POST-CONSTRUCTION
PERFORMANCE EVALUATION REPORT

ANDALUSIA REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

2015

US Army Corps of Engineers ®
Rock Island District

POOL 16

RIVER MILES 462.0-463.0

ROCK ISLAND COUNTY, ILLINOIS

ACKNOWLEDGEMENTS

AND

POINTS OF CONTACT

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EXECUTIVE SUMMARY

General. The design of the Andalusia Habitat Rehabilitation and Enhancement Project (HREP) was to provide the physical conditions necessary to improve and enhance wetland habitat quality. As stated in the Definite Project Report, the Andalusia Habitat Rehabilitation and Enhancement Project (HREP) was undertaken to address the following primary problems: limited management capability in providing quality habitat for waterfowl due to a lack of water level control. In the refuge south of Dead Slough, little or no water was present during the fall waterfowl migration. Sediments from the Mississippi River and adjacent uplands were decreasing the water volume in the refuge and backwater fisheries. This reduced water volume caused a succession from a dominance of aquatic bed palustrine wetlands to a more emergent plant species as well as decreasing deepwater fish habitat off the main channel.

Purpose. The purposes of this Performance Evaluation Report (PER) are as follows:

1. Document the pre- and post-construction monitoring activities for the Andalusia Habitat Rehabilitation and Enhancement Project
2. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR)
3. Summarize project operation and maintenance efforts, to date
4. Provide recommendations concerning future project performance evaluation
5. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects

Project Goals and Objectives. The specific goals and objectives as stated in the DPR were to:

1. Enhance Migratory Waterfowl Habitat
    a. Increase reliable food production area (moist soil species) through water control provisions
    b. Increase reliable resting and feeding water area through mechanical dredging
2. Enhance Aquatic Habitat
    a. Restore deep aquatic habitat through mechanical dredging
    b. Restore lentic-lotic habitat access cross-sectional area through mechanical dredging
    c. Improve dissolved oxygen concentration during critical stress periods through mechanical dredging and gated inlet structure construction
    d. Reduce sedimentation in refuge through levee construction and tributary diversion

Project Performance Monitoring. Pre and post-project monitoring, both qualitative and quantitative, was performed in accordance with the post construction monitoring plan from the original DPR. Monitoring and performance evaluation was conducted by the U.S. Army Corps of Engineers, Illinois Department of Natural Resources, and the U.S. Fish and Wildlife Service. The period of data collection covered in this report includes pre-project monitoring, and quantitative and qualitative post-project monitoring through 2015.

Evaluation of Project Objectives. For the evaluation period of 2004 to 2015, observations were made with regard to the efficacy of the objectives in meeting project goals. In addition, general conclusions were drawn regarding project measures that may affect future project design.

1. **Enhance Migratory Waterfowl Habitat**
    a. **Increase reliable food production area (moist soil species)**
        i. Evaluation Criteria: Increase reliable food production area to 130 acres.
        ii. General Observation: Total acreage of moist soil species within the project area is estimated to be considerably less than the forty acres originally observed in 1997.
        iii. Results: No vegetation surveys conducted.
        iv. Success: Desired acreage does not appear obtained.
        v. Conclusion: The project appears unsuccessful in meeting objective.
        vi. Lessons Learned & Recommendations: Recommend discontinuing vegetation surveys as further assessments of the HREP do not appear prudent given the current status of the HREP features.
    b. **Increase reliable resting and feeding water area**
        i. Evaluation Criteria: Increase reliable resting and feeding water area to 50 acres.
        ii. General Observation: Resting and feeding water area is present and is stable.
        iii. Results: Current total acres of desired water area at elevation 547 feet MSL is 70 acres.
        iv. Success: The evaluation criteria of 50 acres of desired water area has been met.
        v. Conclusion: The project was successful in meeting the objective.
        vi. Lessons Learned & Recommendations: The assessment criterion is sufficient to evaluating the project performance.
2. **Enhance Aquatic Habitat**
    a. **Restore deep aquatic habitat (depth ≥ 6')**
        i. Evaluation Criteria: Maintain 40 acre/feet of deep aquatic habitat (depth of 6 feet or greater) in Dead Slough.
        ii. General Observation: Sediment deposition has infilled the deep aquatic habitat.

iii. Results: Zero acre/feet of deep aquatic habitat remains in Dead Slough.
iv. Success: The evaluation criteria of 40 acre/feet of deep aquatic habitat was not met.
v. Conclusion: The project was unsuccessful in meeting the objective.
vi. Lessons Learned & Recommendations: Sedimentation rates appear higher than anticipated in the DPR. No future PER surveying efforts are recommended, but a more in-depth investigation of the causes of the higher than anticipated sedimentation rates should be conducted in order to provide lessons learned for future projects.

b. Restore lentic-lotic habitat access cross-sectional area

i. Evaluation Criteria: Restore lentic-lotic habitat access cross-sectional area to 180 ft^2.
ii. General Observation: The access channel to Dead Slough has been infilled by sedimentation.
iii. Results: Although the average cross sectional area has been reduced to 24 ft^2, the southern end of the access channel is completely infilled.
iv. Success: The evaluation criteria of 180 ft^2 of cross section area has not been met.
v. Conclusion: The effective cross sectional access is zero, as the southern end of the access channel has been infilled by sedimentation.
vi. Lessons Learned & Recommendations: Sedimentation rates appear higher than anticipated in the DPR. No future PER surveying efforts are recommended, but a more in-depth investigation of the causes of the higher than anticipated sedimentation rates should be conducted in order to provide lessons learned for future projects.

c. Improve dissolved oxygen concentration during critical stress periods

i. Evaluation Criteria: Improve dissolved oxygen concentration during critical stress periods to 4 mg/L.
ii. General Observation: Water quality objective has been met majority of reporting period.
iii. Results: All grab samples exceed 4 mg/L target level, majority of time of continuous monitoring.
iv. Success: Evaluation criteria of exceeding 4 mg/L has been mostly met.
v. Conclusion: The project was mostly successful in meeting objective.
vi. Lessons Learned & Recommendations: Continued lack of depth in access channel could lead to project being essentially isolated from main channel, so while oxygen levels were generally sufficient, the area only provides refuge to fisheries already in the project and does not provide refuge to fisheries outside of the project.

d. Reduce sedimentation in refuge

i. Evaluation Criteria: Reduce sedimentation in refuge to 4.2 acre-feet per year.
ii. General Observation: Sedimentation has occurred at a higher rate than anticipated in the DPR.
iii. Results: The refuge experienced a sedimentation rate of 14 acre-feet per year from the period of 1997 to 2014.
iv. Success: The evaluation criteria of 4.2 acre-feet per year has not been met.
v. Conclusion: The project was unsuccessful in meeting the sedimentation rate objective.
vi. Lessons Learned & Recommendations: Sedimentation rates appear higher than anticipated in the DPR. No future PER surveying efforts are recommended, but a more in-depth investigation of the causes of the higher than anticipated sedimentation rates should be conducted in order to provide lessons learned for future projects. .

Evaluation of Project Operation and Maintenance. The HREP Operation and Maintenance (O&M) Manual was completed in December 1995. Project features that require O&M include the deflection levee, pump station, water control structure, diversion drainage ditch, and inlet channel. However, redredging of the diversion drainage ditch and inlet channel was not considered an O&M requirement. Regular site inspections by the Refuge Manager have resulted in proper coordination and corrective maintenance actions.

Conclusions. The HREP is not meeting the objectives outlined in the DPR regarding deep aquatic habitat, lentic-lotic habitat cross section area, reliable food production area, and sedimentation reduction. However, adequate dissolved oxygen levels and resting/feeding water area have been maintained. At the time of this PER, no additional resources or funding is available to address the significant issues regarding sedimentation in the HREP. Further assessments of the HREP are not recommended given the current status of the HREP features, except for a more in-depth investigation of the causes of the higher than anticipated sedimentation rates.

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INTRODUCTION

The Upper Mississippi River Restoration Environmental Management Program (UMRR-EMP) is a Federal-State partnership to manage, restore and monitor the UMR ecosystem. The UMRR-EMP was authorized by Congress in Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) and reauthorized in 1999. Subsequent amendments have helped shape the two major components of EMP – the Habitat Rehabilitation and Enhancement Projects (HREPs) and Long Term Resource Monitoring (LTRM). Together, HREPs and LTRM are designed to improve the environmental health of the UMR and increase our understanding of its natural resources.

Habitat Rehabilitation and Enhancement Project (HREP) construction is one element of the UMRR-EMP. In general, the projects provide site-specific ecosystem restoration, and are intended and designed to counteract the adverse ecological effects of impoundment and river regulation through a variety of modifications, including flow introductions, modification of channel training structures, dredging, island construction, and water level management. Interagency, multi-disciplinary teams work together to plan and design these projects.

The Andalusia Refuge HREP is part of the UMRR-EMP. This project consisted of a perimeter levee, pump station, water control structure, drainage channels and islands and a moist soil management unit (MSMU) that were designed to enhance migratory waterfowl habitat, and enhance aquatic habitat.

1. Purpose of Project Evaluation Reports. The purposes of this Project Evaluation Report for Andalusia Refuge HREP are to:

a. Document the pre- and post-construction monitoring activities for the Andalusia Refuge HREP
b. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR)
c. Summarize project operation and maintenance efforts, to date
d. Provide recommendations concerning future project performance evaluation
e. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects

2. Scope. This report summarizes available monitoring data, operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) information, and project observations made by the U.S. Army Corps of Engineers (USACE), Illinois Department of Natural Resources (ILDNR), and the U.S. Fish and Wildlife Service (USFWS). The period of data collection covered in this report includes the pre-construction monitoring to post-construction monitoring as of 2015.

3. Project References. Published reports which relate to the Andalusia Refuge HREP are:

a. Definite Project Report with Integrated Environmental Assessment (R-5), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River, Rock Island County, Illinois, July 1989.

b. Operation and Maintenance Manual, Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River Environmental Management Program, Pool 16, River Mile 462.0-463.0, Rock Island County, Illinois, June 1994.

c. Post-Construction Performance Evaluation Report (PER5F), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River Mile 462.0-463.0, Rock Island County, Illinois, February 1996.

d. Post-Construction Supplemental Performance Evaluation Report (SPER501F), Andalusia Refuge Rehabilitation and Enhancement, upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, August 1998.

e. Post-Construction Performance Evaluation Report- Year 8 (2000), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, June 2001.

f. Post-Construction Performance Evaluation Report- Year 8 (2000), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, April 2002

g. Post-Construction Performance Evaluation Report- Year 10 (2002), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, July 2003

4. Project Location. The Andalusia Refuge HREP project is located in Rock Island County, IL, on the left descending bank of the Mississippi River, between River Miles 462.0-463.0 (Figure 1). The project is operated by the ILDNR under the terms of a Cooperative Agreement with the USFWS.

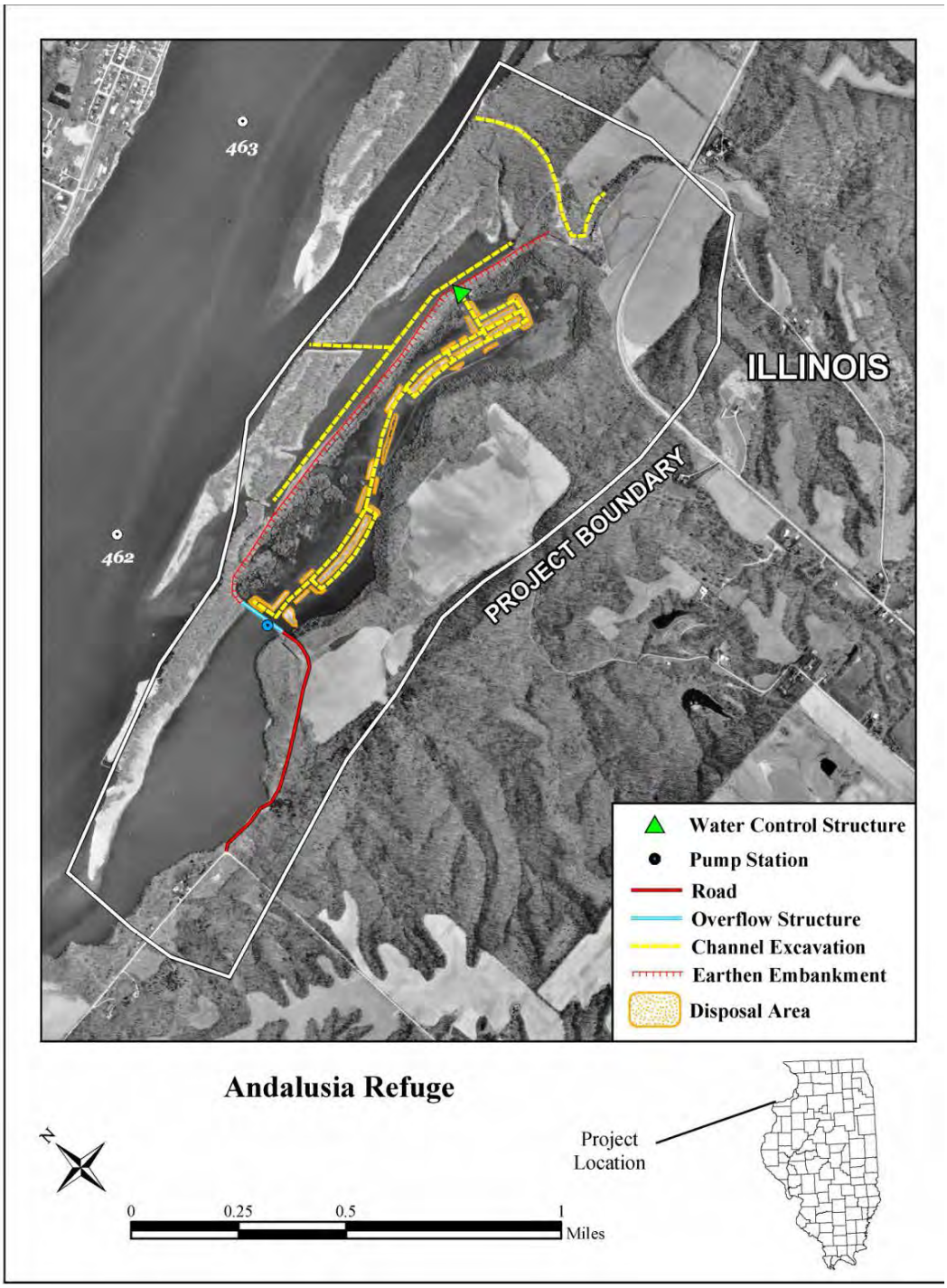

Figure 1. Andalusia Refuge HREP

PROJECT PURPOSE

1. Overview. The design of the Andalusia Refuge HREP was to provide the physical conditions necessary to improve and enhance wetland habitat quality. The specific goals as stated in the Definite Project Report (DPR) were to: enhance migratory waterfowl habitat and enhance aquatic habitat. In order to achieve these goals, the limited management capability in providing quality habitats due to a lack of water level control at the site needed to be addressed. In the refuge south of Dead Slough, little or no water was present during the fall waterfowl migration. Sediments from the Mississippi River and adjacent uplands were decreasing the water volume in the refuge and backwater fisheries. This reduced water volume caused a succession from a dominance of aquatic bed palustrine wetlands to a more emergent plant species as well as decreasing deepwater fish habitat off the main channel. The problems, opportunities, goal, objectives and measures implemented to address the goals and objectives are listed in Table 1.

2. Management Plan. A formal Annual Management Plan has been developed for the Andalusia HREP. This plan was developed by the USACE, in coordination with the ILDNR, as shown in Table 2. The Andalusia HREP is managed by the ILDNR under authority of Cooperative Agreements with the USACE and USFWS.

Table 1. Problems, Opportunities, Goals, Objectives, and Measures

Problems	Opportunities	Goals	Objectives	Restoration Measures
Lack of quality waterfowl habitat	Provide refuge for fall migratory waterfowl	Enhance Migratory Waterfowl Habitat	Increase reliable food production area	Water Control Structure
			Improve reliable resting/feeding water area	Mechanical Dredging
Sedimentation reducing aquatic habitat	Restore backwater fishery habitat	Enhance Aquatic Habitat	Improve Dissolved oxygen concentrations	Water Control Structure, Mechanical Dredging
			Restore lentic-lotic cross sectional area	Mechanical Dredging
			Restore deep aquatic habitat	Mechanical Dredging
			Reduce sedimentation	Levee, Diversion Channel

Table 2. Original Management Plan for Andalusia Refuge HREP as Stated in the DPR

Time Frame	Management Action	Purpose
May to July	Dewater Moist Soil Management Unit (MSMU) by pumping capability or gravity drainage to the draw down elevation of 542 feet MSL [1/]	Expose mudflats to allow revegetation
August to November	Gradually increase MSMU water levels to correspond with growth of marsh plant community [2/]	Provide access to food plants for migratory waterfowl
December to April	Maintain MSMU water levels to maximum extent possible (elevation 547 feet MSL) primarily by use of the pump station [3/]	Control excessive plant growth, if necessary, and provide stable, deeper water to prevent complete ice-up (a critical concern for resident furbearers)

[1/] Some adjustment shall be made to the drawdown elevation so that fisheries benefits are maximized without adversely impacting moist soil plant production.

[2/] Elevations higher than 547 feet MSL must be coordinated with adjacent property owners during the non-crop season.

[3/] Dewatering during February through April may be required to accomplish vegetation changes within the MSMU.

