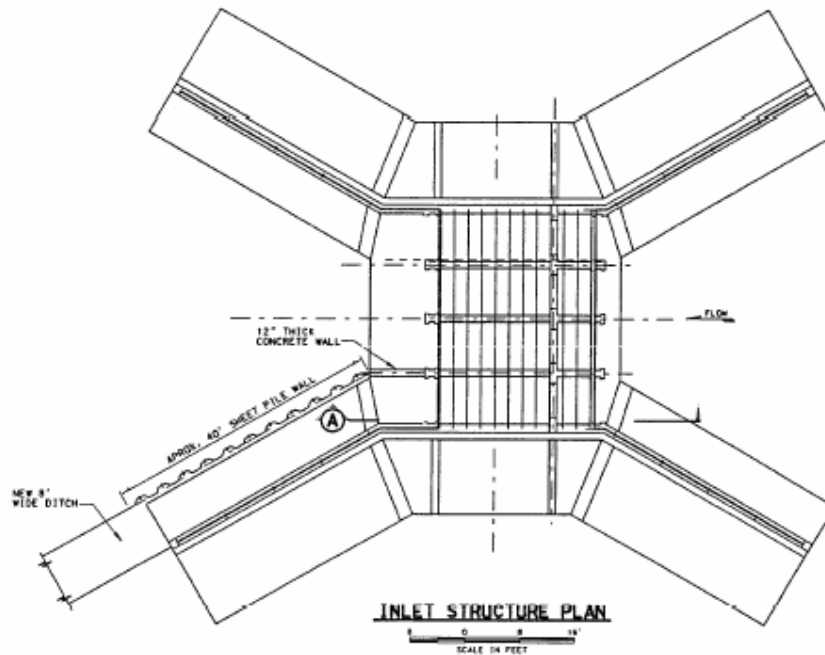
1. ARBED. Product Brochure. *Steel Sheet Piles*. Luxembourg. 1987.
2. Barnes, A. G., P.E.; and T. R. Gambucci, P.E. Interviews with author. Aug 01 - Feb 02.
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4. U.S. Army Engineer District, Rock Island. Civil drawings of Lake Odessa. Rock Island, IL. July 2000.
5. U.S. Army Engineer District, Rock Island District. Hydrograph of Pool 17 at Lock and Dam No. 17. Rock Island, IL. 2001.

Assumptions

1. Constants: $\text{psf} = \frac{\text{lbf}}{\text{ft}^2}$ $\text{cy} = (3\text{-ft})^3$ (unit definitions for MathCAD)
2. Neither a stability nor a structural design is necessary. The loads applied to this structure will be marginal. Simply picking a section based on inspection will be sufficient. Furthermore, this is a preliminary design for a feasibility study. Labor will drive the cost of the dedicated bay more than materials. A small change in size will not affect the feasibility analysis of the entire project.

Design

Preliminary layout



The dedicated bay will have three parts:

1. Concrete wall to extend the bay wall to the end of the base slab.
2. Sheet pile wall to extend the wall to the bank of the canal.
3. New ditch cut to connect the bay to the supply ditches.

Work required to construct:

1. Mobilization
2. Dewatering
3. Cast new concrete wall and drive new sheet pile wall
4. Clearing and grubbing new ditch
5. Cutting new ditch
6. Demobilization.

The author will ignore the cost for mob/demob. This feature will be only one part of a much larger project. The cost of mob/demob will be figured as part of the larger project.

1. Sheet pile wall:

length of wall needed

$$l := 40 \cdot \text{ft}$$

designer determined this length by scaling off of the as-built drawing from Merrick & Co.

Choose a BZ 7 section from ARBED. This choice is arbitrary (see assumption 1). Designer does not predict a high hydrostatic load on the wall. Even if the load is more substantial than predicted, the cost of the material will be negligible. The cost of driving in a 40ft long wall will be dominated by the labor.

$$\gamma := 19.0 \cdot \text{psf}$$

designer assumes that 1/3 of the wall will be above ground, the remaining 2/3 are required below ground. The author chose this requirement arbitrarily.

$$h_{\text{top}} := 539 \cdot \text{ft} \quad h_{\text{inv}} := 532.25 \cdot \text{ft}$$

Hydrograph shows typical elevation for the Mississippi River at this site is 535 - 536 ft 1912 MSL (Gambucci). Elevation of top of wall set to be above this level. Existing invert is at EL 532.25 (Merrick & Co.).

$$h_{\text{above}} := h_{\text{top}} - h_{\text{inv}}$$

$$h_{\text{above}} = 6.75 \cdot \text{ft}$$

$$h_{\text{below}} := 2 \cdot h_{\text{above}}$$

$$h_{\text{below}} = 13.5 \cdot \text{ft}$$

$$h := h_{\text{above}} + h_{\text{below}}$$

$$h = 20.25 \cdot \text{ft}$$

length of individual piles in the vertical dimension: $h = 20.25 \cdot \text{ft}$

length of wall in horizontal dimension: $l = 40 \cdot \text{ft}$

unit weight of material: $\gamma = 19 \cdot \text{psf}$

total weight of steel sheet piles to be installed: $W := \gamma \cdot h \cdot l$

$$W = 15390 \cdot \text{lbf}$$

2. Concrete wall:

volume of concrete required to construct wall:

$$V := h_{\text{above}} \cdot (8 \cdot \text{ft}) \cdot (1 \cdot \text{ft})$$

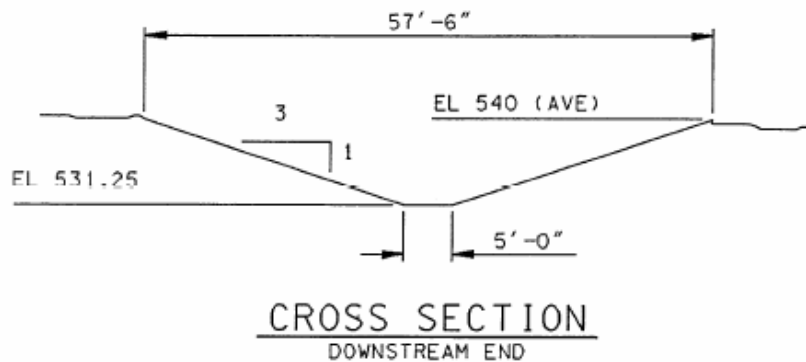
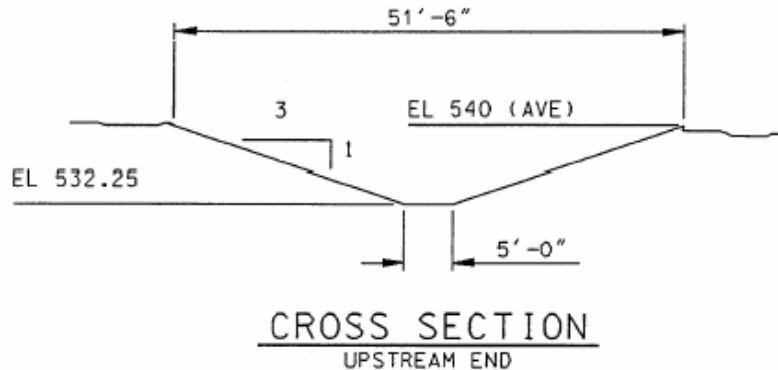
$$h_{\text{above}} = 6.75 \cdot \text{ft}$$

Wall is 8' long as shown on the as-built drawings. The wall height is simply the height above the existing canal invert (base slab) Designer assumes 12" thick will be sufficient.

$$V = 2 \cdot \text{cy}$$

3. Cut new ditch:

length of new ditch $l_{ng} := 500\text{-ft}$ (length scaled from Lake Odessa Civil Drawings)



Elevations of inverts from T. Gambucci, P.E. Side slopes from A. Barnes, P.E. Elevation of top of bank and length of ditch from Civil Drawings of Lake Odessa.

X-Sectional area at upstream end

X-Sectional area at downstream end

$$A_{up} := \frac{1}{2} \cdot (51.5\text{-ft} + 5\text{ft}) \times 7.75\text{-ft}$$

$$A_{dn} := \frac{1}{2} \cdot (57.5\text{-ft} + 5\text{ft}) \times 8.75\text{-ft}$$

$$A_{up} = 218.938\text{ft}^2$$

$$A_{dn} = 273.438\text{ft}^2$$

Volume of ditch cut by average-end-area method:

$$V_{ditch} := \frac{(A_{up} + A_{dn})}{2} \cdot l_{ng}$$

$$V_{ditch} = 4559\text{cy}$$

4. Clearing and Grubbing:

A contractor will have to clear and grub and swath through "dense tree cover" (see plate 3).

$$\text{Area} := (60\text{-ft}) \cdot \text{lng} \quad \text{Area} = 30000 \text{ ft}^2$$

Conclusions

The proposed dedicated bay will require:

$W = 15390 \text{ lbf}$ of BZ 7 section sheet pile wall, and

$V = 2 \text{ cy}$ of cast-in-place concrete.

$V_{\text{ditch}} = 4559 \text{ cy}$ earthwork to cut a new ditch.

$\text{Area} = 30000 \text{ ft}^2$ swath of clearing and grubbing dense tree cover.

This proposed wall will permanently divert flow from bay no. 1 to the upper MSMU. The effects of diminished direct flow to the lake should be considered in the environmental benefits analysis of the Lake Odessa HREP.

The proposed design for the dedicated bay feature is shown on Plate 21.

With the quantity of work required to construct the dedicated bay estimated, the objective has been met.

Objective

To produce estimated quantities for the Fox Pond pump station proposed for the Lake Odessa Habitat Rehabilitation and Enhancement Project.

References

1. EM 1110-2-2902. Conduits, Culverts, and Pipes. 1997.
2. American Institute of Steel Construction, Inc. 1989. Manual of Steel Construction, Allowable Stress Design. 9th Ed. Chicago: AISC
3. Bethlehem Steel Corporation. 1990. Product Brochure. Bethlehem Steel Sheet Piling. Bethlehem, PA.
4. Dziuk, K. Joseph, P.E., A.G. Barnes, P.E., J.T. Behrens, T.R. Gambucci, P.E. Interviews with author. Aug - Nov 2001.
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Assumptions

1. Constants.

Constants: kip = 1000·lbf cy = yd³ (unit definitions for MathCAD)

bf = (1·in)·(12·in)·(1·ft) (definition of a board-foot)

2. Design used here is based on the designs CEMVR used for the Bay Island EMP (DACW25-91-R-0009). Many of the structural design for those structures CEMVR already has on file. Therefore, structural design for many of the features are not required to meet the objective here. If CEMVR constructs the pump stations, then CEMVR will have to produce a set of design calculations.
3. Assume additional 50% to account for unknown topography below the water line.

Design

The Fox Pond pump station will have two structures. USFWS needs bi-directional pumping to manage Fox Pond properly (Dziuk). To accomplish this, CEMVR proposes installing two pump structures. Both structures will have sheet pile type inlets and standard outlets. The inlet for one will be on the Lake Odessa side and the other will be on the Fox Pond side. See plate 25.

The following items are required to construct the Fox Pond pump station:

1. Construct inlet.
2. Install the pumps, pipes, and trash racks.
3. Excavate approach to inlet structure.

Construct Inlet

sheet pile: assume PZ22 section (from *Princeton Wildlife Management Area* contract)

$$n := 29 \quad h := 17\text{-ft} + 4\text{-in} \quad wt := 40.3 \cdot \frac{\text{lbf}}{\text{ft}}$$

$$W_{\text{tsheets}} := n \times h \times wt$$

$$W_{\text{tsheets}} = 20257 \text{ lbf}$$

concrete base:

$$\text{slab} \quad V_1 := (1\text{-ft}) \times (9.17\text{-ft}) \times (14.5\text{-ft}) \quad V_1 = 132.965 \text{ ft}^3$$

$$\text{lip} \quad V_2 := (6.67\text{-ft}) \times (1\text{-ft}) \times (10\text{-in}) \quad V_2 = 5.558 \text{ ft}^3$$

concrete walls:

$$\text{side walls:} \quad V_3 := 2 \cdot [(1.58\text{-ft}) \times (14.5\text{-ft}) \times (10\text{-ft})] \quad V_3 = 458.2 \text{ ft}^3$$

$$\text{back wall:} \quad V_4 := (1.58\text{-ft}) \times (6\text{-ft} + 8\text{-in}) \times (10\text{-ft}) \quad V_4 = 105.333 \text{ ft}^3$$

$$\text{both fillets:} \quad V_5 := (10\text{-ft}) \times (20\text{-in})^2 \quad V_5 = 27.778 \text{ ft}^3$$

concrete top :

$$\text{slab} \quad V_6 := (11\text{-ft} + 4\text{-in}) \times (14\text{-ft} + 10\text{-in}) \times 8\text{-in} \quad V_6 = 112.074 \text{ ft}^3$$

$$\text{beam} \quad V_7 := (6\text{-ft} + 8\text{-in}) \times (1\text{-ft} + 8\text{-in}) \times (1\text{-ft}) \quad V_7 = 11.111 \text{ ft}^3$$

Total volume of concrete:

$$V_{\text{fp}} := \sum_{i=1}^7 V_i \quad V_{\text{fp}} = 853.02 \text{ ft}^3$$

$$V_{\text{fp}} = 32 \text{ cy}$$

Also assume a 6'-8" by 10'-10" trash rack constructed of twenty-eight 2" x 3/8" bars on 3" centers (A36 steel).

$$\gamma_{0.375} = 0.75 \cdot \frac{\text{lbf}}{\text{ft}}$$

$$W_t := 30 \cdot (10\text{-ft} + 10\text{-in}) \cdot \gamma_{0.375}$$

(includes top and bottom bars)

$$W_t = 243.75 \text{ lbf}$$

Excavate approach

The invert of the inlet structures are several feet below the bottom of Lake Odessa and Fox Pond. CEMVR will have to excavate an approach to the pump station. The volume of this excavation must be included in the cost estimate of construction. Assume a 20' x 6'-8" area sloping back at a 3:1 to existing ground in addition to the excavation for the sump. From the drawing, the excavation for the sump will be approximately 6' deep while the excavation for the approach will be 5' deep (see plate 25). Also, assume an additional 50% is required (see assumption 3).

$$\text{excavation for the sump: } V_1 := (6\text{-ft}) \times (14.5\text{-ft}) \times (9.17\text{-ft}) \quad V_1 = 797.79\text{ft}^3$$

$$\text{excavation for the approach: } V_2 := (5\text{-ft}) \times (20\text{-ft}) \times (9.17\text{-ft}) \quad V_2 = 917\text{ft}^3$$

$$\text{excavation for the side slopes: } V_3 := \frac{1}{2} \cdot (5\text{-ft}) \cdot (15\text{-ft}) \cdot (14.5\text{-ft} + 14.5\text{-ft} + 9.17\text{-ft})$$

$$(\text{V3 based on 3:1 sideslopes all around perimeter of the approach}) \quad V_3 = 1431.375\text{ft}^3$$

$$V_{\text{ex}} := 1.5 \cdot \left(\sum_{i=1}^3 V_i \right) \quad V_{\text{ex}} = 4719.247\text{ft}^3 \quad V_{\text{ex}} = 175\text{cy}$$

Trailer pad

$$\text{Sheet pile wall: } W := 11 \cdot \left(40.3 \cdot \frac{\text{lbft}}{\text{ft}} \right) \cdot (9\text{-ft}) \quad W = 3990\text{lbft}$$

$$\text{New fill: } V_{\text{fill}} := 1.5 \times (7.333\text{-ft}) \cdot (12.667\text{-ft}) \cdot (3\text{-ft}) \quad V_{\text{fill}} = 15\text{cy}$$

$$\text{New subbase for slab: } V_{\text{base}} := (1\text{-ft}) \cdot (7.333\text{-ft}) \cdot (12.667\text{-ft}) \quad V_{\text{base}} = 3.44\text{cy}$$

$$\text{New concrete slab: } V_{\text{conc}} := (7.333\text{-ft}) \cdot (12.667\text{-ft}) \cdot (8\text{-in}) \quad V_{\text{conc}} = 2.3\text{cy}$$

Objective

To produce preliminary designs for the pipe structures proposed for the Lake Odessa Habitat Rehabilitation and Enhancement Project.

CEMVR and the USFWS propose installing new pipe structures as part the Lake Odessa Habitat Enhancement and Rehabilitation Project (HREP). The structures are to provide water control to several proposed moist soil management units for the project. The purpose of this analysis is produce preliminary designs for these structures. These preliminary designs are for estimating the quantity of work and materials required to construct them. All that is required are sufficient details and quantities for CEMVR-ED-C to produce a reasonably accurate cost estimate.

There are two types of pipes proposed for the project. The first type of pipe structure are CMP culvert structures. Most of these structures will act as drains for new moist soil units proposed for the project. CEMVR and USFWS propose a total of six CMP structures (see plates 3 and 4). They are the Muscatine Slough structure, the Field 4 & 5 structure, Iowa DNR moist soil unit, the Unit 2 structure, the Fox Pond structure, and the Low Water Crossing Extension. They will be standard CMPs typically used in road construction.

The other type of pipe are high-density polyethylene (HDPE) pipes for five pump pads. The pump pads are simple paving-block surfaces built on the edges of the proposed moist soil units. The proposed operation plan is for the moist soil units is to bring in a portable pump (e.g. Crisafulli brand pump) and set it on the paving block surface when the USFWS is ready to fill the culverts. Normally, a portable pump would discharge through a rubber hose over the top of a berm. However, USFWS needs to allow small vehicles pickup trucks to pass over these berms during filling. Therefore, a pipe is necessary to pass the water through the berm instead of over it. The designer chose plastic pipe because in many proposed pump pads, the pipe will be in the splash zone.

References

1. EM 1110-2-2902, Change 1. Conduits, Culverts, and Pipes. 31 Mar 98.
2. American Society for Testing and Materials. 2001. *Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains*. ASTM A 760-00. Philadelphia, PA.: ASTM
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9. Odhe, W., Iowa Dept. of Natural Resources. Interview with Author. Dec 2001.

Assumptions

1. Constants and Material Properties:

Constants: $\text{kip} = 1000 \cdot \text{lbf}$ $\text{ksi} = \frac{\text{kip}}{\text{in}^2}$ $\text{pcf} = \frac{\text{lbf}}{\text{ft}^3}$ $\text{cy} = (3 \cdot \text{ft})^3$

$\text{plf} = \frac{\text{lbf}}{\text{ft}}$ $\text{ksf} = \frac{\text{kip}}{\text{ft}^2}$ $\text{klf} = \frac{\text{kip}}{\text{ft}}$ $\text{psf} = \frac{\text{lbf}}{\text{ft}^2}$ $\text{pci} = \frac{\text{lbf}}{\text{in}^3}$

CMP properties: Assume ASTM A 760 corrugated culvert pipe (fabricated from ASTM A 929 steel).

$E = 29000 \cdot \text{ksi}$ $f_y = 33 \cdot \text{ksi}$ $f_u = 45 \cdot \text{ksi}$

HDPE pipe properties: Assume ASTM 714 plastic (from EM 2902)

$E_i = 110000 \cdot \text{psi}$ $f_i = 3000 \cdot \text{psi}$ initial values of Young's
Modulus and tensile strength

$E_{50} = 22000 \cdot \text{psi}$ $f_{50} = 1440 \cdot \text{psi}$ 50-year values of Young's
Modulus and tensile strength

$\nu = 0.33$ Poisson's ratio for HDPE

Soil Properties: Assume a SW or SP type soil (Barnes).

$w = 120 \cdot \text{pcf}$ $k = 0.22$ (Barnes)

$E' = 1000 \cdot \text{psi}$ $M_s = 1000 \cdot \text{psi}$ backfill material, tab 6-4 of EM 2902

2. The design load will be an HS 20 vehicle. Most of the pipe structures will be placed in berms inside the project. The most common vehicle that travels on these berms are pickup trucks. However, USFWS will have the need to pass construction equipment through the project on occasion. Designing for the HS20 vehicle will allow for limited construction equipment. The axle load of an HS 20 vehicle is:

$$AL = 32 \cdot \text{kip}$$

The exceptions are the Mucatine Slough structure and the low water crossing structure. These structures are through access roads to the perimeter levee. USFWS will need to pass heavy construction equipment over this road for levee repairs. EM 2902 and ASTM A 796 recommend using 4' minimum cover for these kinds of loads.

3. The topographic data used here came from a digital terrain model (DTM) based on photogrammetric survey data. This will provide sufficient data to produce a reasonably accurate cost estimate. CEMVR has not surveyed all culvert structure sites completely so the accuracy of the DTM is limited. As this is only a preliminary design, complete accuracy required for a construction contract is not required. Also, the locations of the proposed pipe structures have changed throughout the history of this feasibility study. It is not cost effective to send CEMVR-ED-S to survey a site for a pipe that may not be installed at that particular location.

Analysis

CMP culverts

Designer chooses to use a pipe with $2 \frac{2}{3}$ " by $\frac{1}{2}$ " corrugations. Properties of 36" CMP with $2 \frac{2}{3}$ " by $\frac{1}{2}$ " corrugations:

$$S := 3 \cdot \text{ft} \quad s := 36 \cdot \text{in} \quad d := \frac{1}{2} \cdot \text{in} \quad E = 29000 \text{ ksi}$$

(variable names used here are consistent with variable names used by ASTM A 796)

Calculate minimum cover:

- By ASTM A 796, section 11, the formula is: $\sqrt{\frac{(AL) \cdot d}{E \cdot I}}$

$$\text{Where: } AL = 32 \text{ kip} \quad d = 0.5 \text{ in}$$

Axle load (assumption 3) depth of corrugation

$$I := \left(1.892 \times 10^{-3}\right) \cdot \frac{\text{in}^4}{\text{in}} \quad r := 0.1712 \cdot \text{in}$$

Choice of properties to start based on thinnest readily available thickness of CMP (0.064"). Note: minimum cover is inversely proportional to moment of inertia, I. Small I = large cover.

$$\sqrt{\frac{(AL) \cdot d}{E \cdot I}} = 0.54 \quad H_{\min} := \frac{S}{4} \quad S = 3 \text{ ft} \quad H_{\min} = 0.75 \text{ ft}$$

EM 2902 and ASTM A 796 recommend 4' minimum cover for culverts subjected to construction loads (see section 4-3.c.(1) of EM 2902 and section 11.4 of ASTM A 796). Most of the culverts will be in berms with access roads with pickup trucks being the typical loading. The exception is the triple-barrel culvert at Muscatine Slough. This culvert will be through a road that provides access to the main levee. This road must be able to carry heavy construction equipment.

Maintain 4' minimum cover for the Muscatine Slough culvert; 0.75' cover for all others (assumption 2).

Failure Modes:

1. wall crushing strength
2. ring buckling strength
3. longitudinal seam strength
4. handling stiffness

Ring buckling strength and wall crushing strength are determined by examining the thrust in the pipe wall. The formulas for thrust in the pipe wall are in ASTM A 796, section 8 for the ASD method.

[see plate 24 for details of all CMP stoplog structures]

Minimum Cover at Lake Odessa HREP

Loads

$H := 0.75 \cdot \text{ft}$ Set to minimum cover

$EL := H \cdot w \quad w = 120 \text{ pcf} \quad EL = 0.09 \text{ ksf}$

Earth load pressure = wt. of soil column above the pipe, Sect. 6.2.1 of ASTM A 796.

$LL := (0.25 \cdot \text{ft}) \cdot \left[\frac{(1800 - 800) \cdot \text{psf}}{(2 - 1) \cdot \text{ft}} \right] + 1800 \cdot \text{psf}$

Linear extension of the live load table in sect. 6.2.2.1 of ASTM A 796. Includes impact load effects, sect. 6.2.3.

$LL = 2050 \text{ psf}$

$P := EL + LL \quad P = 2140 \text{ psf}$

Total pressure in the pipe, sect. 8.1.1.1, ASTM A 796.

$$T := \frac{P \cdot S}{2} \quad S = 3 \text{ ft} \quad \text{Thrust in the pipe wall}$$

$$T = 3.21 \text{ klf}$$

Size Pipe

required area - wall crushing perspective (sect. 8.1.1.2, ASTM A 796)

$$A := \frac{T \cdot 2}{f_y} \quad T = 3.21 \text{ klf} \quad A = 0.195 \frac{\text{in}^2}{\text{ft}}$$

$$f_y = 33 \text{ ksi}$$

Selected CMP area $A_{\text{pipe}} := 0.775 \frac{\text{in}^2}{\text{ft}}$ Using a 0.064" thick CMP.
 It's thinnest pipe recommended

required area - wall buckling perspective (section 8.1.2, ASTM A 796)

$$\frac{r}{k} \sqrt{\frac{24 \cdot E}{f_u}} = 96.779 \text{ in} \quad k = 0.22 \quad f_u = 45 \text{ ksi}$$

$$r = 0.1712 \text{ in} \quad s = 36 \text{ in}$$

$$\text{because } s < \frac{r}{k} \sqrt{\frac{24 \cdot E}{f_u}} : \quad f_c := f_u - \frac{f_u^2}{48 \cdot E} \left(\frac{k \cdot s}{r} \right)^2$$

$$f_c = 41.887 \text{ ksi} \quad f_c > f_y \quad 0.064" \text{ thick CMP O.K.}$$

required size - seam strength perspective (sect. 8.1.3.3, ASTM A 796).

$$T = 3.21 \text{ klf} \quad SS := 3 \cdot T \quad SS = 9.63 \text{ klf}$$

Seam strength of selected pipe (table 3 of ASTM A 796): $SS_{\text{pipe}} := 16.7 \cdot \text{klf}$ for single line of $5/16"$ rivets

required handling stiffness (sect. 10.1, ASTM A 796)

$$FF := \frac{s^2}{E \cdot I} \quad s^2 = 1296 \text{ in}^2 \quad FF = 0.024 \frac{\text{in}}{\text{lbf}}$$

$$E \cdot I = 54.868 \text{ kip} \cdot \text{in}$$

for CMP installed in a trench cut and a 1/2" depth corrugation, FF shall not exceed:

$$FF_{\max} := 0.060 \cdot \frac{\text{in}}{\text{lbf}} \quad FF < FF_{\max} \quad \text{O.K.}$$

use a 36" diameter, 0.064" thick corrugated metal pipe at the fish nursery. See plates B and C for details of the stoplog slots themselves.