PROJECT DESCRIPTION

1. Project Measures. The Andalusia Refuge HREP consists of a moist soil management unit, deep aquatic habitat, lentic-lotic access channel, diversion drainage ditch, and project access road. A detailed description of each of these measures is provided below. See Figure 1 for locations of measures.

a. Moist Soil Management Unit (MSMU). The main feature is the perimeter levee, constructed to protect the 130-acre MSMU. Other MSMU features include a pump station, water control structure, and interior/side drainage channels with associated islands.

i. Perimeter Levee. The MSMU is surrounded by a perimeter levee approximately 8,600 feet in length with a 12-foot crown (60-foot crown parallel to Dead Slough) and 4 horizontal on 1 vertical side slopes. The top elevation of the perimeter levee varies from 551.8 to 552.8 feet MSL. The perimeter levee at the downstream end consists of a 600-foot-long armored overflow section. The overflow section has a crown width of 12 feet and the side slopes are protected with 6 inches of bedding overlain by 24 inches of riprap. The top elevation of this section is 550.8 feet MSL, equivalent to a 2-year frequency flood event.

ii. Pump Station. The location of the pump station is near the downstream end of the perimeter levee within the overflow section at Station 28+70CE. The pump station is equipped with two pumps that provide the capability to dewater the MSMU during drawdown times and to add water from the Mississippi River into the MSMU if rainfall is insufficient to maintain desired water levels. The pump station was sized to evacuate the MSMU in approximately 14 days. However, actual performance exceeds design requirements. The pump station has dewatered the MSMU in about 7 to 10 days. The rated capacity of both pumps is 6,775 gallons per minute at a Total Dynamic Head of 8.5 feet.

The pump station includes trash racks on both the MSMU and riversides. The sedimentation zone was provided on the MSMU side, which consists of an overflow weir protecting the entrance to the pump station to minimize the input of sediment during drawdown periods. The pump station also has two fence screens on the riverside to provide additional protection. The pump station houses an electrically driven 3-foot by 3-foot sluice gate to allow passage of gravity flows. This gate is used only when gravity discharge through the water control structure alone does not have sufficient capacity to drain the refuge as

quickly as required, or when access to the water control structure is difficult due to wet conditions that would cause damage to the levee surface.

iii. **Water Control Structure.** The water control structure consists of a 36-inch-diameter concrete conduit controlled by a 3-foot by 3-foot sluice gate and is located within the perimeter levee section near the eastern edge of Dead Slough at approximately Station 22+00. The invert of the conduit is at elevation 542 feet MSL.

iv. **Interior/Side Drainage Channels with Associated Islands.** Interior drainage within the MSMU is provided through excavated fish access channels. Two types of typical sections were constructed, Type I and Type II. A Type I section consists of drainage channels constructed on both sides of an island. The excavated material produces an approximate 45-foot-wide island with a top elevation of 551 feet MSL. Type II refuge excavation consists of drainage channel constructed on one side of the excavation with excavated material producing an approximate 10-foot-wide island with an elevation of 551 feet MSL. The overall length of the refuge drainage channels is close to 8,600 feet.

The MSMU was designed to provide a reliable resting and feeding area for migrating waterfowl in existing open areas, as well as an additional food source within the inundated "green tree" portion of the unit.

b. Deep Aquatic Habitat. The Contractor excavated approximately 85,000 cubic yards from Dead Slough for deep aquatic habitat improvement. Upon completion, a channel approximately 4,500 feet in length was excavated to 9 feet below flat pool (elevation 545 feet MSL) with an average bottom width of 60 feet. The excavated material was placed in the levee section adjacent to Dead Slough.

c. Lentic-Lotic Access Channel. A 1,100-foot lentic-lotic access channel connects Sisco Chute to Dead Slough. Originally, the access channel was constructed to have a bottom width of approximately 30 feet with a depth that varied from 4 feet to 9 feet below flat pool (elevation 545 feet MSL). However, the access channel experienced greater than estimated sedimentation rates as a result of the Great Flood of 1993. It was subsequently re-excavated in March 1994 to 7 feet below flat pool to match existing river bottom elevations. The access channel was again excavated in 1998 to 5 feet below flat pool following the Flood of 1997.

d. Diversion Drainage Ditch. Drainage from the watershed along the upstream or eastern edge of the project area is routed through the diversion drainage ditch to Sisco Chute.

The bottom width of the excavated ditch is approximately 30 feet, with an average depth of 3 feet. The drainage ditch was sized to pass a 2-year frequency flood event within the banks. The outlet of the diversion drainage ditch into Sisco Chute was placed near flat pool (elevation 545 feet MSL) in order to reflect the previous drainage outlet and maximize maintenance. The diversion drainage was designed to reduce the present sediment load in the watershed by approximately 25 percent as discussed in the DPR, Appendix K. This reduction was anticipated to improve the water quality in Dead Slough by reducing suspended solids and chemicals associated with agricultural runoff.

e. Project Access Road. The approximately 3,600-foot-long access road follows the Government property line from the pump station to the county road just outside the project limits. The top width of the access road is 12 feet. Crushed stone was placed to a depth of approximately 6 inches.

2. Project Construction. The Andalusia Refuge HREP project was approved for construction in August 1989. Deep aquatic habitat excavation was finished in the summer of 1992. The Great Flood of 1993 caused minor erosion along the access road and some silting of the ditches. The areas were restored by contract modification. Re-excavation of the access channel to remove sediment deposited as a result of the Great Flood of 1993 was completed in March 1994 by the USACE. The Andalusia HREP was essentially complete in September 1994. A low water crossing was installed to improve access road drainage and reduce sediment buildup in August 1997. The access channel was re-excavated in 1998 following the Flood of 1997.

3. Project Operation and Maintenance. In the original DPR it was estimated that the Andalusia Refuge HREP would require little maintenance. Operation and maintenance responsibilities for the Andalusia Refuge HREP were originally outlined in the DPR. The acceptance of these responsibilities was formally recognized by an agreement signed by the ILDNR and the Rock Island District, USACE. A detailed description of all operation and maintenance requirements can be found in the Project Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (OMRR&R Manual). The OMRR&R Manual for the project delegated responsibilities and procedures for post project activities. Project operation and maintenance generally consists of the following:

a. Mowing and maintaining the perimeter levee to ensure serviceability during times of flood.

b. Operating the pump station and water control structure to achieve desired water levels consistent with vegetative growth, and opening the gates to minimize overtopping erosion when the river reaches elevation 550 feet MSL on the Fairport gage with predicted stage to increase.

c. Maintaining the interior/side drainage channels with associated islands as determined by the ILDNR Site Manager.

d. Removing snags and other debris from Dead Slough, the access channel, and the diversion drainage ditch.

Appendix D includes copies of Site Manager Project Inspection Reports from 2010 through 2015, and photos of recent O&M activities and issues.

PROJECT PERFORMANCE MONITORING

1. General. Performance monitoring of the Andalusia Refuge HREP has been conducted by USACE to help determine the extent to which the design meets the habitat improvement objectives. Information from this monitoring will also be used, if required, for adaptive management.

The monitoring and performance evaluation matrix is outlined in Table 3. Pre- and post-project monitoring, both qualitative and quantitative by each of the involved agencies, is as follows.

a. U.S. Army Corps of Engineers. The success of the project relative to original project objectives shall be measured utilizing data, field observations, and project inspections provided by, USFWS, ILDNR, and USACE. The USACE was responsible for collecting field data as outlined in the Post-Construction Evaluation Plan at the specified time intervals. The USACE shall also perform joint inspections with the USFWS and ILDNR in accordance with ER 1130-2-339. The purpose of these inspections is to assure that adequate maintenance is being performed as presented in the DPR and O&M Manual. Joint inspections should also occur after any event that causes damage in excess of annual operation and maintenance costs. The USACE has overall responsibility to measure and document project performance.

b. Illinois Department of Natural Resources. The ILDNR is responsible for operating and maintaining the Andalusia Refuge HREP. The ILDNR is also responsible for monitoring the project through field observations during inspections. Project inspections should be performed on an annual basis following the guidance presented in the O&M Manual. It is recommended that the inspections be conducted in May or June, which is representative of conditions after spring floods. Joint inspections with the USACE and USFWS shall also be conducted as mentioned above. During all inspections, the ILDNR should complete the checklist form as provided in the O&M Manual. This form should also include a brief summary of the overall condition of the project and any maintenance work completed since the last inspection. Once completed, a copy of the form shall be sent to USACE. ‘’

c. U.S. Fish and Wildlife Service. The USFWS does not have project-specific monitoring responsibilities. However, the USFWS should be present at the joint inspections with the USACE and ILDNR as described above.

Table 3. Monitoring and Performance Evaluation Matrix

Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions	USGS	USGS	LTRMP	-
Pre-project Monitoring	Identifies and defines problems at HREP site. Established need for proposed project feature	USFWS	USFWS	USFWS	-
Baseline Monitoring	Establishes baselines for performance evaluation	USACE	USACE	HREP	See Appendix A, Table A-2
Data Collection for Design	Includes identification of project objectives, design of project, and development of performance evaluation plan	USACE	USACE	HREP	See Appendix A, Table A-2
Construction Monitoring	Assesses construction impacts; assess permit conditions are met	USACE	USACE	HREP	See State Section 401, *Stipulations*
Performance Evaluation Monitoring	Determine success of project as related to objectives	USACE/ILDNR	USACE/ILDNR	HREP	See Appendix A, Table A-2
Analysis of Biological Responses to Project	Evaluates predictions and assumptions of habitat unit analysis. Determine critical impact levels, cause-effect relationships, and effect on long-term losses of significant habitat	USACE	USACE	HREP	-

PROJECT EVALUATION

1. Construction and Engineering. Construction began in September 1989 and was substantially completed in September 1994, except for a low water crossing to improve road drainage and reduced sedimentation. Final construction was completed in August 1997.

2. Costs. In the original DPR, cost estimates for the entirety of the project were $1,870,000.00. Initial construction costs were $2,741,000.00. As of the 2014, the total cost of the Andalusia Refuge HREP was $2,785,000.00.

3. Operation and Maintenance. In the original DPR, over the 50-year project life the estimated cost was $570,000.00. From the estimate, an average annual operation and maintenance cost was calculated to be $11,400.00. This amount included pump station energy costs, inspections, mowing, diversion ditch cleanout, levee repair, riprap replacement and pump station maintenance. No OMRR&R costs were available at the time of this report. Sponsor OMRR&R activities including mowing, spring burns, animal burrow repairs, removal of debris in diversion ditch and inlet channel, removal of beaver dens, access road repairs, levee repairs from flooding, riprap replacement and repair, pump station operation, water control structure operation and pump maintenances.

Based on sponsor inspection reports dating back to 2010, OMRR&R issues that are routinely present include tree debris in Dead Slough, beaver activity, silt and vegetation debris in the trash rack and around the pump station, and silting in of the Dead Slough inlet channel. The pump station has suffered from chronic problems associated with detritus clogging the float-inlet channel, and water manipulation has been difficult due to river flood pulses, pump-in operations, etc., which has rendered the water manipulation schedule difficult to adhere to. Sponsor also indicated that the long distance that O&M staff has to travel to get from their office to the HREP, combined with intermittent funding from the State of Illinois, has contributed to less than optimal performance and maintenance of the HREP.

4. History of Major Disturbances. Flooding in 2008, 2013 and 2014 has caused damage to the perimeter levee. The levee damage is partially repaired. The Spring 2013 flood also caused overtopping erosion near the pump station.

5. Ecological Effectiveness. Following is a summary of the performance evaluation plan and schedule for Andalusia Refuge HREP goals and objectives (Table 4).

i. Increase reliable food production area (moist soil species)

General. One of the specific project objectives for the Andalusia HREP was to increase the reliable food production area (moist soil species) for waterfowl usage. The pump station and sluice gate were installed provide water control and increase reliable food production area to 130 acres.

Pre- and Post-Project Conditions. Pre-construction waterfowl usage was low primarily to the erratic food production in the Refuge. Available food such as Duck potato, wild millet and smartweed varied according to water level fluctuations. Summer flooding prevented germination and growth of food producing plants, and late fall flooding often inundated the plants that had survived.

With the addition of water control features, management of a MSMU was possible. In August of 1997 forty acres of food production area was observed. Moist soil plants primarily consisting of pigweeds, nutsedges, wild millet and smartweeds were observed.

Conclusion. The lack of active management of water levels within the unit continues to limit its ability to produce a reliable crop of native moist-soil vegetation available as a food source to migrating waterfowl. All species of moist soil plants initially found on the project area can still be found there, but the total acreage of this cover type within the project area is estimated to be considerably less than the 40 acres originally observed in 1997.

While maintenance of the perimeter levee is likewise constrained by the sponsor's limited resources, it is interesting to note that the original cover planting of reed canary grass (*Phalaris arundinaceae*), a species no longer used for planting on UMRR ecosystem restoration projects due to its invasive and monotypic characteristics, has served the levee structure fairly well despite reduced maintenance activity, by protecting the structural integrity of the levee during frequent flood episodes, and by preventing overgrowth by woody vegetation.

Based on site reconnaissance of water depths, USFWS staff had suggested that the backwater area west of the HREP and immediately west of the pump station be considered for future additional MSMU area. This recommendation was coordinated with the UMRR manager. Since this project is closed, changes would be considered as a New Start project and the Sponsors would need to follow the UMRR New Start process.

ii. Increase reliable resting and feeding water area

General. Mechanical dredging was used to provide islands within the MSMU, and water control structures were installed to provide a reliable water elevation for resting and feeding area. The Year 50 Goal is 50 acres of reliable resting and feeding water area.

Pre- and Post-Project Conditions. Pre-construction Refuge conditions were dominated by shallow water and varying species of wetland vegetation. Dead Slough had no deep open water and was 100 percent composed of submergent vegetation. Backwater ponds and inlets had converted to vegetated mudflats, willow thickets and other emergent wetland types.

The MSMU and adjacent levee constructed as part of the project enabled maintaining a water elevation of 547 feet MSL over the winter months. In 1997 sedimentation transects were conducted and indicated that 50 acres of open water existed at elevation 547. Subsequent sedimentation transects were conducted in 2014. The 2014 survey indicated 70 acres of desired water area exists at elevation 547.

Conclusion. The project measures were successful in providing the desired area of feeding and resting water. The perimeter levee appears to have adequately minimized sedimentation and geomorphologic changes within the MSMU.

iii. Restore deep aquatic habitat (depth ≥ 6')

General. Mechanical dredging was conducted to create enhance aquatic habitat, specifically deep aquatic habitat (depth ≥ 6'). The Year 50 Goal for this objective is maintaining 40 acre/feet of habitat depth six feet or greater in Dead Slough.

Pre- and Post-Project Conditions. Prior to project construction, 100 percent of Dead Slough was composed of submergent vegetation, and the maximum depth was 1.5 feet below flat pool (545 feet MSL). As part of the HREP construction, approximately 85,000 cubic yards of materials were mechanically dredged from Dead Slough. Sedimentation transects A, C and E intersect these dredge cuts. Surveys of these transects have been conducted in 1996, 2006 and 2014. The as-built volume of deep aquatic habitat (1992) was 55.8 acre/feet. In 1996 the volume had decreased to 34 acre/feet. The 2006 survey indicated a further reduction to 3.8 acre/feet. As of 2014, there is no deep aquatic habitat remaining in Dead Slough. Sedimentation transects are included in Appendix B.

Conclusion. The project measures were unsuccessful in providing the ability to maintain deep aquatic habitat. Sedimentation rates, either progressively or in punctuated events (flooding) appear higher than anticipated in the DPR. No further surveying of sedimentation transects is recommended.

iv. Restore lentic-lotic habitat access cross-sectional area

General. Restore lentic-lotic habitat access cross-sectional area was established as an objective to increase connectivity with the Mississippi River. The Year 50 Goal for this objective is 180 square feet of cross-sectional area in the Dead Slough access channel.

Pre- and Post-Project Conditions. Prior to construction, Dead Slough had no connection to the Mississippi River except during floods. There was no deep open water and the Slough was dominated by aquatic vegetation. Fish populations were sporadic and stage dependent, and severe summer and winter fish kills were reported. Fish were trapped in the Slough after floodwaters recede, and then subject to extreme dissolved oxygen and temperate stress.

As part of the project, a 1,100-foot long access channel was constructed to connect Sisco Chute (Mississippi River) to Dead Slough. Original construction of the access channel had a bottom width of 30 feet, with a depth of 4 to 9 feet below flat pool. Following the Great Flood of 1993, the channel was re-excavated to a depth of 7 feet below flat pool. After silting in again, the channel was re-excavated in 1998 to 5 feet below flat pool. Soundings in July 2002 indicated the cross-sectional area of the channel was 135 square feet.

Access channel sedimentation transects were surveyed in 2014. Two transects are located in the access channel, D1, located on the north end and influenced by the Mississippi River, and D2, located on the south end adjacent to Dead Slough. The 2014 survey data indicated that the cross sectional area below flat pool (elevation 545 feet MSL) at D1 is 48 square feet, while the cross sectional area at D2 is 0 square feet. As the access channel is silted in at D2, the effective cross sectional area is 0 square feet. Sedimentation transects are included in Appendix B.

Conclusion. The project measures were unsuccessful in providing the ability to maintain adequate cross-sectional area in the access channel. It is apparent that sedimentation rates in the access channel, either associated with flooding or normal river function are too great to keep the access channel open for any extended period of time.

v. Improve dissolved oxygen concentration during critical stress periods

General. The water quality objective of the Andalusia Refuge project is to improve dissolved oxygen (DO) concentrations in Dead Slough during critical seasonal stress periods, which is targeted at 4.0 mg/L.

Pre- and Post-Project Conditions. Prior to project completion, severe winter and summer fish kills in Dead Slough were reported by local residents and ILDNR personnel. It is presumed these fish kills were due to low DO concentrations coupled with thermal stress. In an effort to avoid future fish kills, dredging was utilized to create both deep aquatic habitat within Dead Slough and an access channel from the slough to the Mississippi River.

A fish kill in Dead Slough during the summer of 2006 reported by the ILDNR was likely the result of low DO concentrations. However, there were no fish kills reported to USACE staff during the current reporting period of 2007 to 2015. For this evaluation period, DO concentrations remained well above 4 mg/L for all grab samples and a majority of the time during continuous monitoring. During the summer season, continuous monitoring data indicates that DO concentrations did fall below 4 mg/L occasionally, but most often the duration for low DO was only a few hours during the night, returning above the target level during the following daytime hours. See Appendix C, Water Quality Analysis, for detailed information.

Conclusion. For the current evaluation period, the project was mostly successful in attaining this goal during the critical seasonal stress periods, especially during the winter months. Due to the large amount of sediment deposition in Dead Slough and the access channel, this success may be short-lived. With a lack of sufficient depth in the access channel, the project is at times isolated from the main channel, which may prohibit fish from entering or exiting the slough during severe conditions. Additionally, fish present in Dead Slough maybe exposed to more frequent durations of low DO and thermal stresses, leading to more frequent fish kills in critical seasonal stress periods.

vi. Reduce sedimentation in refuge

General. The final objective for the HREP was to reduce sedimentation in refuge. The Year 50 goal is 4.2 acre-feet of annual sedimentation within Dead Slough and the MSMU.

Pre- and Post-Project Conditions. An average sedimentation rate of 0.5 inches/year was calculated for the Refuge from the period 1936 to 1987, with a sedimentation rate of 0.8 inches/year in Dead Slough. The Mississippi River and adjacent upland erosion were identified as sedimentation sources, with a contribution of 11 acre-feet per year and 6 acre-feet per year respectively.

A two-year event perimeter levee was constructed around the MSMU as part of the HREP construction. In addition, a drainage diversion ditch was installed on the eastern edge of the Refuge. These two features were constructed to reduce the sediment load entering the Refuge.

Sedimentation transects A, C, E, I and K intersect the MSMU and Dead Slough. The transects were surveyed in 1997, 2006 and 2014. Transects C and E did not include Dead Slough in the 2006 survey effort. Differences in bottom sediment elevations between the 1997, 2006 and 2014 were calculated for each transect, and sedimentation rates calculated based on the appropriate time period. For the MSMU an average sedimentation rate of 0.08 inch/year was determined for the 2006 to 2014 time period. For Dead Slough, a 1.6 inch/year sedimentation rate was determined for the 1997 to 2014 time period. An average sedimentation rate of 0.07 feet/year for the 1997-2014 time period over the 200 acre portion of the Refuge that can be inundated converts to an average of 14 acre-feet per year of sedimentation. Sedimentation transects are included in Appendix B.

Conclusion. The project measures were unsuccessful in providing the ability to reduce sedimentation to the desired rate of 4.2 acre-feet per year. The effects of flood sediment deposition and/or normal deposition are greater than anticipated in the DPR. Dead Slough is where the majority of sedimentation is occurring, which is logical considering its proximity to the Mississippi River, and lack of levee protection.

Table 4. Performance Evaluation and Monitoring Schedule

				Monitoring Target Values			
Goal	**Objective**	**Enhancement Measure**	**Units**	**Year 0 w/ Project**	**Year 22 w/ Project**	**Year 50 Target w/ Project**	**Feature Measurement**
Enhance Migratory Waterfowl Habitat	Increase reliable food production area (moist soil species)	Provide water control	Acres	0	NM*	130	Vegetation Transects
	Increase reliable resting and feeding water area	Mechanical dredging	Acres	0	70	50	Hydrographic Soundings
Enhance Aquatic Habitat	Restore deep aquatic habitat (depth ≥6')	Mechanical dredging	Ac-ft	0	0	40	Hydrographic Soundings
	Restore lentic-lotic habitat access cross-sectional area	Mechanical dredging	Ft^2	0	0	180	Hydrographic Soundings
	Improve DO concentration during critical stress periods	Mechanical dredging and gated inlet structure	Mg/L (min) (max) (avg)	<4	4.46 25.90 11.33	≥4	Water Quality Testing at Stations
	Reduce sedimentation in refuge	Construct levee and divert tributary	Ac-ft year	11	14.4	4.2	Hydrographic Soundings

***Not Measured**

CONCLUSIONS

The HREP is not meeting the objectives outlined in the DPR regarding deep aquatic habitat, lentic-lotic habitat cross section area, reliable food production area, and sedimentation reduction. However, adequate dissolved oxygen levels and resting/feeding water area have been maintained. At the time of this PER, no additional resources or funding is available to address the significant issues regarding sedimentation in the HREP. Further assessments of the HREP are not recommended given the current status of the HREP features, except for a more in-depth investigation of the causes of the higher than anticipated sedimentation rates.

LESSONS LEARNED AND RECOMMENDATIONS FOR FUTURE SIMILAR PROJECTS

- Supervisory Control and Data Acquisition technology should be implemented at HREPs where feasible to lower O&M labor and costs.
- Location of base of operations for sponsor personnel responsible for O&M may have ramifications for performance of systems in HREP.
- The current methodology for estimating sedimentation through sporadic surveys of widely spaced transects is not sufficient.

REFERENCES

Published reports relating to the Andalusia HREP or which were used as references in the production of this document are presented below.

Definite Project Report with Integrated Environmental Assessment (R-5), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River, Rock Island County, Illinois, July 1989. This report marks the conclusion of the planning process and serves as a basis for approval of the preparation of final plans and specifications and subsequent project construction.

Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 16, River Miles 462.0-463.0, Andalusia Refuge, Solicitation No. DACW25-90-B-0031. These documents were prepared to provide sufficient detail of project features to allow construction of a confined dredged material placement site, hydraulically dredged channels, mechanically excavated channels, potholes, and check dams.

Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 16, River Miles 462.0-463.0, Andalusia Refuge, Contract No. DACW25-93-C-0034. This document was prepared to provide sufficient detail of project features to allow planting of mast trees.

Operation and Maintenance Manual, Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River Environmental Management Program, Pool 16, River Miles 462.0-463.0, Rock Island County, Illinois, June 1994. This manual was prepared to serve as a guide for the operation and maintenance of the Andalusia HREP. Operation and maintenance instructions for major features of the project are presented.

Post-Construction Performance Evaluation Report (PER5F), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River Mile 462.0-463.0, Rock Island County, Illinois, February 1996.

Post-Construction Supplemental Performance Evaluation Report (SPER501F), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois*,* August 1998

Post-Construction Performance Evaluation Report –Year 8 (2000), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, June 2001

Post-Construction Performance Evaluation Report- Year 8 (2000), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, April 2002

Site Manager's Project Inspection and Monitoring Results, Andalusia Refuge Rehabilitation and Enhancement, Operation and Maintenance Manual, Upper Mississippi River Environmental Management Program, Pool 16, River Miles 462 through 463, Rock Island County, Illinois, July 1996, August 1997, June 1998, July 1999, September 2000, September 2001, October 2002, June 2014.

Post-Construction Performance Evaluation Report- Year 10 (2002), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0-463.0, Rock Island County, Illinois, July 2003*.*

POST-CONSTRUCTION
PERFORMANCE EVALUATION REPORT

ANDALUSIA REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

2015

APPENDIX A

PERFORMANCE MONITORING AND ASSESSMENT GUIDANCE TABLES

Appendix A
Performance Monitoring and Assessment Guidance Tables

TABLE A-1. Sedimentation Transect Project Objectives to Be Evaluated

Transect	Increase Reliable Resting and Feeding Water Area	Restore Deep Aquatic Habitat	Restore Lentic-Lotic Habitat Access Cross-Sectional Area	Reduce Sedimentation in Refuge
Dead Slough				
A	X	X		X
C	X	X		X
D[1/]			X	
D1[1/]			X	
D2[1/]			X	
E	X	X		X
I	X			X
K	X			X
L[2/]				
M[2]				
P[2]				

[1/] Transects added during post-construction phase

[2/] Transects undisturbed by project construction

Appendix A
Performance Monitoring and Assessment Guidance Tables

TABLE A-2. Resource Monitoring and Data Collection Summary[1/]

	Water Quality Data													
	Pre-Project Phase		Design Phase		Post-Construction Phase		Engineering Data			Natural Resource Data				
Type Measurement	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Jun-Sep	Dec-Mar	Pre-Project Phase	Design Phase	Post-Construction	Pre- Project Phase	Design Phase	Post-Construction Phase	Sampling Agency	Remarks
POINT MEASUREMENTS														
Water Quality Stations[2/]													Corps	
Turbidity					2M	M								
Secchi Disk Depth	2W				2M	M								
Suspended Solids	2W				2M	M								
Dissolved Oxygen	2W				2M	M								
Specific Conductance	2W				2M	M								
Water Temperature	2W				2M	M								
PH	2W				2M	M								
Total Alkalinity					2M	M								
Chlorophyll (a,b,c)	2W				2M	M								
Velocity					2M	M								
Water Depth	2W				2M	M								
Pheophytin (a)	2W				2M	M								
Percent Ice Cover						M								
Ice Depth						M								
Percent Snow Cover						M								
Snow Depth						M								
Wind Direction					2M	M								
Wind Speed					2M	M								
Wave Height					2M	M								
Air Temperature					2M	M								
Percent Cloud Cover					2M	M								
Sediment Test Stations[3/]													Corps	
Bulk Sediment			1											
Elutriate			1											
Boring Stations													Corps	
Geotechnical Borings[4/]								1						
Column Settling Analysis[5/]								1						
Waterfowl Numbers													ILDNR	
Aerial Survey												Y		
Fish Stations													ILDNR	
Electrofishing/Netting												M		
TRANSECT MEASUREMENTS														

Appendix A
Performance Monitoring and Assessment Guidance Tables

TABLE A-2. Resource Monitoring and Data Collection Summary[1/]

	Water Quality Data													
	Pre-Project Phase		Design Phase		Post-Construction Phase		Engineering Data			Natural Resource Data				
Type Measurement	**Apr-Sep**	**Oct-Mar**	**Apr-Sep**	**Oct-Mar**	**Jun-Sep**	**Dec-Mar**	**Pre-Project Phase**	**Design Phase**	**Post-Construction**	**Pre- Project Phase**	**Design Phase**	**Post-Construction Phase**	**Sampling Agency**	**Remarks**
Hydrographic Soundings[6/]													Corps	
Hydrographic Soundings							1		5Y					
Vegetation Transects													Corps	
Moist Soil Plant Survey												5Y		
AREA MEASUREMENTS														
Mapping[7/]													Corps	
Aerial Photos/Remote Sensing										1		5Y		

1/ Resource Monitoring and Data Collection Summary

2/ Water Quality Stations W-M462.5O

3/ Sediment Test Stations (Design Phase)

DPR-R-1	DPR-L-1
DPR-R-2	DPR-L-2
DPR-R-3	DPR-L-3

4/ Boring Stations (Design Phase)

DPR-A-87-1	DPR-A-87-8
DPR-A-87-2	DPR-A-87-9
DPR-A-87-3	DPR-A-87-10
DPR-A-87-4	DPR-A-87-11
DPR-A-87-5	DPR-A-87-12
DPR-A-87-6	DPR-A-87-13
DPR-A-87-7	DPR-A-87-14

5/ Column Settling Stations (Design Phase) (50# Settlement Analysis)
DPR-Sample 1; DPR-Sample 2
DPR Sample 2

6/ Hydrographic Soundings

PER	O&M Manual	DPR
A	S-M462.6X to S-M462.9Q	Range A
C	S-M462.5U to S-M462.8L	Range C
D	None	None
D1	None	None
D2	None	None
E	S-M462.3U to S-M462.5M	Range E
I	S-M462.1W to S-M462.2N	Range I
K	S-M462.0Q to S-M462.1N	Range K
L	S-M461.8O to S-M461.8V	Range L
M	S-M461.7X to S-M461.7O	Range M
P	S-M461.3Y to S-M461.2S	Range P

7/ Mapping (Post-Construction Phase) – aerial survey shall be performed of the project area to determine the amount of waterfowl resting and feeding in project water areas

July 12, 1993 – color aerial photos (1" = 1000')
April 17, 1994 – color aerial photos (1" = 1000'
November 21, 1995 – black & white photos (1" = 1400')
November 24, 1995 – black & white photos (1" = 2800')
September 26, 1996 – color oblique aerial photos

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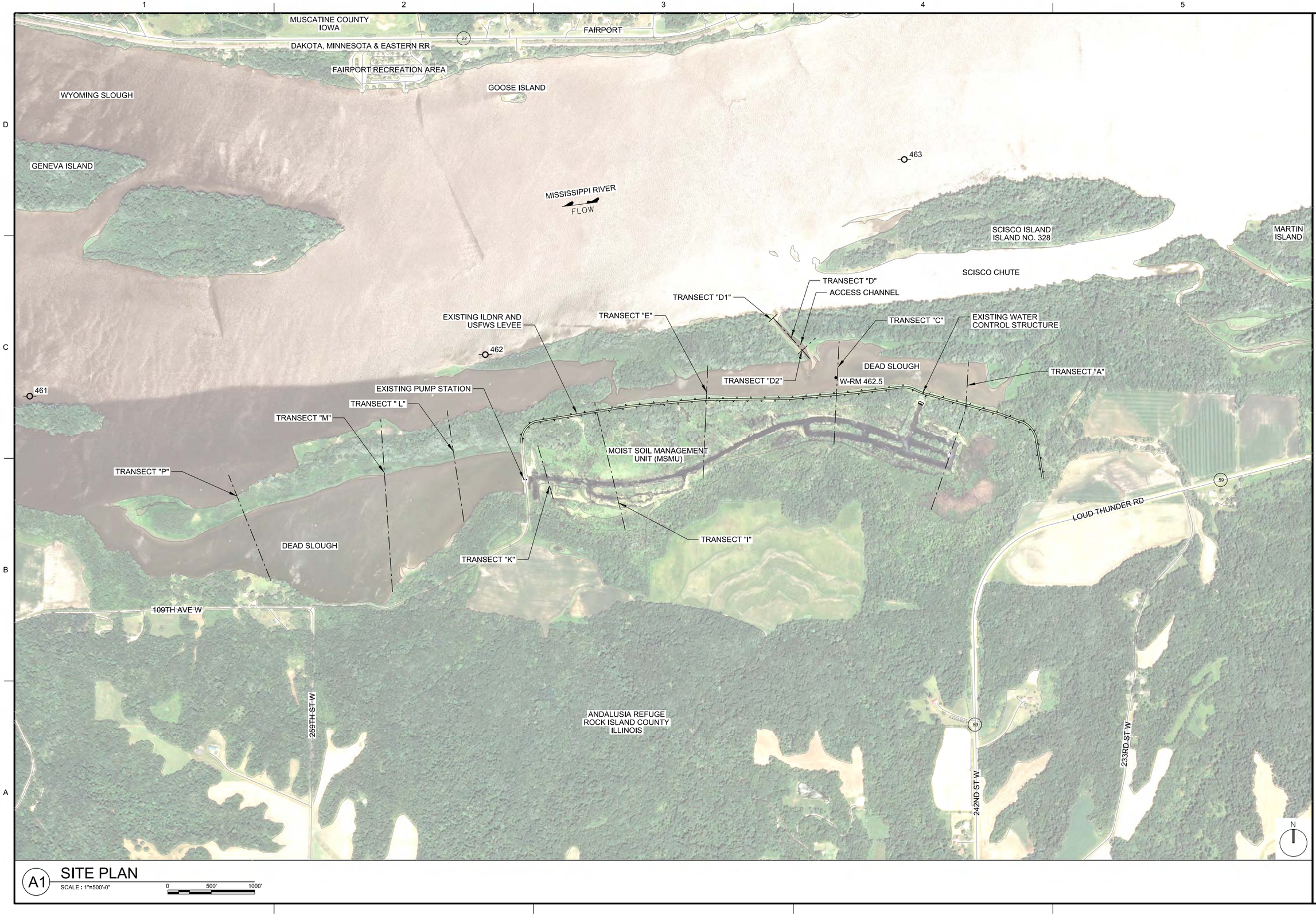
APPENDIX B

SURVEY TRANSECTS AND CROSS SECTION PLATES



A1 SITE PLAN

SCALE : 1"=500'-0" 0 500' 1000'

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CKD BY:
SUBMITTED BY:
DATE:
SOLICITATION NO.:
CONTRACT NO.:
PROJECT CODE:
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FILE NAME: PER_C-101XXX.dgn

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
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SITE PLAN