Maximum Cover at Lake Odessa HREP

The Muscatine Slough structure will require 4' of minimum cover (assumption 2). With the invert at 532.67' and a 36" culvert, there would be only 2.16' cover above the top of the pipe. EM 2902 recommends 4' minimum cover for embankments that allow construction equipment to pass. Extra fill is required.

Loads

H := 4-ft Set to the minimum cover for a pipe with construction loads.

$$EL := H \cdot w \quad w = 120 \text{ pcf} \quad EL = 0.48 \text{ ksf}$$

$$LL := 0.4 \text{ ksf} \quad \text{Live load of H20 hwy loading, sect. 6.2.2.1 of ASTM A 796. Includes impact load effects, sect. 6.2.3.}$$

$$P := EL + LL \quad P = 0.88 \text{ ksf} \quad \text{Total pressure in the pipe, sect. 8.1.1.1 ASTM A 796.}$$

$$T := \frac{P \cdot S}{2} \quad S := 3.0 \text{ ft} \quad T = 1.32 \text{ klf} \quad \text{Thrust in the pipe wall.}$$

Size Pipe

required area - wall crushing perspective (sect. 8.1.1.2 ASTM A 796).

$$A := \frac{T \cdot 2}{f_y} \quad T = 1.32 \text{ klf} \quad f_y = 33 \text{ ksi} \quad A = 0.08 \frac{\text{in}^2}{\text{ft}}$$

$$\text{Selected CMP area: } A_{\text{pipe}} := 0.775 \cdot \frac{\text{in}^2}{\text{ft}} \quad \text{Using a 0.064" thick CMP. It's the thinnest pipe recommended.}$$

required size - wall buckling perspective (sect. 8.1.2 ASTM A 796)

$$\frac{r}{k} \cdot \sqrt{\frac{24 \cdot E}{f_u}} = 96.779 \text{ in} \quad k = 0.22 \quad f_u = 45 \text{ ksi}$$

$$r = 0.1712 \text{ in} \quad s := 42 \cdot \text{in}$$

$$\text{because } s < \frac{r}{k} \cdot \sqrt{\frac{24 \cdot E}{f_u}} : f_c := f_u - \frac{f_u^2}{48 \cdot E} \cdot \left(\frac{k \cdot s}{r} \right)^2$$

$$f_c = 40.762 \text{ ksi} \quad f_c > f_y \quad 0.064" \text{ thick CMP is OK}$$

required size - seam strength perspective (sect. 8.1.3.3 ASTM A 796).

$$T = 1.32 \text{ klf} \quad SS := 3 \cdot T \quad SS = 3.96 \text{ klf}$$

Seam strength of selected pipe (table 3 of ASTM A 796): $SS_{\text{pipe}} := 16.7 \cdot \text{klf}$ for single-line of 5/16" rivets

required handling stiffness (sect. 10.1 ASTM A 796).

$$FF := \frac{s^2}{E \cdot I} \quad s^2 = 1764 \text{ in}^2 \quad FF = 0.032 \frac{\text{in}}{\text{lbf}}$$

$$E \cdot I = 54.868 \text{ kip} \cdot \text{in}$$

for CMP installed in a trench cut and a depth of corrugation of 1/2", FF shall not exceed:

$$FF_{\text{max}} := 0.060 \cdot \frac{\text{in}}{\text{lbf}} \quad FF < FF_{\text{max}} \quad \text{OK}$$

use a 36", 0.064 in thick, corrugated pipe.

Calculate the quantity of fill over the the new pipe. The design assumes 1.84' of fill over the 3' width of pipe, then sloping down to existing grade at 5% slope. Volume over the center of the road is:

$$v := (1.84 \cdot \text{ft}) \cdot (3 \cdot \text{ft}) \cdot (16 \cdot \text{ft}) \quad v = 88.32 \text{ ft}^3$$

simply assume both side slopes have 1.5 times this amount .

$$V_{\text{total}} := 3.5 \cdot v \quad V_{\text{total}} = 309.12 \text{ ft}^3 \quad V_{\text{total}} = 11.449 \text{ cy} \quad \text{use 12 cy.}$$

Remaining CMP pipes

The remaining CMP sites will all have between 0.75' and 4' of cover. It is reasonable to assume that a CMP with the same properties as the ones for the Fish Nursery and the Muscatine Slough will suffice. It should be noted; however, that not all the remaining pipes are identical. The Field 4&5 pipe is only 24" in diameter instead of a 36" and the Low Water Crossing structure is a 64" x 43" pipe-arch. All that is required here is enough design for a reasonably accurate cost estimate so no further design is necessary. If CEMVR approves the Lake Odessa HREP for construction, these design computations should be completed to ensure these assumptions are valid.

HDPE Pipes

A 16" diameter pipe will be required to adequately convey the water from the pumps to the moist soil unit (Behrens). EM 2902 recommends high-density polyethylene pipe (HDPE) for this kind of application (see tab 6-1, p6-2).

Possible failure modes:

pipe stiffness
 pipe deflection
 ring buckling strength
 hydrostatic wall buckling
 wall crushing strength
 wall strain cracking.

EM 2902 recommends a minimum 3' of cover over the top of any plastic pipe (see paragraphs 6-3 h and i). The mechanical design and basic geometry of the berms limits cover to 1'-10". Since the maximum load expected is only pickup trucks, these pipes will be sized for 1'-10" of cover. However, the designer will use the HS20 load as the design load to allow for the occasional construction vehicle.

$D_o := 16 \text{ in}$ outside diameter of HDPE pipe

Required size - pipe stiffness: required criteria from eq 6-1 and 6-2, EM 2902.

$$FF = \frac{D^2}{E_i \cdot I} \cdot 1000 \leq C_{FF} \quad PS = \frac{E_i \cdot I}{0.149 \cdot R^3} \geq \frac{C_{PS}}{D}$$

where... $C_{FF} := 95 \cdot \frac{\text{in}}{\text{lbf}} \quad C_{PS} := 565 \cdot \frac{\text{lbf}}{\text{in}}$

$E_i = 110 \text{ ksi} \quad D := D_o \quad D = 16 \text{ in} \quad R := \frac{D}{2} \quad R = 8 \text{ in}$

I = moment of inertia of wall per inch length of pipe. Minimum I will be greater of...

$I := 1000 \cdot \frac{D^2}{E_i \cdot C_{FF}} \quad I = 0.024 \text{ in}^3 \quad \text{Flexibility factor}$

$I := \frac{0.149 \cdot R^3}{E_i} \cdot \frac{C_{PS}}{D} \quad I = 0.024 \text{ in}^3 \quad \text{Pipe stiffness}$

$I = \frac{t^3}{12} \quad t := \sqrt[3]{12 \cdot I} \quad t = 0.665 \text{ in} \quad PS := \frac{C_{PS}}{D} \quad PS = 35.313 \text{ psi}$

required size - pipe deflection

Paragraph 6-5.b.(2) recommends specifying a pipe with a minimum PS value of the lesser of 46 psi or twice the value calculated in eq. 6-2 for SP soils. The boring logs show SP is a predominant soil at the pump pad sites (Barnes). Here, PS = 35.312 psi so the designer will specify a minimum PS of 46 psi.

$$PS := 46 \cdot \text{psi} \quad I := \frac{PS \cdot (0.149) \cdot R^3}{E_i} \quad I = 0.032 \frac{\text{in}^4}{\text{in}} \quad t := \sqrt[3]{12 \cdot I} \quad t = 0.726 \text{ in}$$

$$\text{Use } t := \frac{3}{4} \cdot \text{in} \quad I := \frac{t^3}{12} \quad I = 0.035 \frac{\text{in}^4}{\text{in}}$$

required size - wall crushing:

P_{ST} = loading due to short-term loads (i.e. HS 20). Use Boussinesq equation (eq 2-3 in EM 2902) assuming direct vertical pressure from wheel to pipe.

$$P := 16 \cdot \text{kip} \quad \text{wheel load of HS 20} \quad z := 1 \cdot \text{ft} + 10 \cdot \text{in} \quad \text{depth to crown of pipe}$$

$$R' := z \quad \text{radial dist. to pressure surface} \quad W_c := \frac{3 \cdot P \cdot z^3}{2 \cdot \pi \cdot R^5} \quad W_c = 2273 \text{ psf}$$

use $P_{ST} := W_c$

$$T_{ST} := \frac{D \cdot P_{ST}}{2} \quad T_{ST} = 1.515 \text{ klf} \quad D = 16 \text{ in}$$

$$P_{LT} := z \cdot w \quad P_{LT} = 220 \text{ psf} \quad z = 22 \text{ in} \quad \text{depth to pipe crown}$$

$w = 120 \text{ pcf}$ unit weight of soil (assumption 1)

$$T_{LT} := \frac{D \cdot P_{LT}}{2} \quad T_{LT} = 146.667 \text{ plf} \quad T_{ST} = 1.515 \text{ klf}$$

$$f_{50} = 1440 \text{ psi} \quad f_i = 3000 \text{ psi}$$

$$A := 2 \cdot \left(\frac{T_{ST}}{f_i} + \frac{T_{LT}}{f_{50}} \right) \quad A = 1.214 \frac{\text{in}^2}{\text{ft}} \quad A := \frac{(12 \cdot \text{in}) \cdot t}{1 \cdot \text{ft}} \quad A = 9 \frac{\text{in}^2}{\text{ft}}$$

wall thickness of $\frac{3}{4}$ " is acceptable

required size - ring buckling strength:

$$f_{cr} = 0.77 \cdot \frac{R}{A} \cdot \sqrt{\frac{B \cdot M_s \cdot E_{50} \cdot I}{0.149 \cdot R^3}} \quad B = 1 - 0.33 \cdot \frac{h_w}{h} \quad \text{assume } h_w := 0 \quad B := 1$$

$M_s = 1000 \text{ psi}$ assumed value of soil modulus.

$$E_{50} = 22000 \text{ psi} \quad I = 0.035 \frac{\text{in}^4}{\text{in}} \quad R = 8 \text{ in} \quad A = 9 \frac{\text{in}^2}{\text{ft}}$$

$$f_{cr} := 0.77 \cdot \frac{R}{A} \cdot \sqrt{\frac{B \cdot M_s \cdot E_{50} \cdot I}{0.149 \cdot R^3}} \quad f_{cr} = 826.997 \text{ psi}$$

$$\text{service load stress} \quad f := \frac{T_{LT} + T_{ST}}{A} \quad f = 184.659 \text{ psi} \quad f \leq f_{cr} \quad \text{o.k.}$$

required size - hydrostatic buckling strength

predicted deflection from eq 6-3 of EM 2902

$$\frac{\Delta Y}{D} = \left(\frac{D_L \cdot K \cdot P}{0.149 \cdot PS + 0.061 \cdot E'} \right) \cdot 100 \quad D_L := 1.5 \quad K := 0.11 \quad PS = 46 \text{ psi} \quad D = 16 \text{ in}$$

$$P := P_{ST} + P_{LT} \quad P = 2492.89 \text{ psf} \quad E' = 1000 \text{ psi}$$

$$\Delta Y := D \cdot \left(\frac{D_L \cdot K \cdot P}{0.149 \cdot PS + 0.061 \cdot E'} \right) \quad \Delta Y = 0.674 \text{ in} \quad \frac{\Delta Y}{D} = 0.042 \quad \frac{\Delta Y}{D} \leq 5\% \quad \text{o.k.}$$

critical stress formula

$$P_{cr} = C \cdot \left[\frac{K \cdot E_{50} \cdot I}{(1 - \nu^2) \cdot R^3} \right] \quad C := 0.69 \text{ ovality factor for 4.2\% strain.} \quad I = 0.035 \frac{\text{in}^4}{\text{in}}$$

$$K := 216 \quad R = 8 \text{ in}$$

$$\nu = 0.33 \quad E_{50} = 22000 \text{ psi} \quad (\text{see assumption 1})$$

$$P_{cr} := C \cdot \left[\frac{K \cdot E_{50} \cdot I}{(1 - \nu^2) \cdot R^3} \right] \quad P_{cr} = 252.657 \text{ psi}$$

$$f := \frac{T_{LT} + T_{ST}}{A} \quad T_{LT} = 146.667 \text{ plf} \quad A = 9 \frac{\text{in}^2}{\text{ft}} \quad f = 184.659 \text{ psi}$$

$$T_{ST} = 1515 \text{ plf} \quad f \leq P_{cr} \quad \text{o.k.}$$

required size - wall strain cracking:

$$\epsilon_b := \frac{t}{D} \cdot \left(\frac{0.03 \cdot \frac{\Delta Y}{D}}{1 - 0.02 \cdot \frac{\Delta Y}{D}} \right) \quad \epsilon_b = 0.0000592 \quad \text{less than 2.5\% O.k.}$$

use a 16" O.D. pipe with 1'-10" of cover and a minimum SDR of 21 (thickness 0.762").

Conclusions

The calculations above show the proposed pipes structures have sufficient capacity to withstand the loads likely to be applied to them. Plates 23 and 24 provide enough detail for CEMVR-ED-C to produce a reasonably accurate cost estimate.

The accuracy of the cross sections shown in plates 23 and 24 is limited. The sections are based off of a DTM CEMVR produced from a photogrammetric overflight. The cameras used in photogrammetry cannot record topography below a water surface. Many of the details of these structures will depend on the ground surface under the water. CEMVR will need to produce more detailed cross sections for these structures if the project is approved for construction.

The limited survey data is particularly important to the Unit 2 pump pad and CMP. CEMVR did not have any topographic data for their proposed location.

With a preliminary design of the proposed pipe structures complete, the objective has been met.

APPENDIX L

REAL ESTATE PLAN

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT (R-14PR)
PUBLIC REVIEW DRAFT**

LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA**

**APPENDIX L
REAL ESTATE PLAN**

**UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT
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LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

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LOUISA COUNTY, IOWA**

**APPENDIX L
REAL ESTATE PLAN**

Contents

I.	PURPOSE	L-1
II.	DESCRIPTION OF LANDS, EASEMENTS, AND RIGHT-OF-WAY	
	(LER) REQUIRED FOR CONSTRUCTION, OPERATION AND	
	MAINTENANCE OF THE PROJECT.....	L-1
III.	LANDS REQUIRED OWNED BY SPONSOR	L-1
IV.	NON-STANDARD ESTATE DISCUSSION	L-2
V.	FEDERAL PROJECT WITHIN THE LER REQUIRED FOR	
	THE PROJECT	L-2
VI.	FEDERALLY OWNED LAND REQUIRED FOR PROJECT	L-2
VII.	NAVIGATIONAL SERVITUDE	L-2
VIII.	MAP DEPICTING THE AREA.....	L-2
IX.	POSSIBILITY OF INDUCED FLOODING DUE TO PROJECT	L-2
X.	BASELINE COST ESTIMATE.....	L-3
XI.	RELOCATION ASSISTANCE BENEFITS.....	L-3
XII.	MINERAL ACTIVITY/TIMBER HARVESTING IN PROJECT AREA	L-3
XIII.	SPONSOR’S LEGAL AND PROFESSIONAL CAPABILITY TO	
	REQUIRE LER	L-3
XIV.	ZONING ORDINANCES PROPOSED	L-3
XV.	SCHEDULE OF LAND ACQUISITION MILESTONES	L-3
XVI.	FACILITY OR UTILITY RELOCATIONS	L-3
XVII.	IMPACTS OF SUSPECTED OR KNOWN CONTAMINANTS	L-3
XVIII.	LANDOWNER’S SUPPORT OR OPPOSITION TO THE PROJECT	L-3
XIX.	RISKS OF ACQUIRING LANDS BEFORE EXECUTION OF THE PCA	L-3
XX.	OTHER REAL ESTATE ISSUES RELEVANT TO THE PROJECT	L-4
XXI.	PROJECT MAP	L-1
EXHIBIT B	ASSESSMENT OF NON-FEDERAL SPONSOR’S REAL ESTATE CAPABILITY	L-B-1

REAL ESTATE PLAN
LAKE ODESSA
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOLS 17 AND 18, MISSISSIPPI RIVER MILES 434.5 THROUGH 441.5
LOUISA COUNTY, IOWA

I. Purpose

The Lake Odessa Habitat Rehabilitation and Enhancement Project is a part of the Upper Mississippi River System – Environmental Management Program authorized by Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended. The project is located on the Mississippi River in Pools 17 and 18 between River Miles (RM) 434.5 and 441.5.

The project will be constructed at 100% Federal cost; therefore a formal project cooperation agreement is not required. Since the United States Fish and Wildlife Service (USFWS) manages the project lands, the USFWS will enter into a Memorandum of Agreement (MOA) with the United States to establish relationships, arrangements, and general procedures for the construction, operation, and maintenance of the project.

II. Description of Lands, Easements, and Right-of-Way (LER) Required for Construction, Operation and Maintenance of the Project

Since all of the project features will be constructed on lands that are currently owned by the United States, no additional real estate interests are required for the construction, operation, or maintenance of the project.

The project study area consists of Lake Odessa and surrounding features along the Mississippi River located near Lock and Dam 17 in Mississippi River Pools 17 and 18. The lands are located between RM 434.5 and 441.5. The site is located on Government-owned lands in Sections 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29, 33, 34, 35, and 36 of Township 74N, Range 2W of the 5th PM, and in Sections 1, 2, 3, and 11 of Township 73N, Range 2W of the 5th PM.

A project map is included as Exhibit A, attached hereto.

III. Lands Required Owned By Sponsor

The Federal Government owns all the lands required for the project; however, the Department of the Interior, USFWS, currently manages the project lands under a cooperative agreement between the USFWS and the U.S. Army Corps of Engineers.

IV. Non-Standard Estate Discussion

The project does not require the use of any non-standard estates.

V. Federal Project within the LER Required for the Project

The Lake Odessa Habitat Rehabilitation and Enhancement Project does not affect lands that were acquired for a Federal cooperation project. Government-owned lands are within the project boundary and are discussed in detail in paragraph VI.

VI. Federally Owned Land Required for Project

The Lake Odessa Project will be constructed on lands that were acquired for the Mississippi River 9-Foot Channel Project. The Government owns fee simple title to approximately 6,800 acres within the project boundary. The Government-owned tracts are identified as Tract Nos. A-1, Fla-1A, Fla-1B, Fla-1C, Fla-2, Fla-3, Fla-4, Fla-5, Fla-6, Fla-7, Fla-8, Fla-8A, Fla-8B, Fla-9, Fla-9A, Fla-9B, Fla-9C, Fla-98, Fla-99, Fla-18, Fla-101, Fla-102, Fla-103, Fla-104, Fla-105, Fla-106, Fla-107, Fla-108, Fla-108A, Fla-108B, Fla-109, Fla-110, Fla-111, Fla-112, Fla-113, Fla-114, Fla-115, Fla-116, Fla-117, Fla-118, Fla-119, Fla-120, Fla-121, Fla-122, Fla-123, Fla-124, Fla-125, Fla-126, Fla-127, Fla-128, Fla-129, Fla-130, Fla-131, Fla-132, Fla-133, Fla-134, Fla-135, Fla-136, Fla-137, Fla-138, Fla-139, Fla-140, Fla-141, Fla-142, Fla-143, Fla-144, Fla-145, Fla-146, Fla-147, Fla-148, Fla-149, Fla-150, Fla-151, Fla-152, Fla-153, Fla-154, Fla-155, Fla-156, Fla-157, Fla-158, Fla-159, Fla-160, Fla-161, Fla-162, Fla-163, Fla-164, Fla-165, Fla-166, Fla-167, Fla-168, Fla-169, Fla-170, Fla-171, Fla-172, Fla-173, Fla-174, Fla-175, Fla-176, Fla-177, Fla-178, Fla-179, and Fla-180.

These lands are colored in green on the Exhibit A – Project Map.

VII. Navigational Servitude

Borrow material needed for the project would be dredged from within Navigational Servitude waters. Since all of the material will be taken from areas that lie below the ordinary high water mark, Navigational Servitude applies as detailed in ER 405-1-12, paragraph 12-7.

VIII. Map Depicting the Area

A map is attached as Exhibit A – Project Map. Lands currently owned by the United States in the project area are colored in green.

IX. Possibility of Induced Flooding Due to Project

It is not anticipated that the project will cause induced flooding.

X. Baseline Cost Estimate

Since all of the lands required for the project are on Government-owned lands, a cost estimate is not required.

XI. Relocation Assistance Benefits

There are no anticipated Relocation Assistance costs due to the project.

XII. Mineral Activity/Timber Harvesting in Project Area

No mineral activity is known to exist in the project area. There is no known timber harvesting in the project area that may affect the project.

XIII. Sponsor's Legal and Professional Capability to Acquire LER

As has been done on past Environmental Management Program projects, the USFWS will enter into a Memorandum of Agreement (MOA) with the United States upon project approval and authorized funding. The USFWS is highly capable of performing the requirements of the MOA and has successfully performed similar requirements on past projects.

XIV. Zoning Ordinances Proposed

No known zoning ordinances are proposed.

XV. Schedule of Land Acquisition Milestones

There are no Acquisition Milestones applicable to this project.

XVI. Facility or Utility Relocations

There are currently no planned facility or utility relocations.

XVII. Impacts of Suspected or Known Contaminants

There are no known hazardous, toxic, radioactive waste or other regulated contaminants in connection with the project features.

XVIII. Landowner's Support or Opposition to the Project

The Federal Government owns all lands required for the project.

XIX. Risks of Acquiring Lands before Execution of the PCA

There are no lands for the sponsor to acquire.

XX. Other Real Estate Issues Relevant to the Project

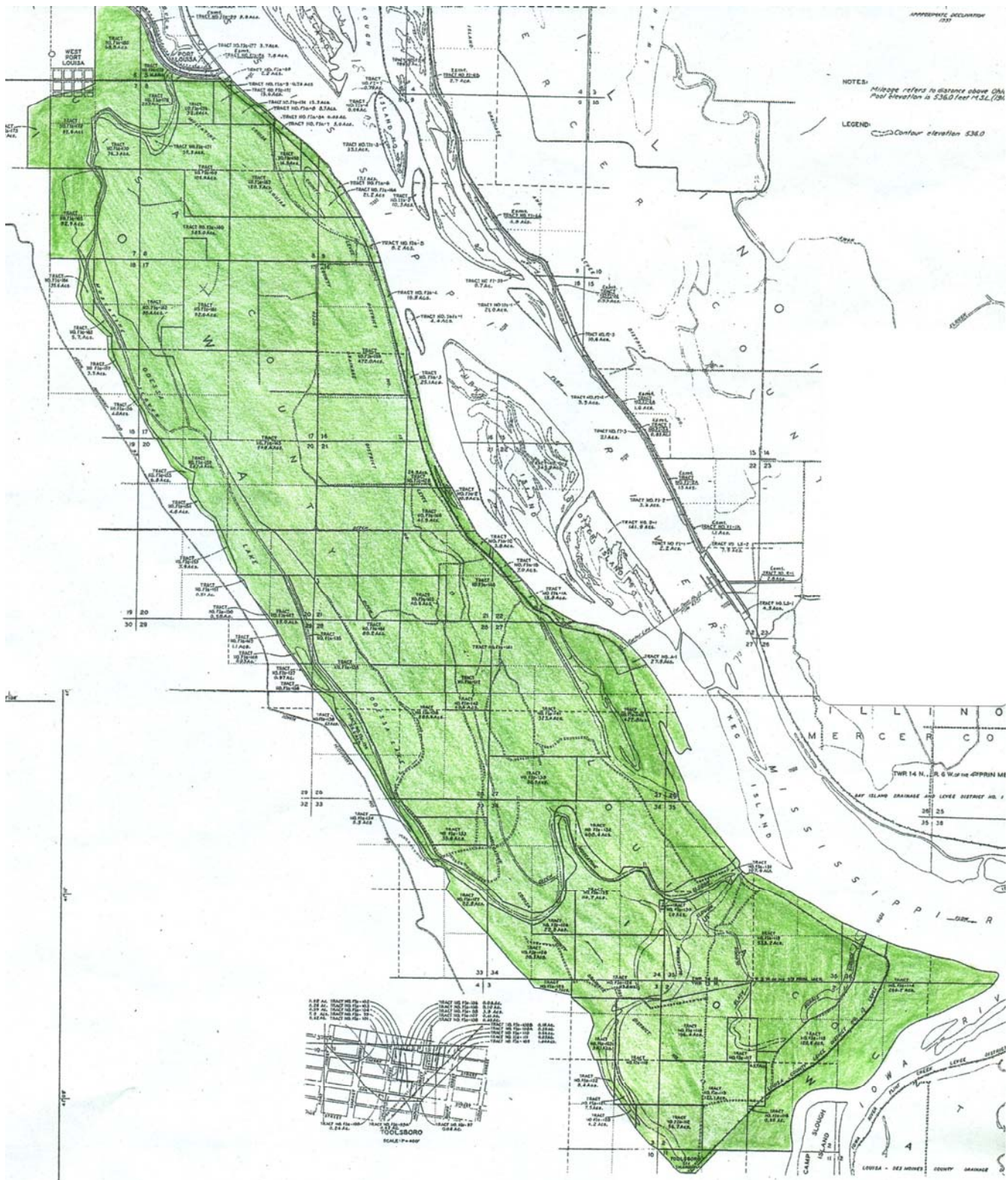
There are currently no other Real Estate issues relevant to the project.

/s/

Rod Hallstrom
Realty Specialist

Date: 29 Jan 03

Figure 1 - PROJECT MAP



**EXHIBIT A
PROJECT MAP**

EXHIBIT B

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE CAPABILITY

Appendix 12E, ER 405-1-12)

EMP LAKE ODESSA HABITAT REHABILITATION AND ENHANCEMENT PROJECT

1. Legal Authority

- a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? Yes.**
- b. Does the sponsor have the power of eminent domain for this project? Yes, however, this is not required.**
- c. Does sponsor have “quick take” authority for this project? Yes, however, this is not required.**
- d. Are any of the land/interests in land required for the project located outside the sponsor’s political boundary? No**
- e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? Yes, Government Owned Land, however, all project features are located on this land.**

2. Human Resource Requirements

- a. Will the sponsor’s in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? No.**
- b. If the answer to II.a is “yes”, has a reasonable plan been developed to provide such training?**
- c. Does the sponsor’s in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? Yes**
- d. Is the sponsor’s projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? Yes**
- e. Can the sponsor obtain contractor support, if required in a timely fashion? Yes**

- f. Will the sponsor likely request USACE assistance in acquiring real estate? (If “yes”, provide description). No.

3. Other Project Variables

- a. Will the sponsor’s staff be located within reasonable proximity to the project site? Yes
- b. Has the sponsor approved the project/real estate schedule/milestones? Yes

4. Overall Assessment

- a. Has the sponsor performed satisfactory on other USACE projects? Yes
- b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. (If sponsor is believed to be “insufficiently capable”, provide explanation. Highly capable

5. Coordination

- a. Has this assessment been coordinated with the sponsor? Yes
- b. Does the sponsor concur with this assessment? (If “no”, provide explanation). Yes

/s/

ROD HALLSTROM
Realty Specialist

DATE: 29 Jan 03

APPENDIX M

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III - Administration Approval Documents
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1

1/

- I -Draft Coordination Documents
- II - Public Review Documents
- III - Administration Approval Documents
- IV - Construction Plans and Specifications
- V - Operations and Maintenance Instructions
- VI - Project Performance Evaluation Documents

LAKE ODESSA EMP HREP	90H	1 AUG 04	I	II	III	IV	V	VI	1/
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RICK BEST
GENERAL MANAGER
WQPT
6600 34TH AVE
MOLINE IL 61265

1

JIM GRAHAM
GENERAL MANAGER
KWQC TV
805 BRADY ST
DAVENPORT IA 52803

1

MILTON GRANT
GENERAL MANAGER
KLJB CHANNEL 18 TV
937 E 53RD ST STE D
DAVENPORT IA 52807-2614

1

FRED BAYNE
205 N 4TH ST
WAPELLO IA 52653

1

DONALD BOWERS
9829 F AVE
WAPELLO IA 52653

1

MICHAEL NOEL
905 CHERRY CIRCLE
MT PLEASANT IA 52641

1

1/

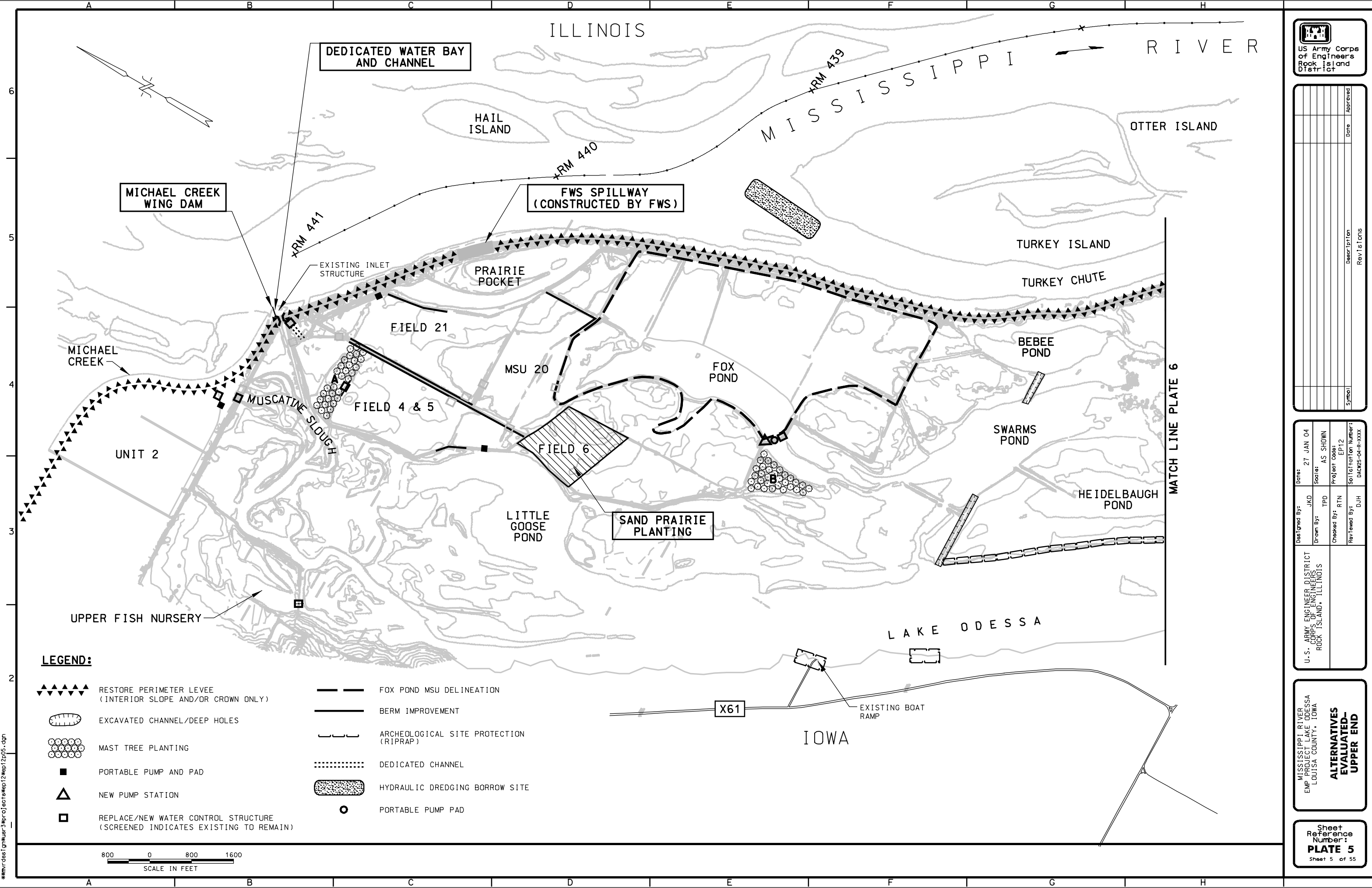
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- II - Public Review Documents
- III - Administration Approval Documents
- IV - Construction Plans and Specifications
- V - Operations and Maintenance Instructions
- VI - Project Performance Evaluation Documents

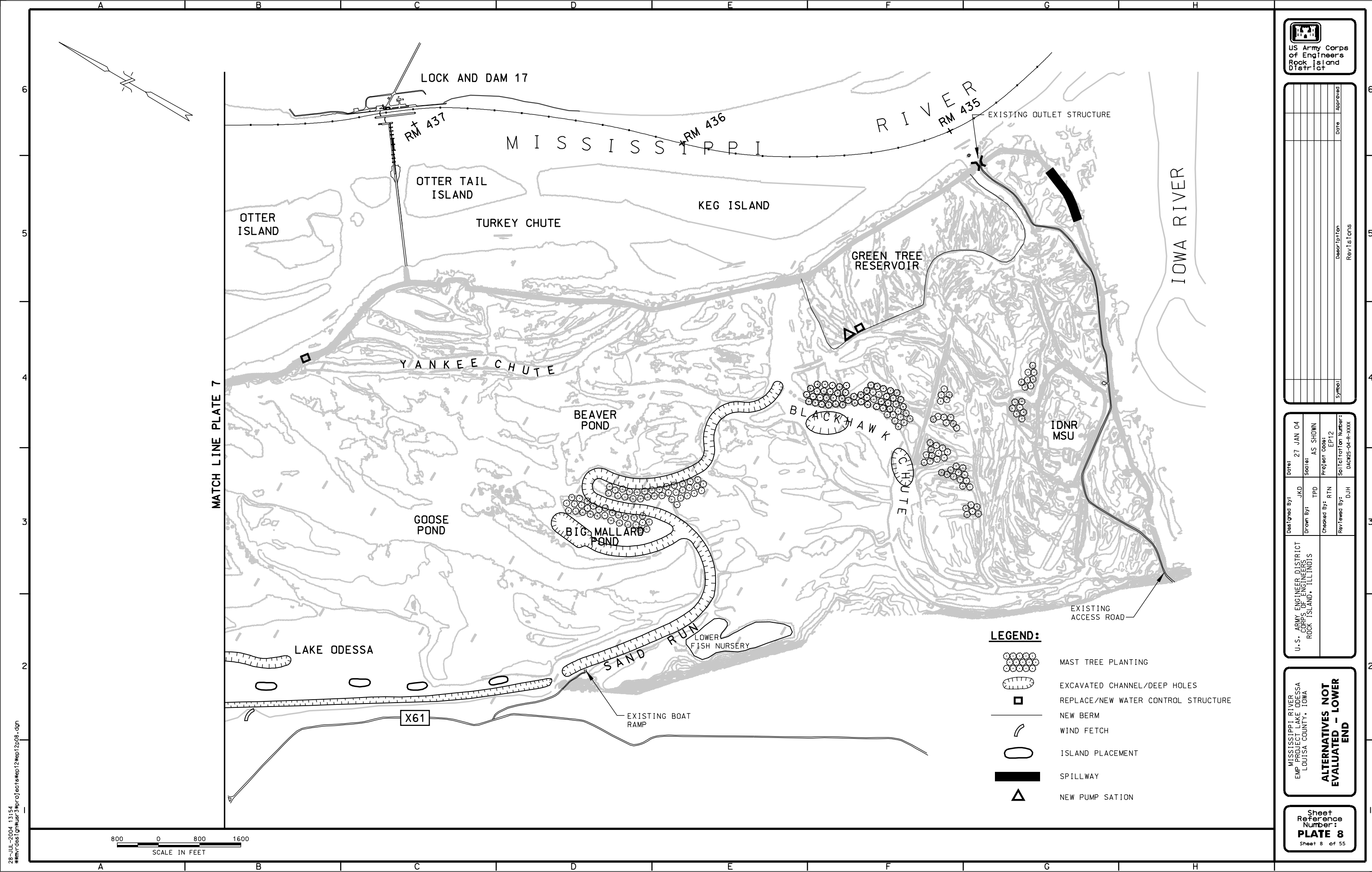
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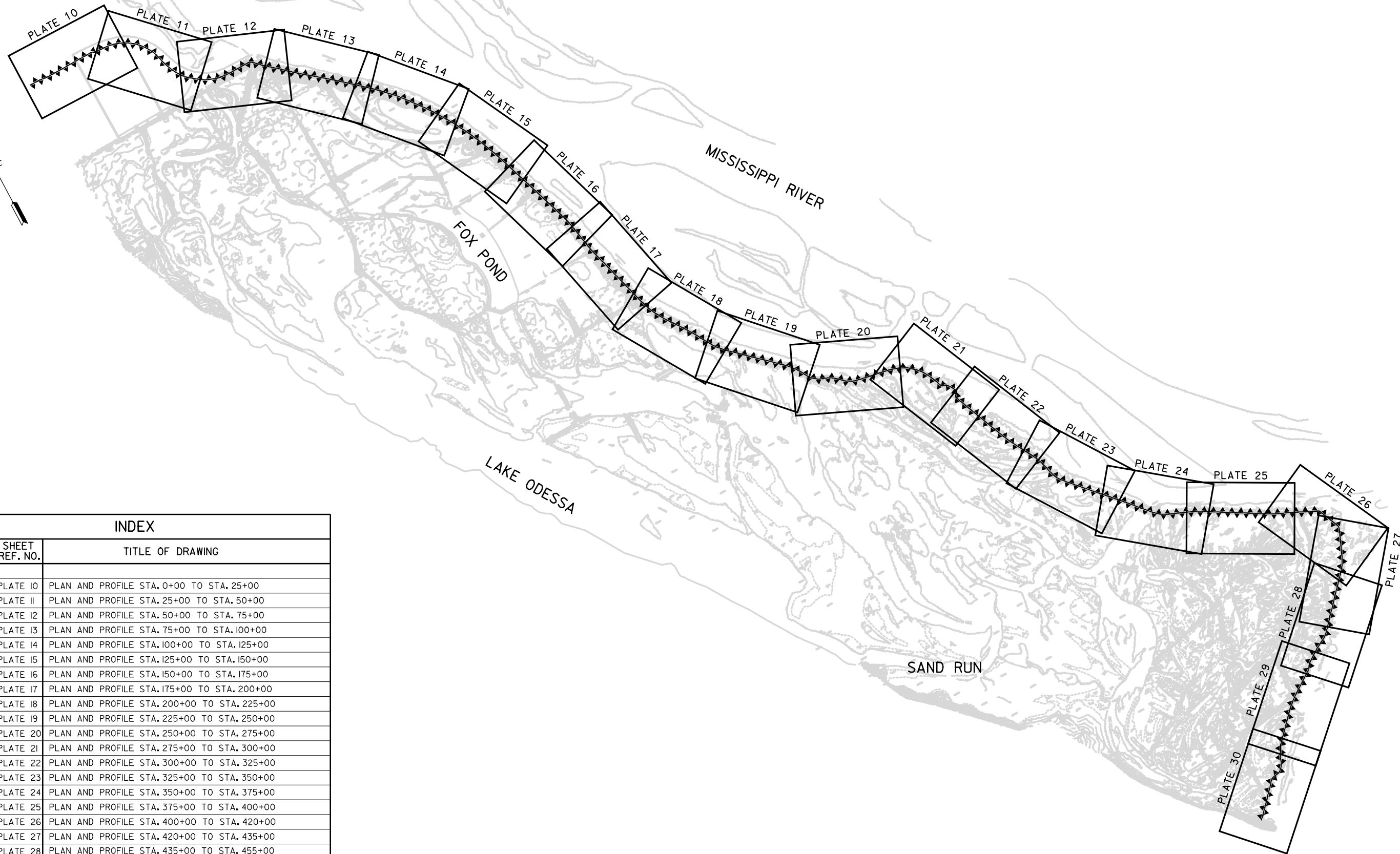
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I - Draft Coordination Documents
II - Public Review Documents
III - Administration Approval Documents
IV - Construction Plans and Specifications
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VI - Project Performance Evaluation Documents







INDEX		
SHEET NO.	SHEET REF. NO.	TITLE OF DRAWING
10	PLATE 10	PLAN AND PROFILE STA. 0+00 TO STA. 25+00
11	PLATE 11	PLAN AND PROFILE STA. 25+00 TO STA. 50+00
12	PLATE 12	PLAN AND PROFILE STA. 50+00 TO STA. 75+00
13	PLATE 13	PLAN AND PROFILE STA. 75+00 TO STA. 100+00
14	PLATE 14	PLAN AND PROFILE STA. 100+00 TO STA. 125+00
15	PLATE 15	PLAN AND PROFILE STA. 125+00 TO STA. 150+00
16	PLATE 16	PLAN AND PROFILE STA. 150+00 TO STA. 175+00
17	PLATE 17	PLAN AND PROFILE STA. 175+00 TO STA. 200+00
18	PLATE 18	PLAN AND PROFILE STA. 200+00 TO STA. 225+00
19	PLATE 19	PLAN AND PROFILE STA. 225+00 TO STA. 250+00
20	PLATE 20	PLAN AND PROFILE STA. 250+00 TO STA. 275+00
21	PLATE 21	PLAN AND PROFILE STA. 275+00 TO STA. 300+00
22	PLATE 22	PLAN AND PROFILE STA. 300+00 TO STA. 325+00
23	PLATE 23	PLAN AND PROFILE STA. 325+00 TO STA. 350+00
24	PLATE 24	PLAN AND PROFILE STA. 350+00 TO STA. 375+00
25	PLATE 25	PLAN AND PROFILE STA. 375+00 TO STA. 400+00
26	PLATE 26	PLAN AND PROFILE STA. 400+00 TO STA. 420+00
27	PLATE 27	PLAN AND PROFILE STA. 420+00 TO STA. 435+00
28	PLATE 28	PLAN AND PROFILE STA. 435+00 TO STA. 455+00
29	PLATE 29	PLAN AND PROFILE STA. 455+00 TO STA. 480+00
30	PLATE 30	PLAN AND PROFILE STA. 480+00 TO STA. 503+96



US Army Corps
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Rock Island
District

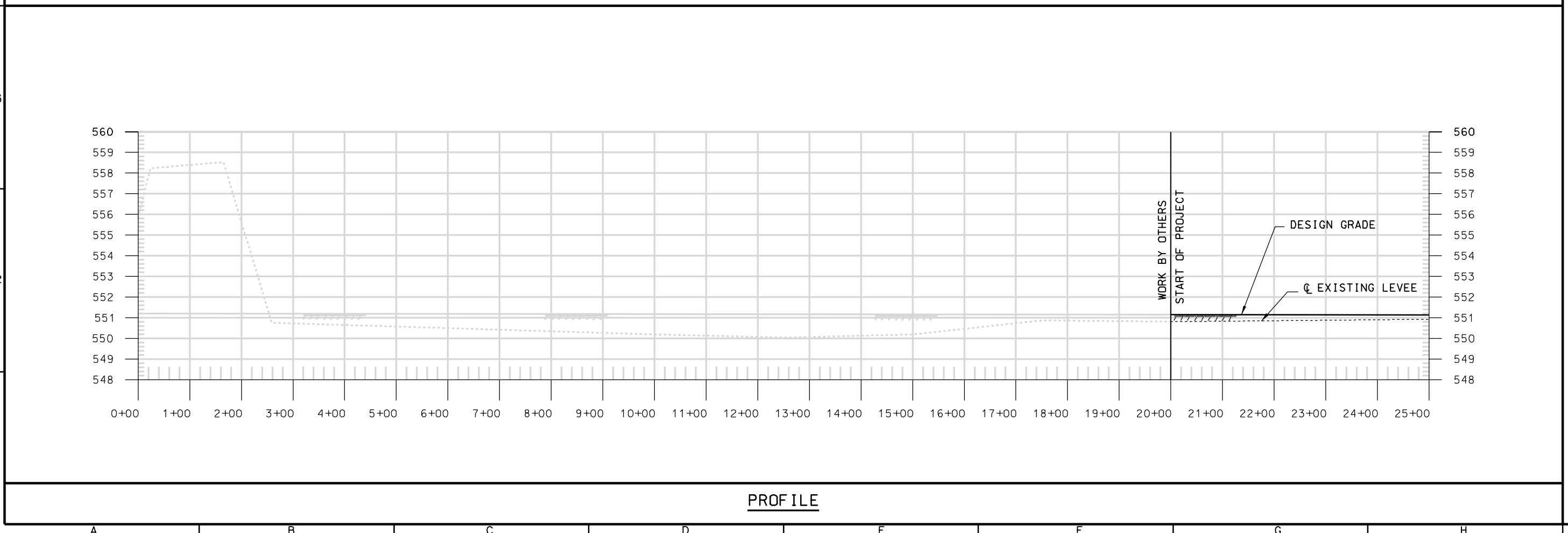
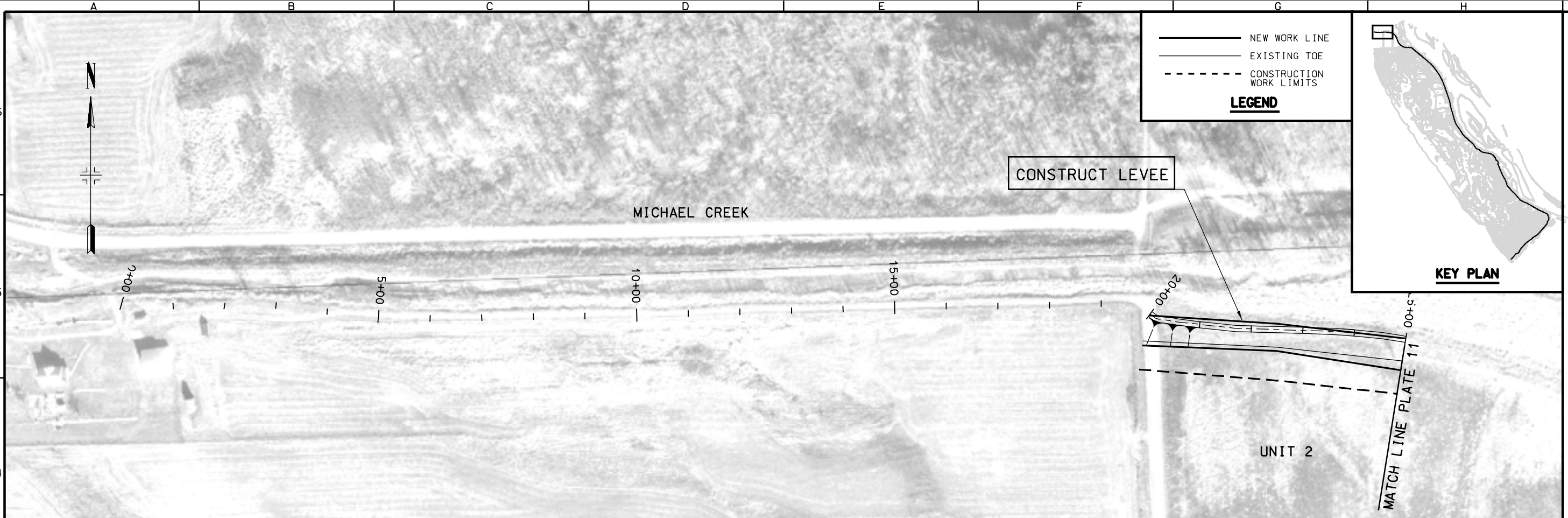
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	TPD	AS SHOWN
	Checked By: RTN	Project Code: EP12
	Reviewed By: DWH	Solicitation Number: DPCHE-04-R-0004

MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

PERIMETER LEVEE PLAN

Sheet
Reference
Number:
PLATE 9
Sheet 9 of 55

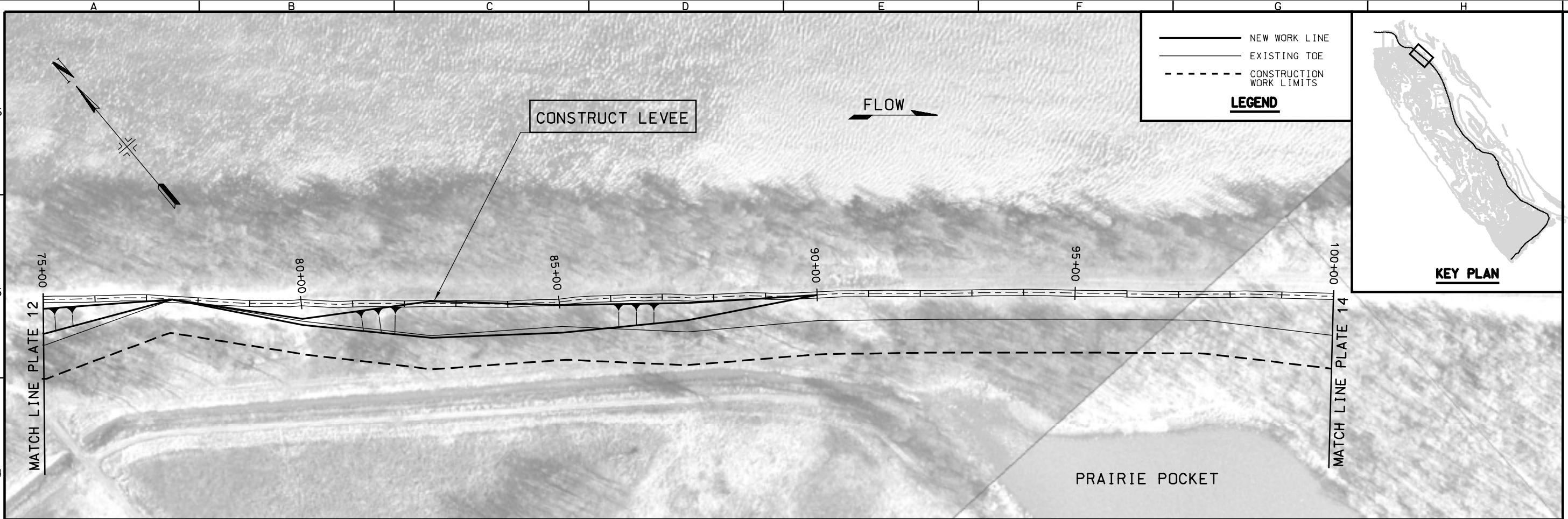
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Checked By: RTN	Project Code: EP12	
Reviewed By: DJH	Solicitation Number: DAG25-04-R-XXXX	

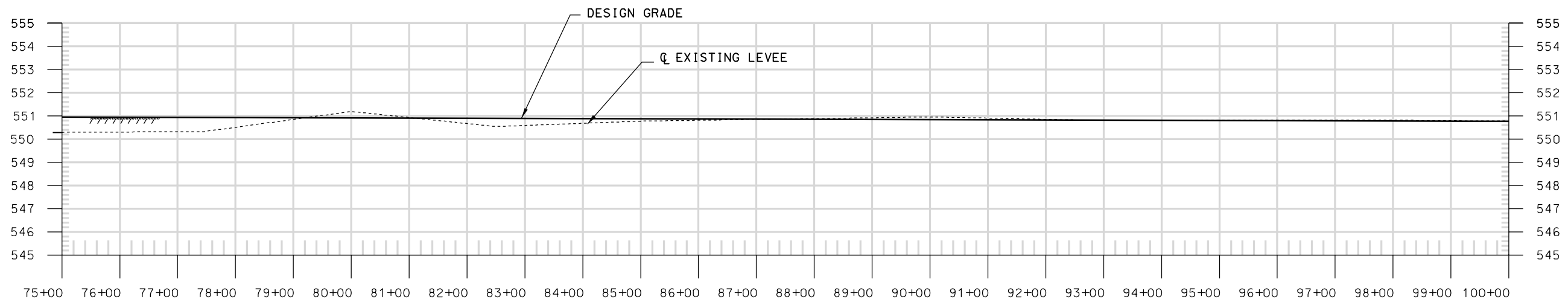
EMP. PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

PLAN AND PROFILE
STA. 0+00 TO
STA. 25+00

Sheet
Reference
Number:
PLATE 10
Sheet 10 of 55



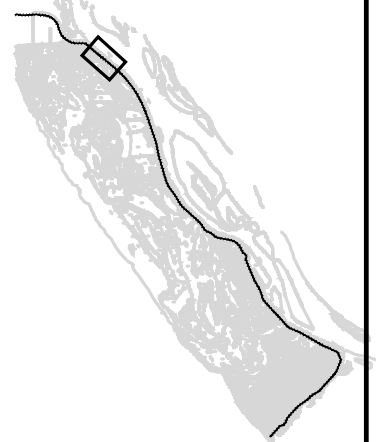
PLAN VIEW



PROFILE



US Army Corps
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Rock Island
District