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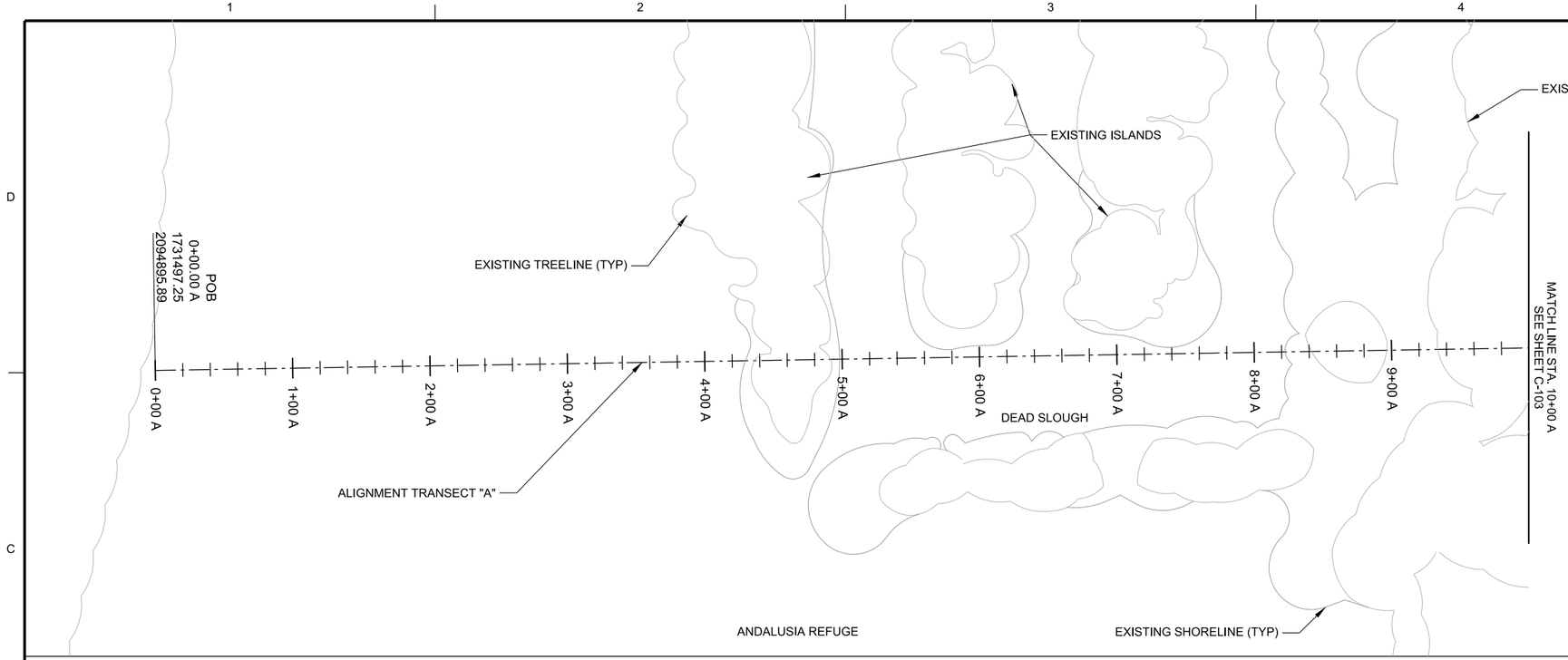

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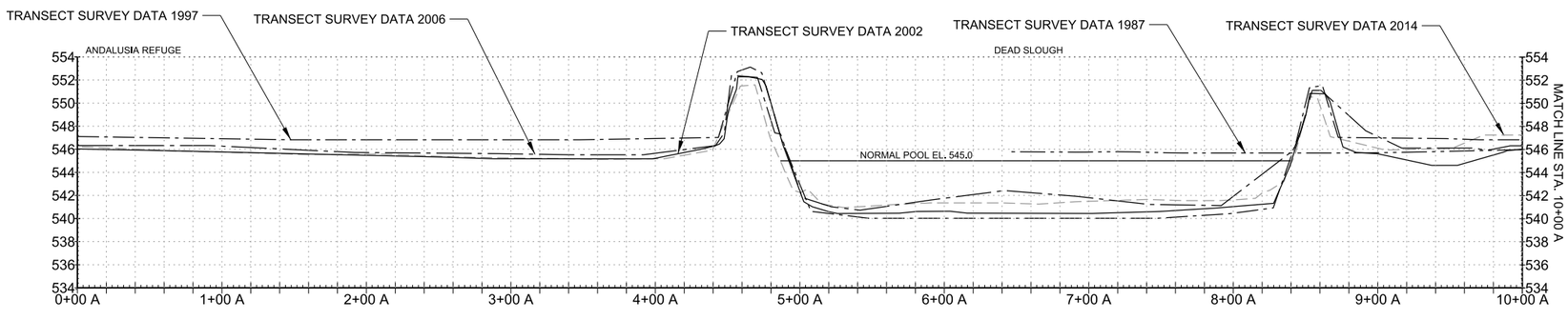

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TRANSECT "A" PLAN AND PROFILE
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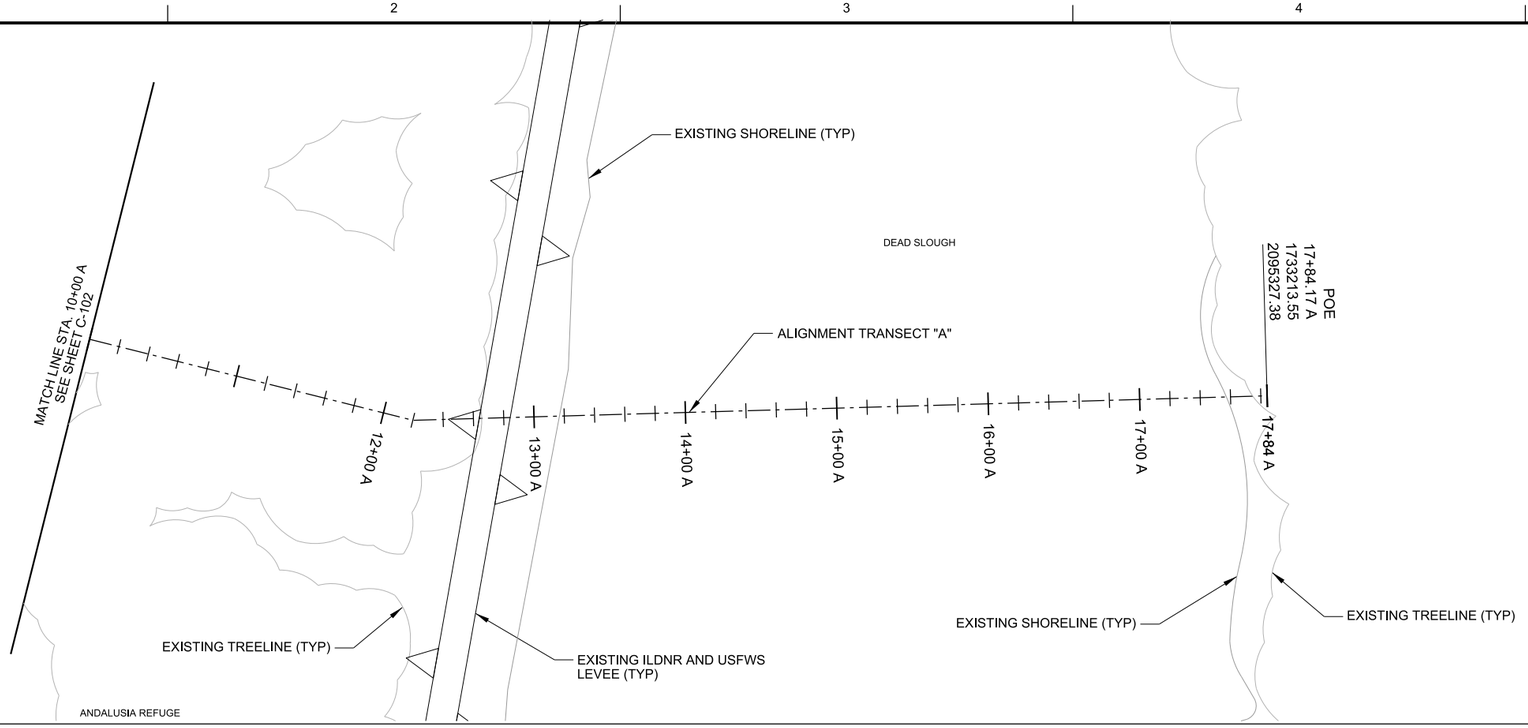

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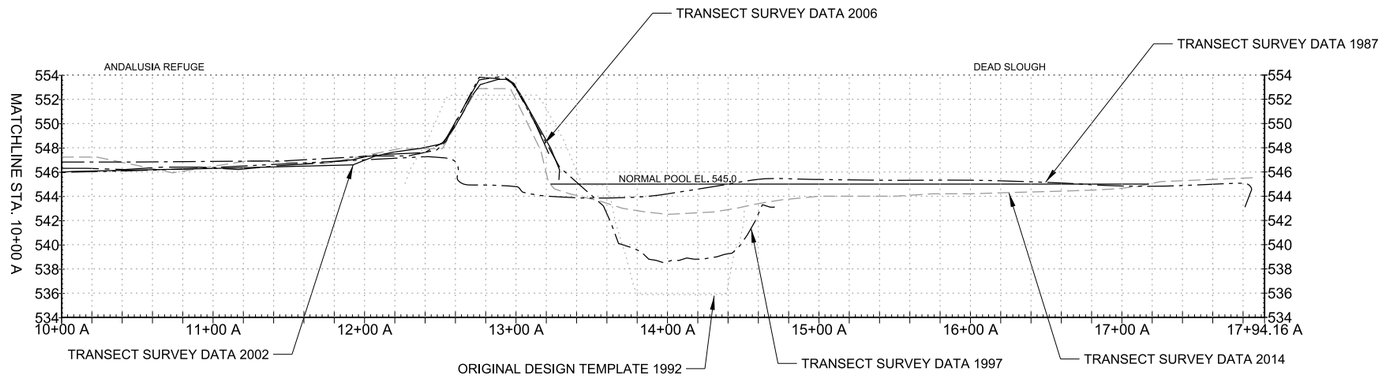

A1 TRANSECT "A" PROFILE STA. 9+00 A TO STA. 17+84.16 A

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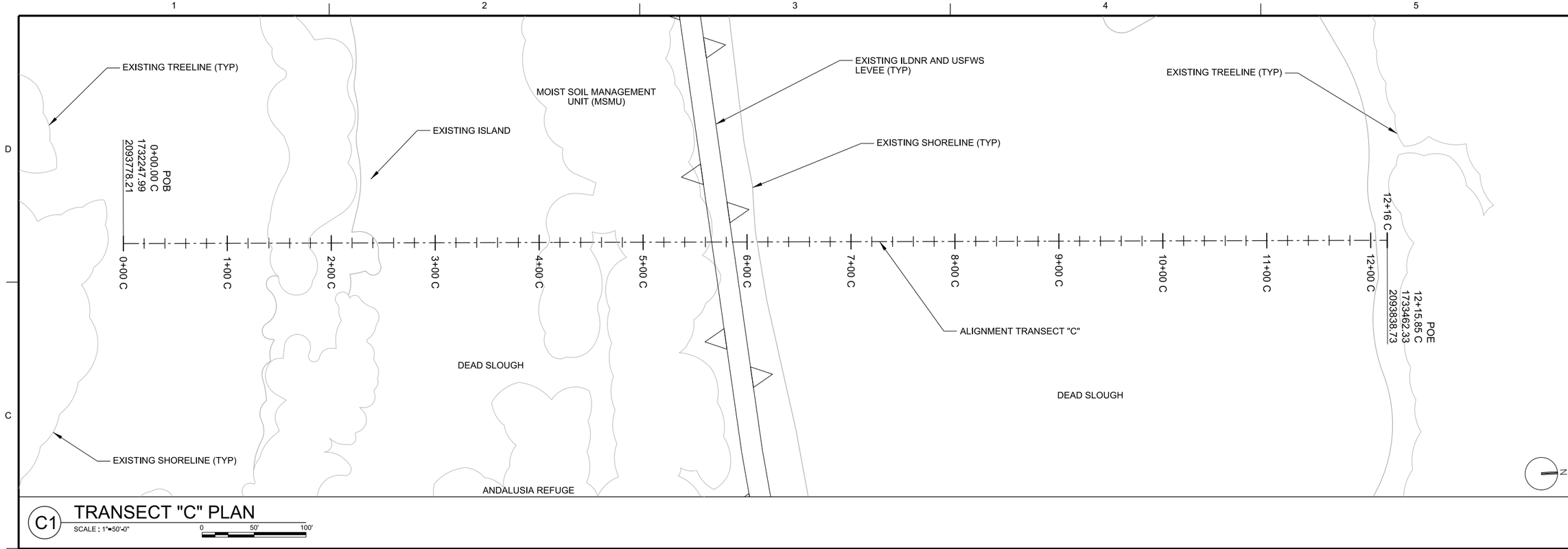

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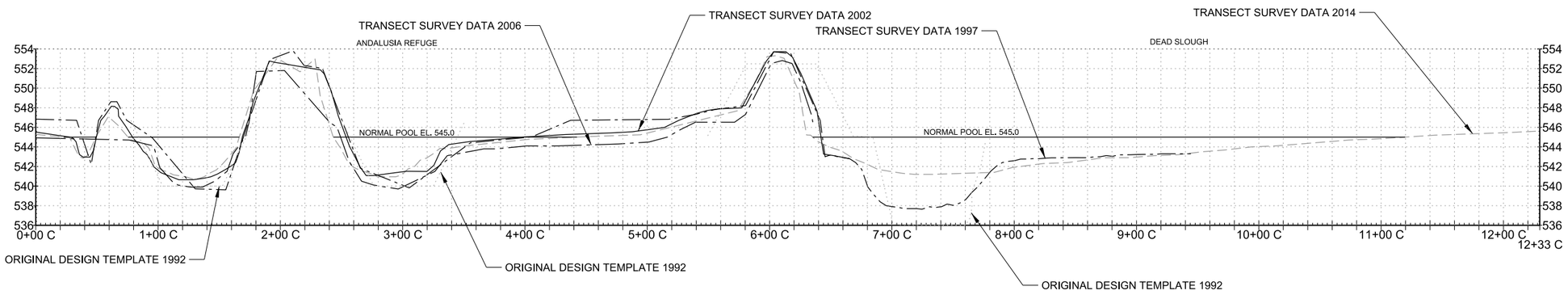

A1 TRANSECT "C" PROFILE

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TRANSECT "C" PLAN AND PROFILE

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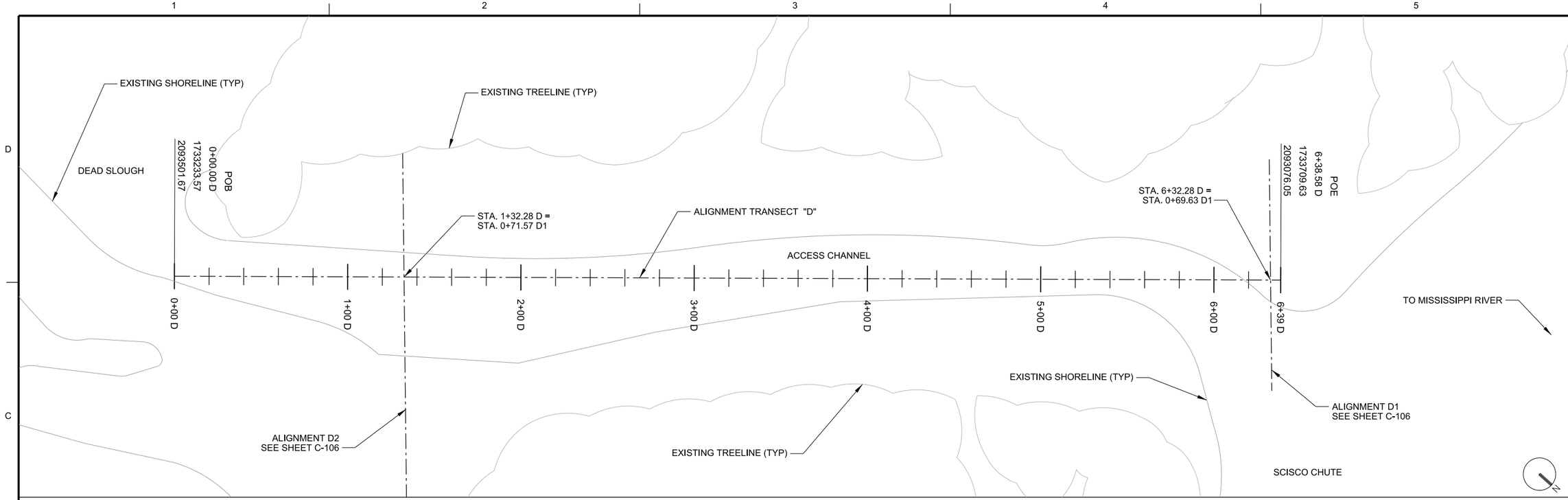

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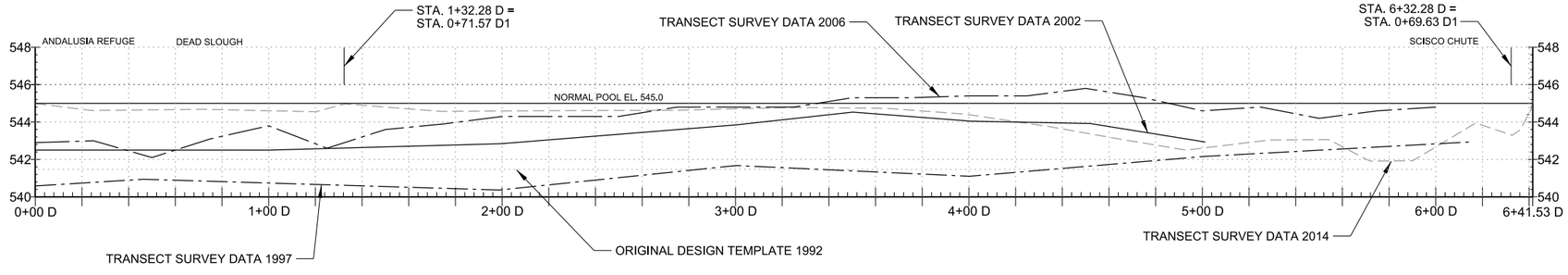

A1 TRANSECT "D" PROFILE

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TRANSECTS "D" PLAN AND PROFILE

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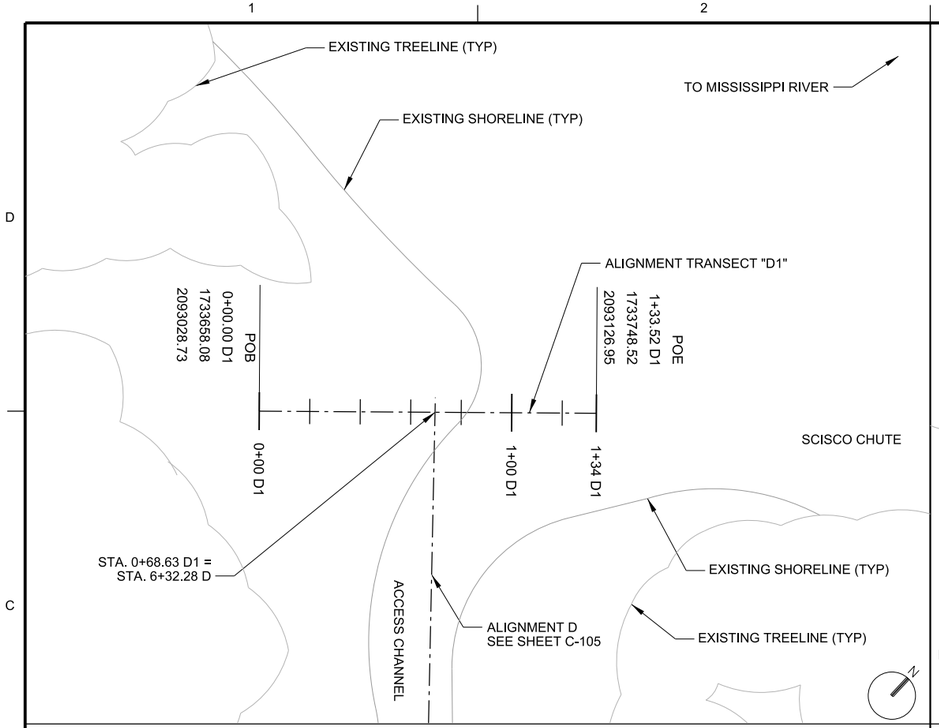

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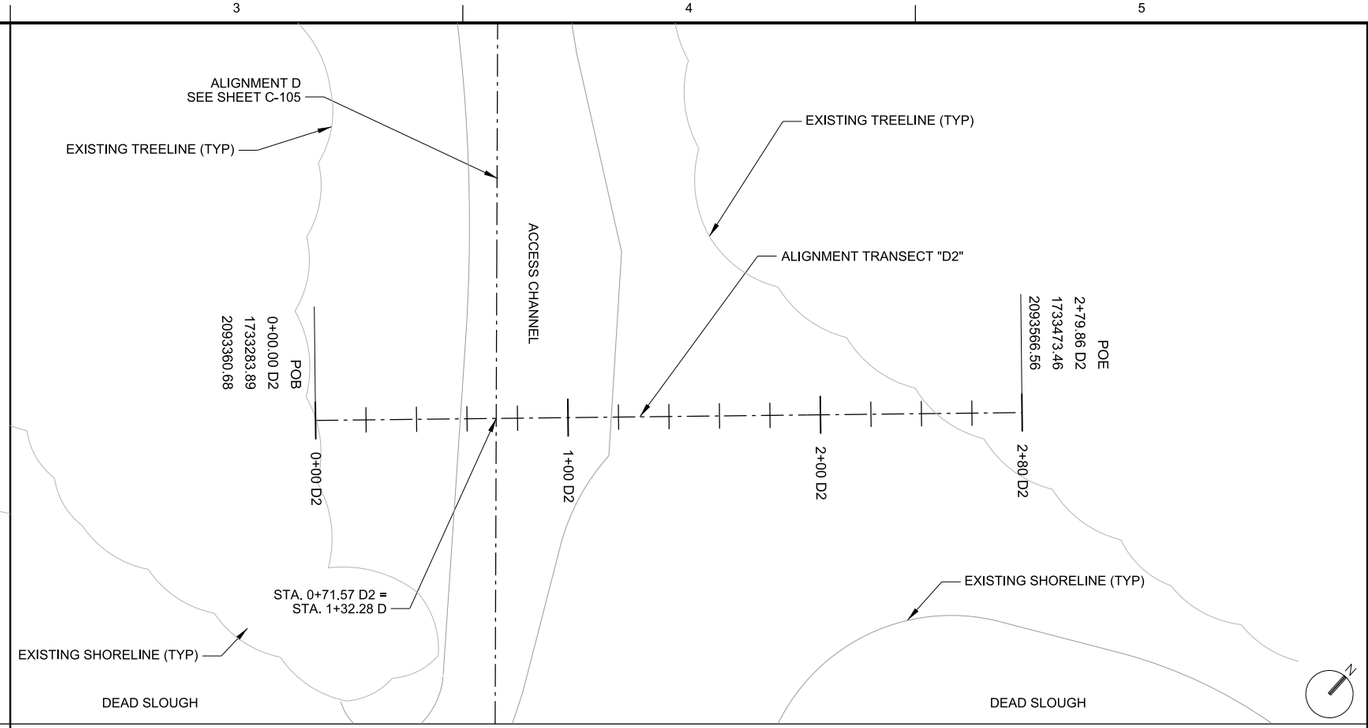

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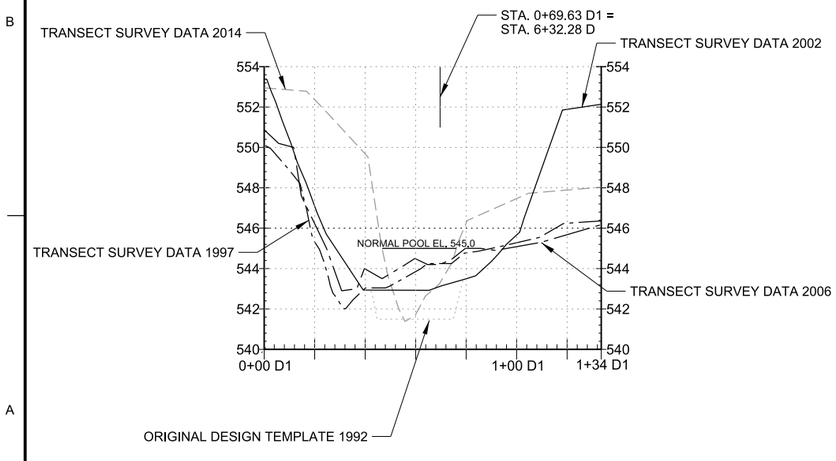

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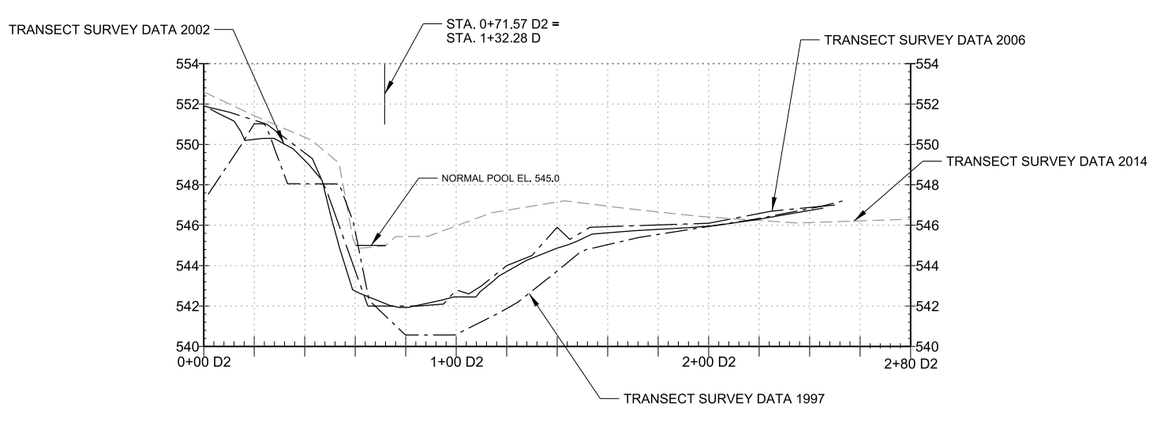

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SCALE : 1"=30'-0" 0 30' 60'

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PLOT SCALE: AS SHOWN
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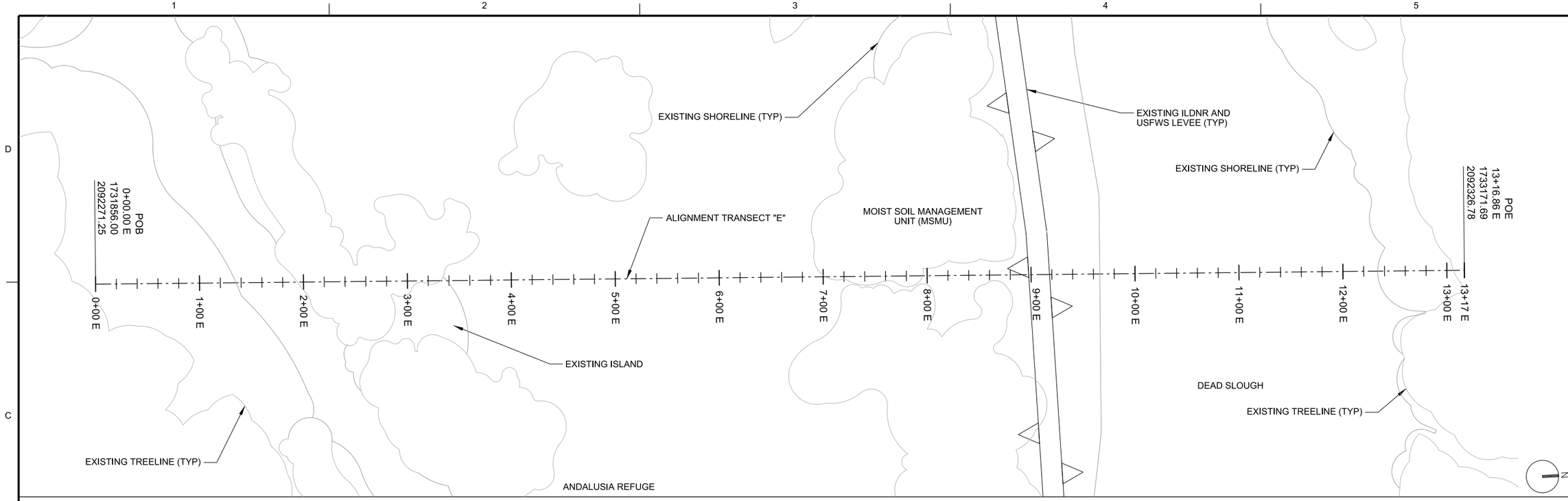
SIZE: ANSI D
FILE NAME: PER_C-106XX.dgn

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT
ROCK ISLAND, ILLINOIS

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECTS "D1 & D2" PLANS AND PROFILES

Sheet ID
C-106



C1 TRANSECT "E" PLAN

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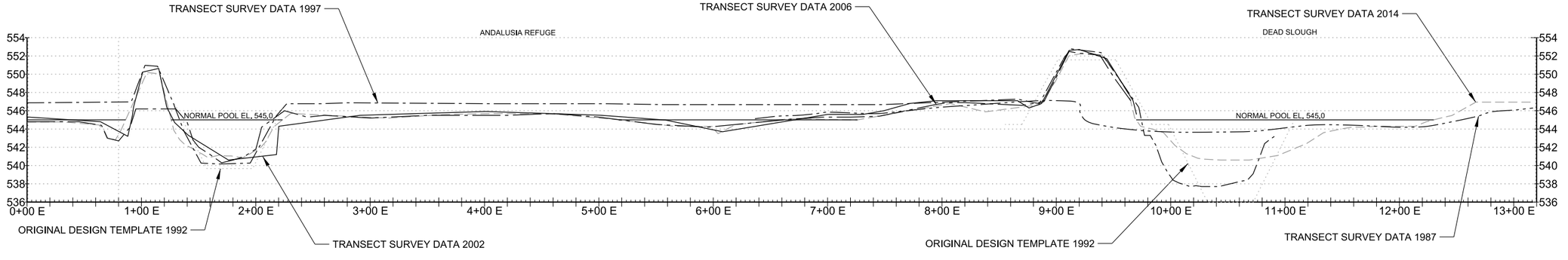

A1 TRANSECT "E" PROFILE

SCALE : 1"=50'-0" 0 50' 100'

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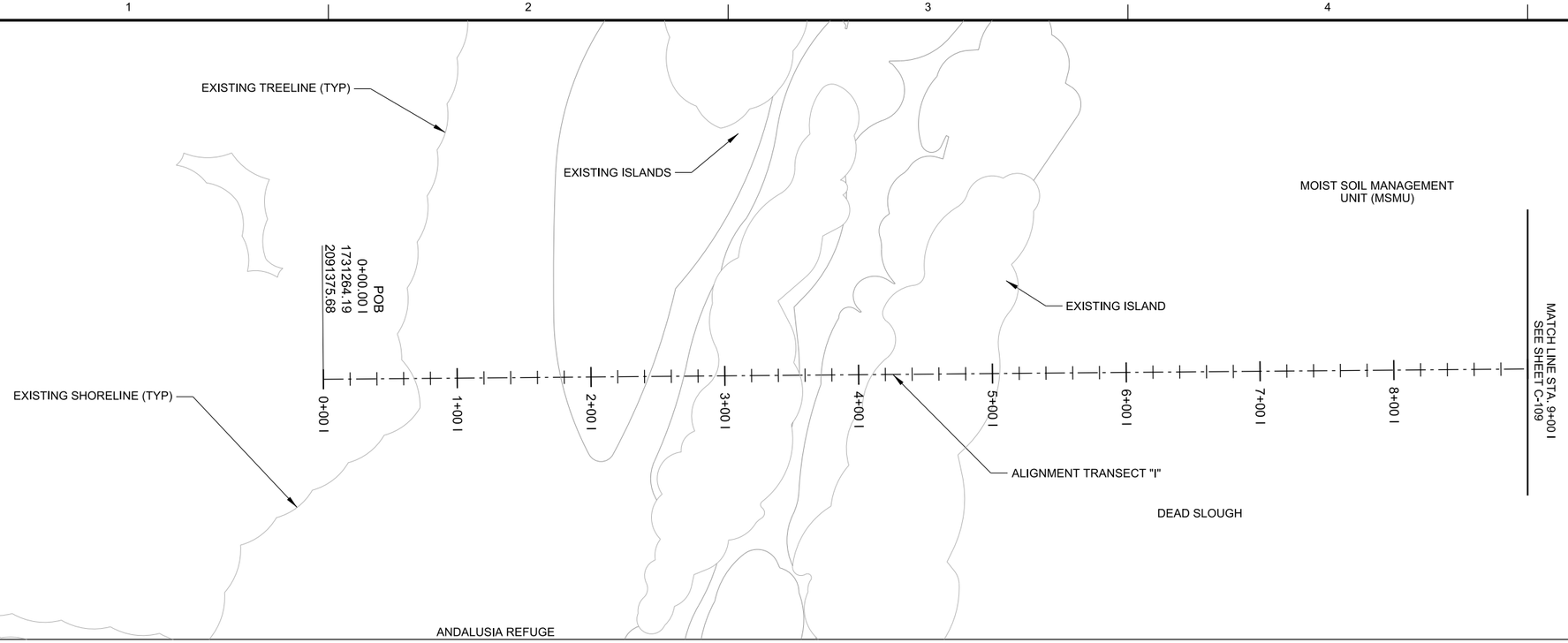
U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT
ROCK ISLAND, ILLINOIS

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "E" PLAN AND PROFILE

Sheet ID
C-107



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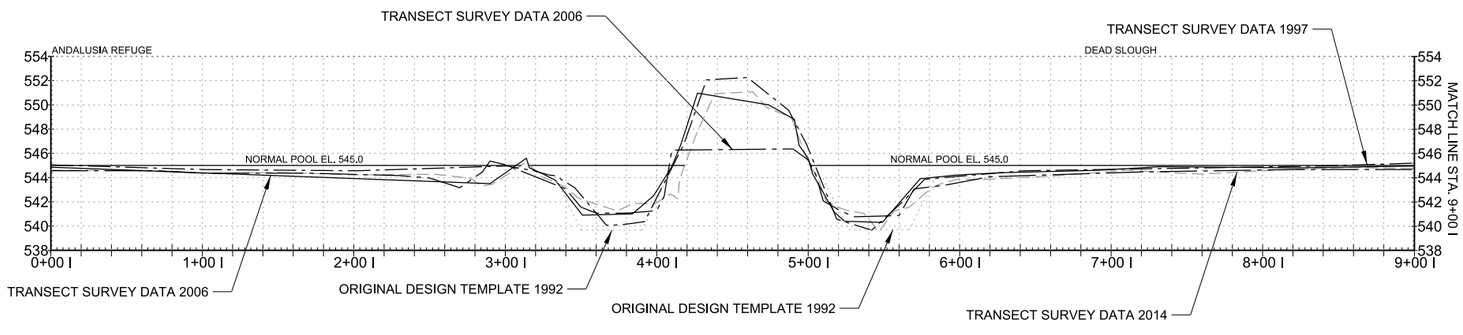