KEY PLAN

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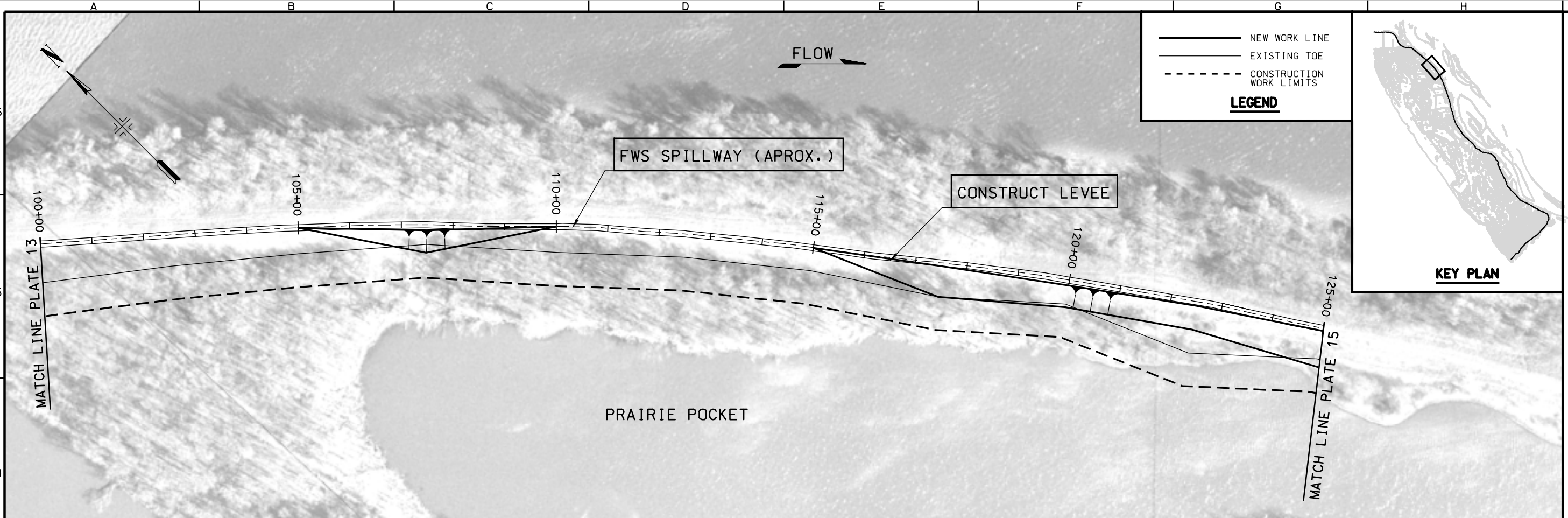
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MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

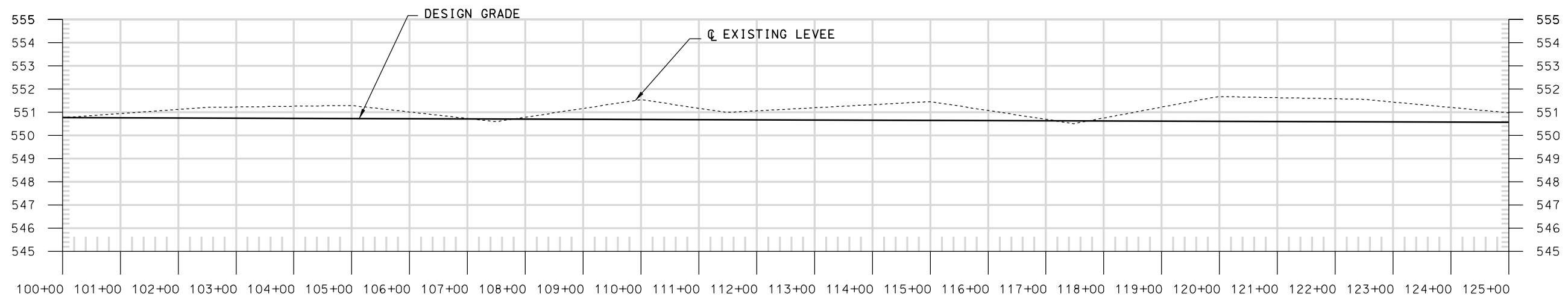
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STA. 75+00 TO
STA. 100+00

Sheet
Reference
Number:
PLATE 13
Sheet 13 of 55

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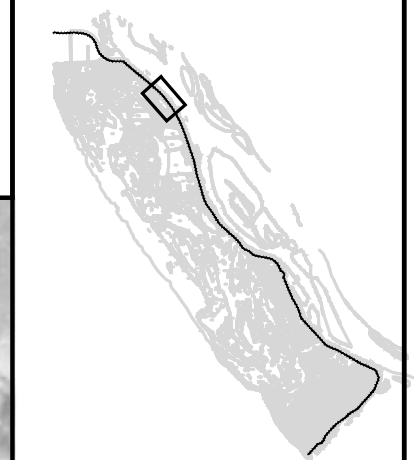
PLAN VIEW



PROFILE



US Army Corps
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Rock Island
District



KEY PLAN

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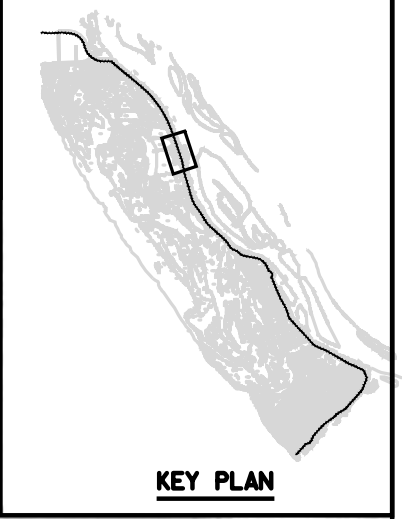
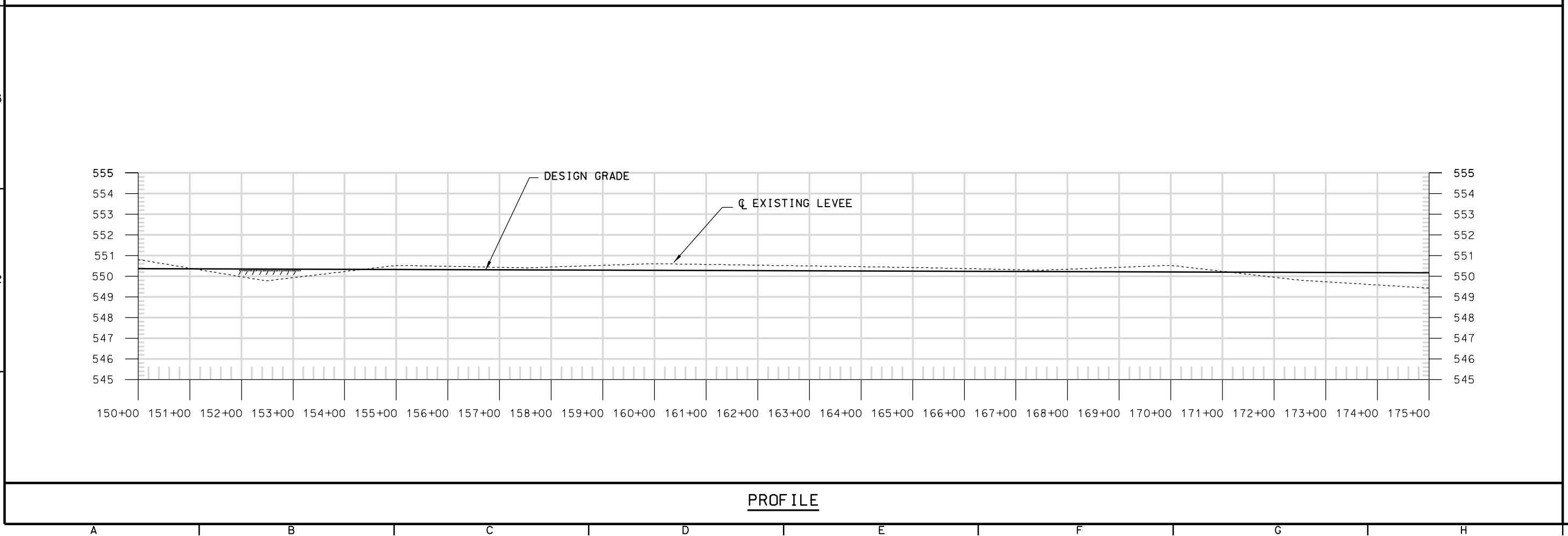
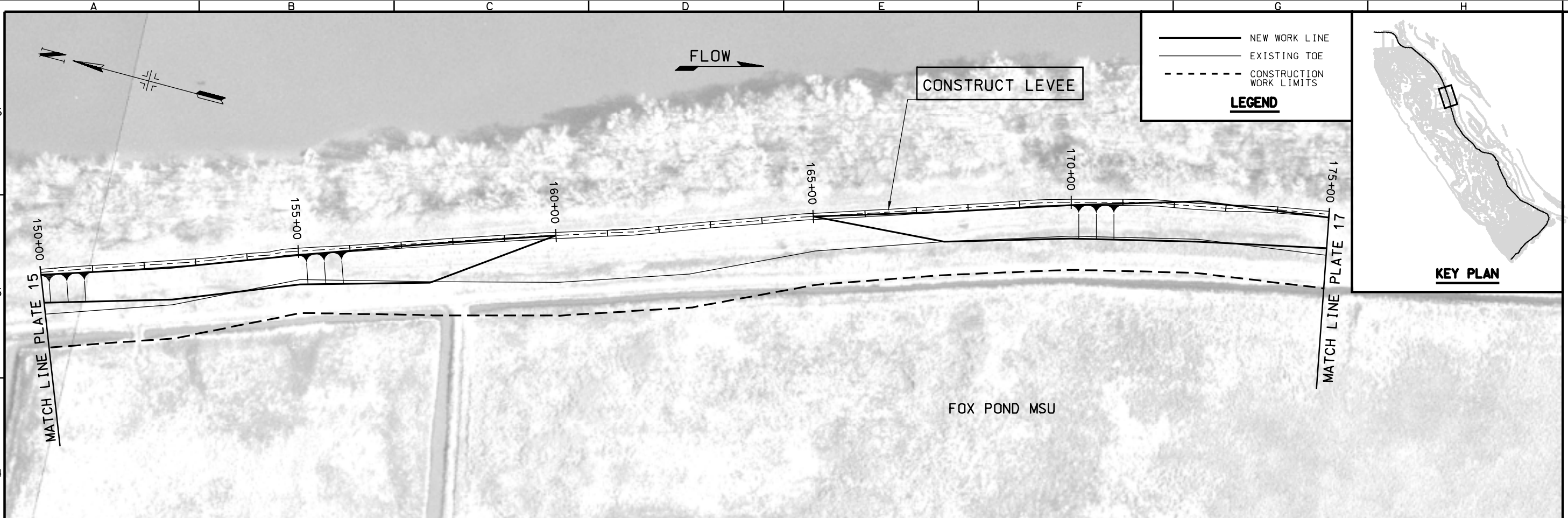
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	Reviewed By: DJH	Solicitation Number: DACW25-04-R-XXXX

PLAN AND PROFILE
STA. 100+00 TO
STA. 125+00

Sheet
Reference
Number:
PLATE 14
Sheet 14 of 55

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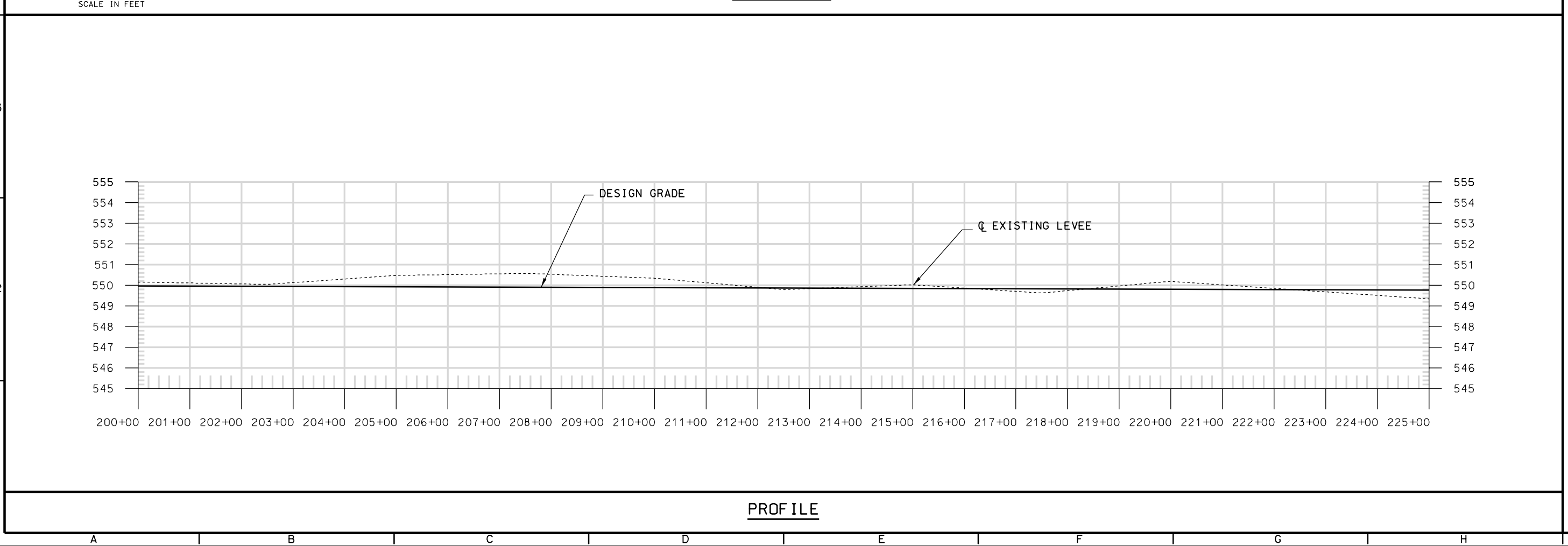
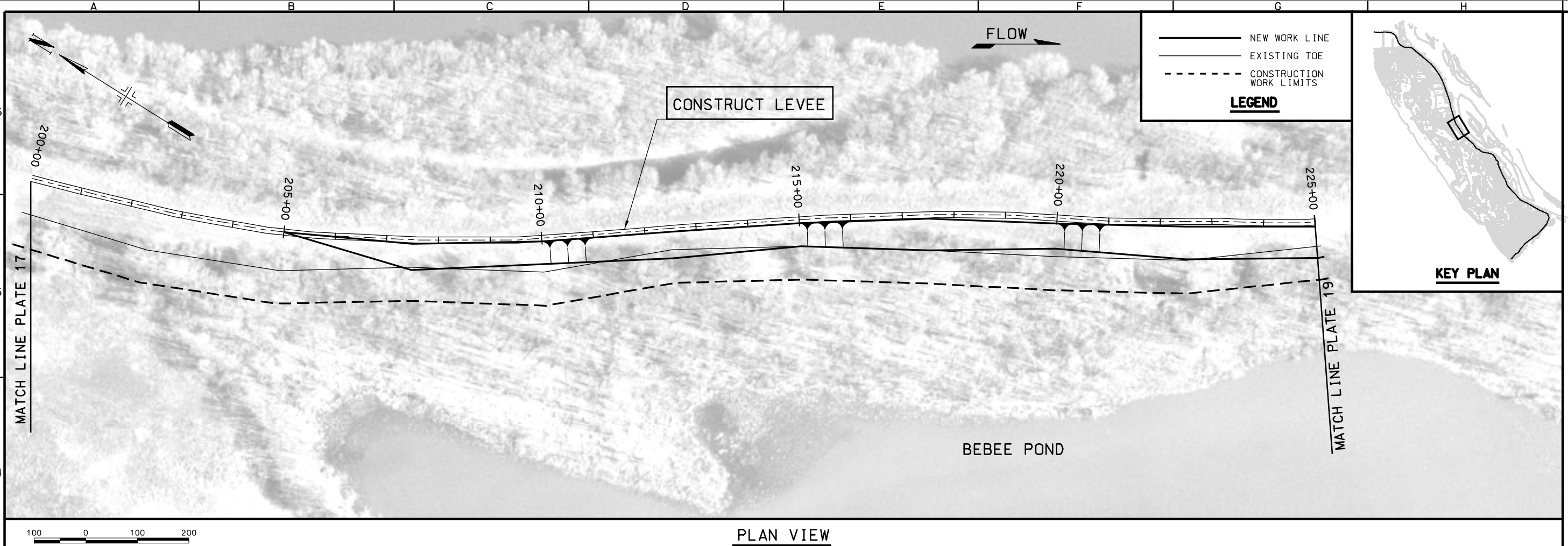
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	Reviewed By:	DJH	Solicitation Number:	DACR25-04-R-XXXX

MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

**PLAN AND PROFILE
STA. 150+00 TO
STA. 175+00**

Sheet
Reference
Number:
PLATE 16
Sheet 16 of 55



US Army Corps
of Engineers
Rock Island
District


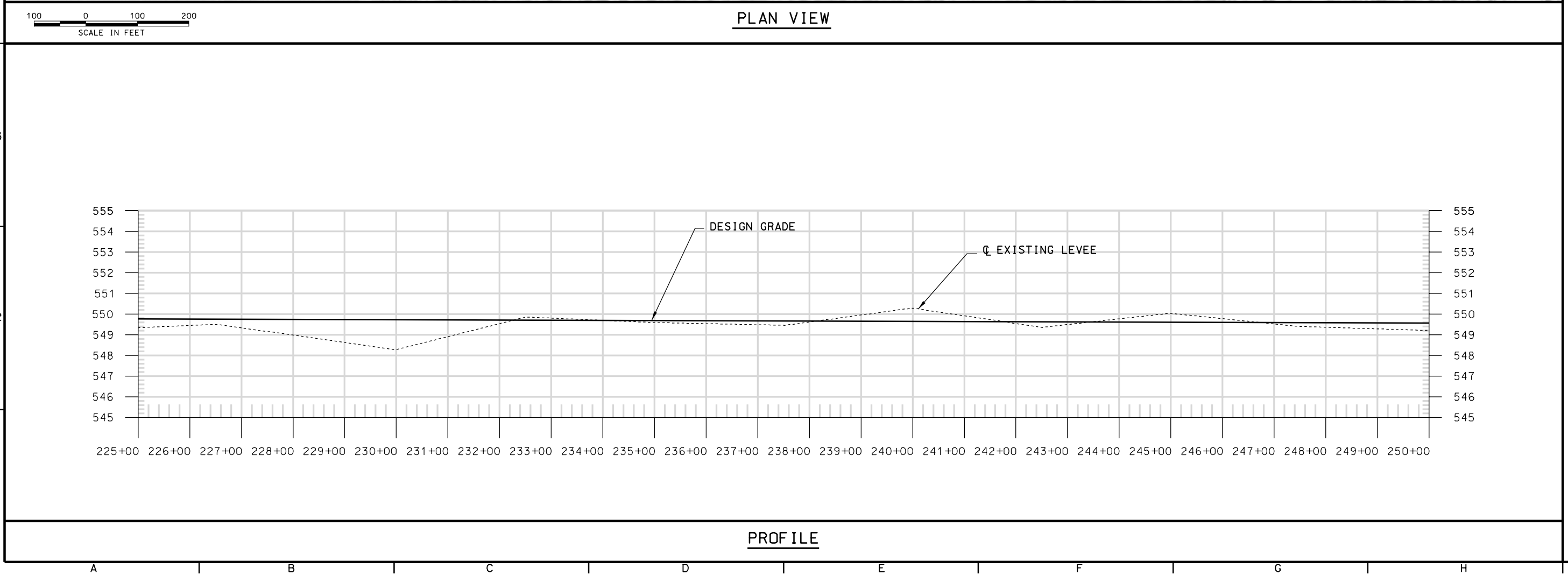
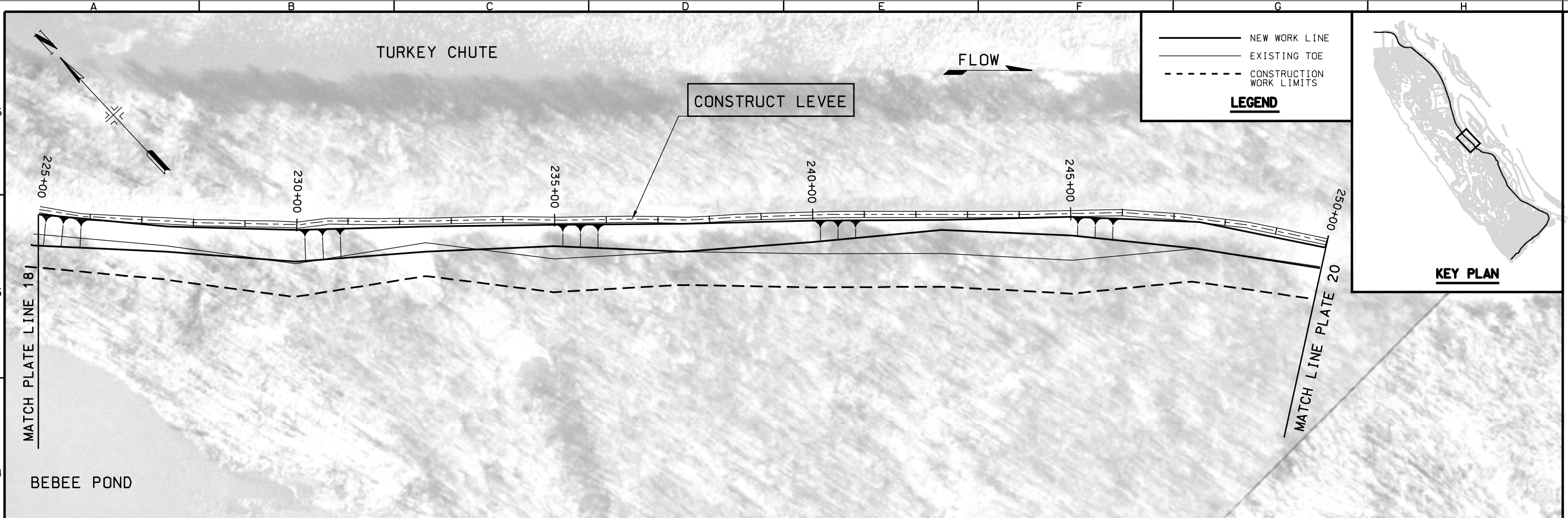
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Reviewed By:	DJH	Solicitation Number: DACW55-04-R-XXXX

PLAN AND PROFILE
STA. 200+00 TO
STA. 225+00

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Reference
Number:
PLATE 18
Sheet 18 of 55

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Rock Island
District

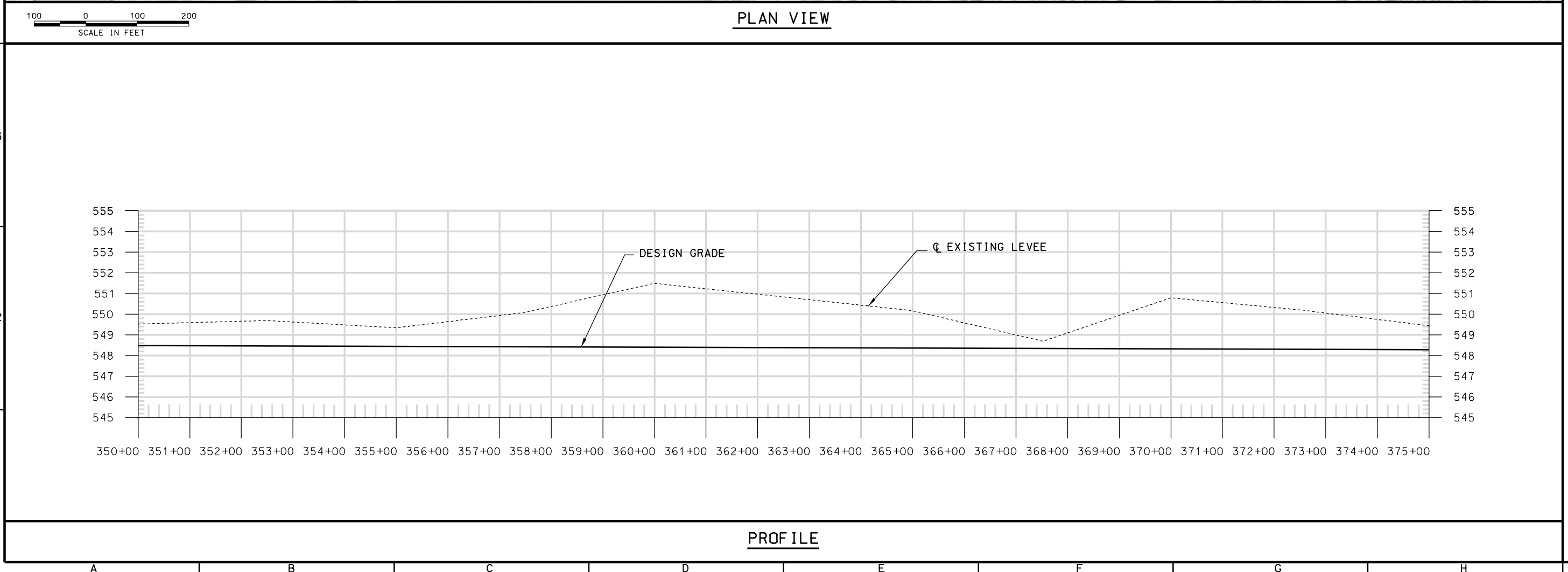
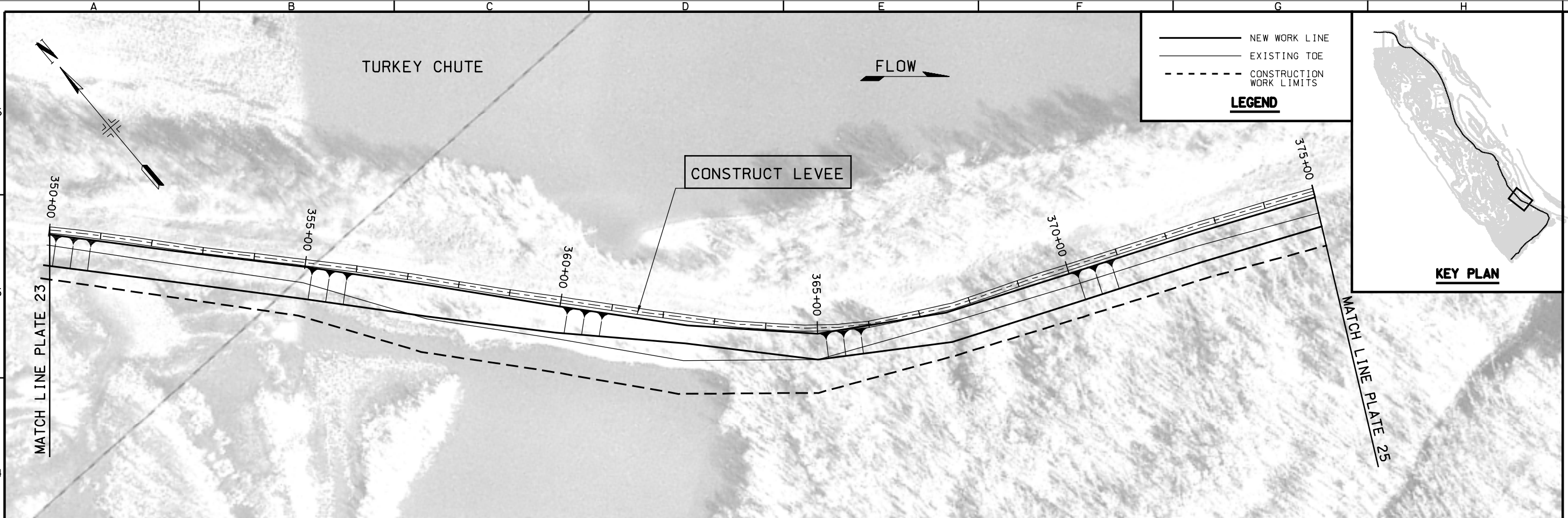
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	Reviewed By: DUH	Solicitation Number: DACW25-04-R-XXXX	