A1 TRANSECT "I" PROFILE STA. 0+00 I TO STA. 9+00 I

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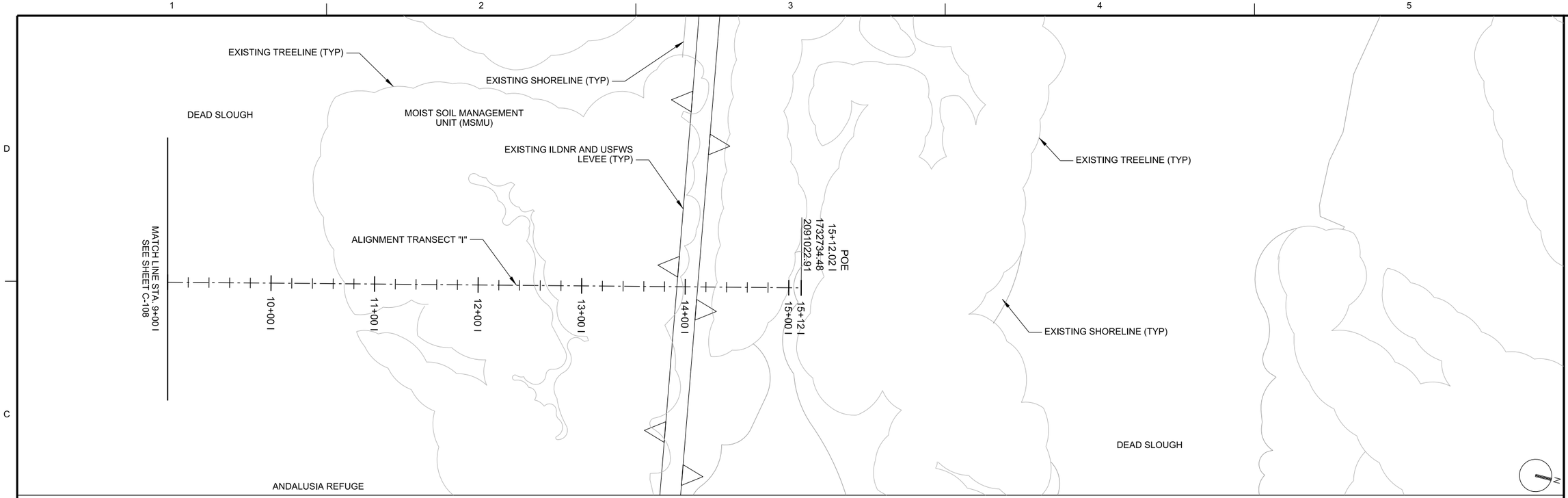
MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "I" PLAN AND PROFILE
STA. 0+00 I TO STA. 9+00 I

Sheet ID
C-108



C1 TRANSECT "I" PROFILE STA. 9+00 I TO STA. 15+21 I

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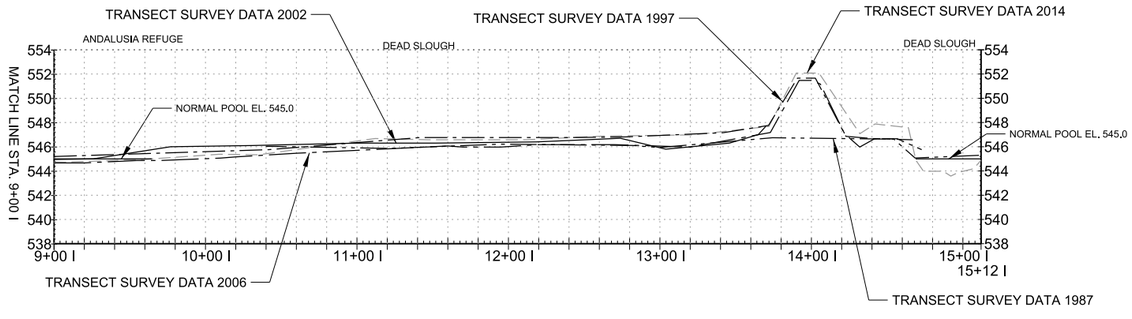

A1 TRANSECT "I" PROFILE STA. 9+00 I TO STA. 15+12 I

SCALE : 1"=50'-0"

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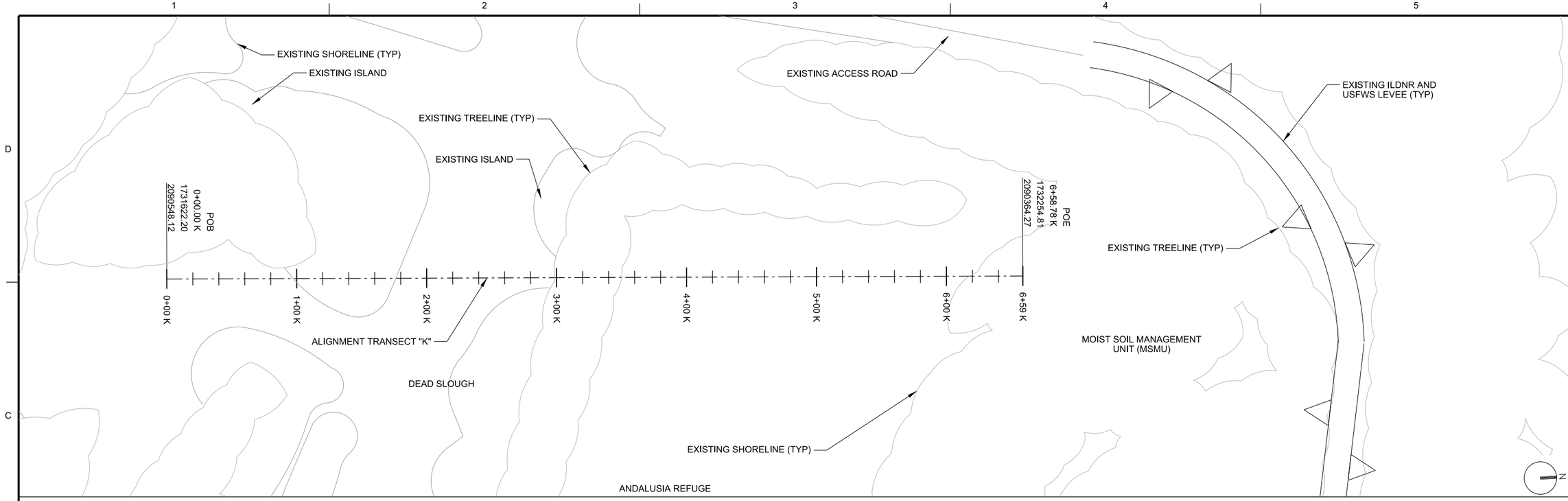
MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

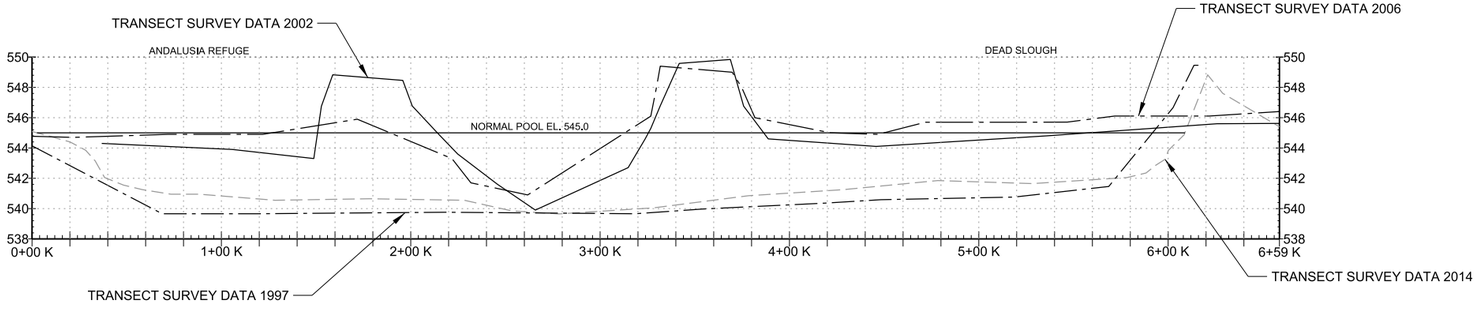
TRANSECT "I" PLAN AND PROFILE
STA. 9+00 I TO STA. 15+21 I

Sheet ID
C-109



C1 TRANSECT "K" PLAN

SCALE : 1"=40'-0" 0 40' 80'



A1 TRANSECT "K" PROFILE

SCALE : 1"=40'-0" 0 40' 80'

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U.S. ARMY CORPS OF ENGINEERS
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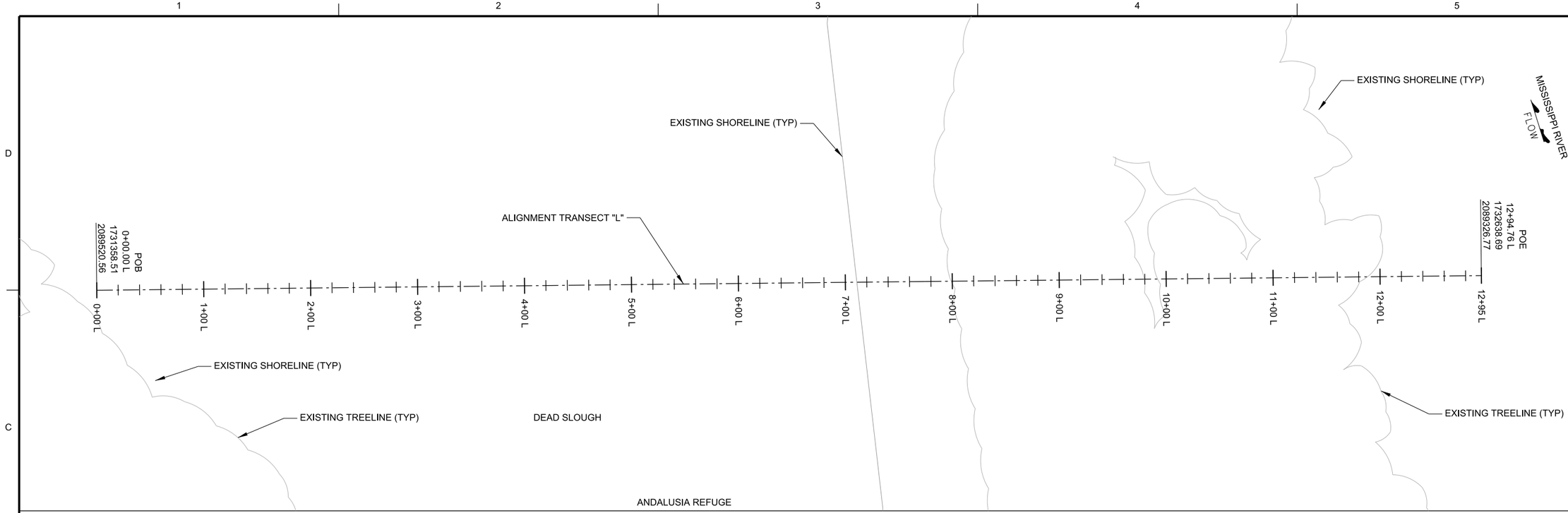
MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "K" PLAN AND PROFILE

Sheet ID
C-110



C1 TRANSECT "L" PLAN

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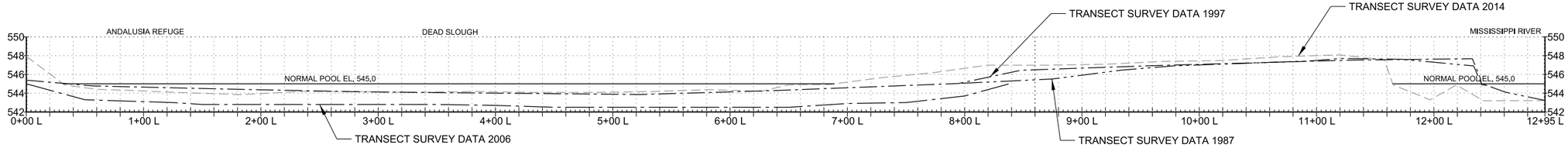

A1 TRANSECT "L" PROFILE

SCALE : 1"=50'-0" 0 50' 100'

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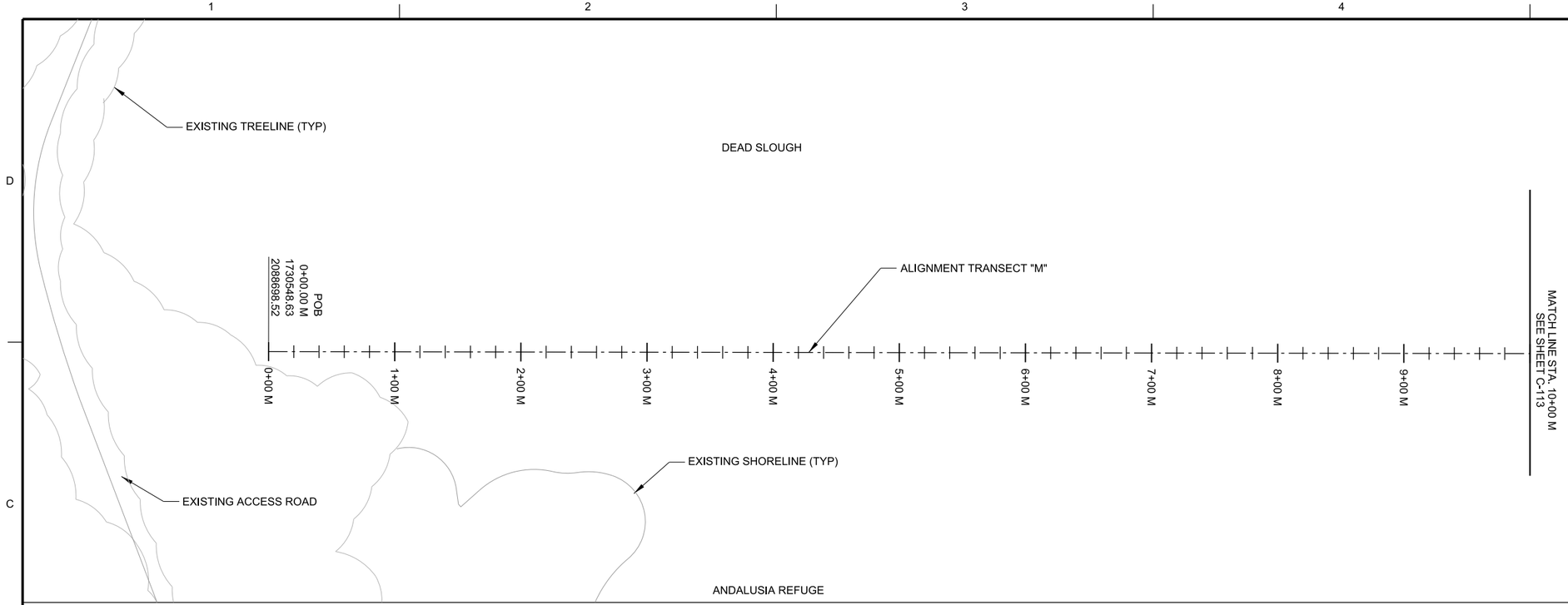
U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT
ROCK ISLAND, ILLINOIS

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "L" PLAN AND PROFILE

Sheet ID
C-111



C1 TRANSECT "M" PLAN STA. 0+00 M TO STA. 10+00 M

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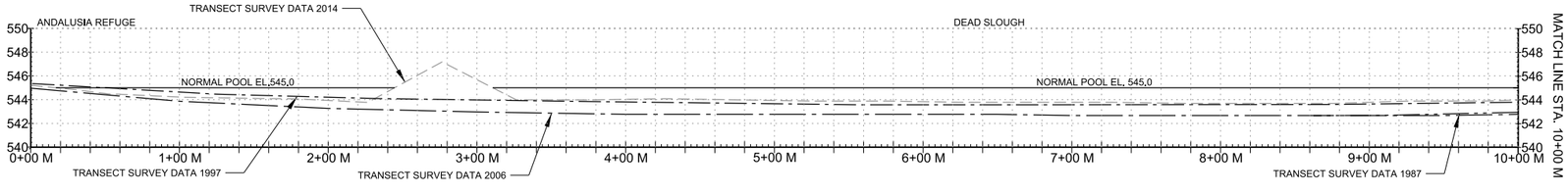

A1 TRANSECT "M" PROFILE STA. 0+00 M TO STA. 10+00 M

SCALE : 1"=50'-0"

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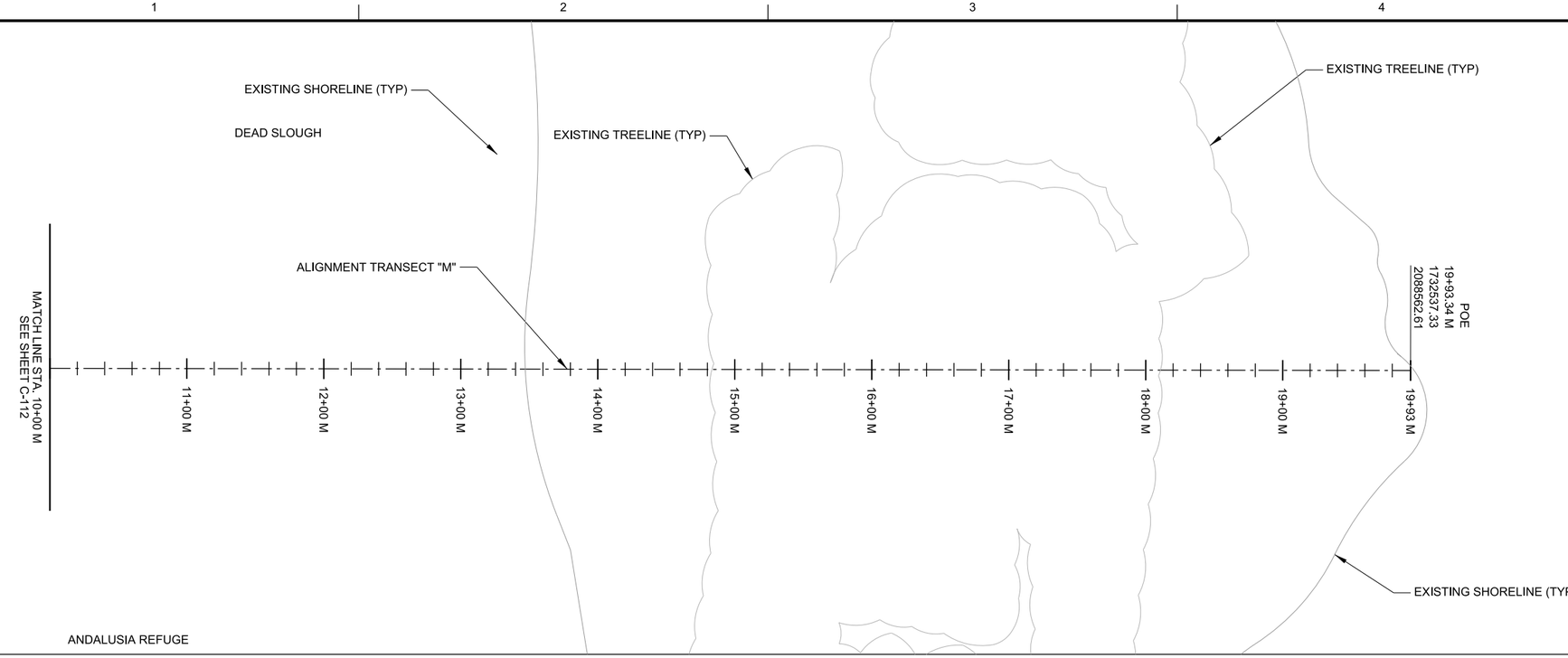
MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "M" PLAN AND PROFILE
STA. 0+00 M TO STA. 10+00 M