PLAN AND PROFILE
STA. 225+00 TO
STA. 250+00

Sheet
Reference
Number:
PLATE 19
Sheet 19 of 55

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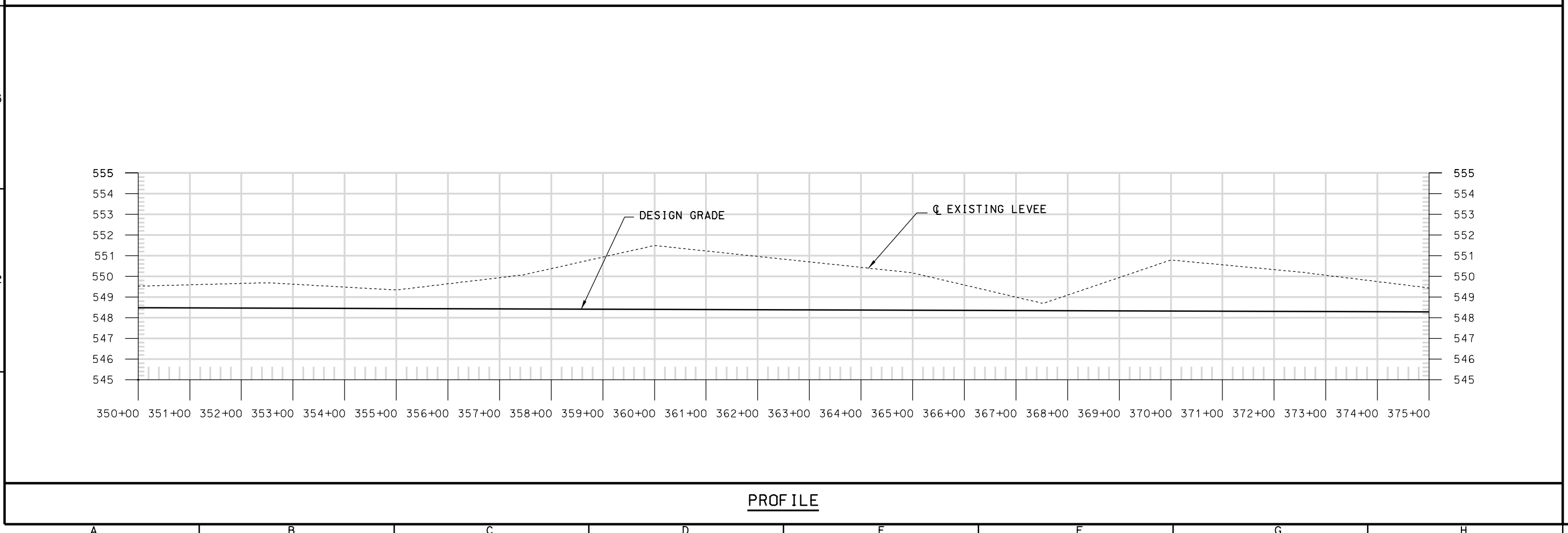
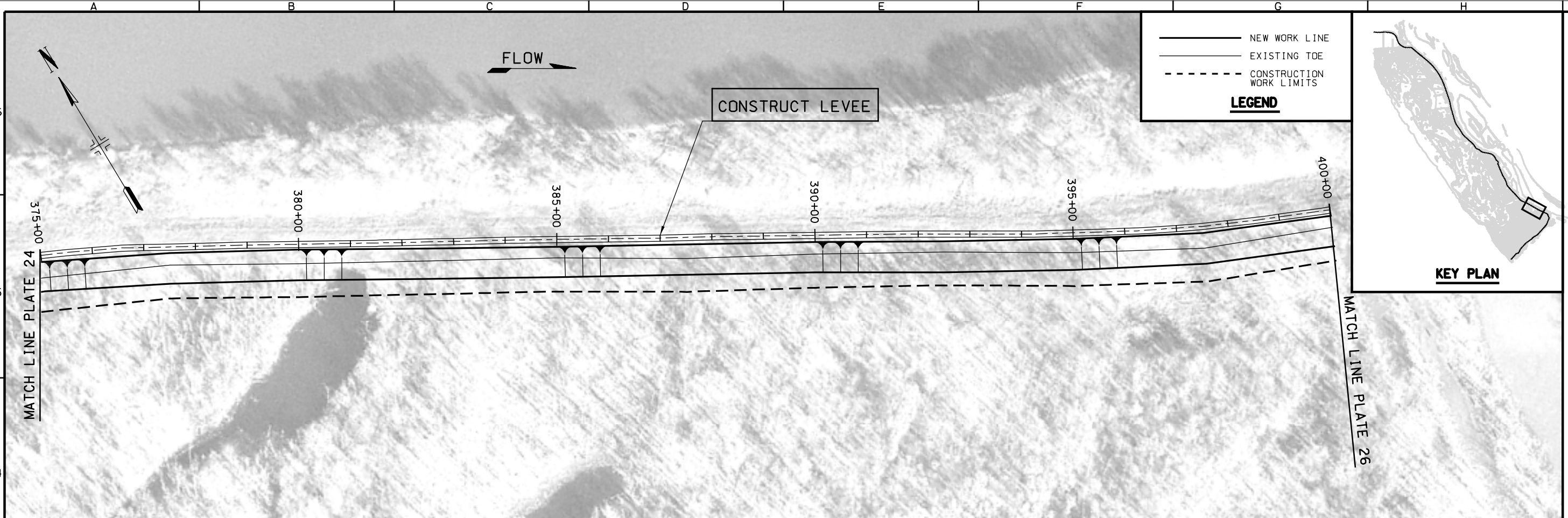
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	Reviewed By:	DJH	Solicitation Number:	DAG25-04-R-XXXX	

EMP. PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

PLAN AND PROFILE
STA. 350+00 TO
STA. 375+00

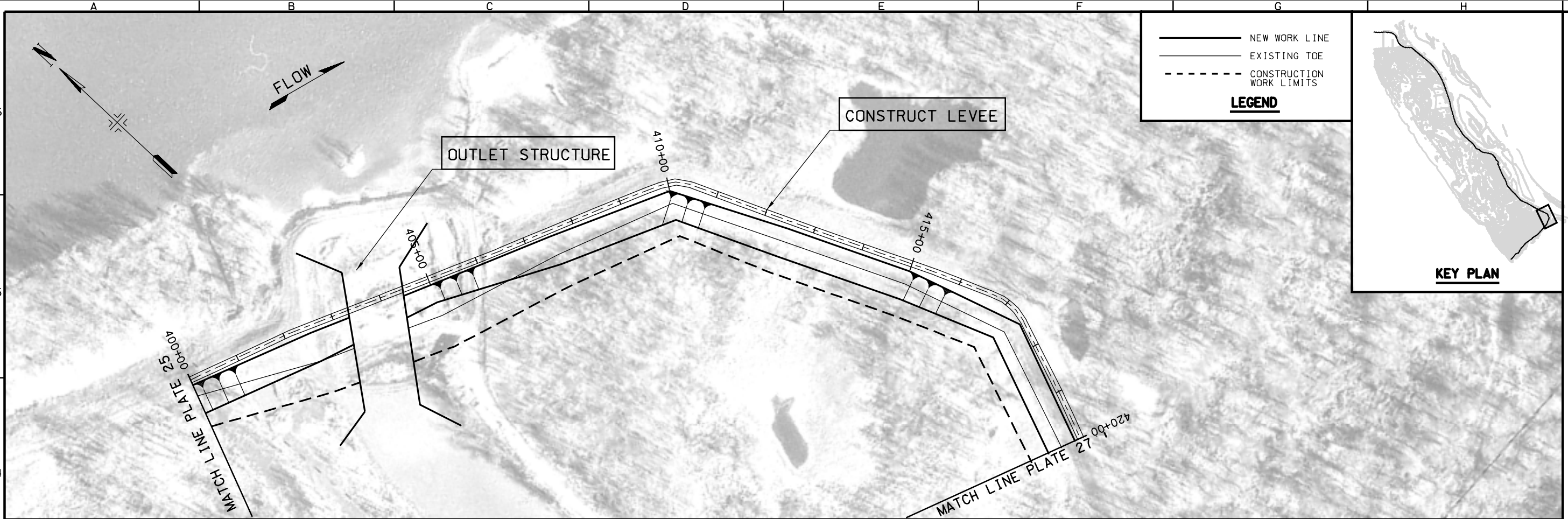
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Reference
Number:
PLATE 24
Sheet 24 of 55

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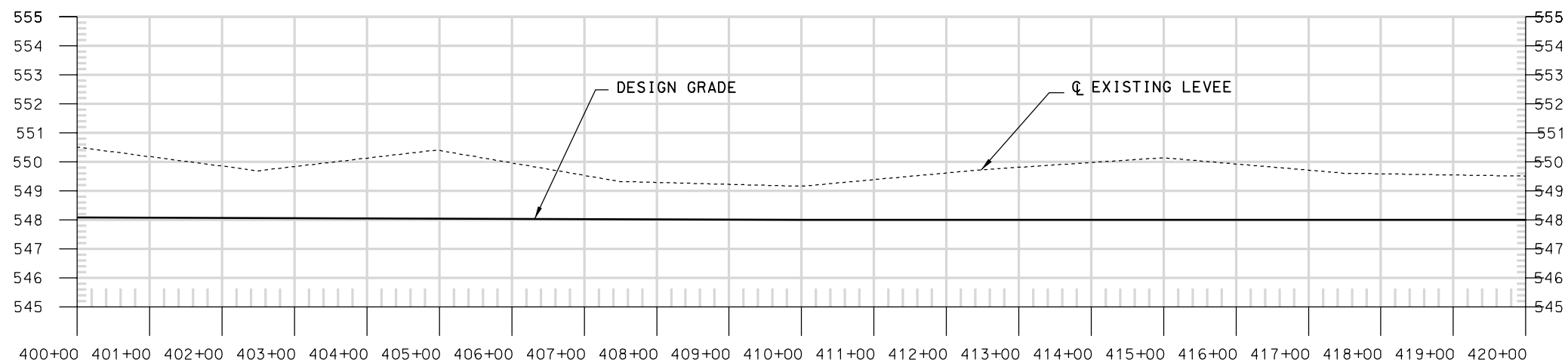
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	Reviewed By:	DJH	Specification Number:	DACW25-04-R-XXXX	

**PLAN AND PROFILE
STA. 375+00 TO
STA. 400+00**

Sheet
Reference
Number:
PLATE 25
Sheet 25 of 55



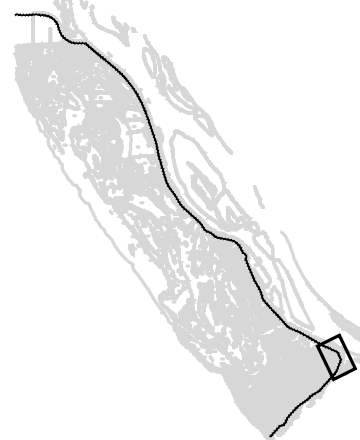
PLAN VIEW



PROFILE



US Army Corps
of Engineers
Rock Island
District



KEY PLAN

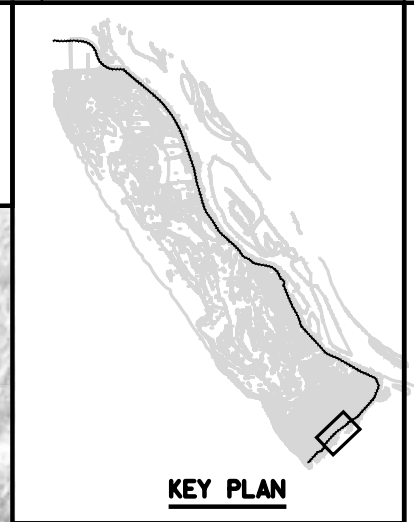
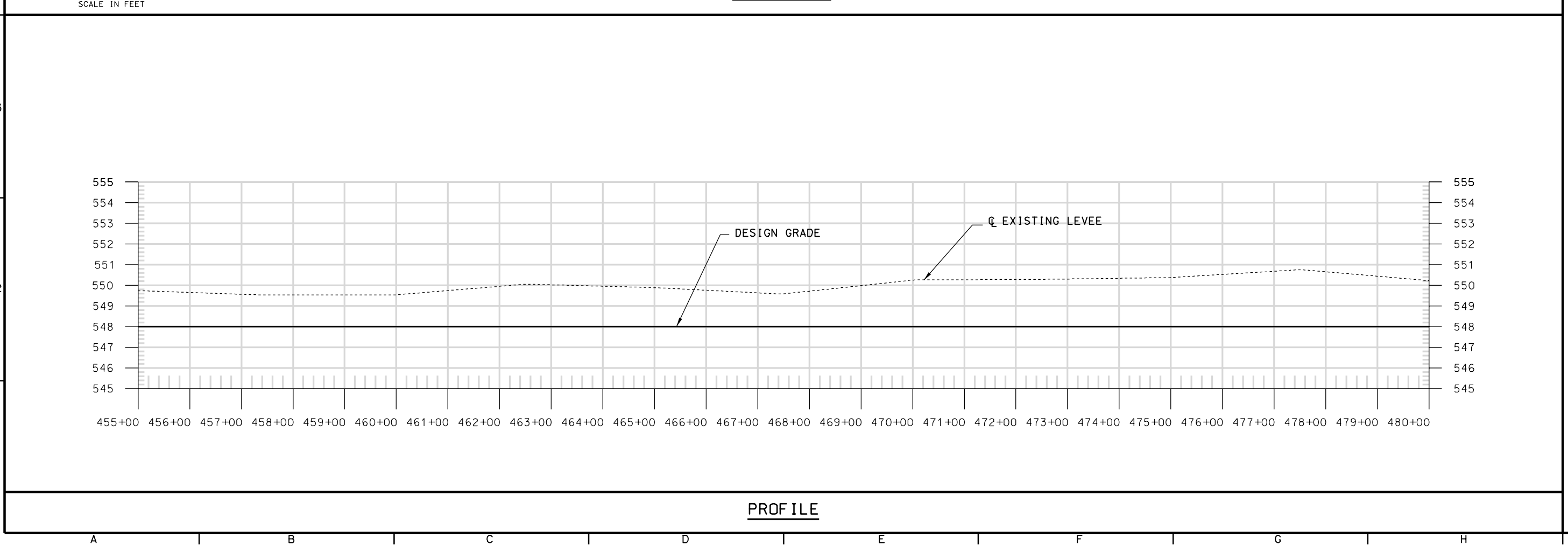
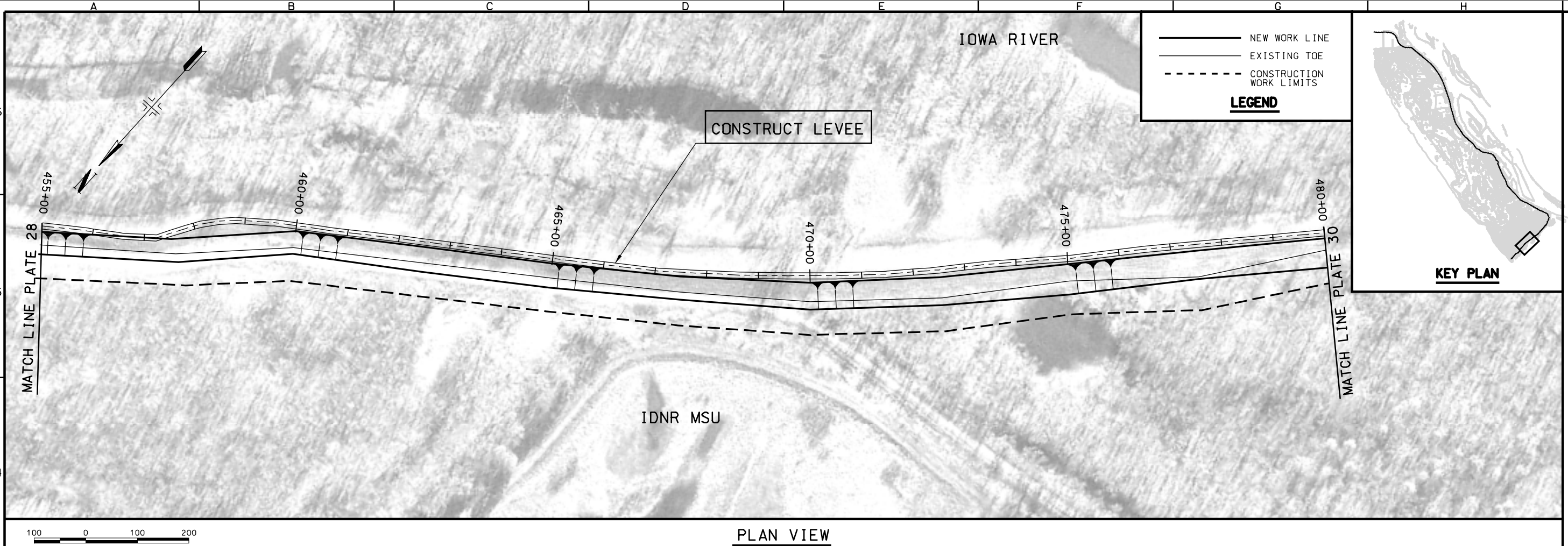
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	Reviewed By: DJH	Solicitation Number: DACW55-04-R-XXXX	

MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

Sheet
Reference
Number:
PLATE 26
Sheet 26 of 55

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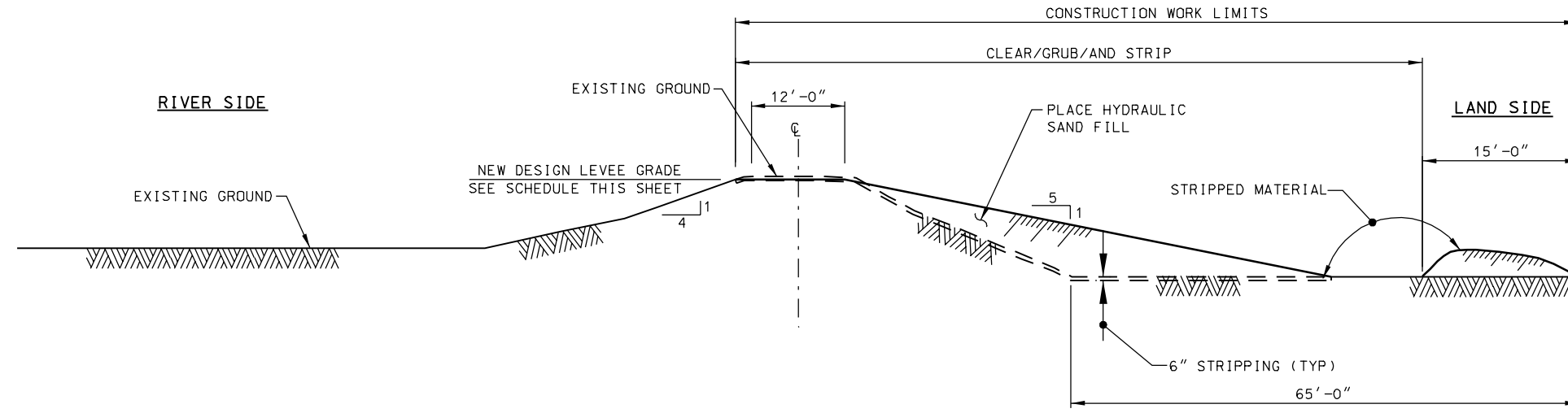
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MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

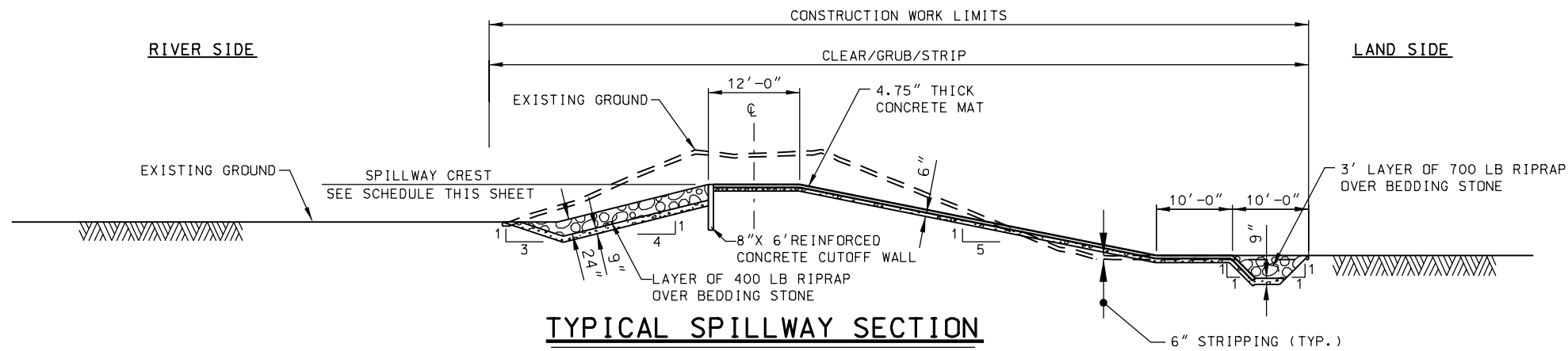
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STA. 455+00 TO
STA. 480+00**

Sheet
Reference
Number:
PLATE 29
Sheet 29 of 55

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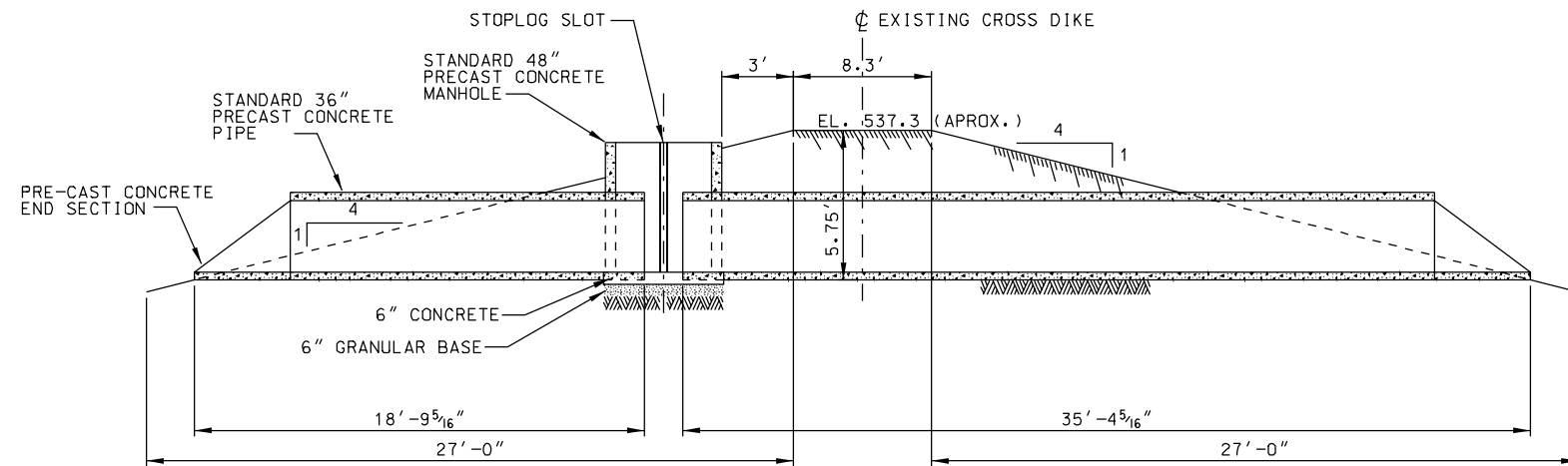
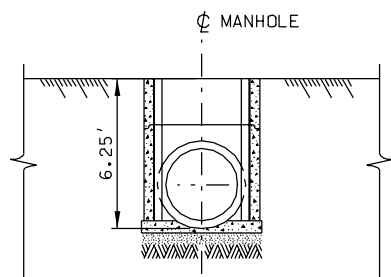
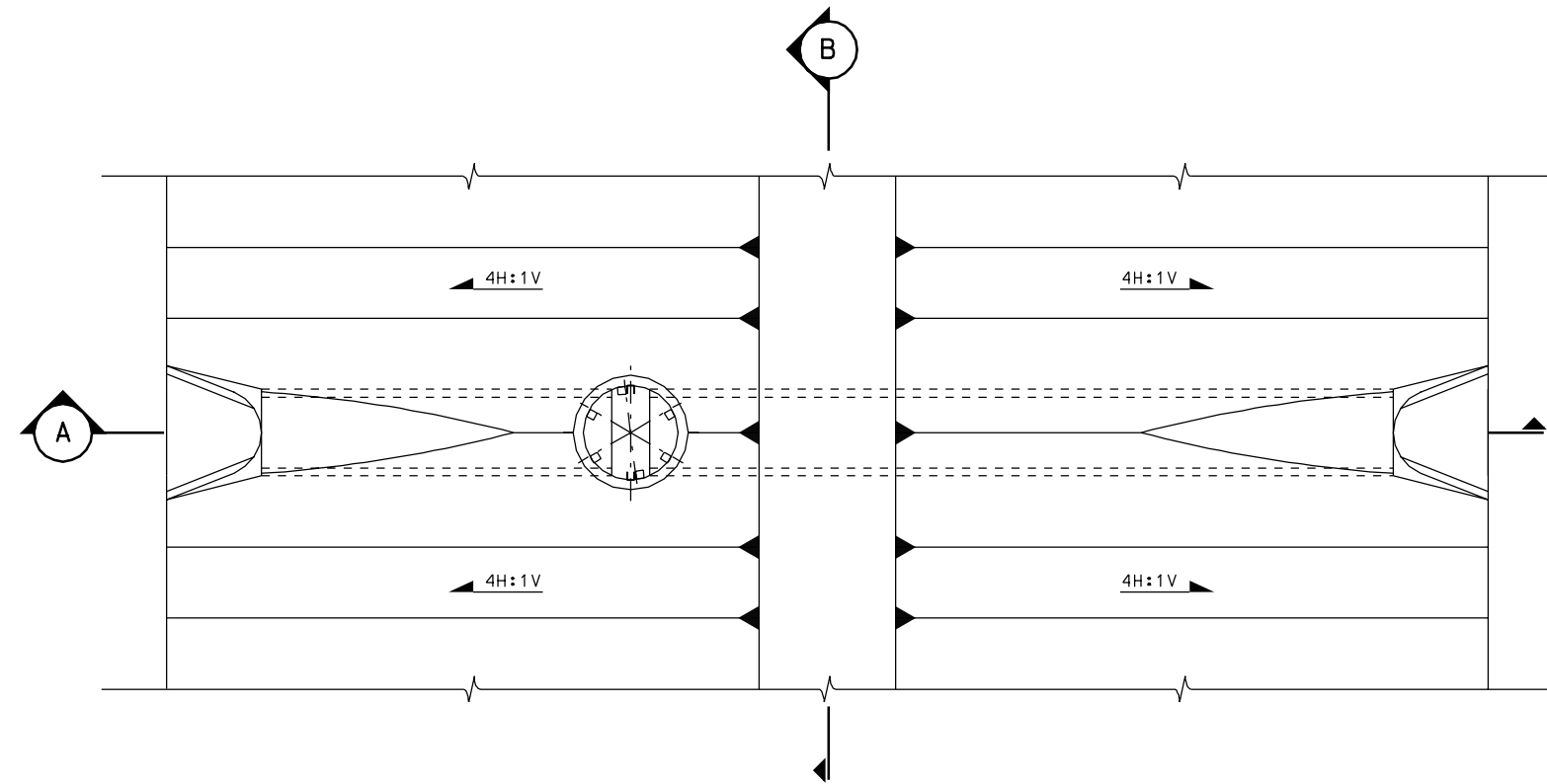


TYPICAL PERIMETER LEVEE SECTION



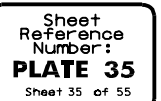
TYPICAL SPILLWAY SECTION





NOTE:
CROWN WILL HAVE TO BE RAISED 0.5'
ABOVE PRE-CONSTRUCTION ELEVATION
TO ACCOMMODATE NEW CULVERT.



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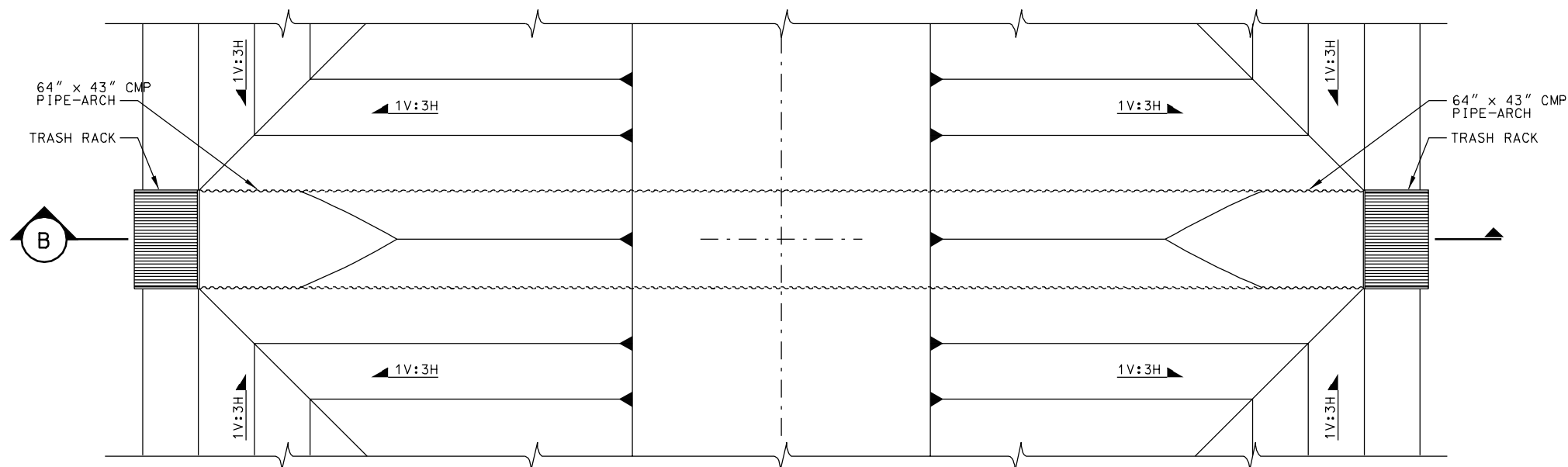
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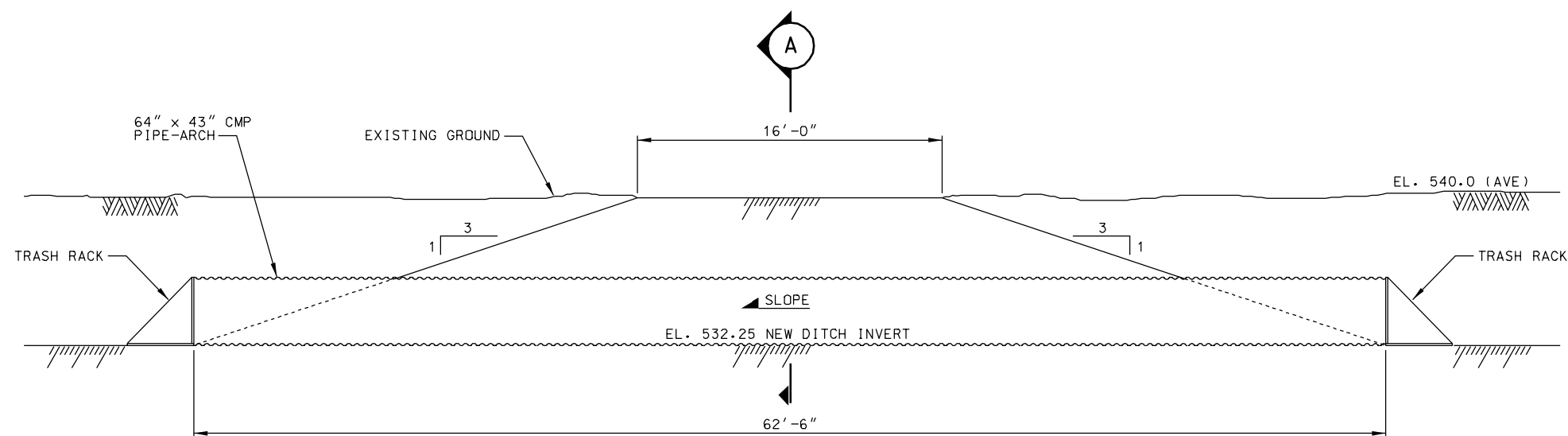
MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

**ACCESS ROAD
WATER CROSSING
FOR DEDICATED
WATER BAY**

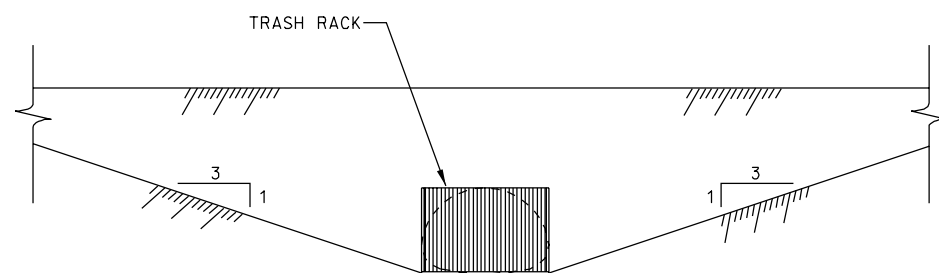
Sheet
Reference
Number:
PLATE 36
Sheet 36 of 55



PLAN

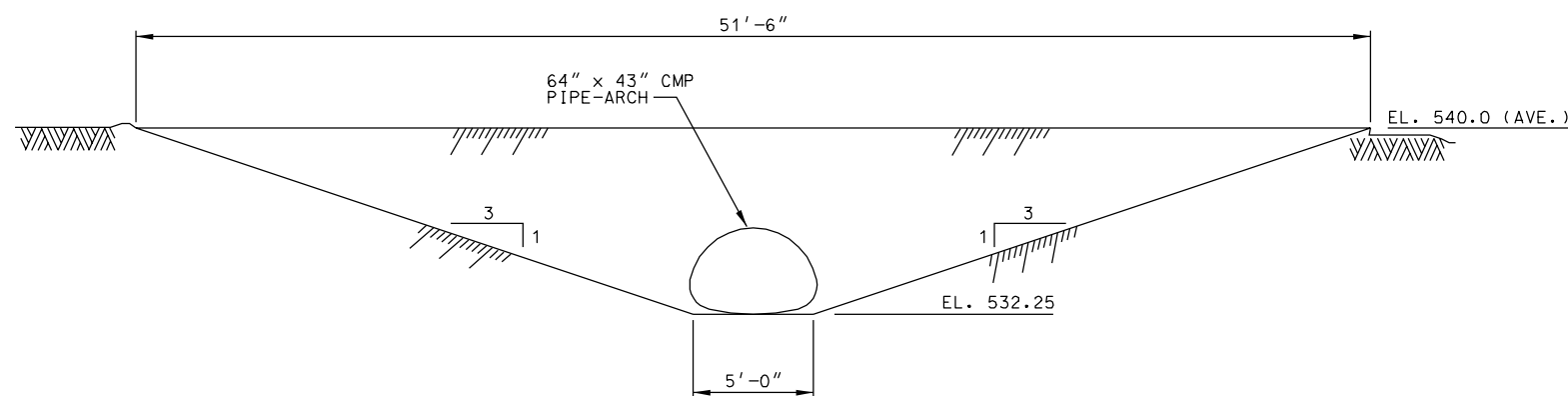


SECTION



TRASH RACK END VIEW

BOTH ENDS SIMILAR

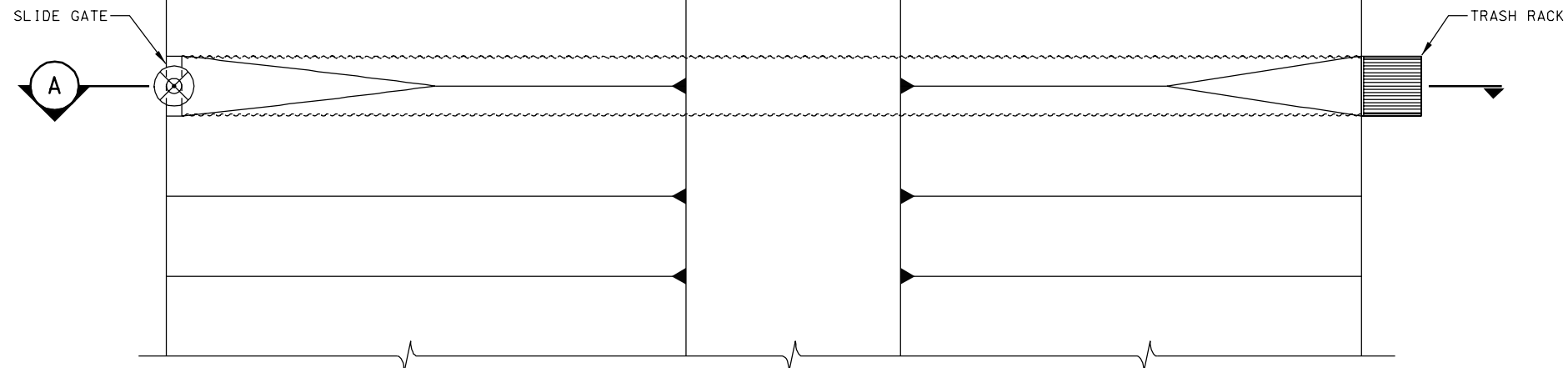


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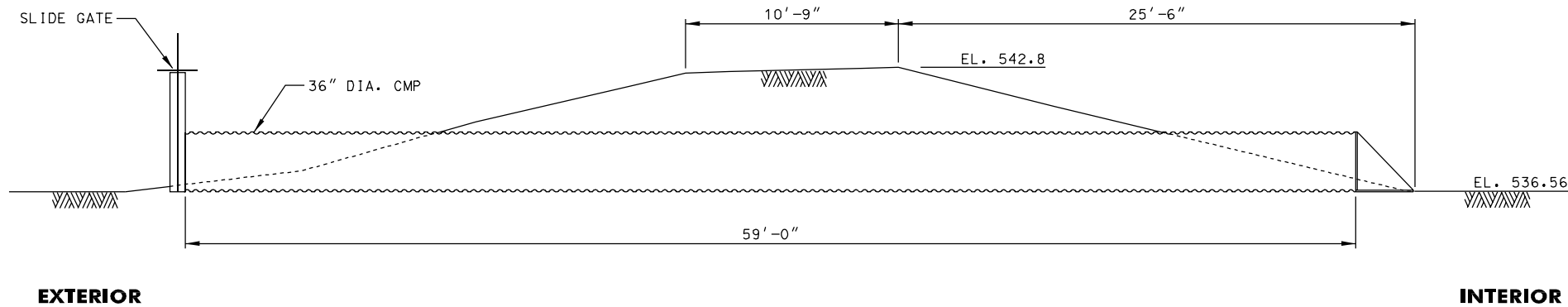




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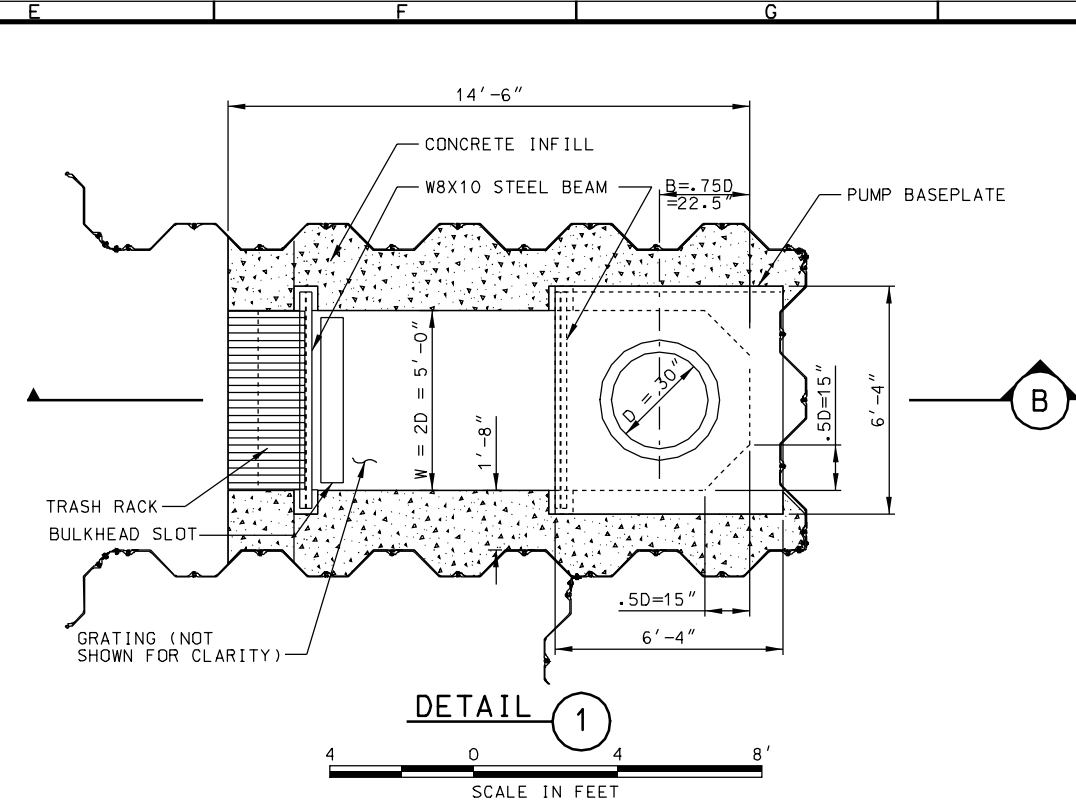


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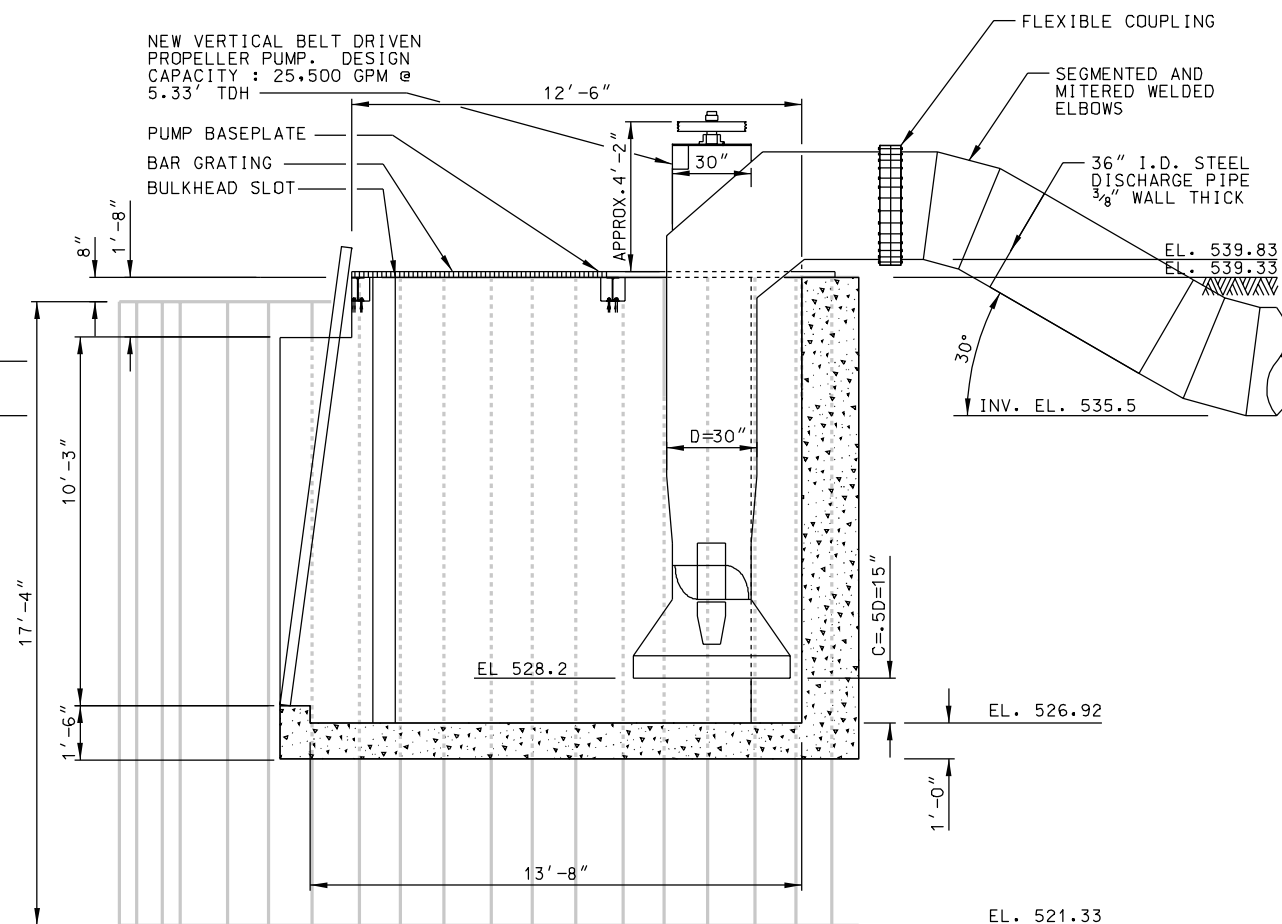
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Sheet
Reference
Number:
PLATE 38
Sheet 38 of 55



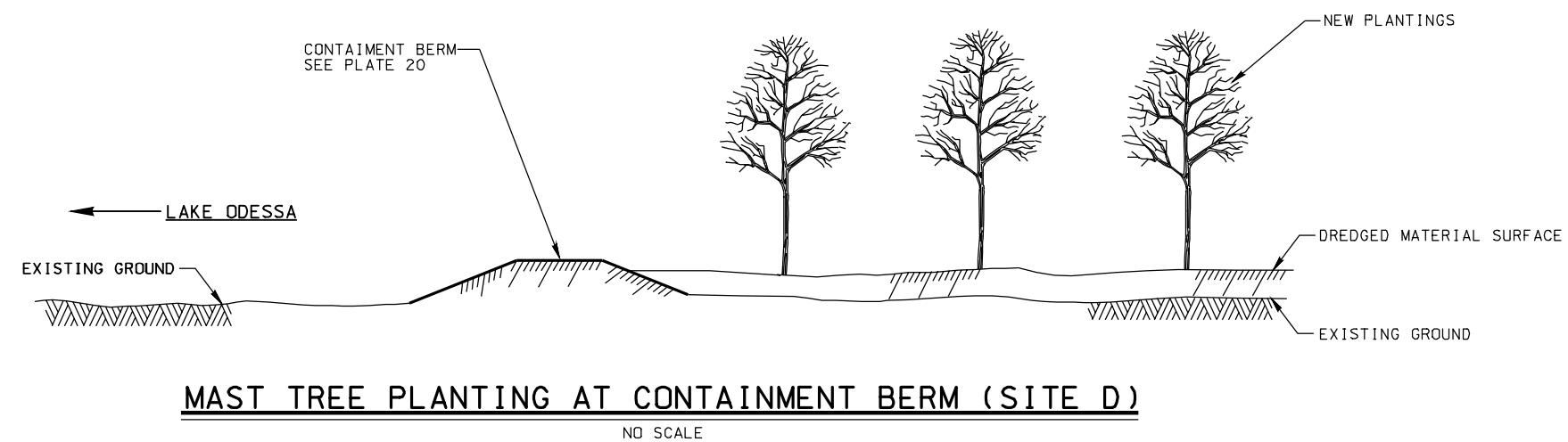
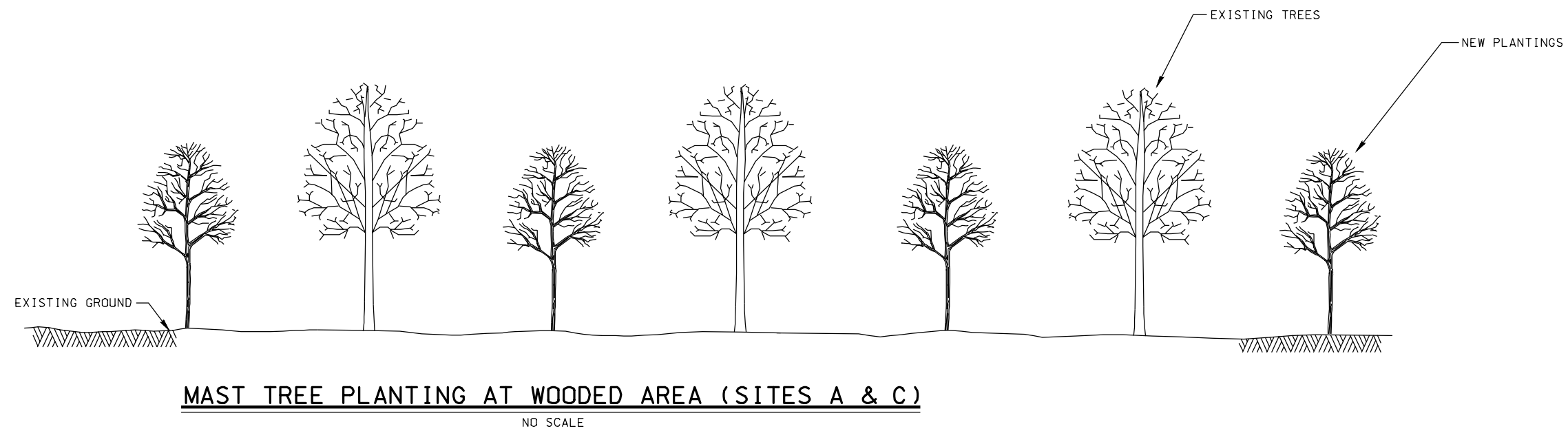
DETAIL 1

A scale bar labeled "SCALE IN FEET" with markings at 4, 0, 4, and 8.