Sheet ID
C-112



C1 TRANSECT "M" PLAN STA. 10+00 M TO STA. 19+93.34 M

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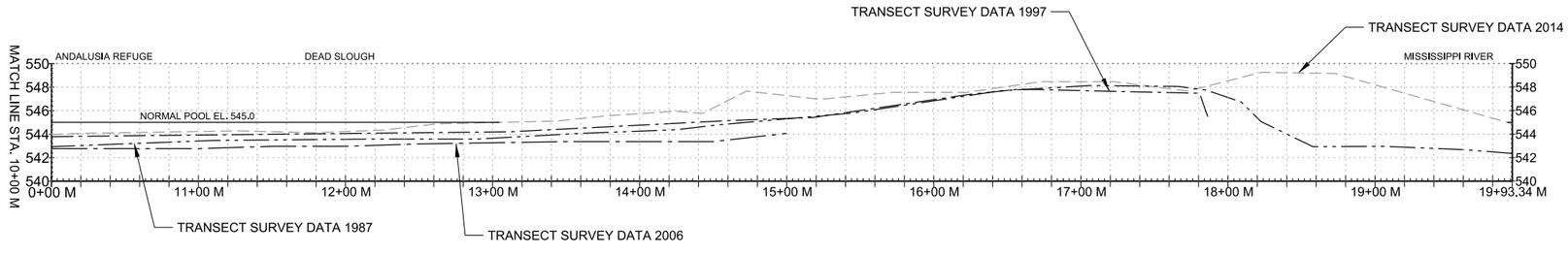

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SCALE : 1"=50'-0"

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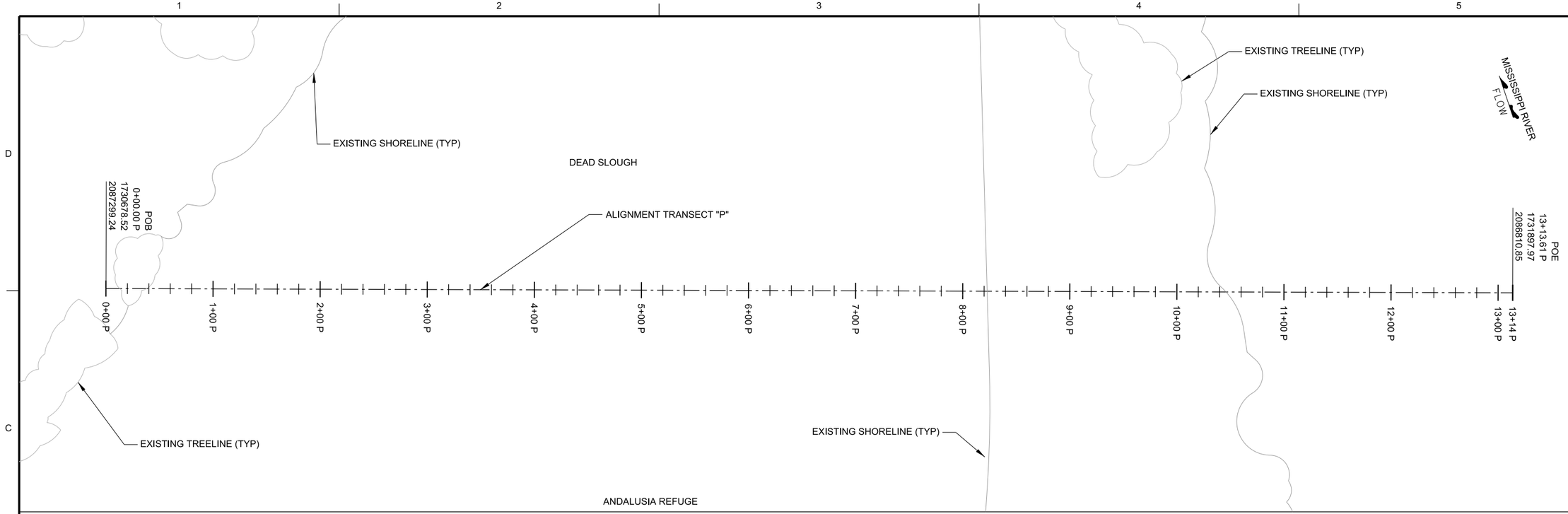
U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT
ROCK ISLAND, ILLINOIS

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "M" PLAN AND PROFILE
STA. 10+00 M TO STA. 19+93.34 M

Sheet ID
C-113



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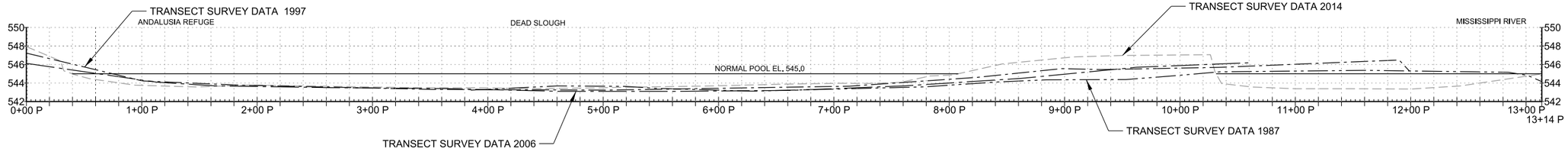

A1 TRANSECT "P" PROFILE

SCALE : 1"=50'-0" 0 50' 100'

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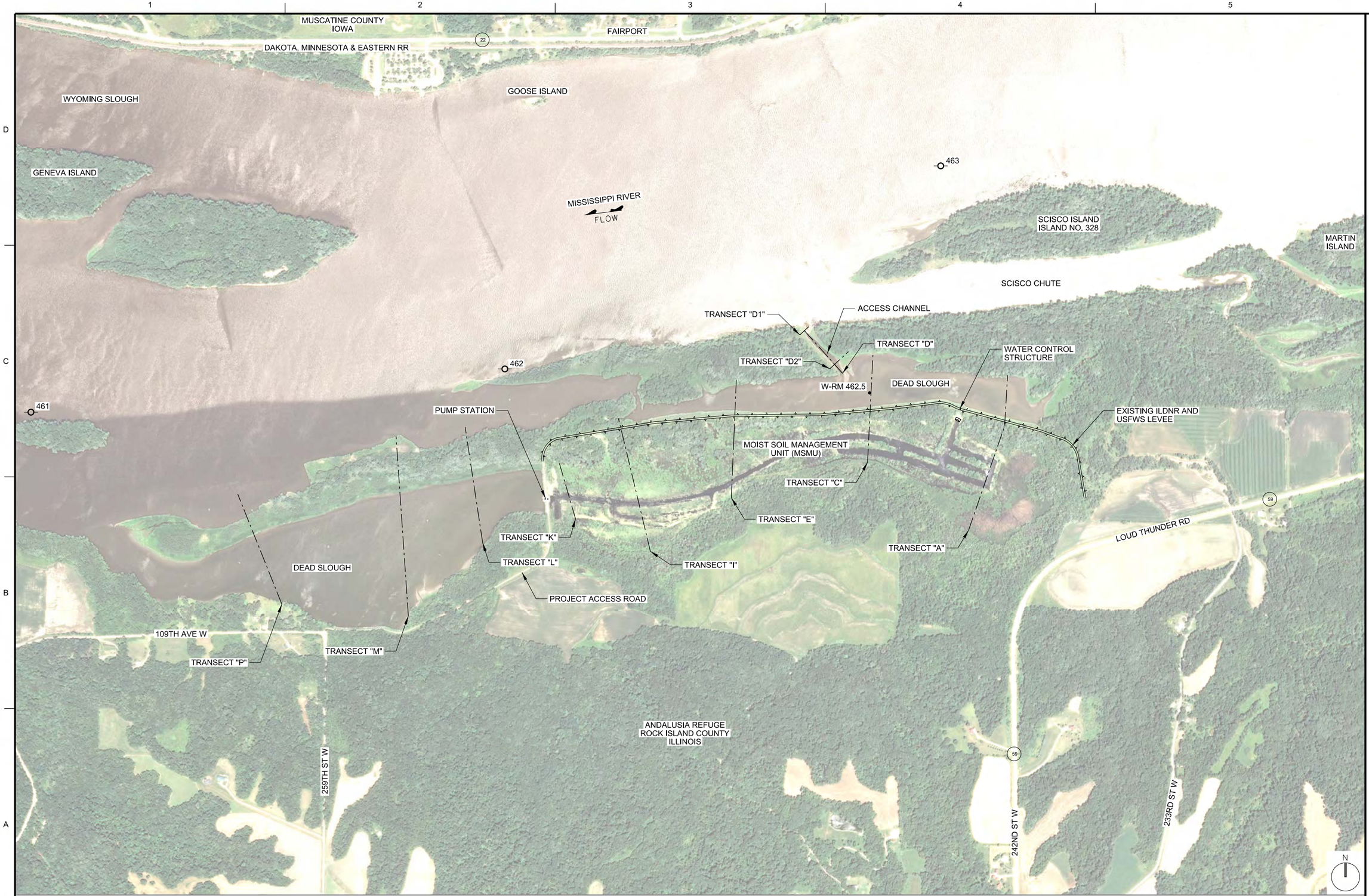
MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

TRANSECT "P" PLAN AND PROFILE

Sheet ID
C-114



A1 MONITORING PLAN

SCALE : 1"=500'-0" 0 500' 1000'

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ROCK ISLAND, ILLINOIS

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PROJECT CODE:
FILE NAME: PER_O-101XXX.dgn

MISSISSIPPI RIVER
RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, IL
ANDALUSIA REFUGE PER - HREP

MONITORING PLAN

Sheet ID
O-101

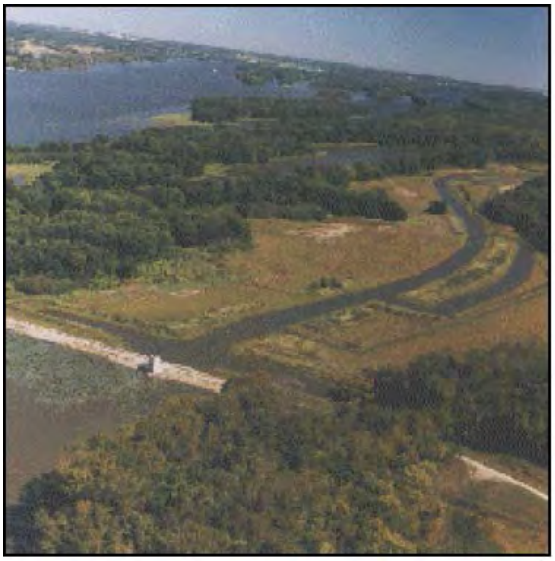
POST-CONSTRUCTION
PERFORMANCE EVALUATION REPORT

ANDALUSIA REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

2015

APPENDIX C
WATER QUALITY ANALYSIS

ANDALUSIA REFUGE
MISSISSIPPI RIVER
ROCK ISLAND COUNTY, IL
POOL 16



POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT

WATER QUALITY ANALYSIS

NOVEMBER 2015

US Army Corps of Engineers
Rock Island District

ANDALUSIA REFUGE POST-CONSTRUCTION
PERFORMANCE EVALUATION REPORT
WATER QUALITY ANALYSIS

TABLE OF CONTENTS

APPENDICES

ANDALUSIA REFUGE PERFORMANCE EVALUATION REPORT (WATER QUALITY)

Goal: Enhance aquatic habitat

Objectives: Improve dissolved oxygen concentration during critical stress periods

Enhancement Features: Mechanical dredging and water control structure

Background: The water quality objective of the Andalusia Refuge project is to improve dissolved oxygen (DO) concentrations in Dead Slough during critical seasonal stress periods. The Year 50 Target level is to maintain a DO concentration $\geq$ 4 mg/L most of the time. Prior to project completion, severe winter and summer fish kills in Dead Slough were reported by local residents and ILDNR personnel. It is presumed these fish kills were due to low DO concentrations coupled with thermal stress. In an effort to avoid future fish kills, dredging was utilized to create both deep aquatic habitat within Dead Slough and an access channel from the slough to the Mississippi River.

This water quality performance evaluation report discusses post project construction water quality monitoring data collected by USACE Water Quality and Sedimentation Section (EC-HQ) personnel from December 2007 through March 2015 for the Andalusia Refuge. Post-project monitoring has been ongoing since April 7th, 1992, and previous performance evaluation reports were completed in 1997, 1998, 2000, 2001, 2002, 2003, and 2007. Due to the cyclical nature of Rock Island District's UMRR water quality monitoring program, sampling was not continuous during the whole post-construction observation period.

During the current study period noted above, EC-HQ personnel performed water quality monitoring at one site within the project area, W-M462.5O, which is located within a dredged channel in Dead Slough. The monitoring site location is shown on Plate 1. Data gathered by EC-HQ staff included a combination of both periodic grab samples and in-situ continuous monitors (YSI model 6000, 6600, or 6600-V2 series and Hach DS5X series sondes). Grab samples were gathered near the surface, while sondes were positioned 1.5 to 3 feet above the bottom when water quality monitoring commenced. Over the life of the project, as water depth decreased due to sediment deposition at the sampling site, the sondes were deployed at 1.0 to 1.5 feet above the bottom. The sites were usually visited biweekly during the summer season of June through September and 2 or 3 times total per winter season of December through March. Sampling frequency was limited due to lack of depth within the access chute and at the monitoring site. The following variables were typically measured: water depth, velocity, wave height, air and water temperature, cloud cover, wind speed and direction, DO, pH, total alkalinity, specific conductance, Secchi disk depth, turbidity, total suspended solids (TSS), chlorophyll (a, b and c) and pheophytin a.

Monitoring Results: The grab sample results from water quality monitoring performed during this monitoring period are found in Appendix B. Due to a lack of access (the access channel was constructed as part of the project), EC-HQ staff was not able to gather pre-construction water quality data. Therefore, all information and comparisons in this report reflect data gather after the project was completed.

As identified in Table 12-2 of the Andalusia Refuge DPR, post construction water quality monitoring should be performed to identify dissolved oxygen concentrations during critical seasons at fixed stations, in order to verify Dead Slough excavation effectiveness. The minimum dissolved oxygen standard listed for this project, particularly during winter months, was set at 4.0 mg/L for all out-years.

Table 1 below provides a summary of DO data from grab samples collected at site W-M462.5O during 1992 to 2007 (at 5-year increments) and the current monitoring period (7 years).

Site W-M462.5O	04/07/92 - 02/25/97	06/18/97 - 12/17/02	02/13/03 - 09/18/07	12/20/07 - 03/10/15
Number of Samplings	42	64	54	31
Winter Samplings	17	17	14	11
Summer Samplings	25	47	40	20
DO Conc. $\leq$ 4 mg/L	2 (4.8%)	1 (1.6%)	7 (12.9%)	0
DO Conc. $\leq$ 4 mg/L Winter Samplings	0	0	0	0
DO Conc. $\leq$ 4 mg/L Summer Samplings	2 (8.0%)	1 (2.1%)	7 (17.5%)	0
Minimum DO Conc. (mg/L)	3.04	3.86	1.11	4.46
Maximum DO Conc. (mg/L)	24.00	25.99	24.07	25.90
Average DO Conc. (mg/L)	10.69	10.11	8.97	11.33

In evaluating the grab sample DO concentrations collected since 1992 and comparing them to DO concentrations from this report period of December 2007 to March 2015, it appears as though DO is actually improving at site W-M462.5O. The minimum, maximum, and average DO for the report period was higher than during any previous monitoring period increment. Additionally, no grab sample DO measurements taken during the current monitoring period were below the 4.0 mg/L target level. Based on previous measurements, summer samplings had the highest frequency of measurements falling below 4.0 mg/L. However, during this current period, the average summer season DO value was 8.97 mg/L (slightly skewed upward due to measurements taken during likely algal bloom in 2009) and the median DO value was 8.44 mg/L. Continuing the trend of previous monitoring efforts, grab sample DO concentrations during the winter season were all well above the target, sometimes near or above super-saturation.

As stated in the background section of this report, Rock Island District's UMRR water quality monitoring program is cyclical in nature. Due to these monitoring cycles, limited access into the project site, and low water depth at the monitoring location, in-situ continuous monitoring sondes were only deployed 6 times in 2008 (5 summer deployments, 1 winter deployments) and 8 times in 2009 (7 summer deployments, 1 winter deployment). During winter deployments, the sondes rarely measured DO concentrations below the 4 mg/L target level and were typically above 10 mg/L. Additionally, supersaturated conditions were common. The results from a best case deployment are shown in Figure 2 of Appendix A. Sonde data from summer deployments showed that DO concentrations occasionally fell below the 4 mg/L target level (usually at night) but rarely remained below 4 mg/L for more than a few hours. Daytime DO concentrations were often supersaturated as a result of plant photosynthesis. The results from a worst case deployment are represented by the DO and pH data from July 1st to 15th, 2008, displayed in Figure 1. The diurnal pattern of rising temperature and DO values during the day and falling temperature and DO values during the night is evident in most deployments. The longest period that DO concentrations remained below 4 mg/L during the critical winter stress period was from February 29th to March 2nd,

2008. Results of DO monitoring during this deployment are displayed in Figure 3. A probable explanation for the prolonged low DO concentration lies in the field observations for that winter at the sampling site, which noted ice and snow cover since mid-December of 2007. Chlorophyll-a analysis performed on February 7th at the monitoring site revealed a very low value of 1.6 mg/m^3. A flow velocity measurement taken on February 7th, 2008, showed only 0.21 cm/s in Dead Slough. With little water inflow, no light penetration, and a low amount of photosynthetic organisms in the surface water, there was little opportunity for oxygenated water to flow into the site or for photosynthesis to occur to produce oxygen.