SECTION (B)

A horizontal scale bar with tick marks at 0, 4, and 8 feet. The text "SCALE IN FEET" is centered below the bar.



- NOTES:

1. DENSITY OF TREE PLANTING SHALL BE 40 TREES/ACRE.
2. SITE D SHALL NOT BE PLANTED UNTIL DREDGED MATERIAL HAS DRIED SUFFICIENTLY AND SITE IS PROPERLY GRADED.

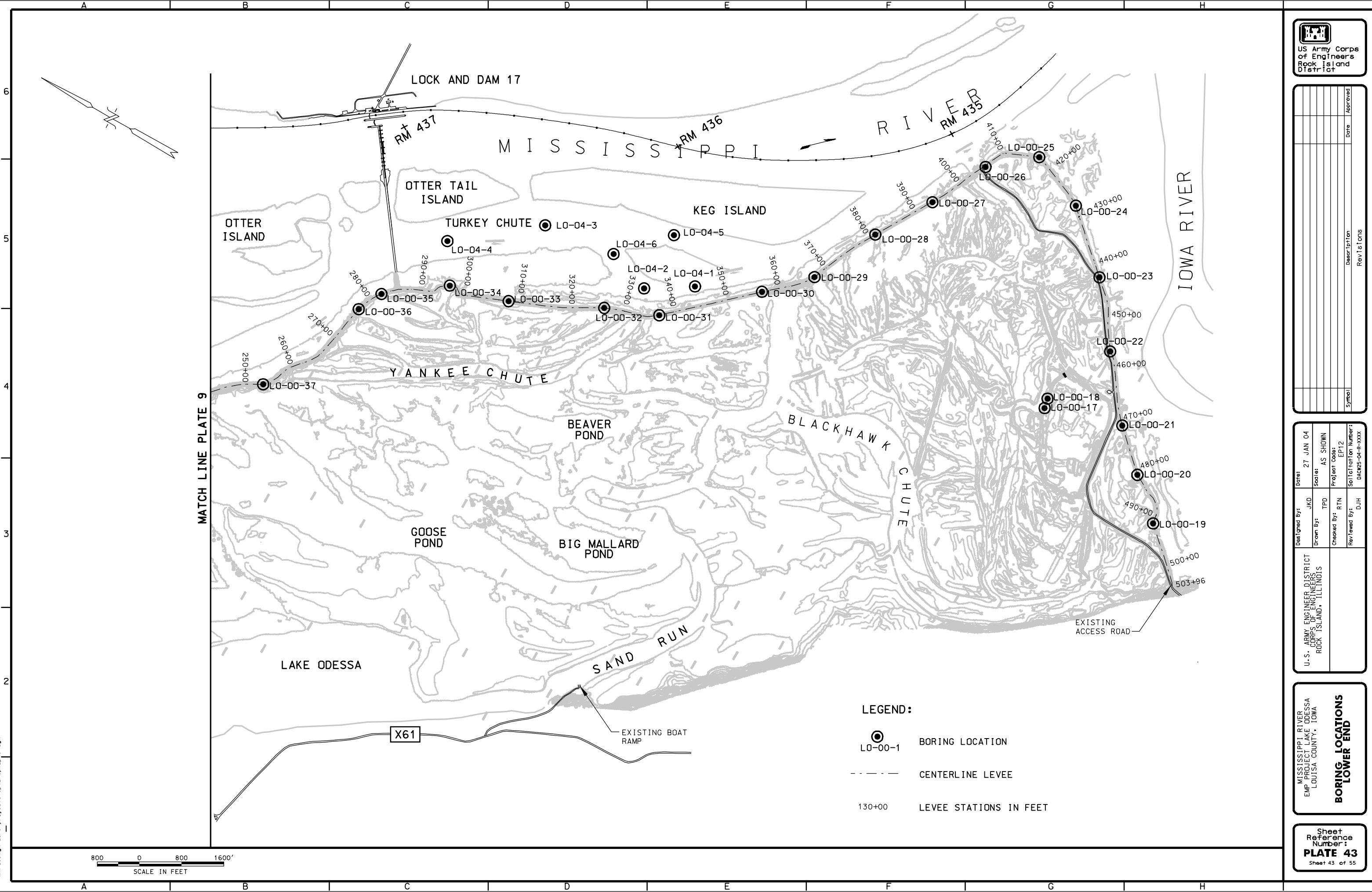
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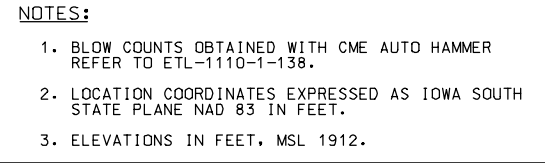
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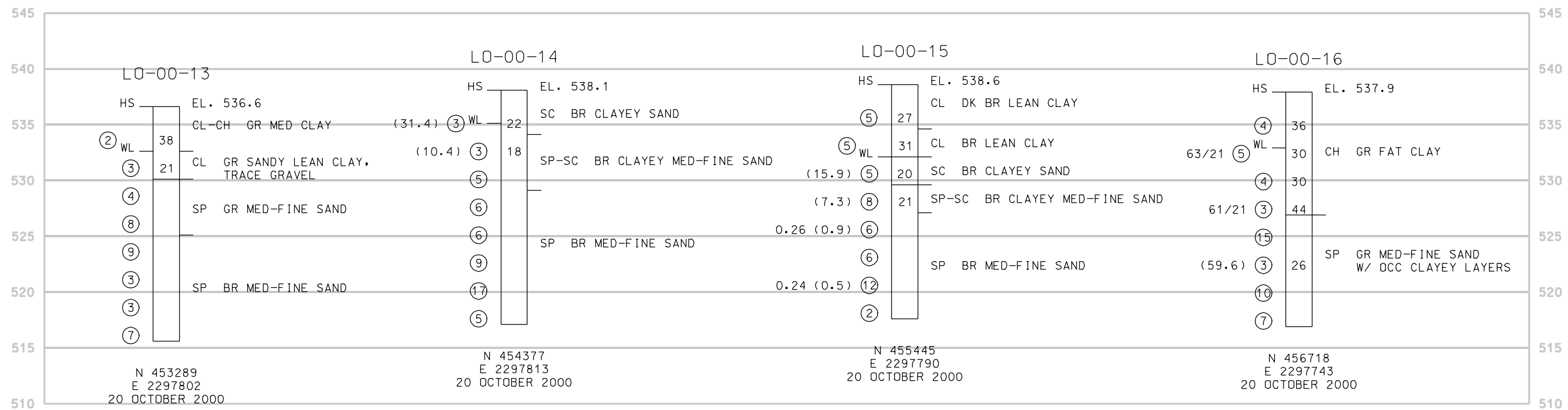
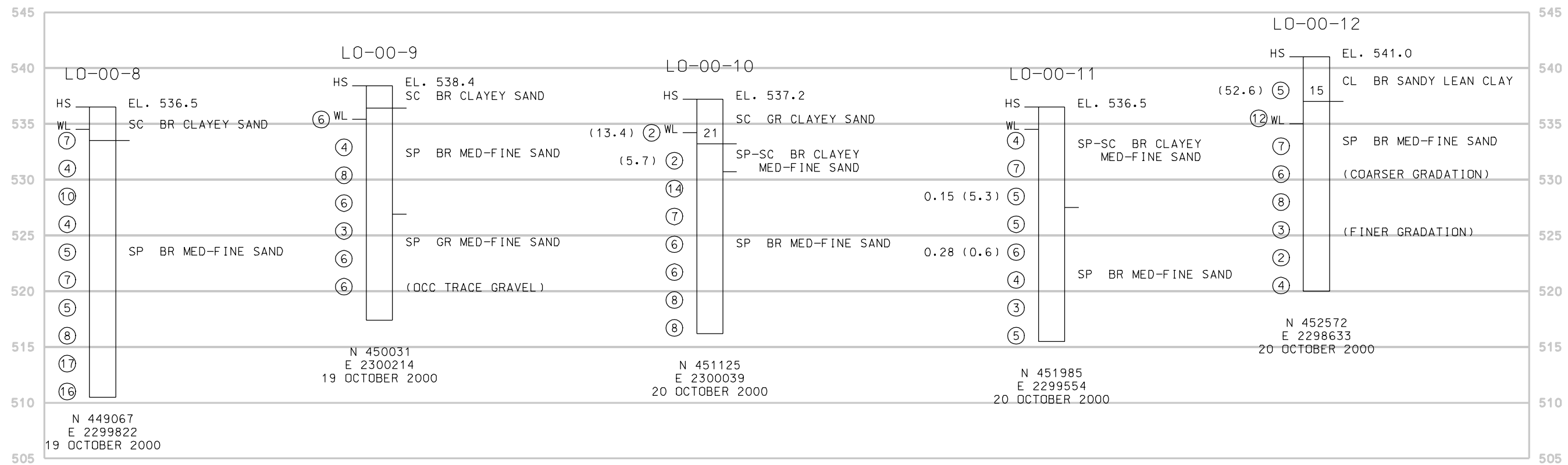
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

**MAST TREE
PLANTING DETAILS**

Sheet
Reference
Number:
PLATE 41
Sheet 41 of 55





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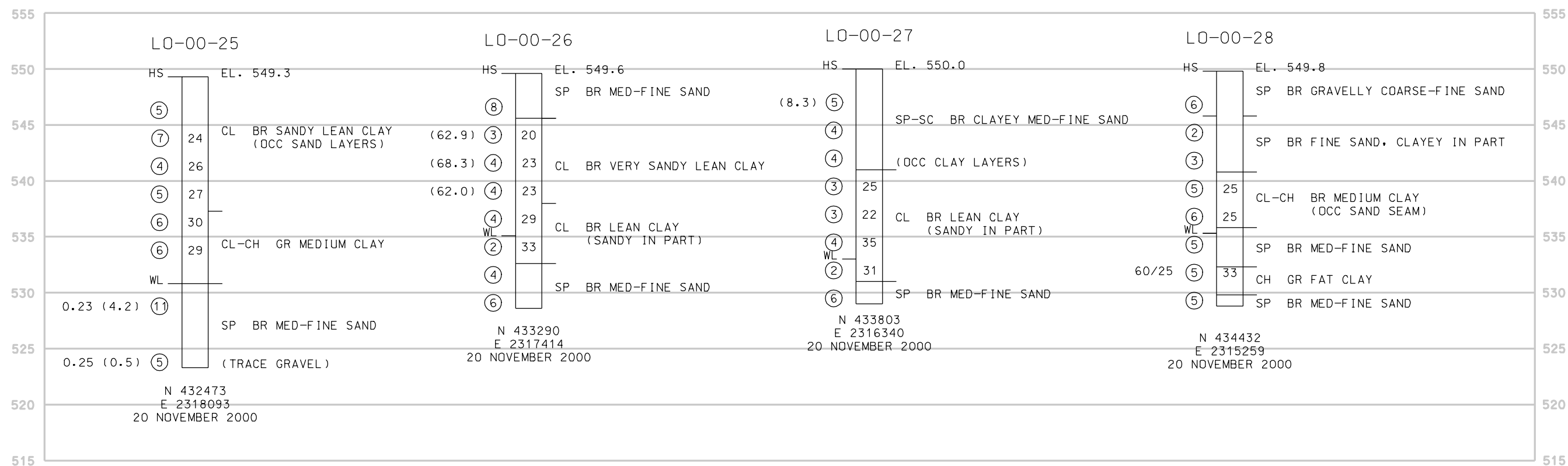
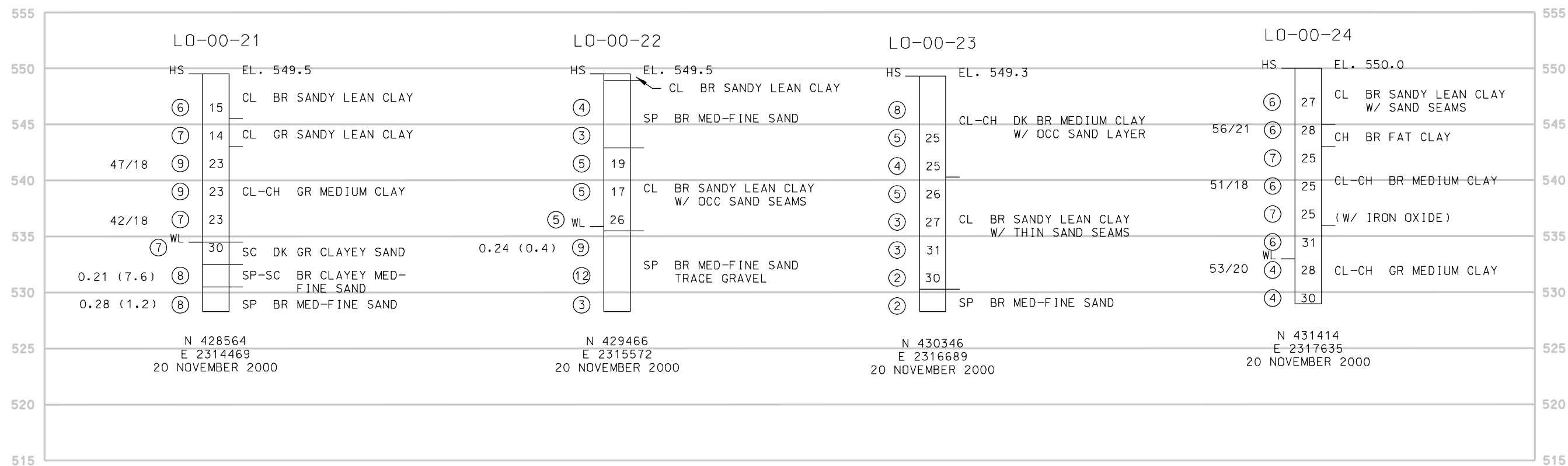
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By:	JKD	Date:	27 JAN 04
	Drawn By:	MMO	Scale:	AS SHOWN
	Checked By:	XXX	Project Code:	EP12
	Reviewed By:	XXX	Solicitation Number:	DISPCE-ALB-XXX

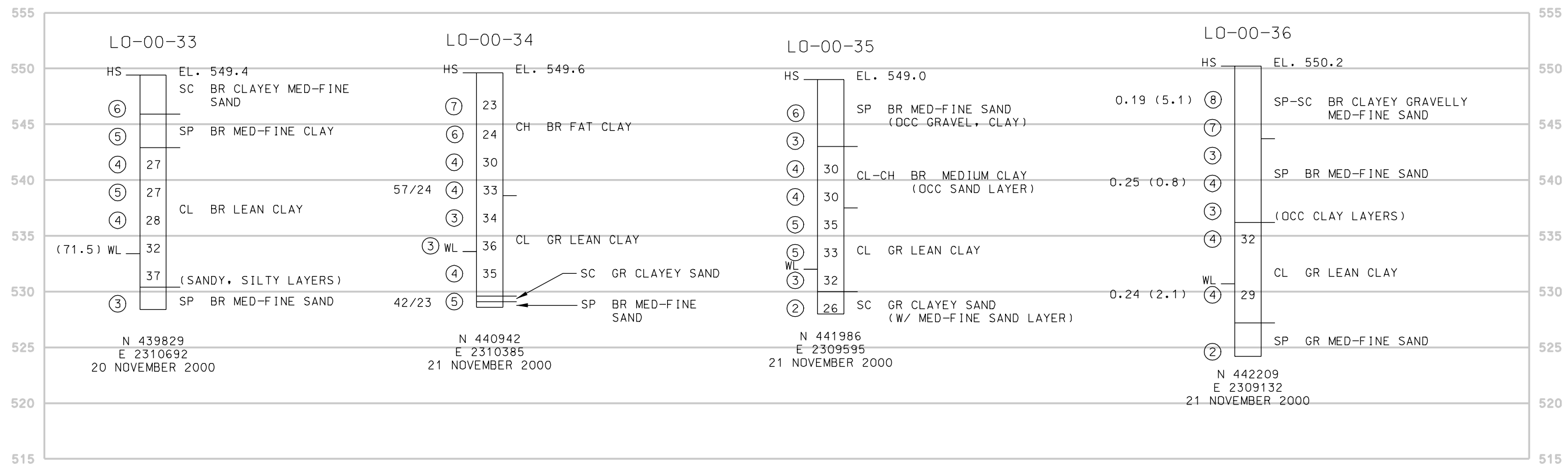
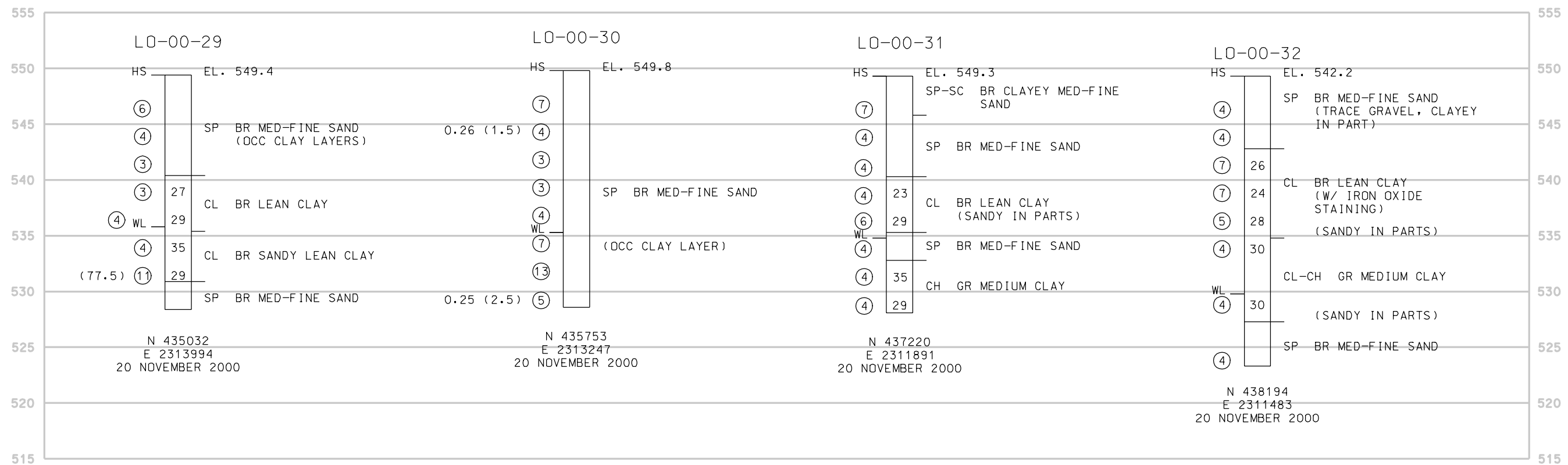
MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

BORING LOGS II

Sheet
Reference
Number:
PLATE 45
Sheet 45 of 55







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Rock Island
District

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U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Drawn By: MMD Checked By: XXX Reviewed By: XXX Project Code: EP12 Specification Number: DACP25-04-R-XXXX	Date: 27 JAN 04 Social: AS SHOWN
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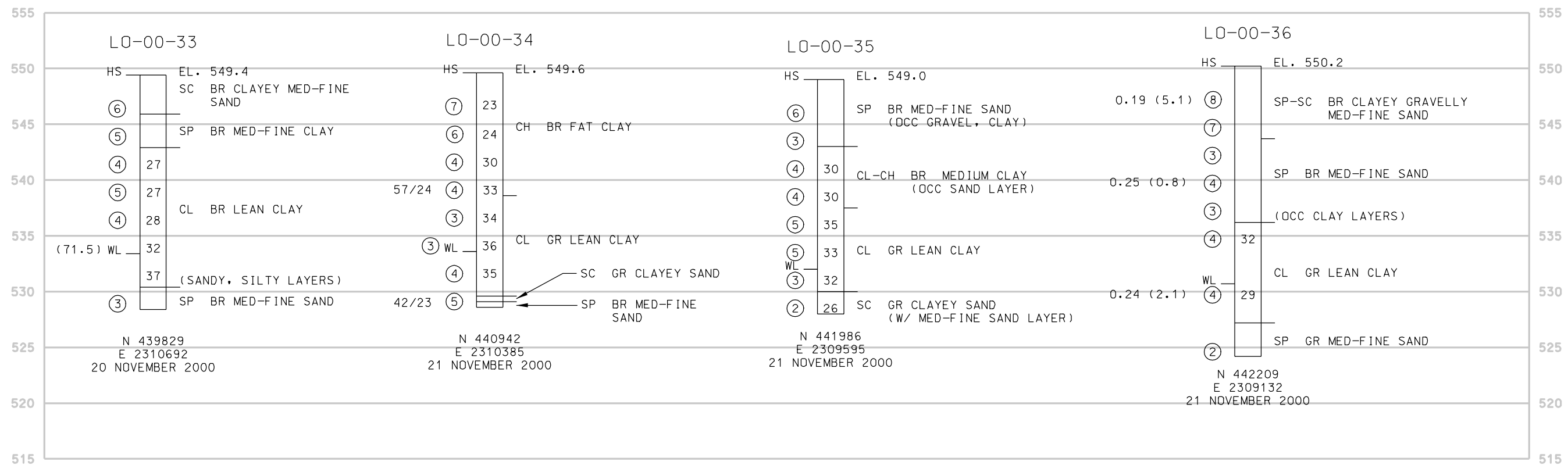
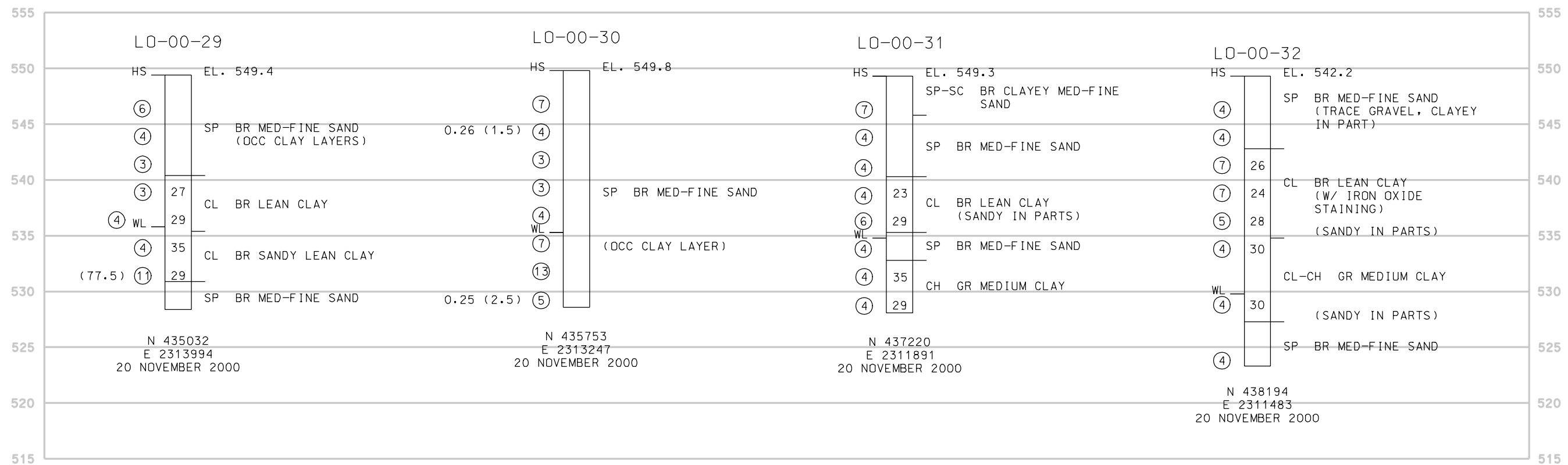
MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

BOKING LOGS A

Sheet
Reference
Number:
PLATE 48
Sheet 48 of 55

Sheet 48 of 55

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Rock Island
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U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Drawn By: MMD Checked By: XXX Reviewed By: XXX Project Code: EP12 Specification Number: DADP25-04-R-XXXX	Date: 27 JAN 04 Social: AS SHOWN
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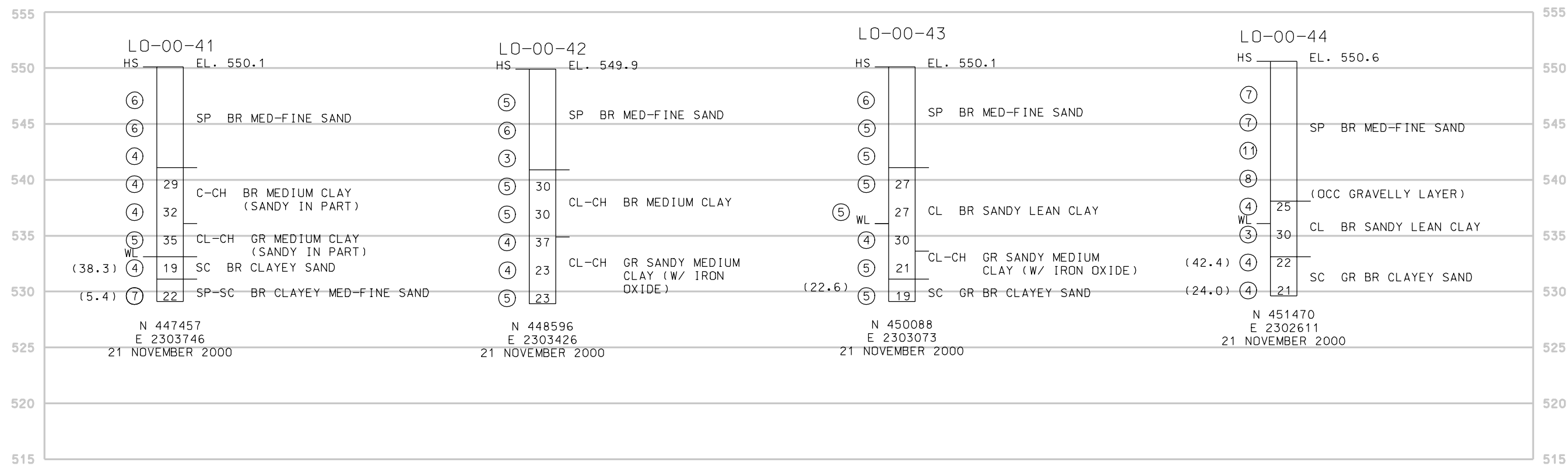
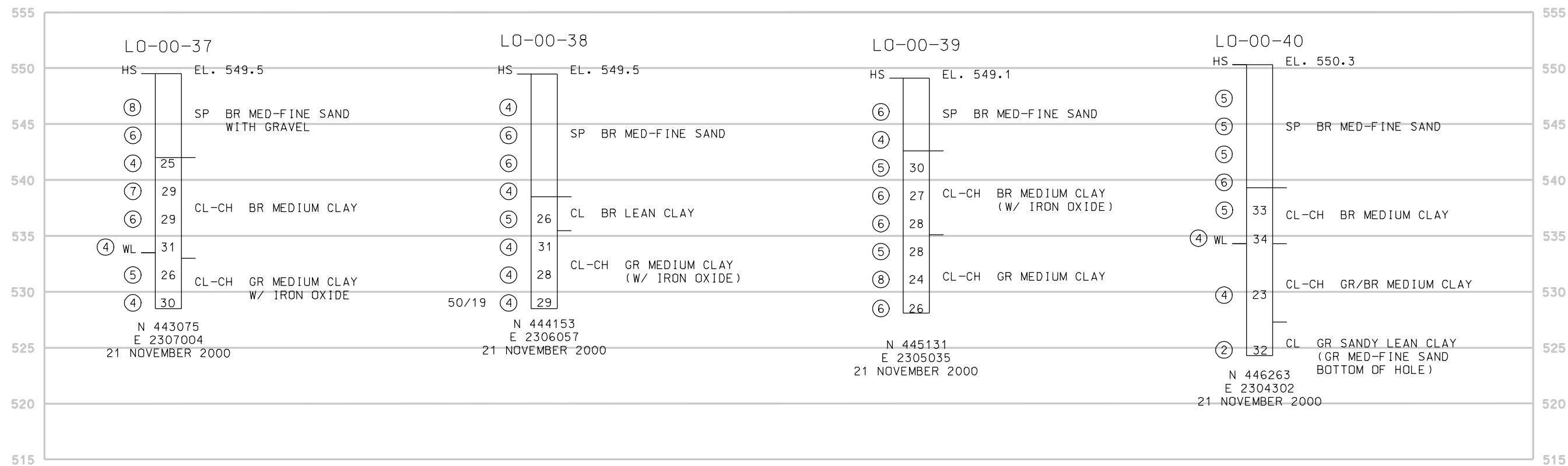
MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

BORING LOGS V

Sheet
Reference
Number:
PLATE 48
Sheet 48 of 55

Sheet 48 of 55

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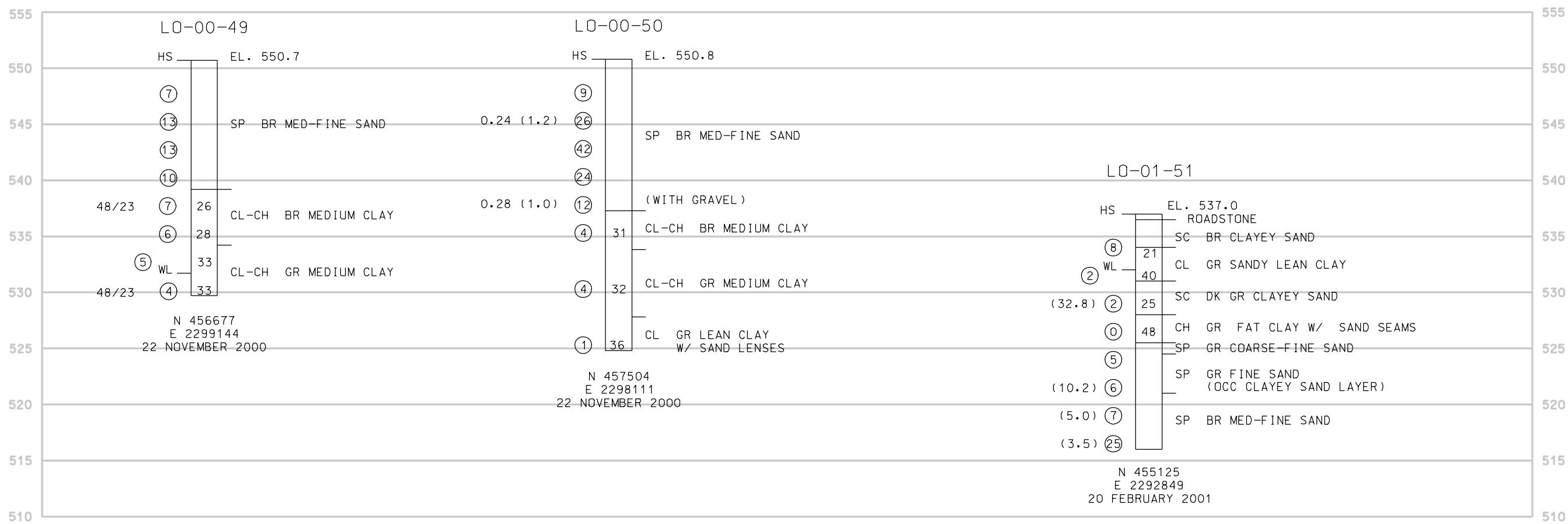
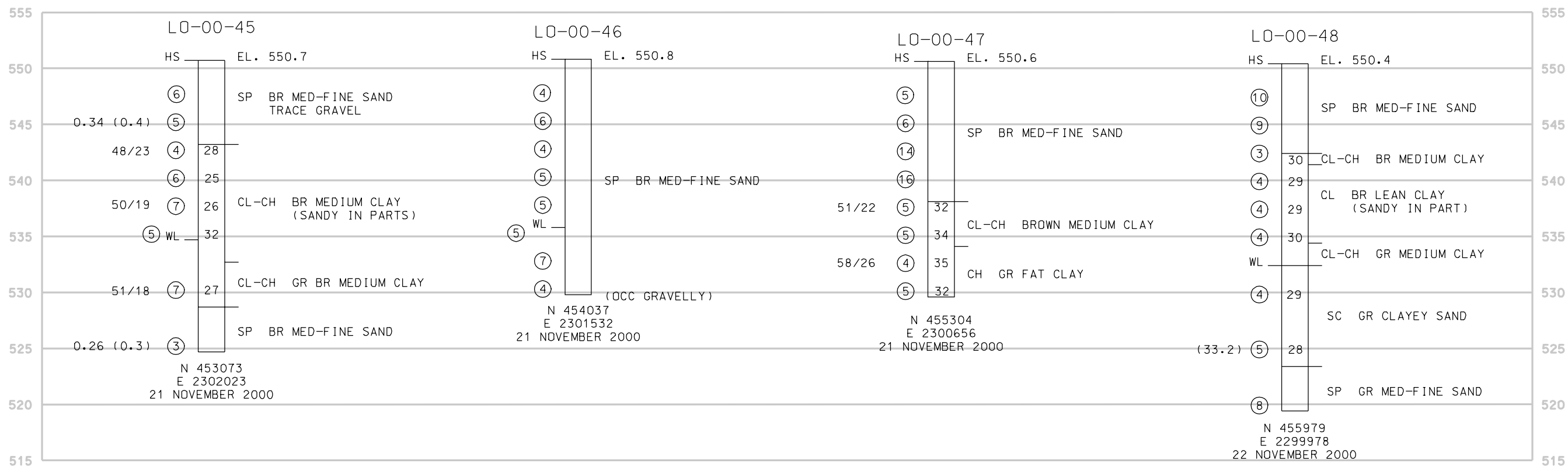


U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By:	JKD	Date:	27 JAN 04
	Drawn By:	MMO	Scale:	AS SHOWN
	Checked By:	XXX	Project Code:	EP12
	Reviewed By:	XXX	Solicitation Number:	DDPWS-04-R-XXX

MISSISSIPPI RIVER
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LOUISA COUNTY, IOWA

BORING LOGS VI

Sheet
Reference
Number:
PLATE 49
Sheet 49 of 55

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U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By: JKD	Date: 27 JAN 04
	Drawn By: MMD	Scale: AS SHOWN
	Checked By: XXX	Project Code: EP12
	Reviewed By: XXX	Solicitation Number: DICKSE-ALB-XXX

MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

Sheet
Reference
Number:
PLATE 50
Sheet 50 of 55

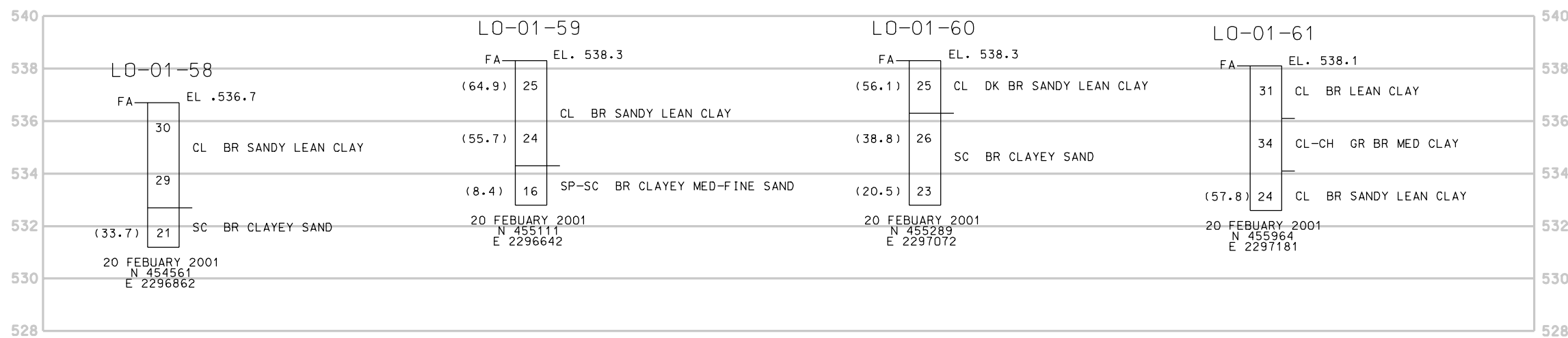
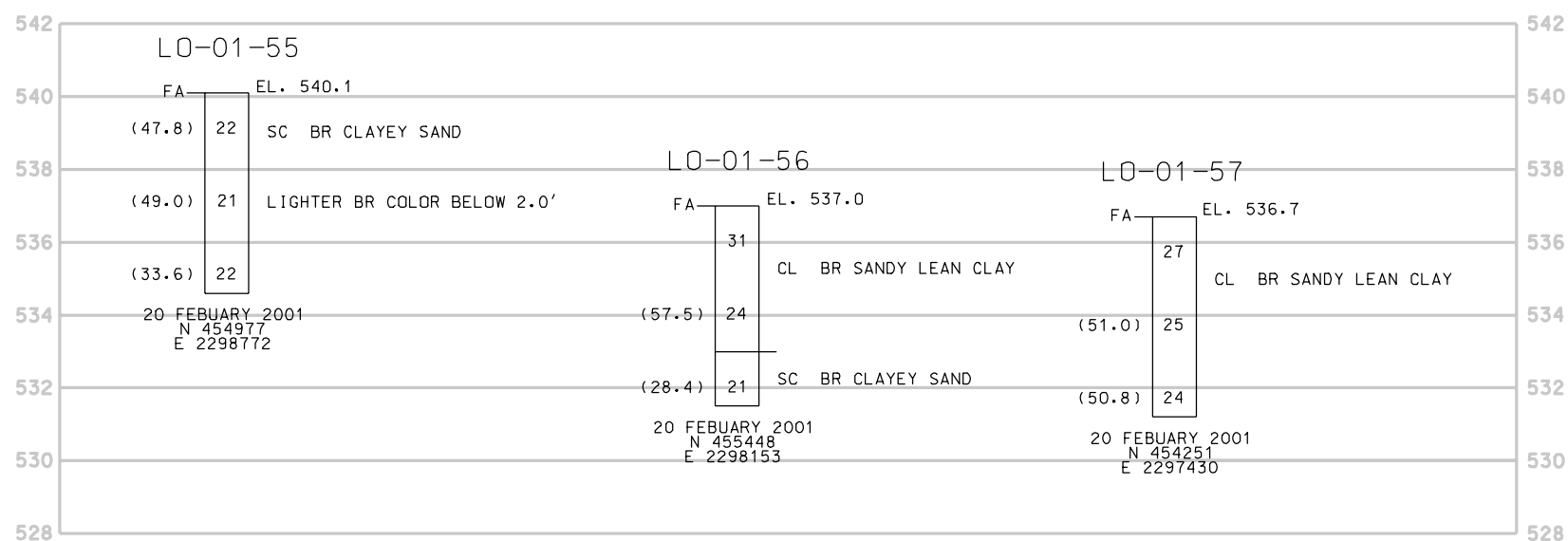
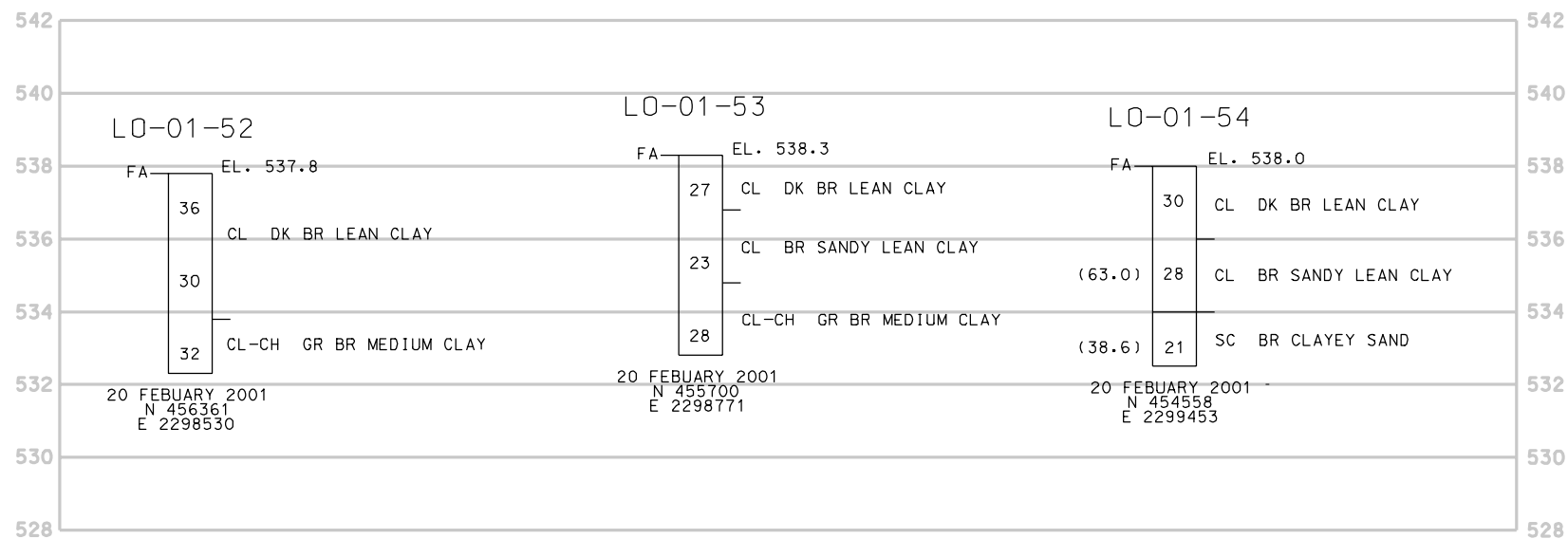
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U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By: JKD	Date: 27 JAN 04
	Drawn By: TPD	Scale: AS SHOWN
	Checked By: XXX	Project Code: EP12
	Reviewed By: YYY	Solicitation Number: DPCOE-04-P-000

MISSISSIPPI RIVER
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LOUISA COUNTY, IOWA

BORING LOGS VIII

Sheet
Reference
Number:
PLATE 51
Sheet 51 of 55



LEGEND

BORING NUMBER

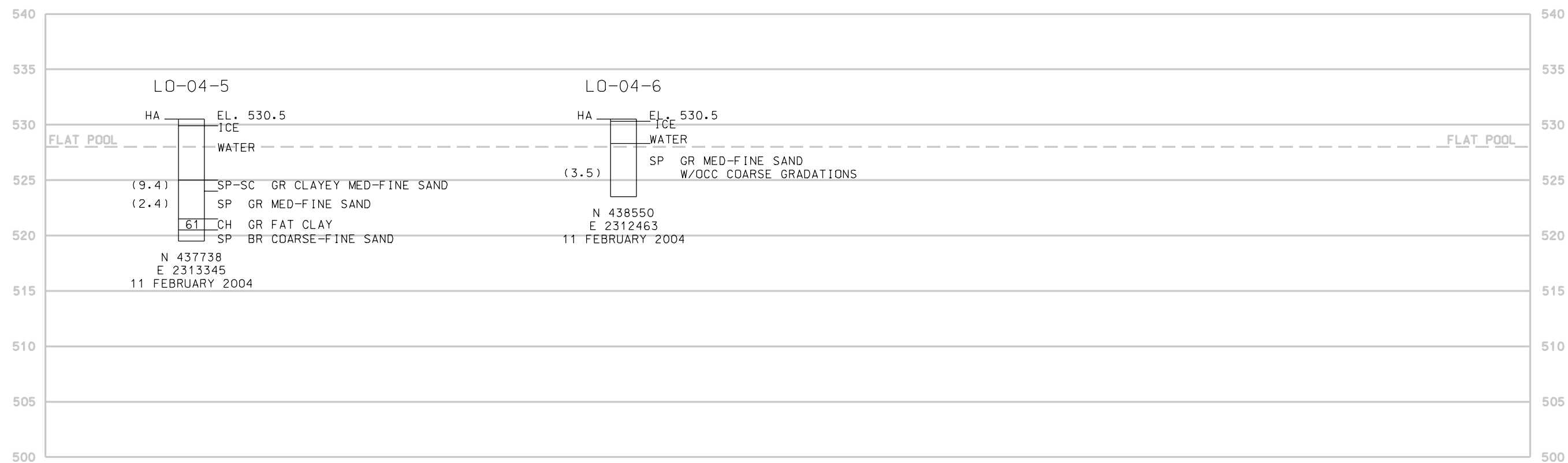
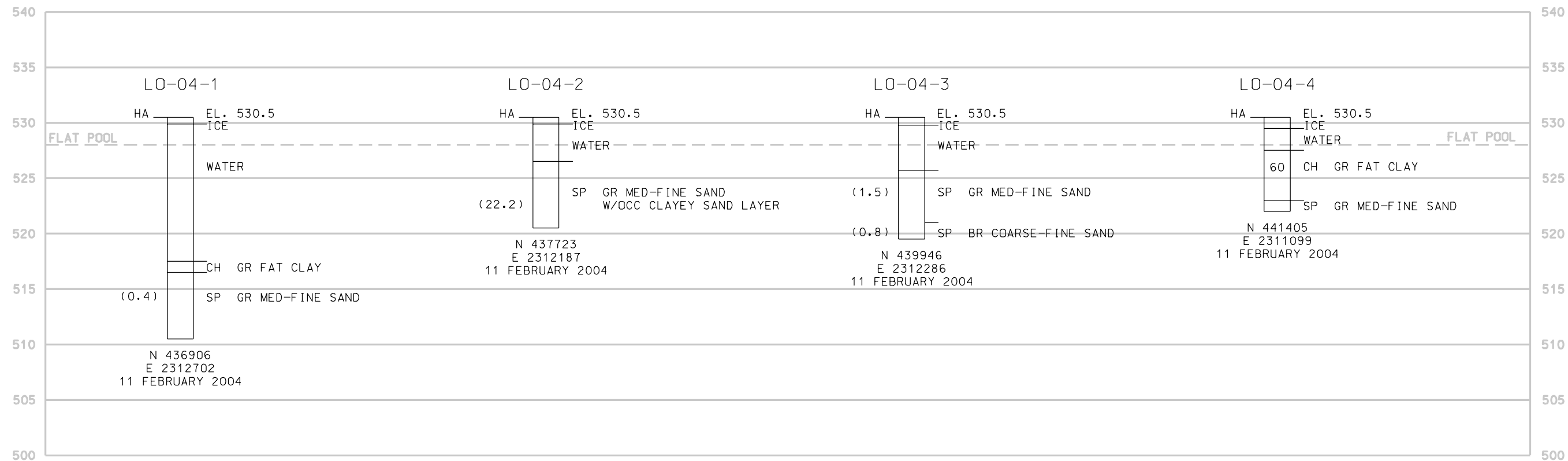
HOLE ADVANCED BY HOLLOW STEM		HS	TOP ELEVATION
HOLE ADVANCED WITH FLIGHT AUGER		FA	
HOLE ADVANCED WITH 3 1/4" ROLLER BIT		RB	
HOLE ADVANCED BY HAND AUGER AND THIN WALL TUBE		HA	NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT
WATER LEVEL		WL	
D ₁₀ SIZE (mm)		0.21	
LIQUID AND PLASTIC LIMIT		44/21	MAJOR STRATA CHANGE
PERCENT PASSING #200 SIEVE		(6.7)	MINOR STRATA CHANGE

NUMBER OF BLOWS TO DRIVE STANDARD
SPLIT SPOON (2" DIA) ONE FOOT WITH (17)
140 LB HAMMER AND 30 INCH DROP

LOCATION OF BORING
DATE OF DRILLING

NOTES:

1. BLOW COUNTS OBTAINED WITH CME AUTO HAMMER REFER TO ETL-1110-1-138.
2. LOCATION COORDINATES EXPRESSED AS IOWA SOUTH STATE PLANE NAD 83 IN FEET.
3. ELEVATIONS IN FEET, MSL 1912.



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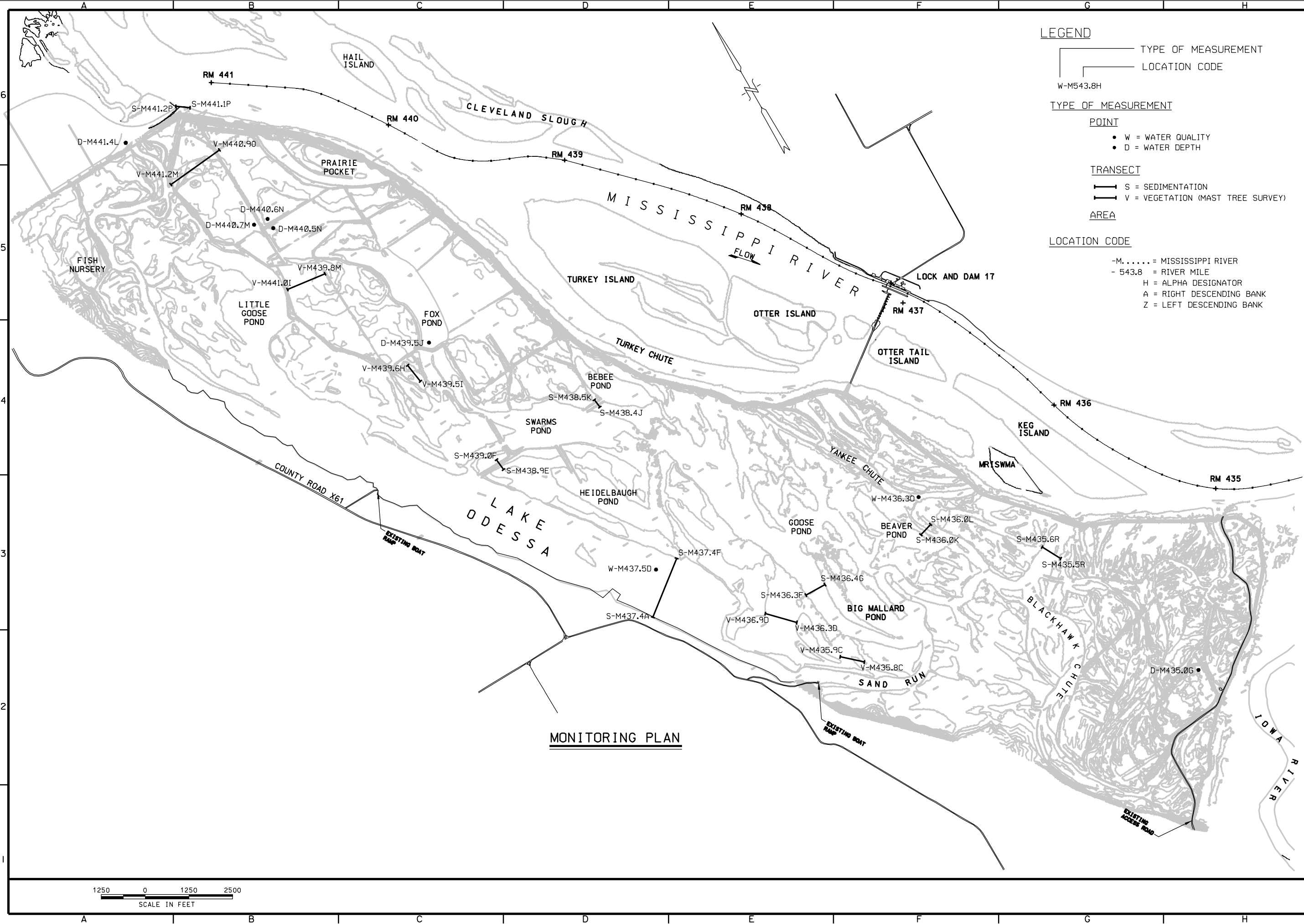
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By: JKD	Date: 27 JAN 04
	Drawn By: MMD	Scale: AS SHOWN
	Checked By: XXX	Project Code: EP12
	Reviewed By: XXX	Solicitation Number: DCPPE-ALB-XXX

MISSISSIPPI RIVER
EMP PROJECT LAKE ODESSA
LOUISA COUNTY, IOWA

BORING LOGS IX

Sheet
Reference
Number:
PLATE 52
Sheet 52 of 55





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Rock Island
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U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By:	JKD	Date:	27 JAN 04
	Drawn By:	TPD	Scale:	AS SHOWN
	Checked By:	RTN	Project Code:	EP12
	Reviewed By:	DWH	Specification Number:	
			Release Date:	

**FUTURE
MONITORING PLAN**

Sheet
Reference
Number:
PLATE 55
Sheet 55 of 55