Other important elements under the "Enhance aquatic habitat" project objective in Table 12-1 of the Definite Project Report are the restoration of deep aquatic habitat in Dead Slough and restoration of an access channel to the slough. According to the USACE Andalusia Refuge PER from 2001, the Year 50 Targets are to maintain a flat pool depth > 6' in Dead Slough dredge channels and depth ≥ 2' in the slough's access channel. Flat pool adjusted water depth at the Dead Slough sampling site was determined according to the method described in the 2001 Andalusia Refuge PER. Since that report, subsequent reports have used the same methodology to determine flat pool depths at the sampling site. Average annual sediment accumulation was calculated by subtracting average annual water depths from successive years. The loss of water depth at the sampling site from 1992 through 2015 is illustrated in Figure 4. A summary of water depth and sediment accumulation is provided in Table 2. Average sediment accumulation per year at site W-M462.5O since post construction monitoring commenced in 1992 was 3.1 inches, based on water depth measurements taken at the time of water quality monitoring at the sampling site and water surface elevations provided by the Rivergages.com website for the Fairport, IA gage. Gage data at Fairport (RM 463.5) was interpolated to the monitoring site location (RM 462.5) using the average water surface elevation slope for the Mississippi River at this section of Pool 16. The average annual sediment accumulation rate for the current report period is 1.8 in/yr. Due to the lack of data collected between 2010 and 2014, this sedimentation rate is likely under-estimated and should not be used. However, a distinct downward trend in water depth at the sampling site can be seen utilizing the trend line in Figure 3. The sampling site in Dead Slough has not met the Year 50 Target depth of 6' or greater since 1997.

In comparing the largest flood events since project completion to sediment accretion rates, scouring often occurred during years which experienced the highest events for this location. See Table 3 for a list of high water events and stages. The highest water surface elevation measured at the Fairport gage was on July 9th 1993, when sediment appears to have scoured 0.83" at the sampling site. In 2001, scour also occurred as a result of the 3rd highest flood event in gage history, with a loss of 4.06" of sediment. Again in 2008, 2.88" of sediment was scoured during a summer sampling season in which the 4th highest flood event occurred. High river stages in 2014 and 1997 did not have the same scouring result at the sampling site, however.

Occasional depth measurements and visual observations suggest that the access channel also has not met its target depth for several years. Sediment accretion has resulted in a narrow channel that is less than 2' deep in most locations, making it nearly impassable for boats with outboards. Shallower water depths have contributed to an increase in American lotus coverage in Dead Slough. The portion of the slough near the south end of the access channel is completely choked by lotus growth during the summer

months; thus, making passage into Dead Slough extremely difficult. See the photos in Appendix C for a depiction of the closure issue at the access chute during 2014.

Discussion and Conclusions: The water quality objective of the Andalusia Refuge project is to improve dissolved oxygen (DO) concentrations in Dead Slough during critical seasonal stress periods, which is targeted at 4.0 mg/L. For the current evaluation period of 2007 to 2015, the project was mostly successful in attaining this goal during the critical winter months, with DO concentrations remaining well above 4 mg/L for all of the grab samples and a majority of the time during continuous monitoring. During the summer season, continuous monitoring data indicates that DO concentrations did fall below 4 mg/L occasionally, but most often the duration for low DO was only a few hours during the night, returning above the target level during the following daytime hours. Through inspection of continuous monitoring data, it should be noted that there were 2 separate instances where DO concentrations were below 4 mg/L for a period of 3 days (Illustrated in Figures 1 and 3 of Appendix A). A fish kill in Dead Slough during the summer of 2006 reported by Tom Vandermore of the ILDNR was likely the result of low DO concentrations. There were no fish kills reported to USACE staff during the current reporting period.

In addition to improving DO levels, restoration of deep aquatic habitat in Dead Slough and restoration of an access channel to the slough are other objectives of the Andalusia Refuge project. Year 50 target water level depths are $\geq$ 2' in the access channel and $\geq$ 6' in Dead Slough. Both target depths are not currently being met due to a much higher than anticipate rate of sedimentation throughout the project area. With a lack of sufficient depth in the access channel, the project could essentially be isolated from the main channel and fish may not be able to enter the slough during severe winters. Additionally, fish present in Dead Slough maybe exposed to more frequent durations of low DO and thermal stresses, leading to more frequent fish kills in critical seasonal stress periods.

References:

U.S. Army Corps of Engineers. 2007. *Upper Mississippi River System Environmental Management Program Post-Construction Performance Evaluation Report – Year 15 (2007). Andalusia Refuge Habitat Rehabilitation and Enhancement*. USACE, Rock Island District, Rock Island, IL.

U.S. Army Corps of Engineers. 2001. *Upper Mississippi River System Environmental Management Program Post-Construction Performance Evaluation Report – Year 8 (2000). Andalusia Refuge Habitat Rehabilitation and Enhancement*. USACE, Rock Island District, Rock Island, IL.

U.S. Army Corps of Engineers. 1988. *Upper Mississippi River System Environmental Management Program Definite Project Report (R-4) with Integrated Environmental Assessment. Andalusia Refuge Rehabilitation and Enhancement.* USACE, Rock Island District, Rock Island, IL.

US Army Corps of Engineers, Rock Island District. *Rivergages.com*. October 2015. Web. http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm

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WATER QUALITY ANALYSIS
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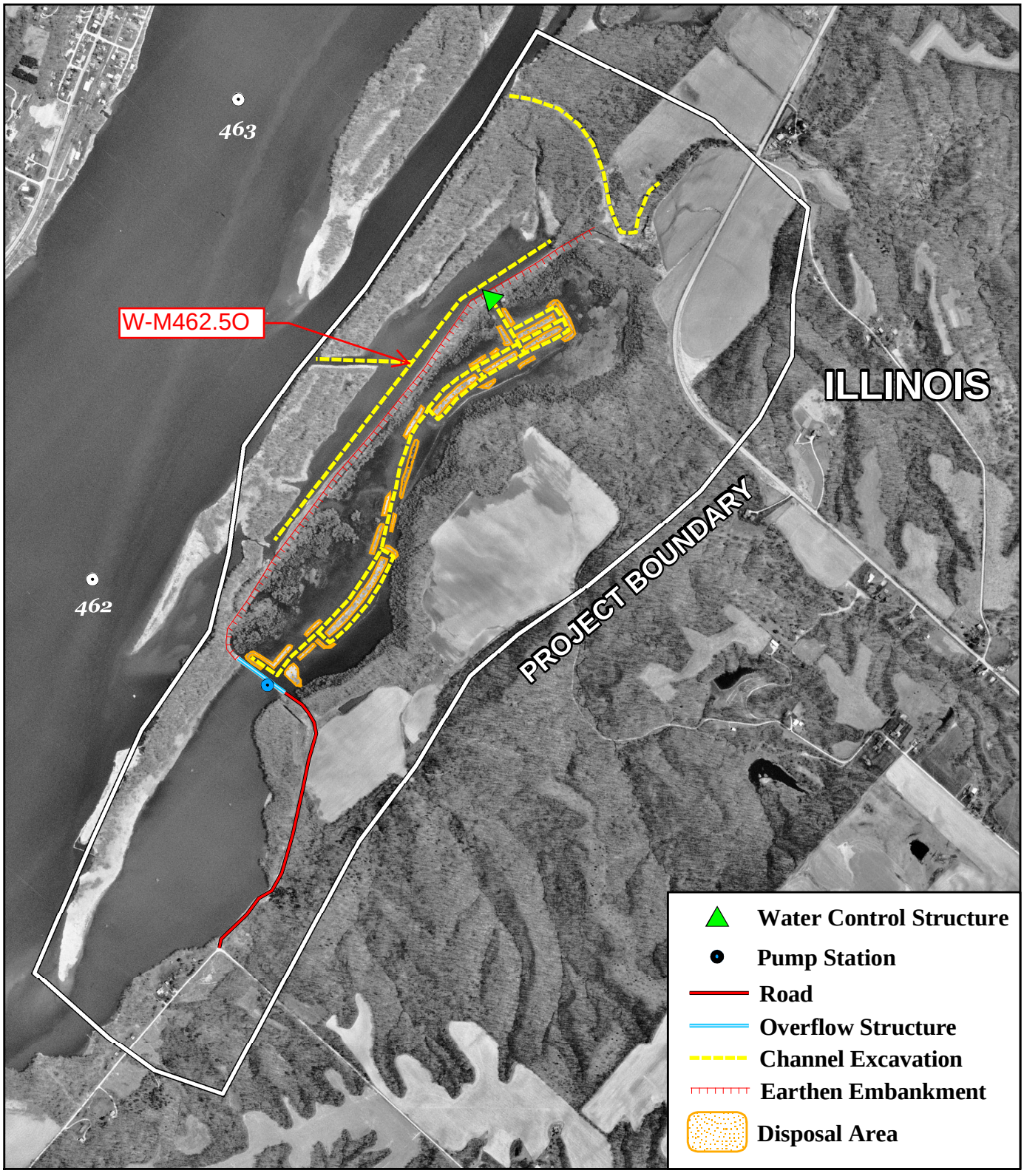
APPENDIX A

PLATES, FIGURES, AND TABLES

Andalusia Refuge HREP Project

Plate 1



Andalusia Refuge

N

0 0.25 0.5 1 Miles

Project Location

Plate 2

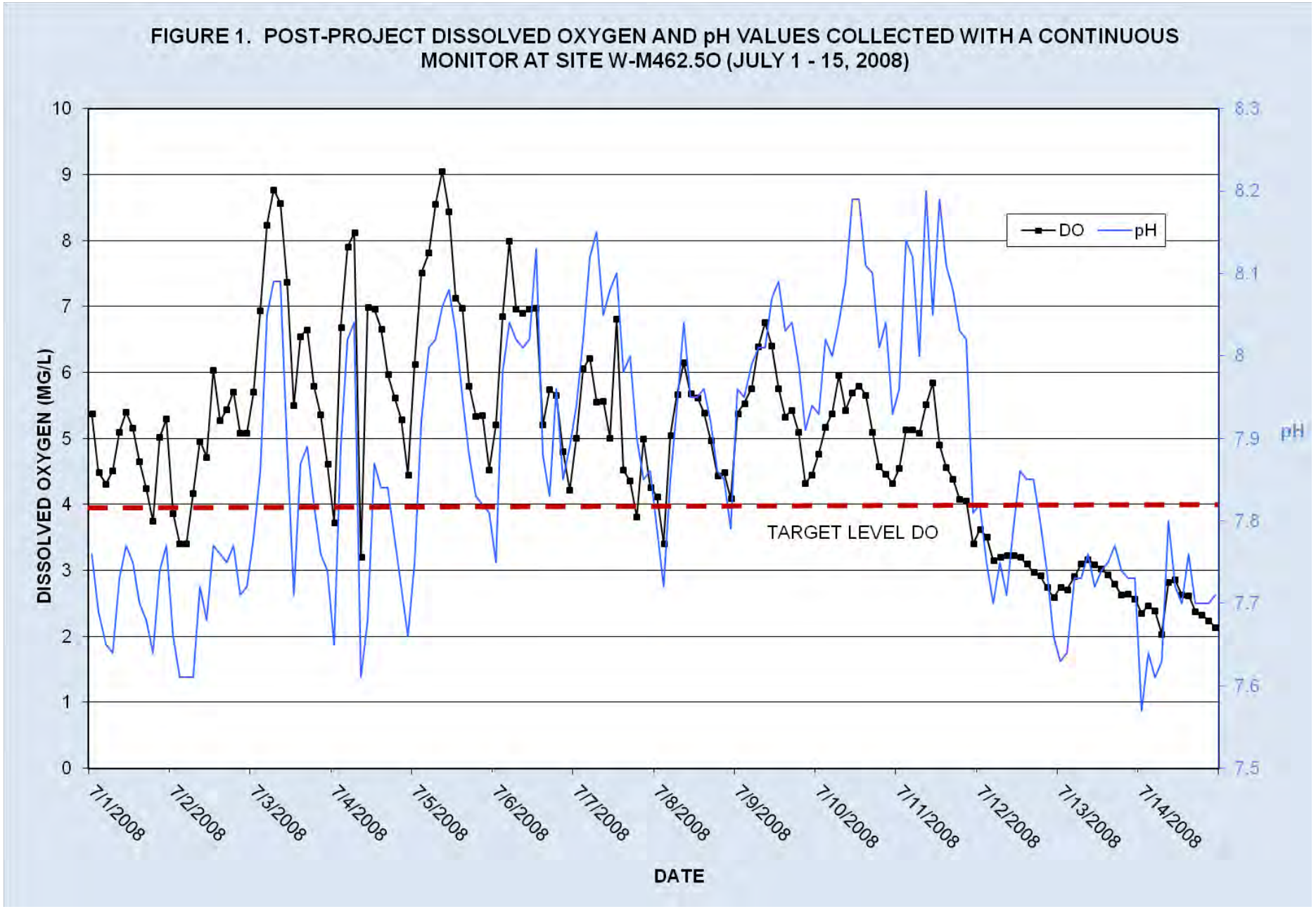


Figure 1. Worst Case Deployment during Current Monitoring Period, July 1st to 15th, 2008

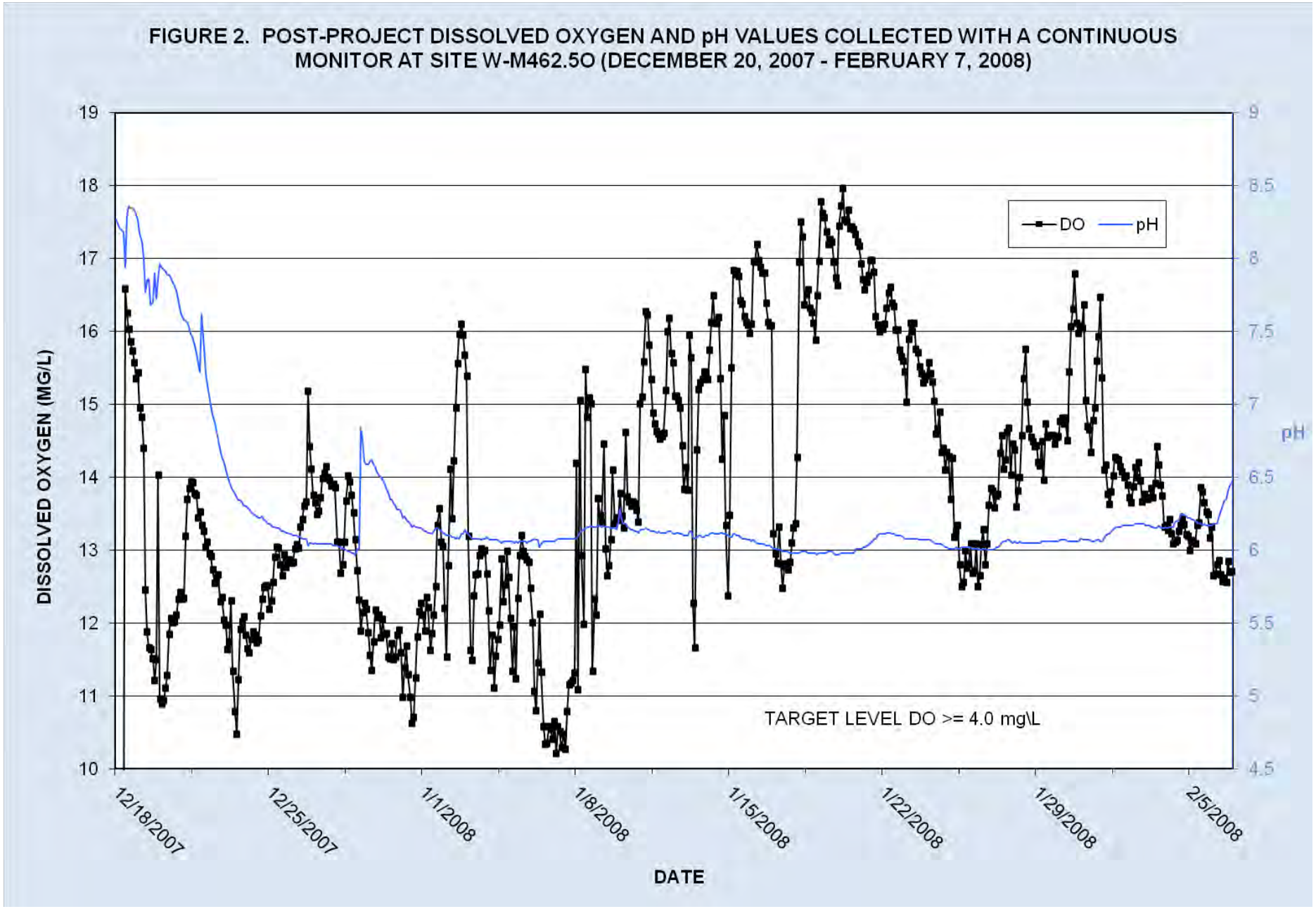


Figure 2. Best Case Deployment during Current Monitoring Period, December 20th, 2007, to February 7th, 2008

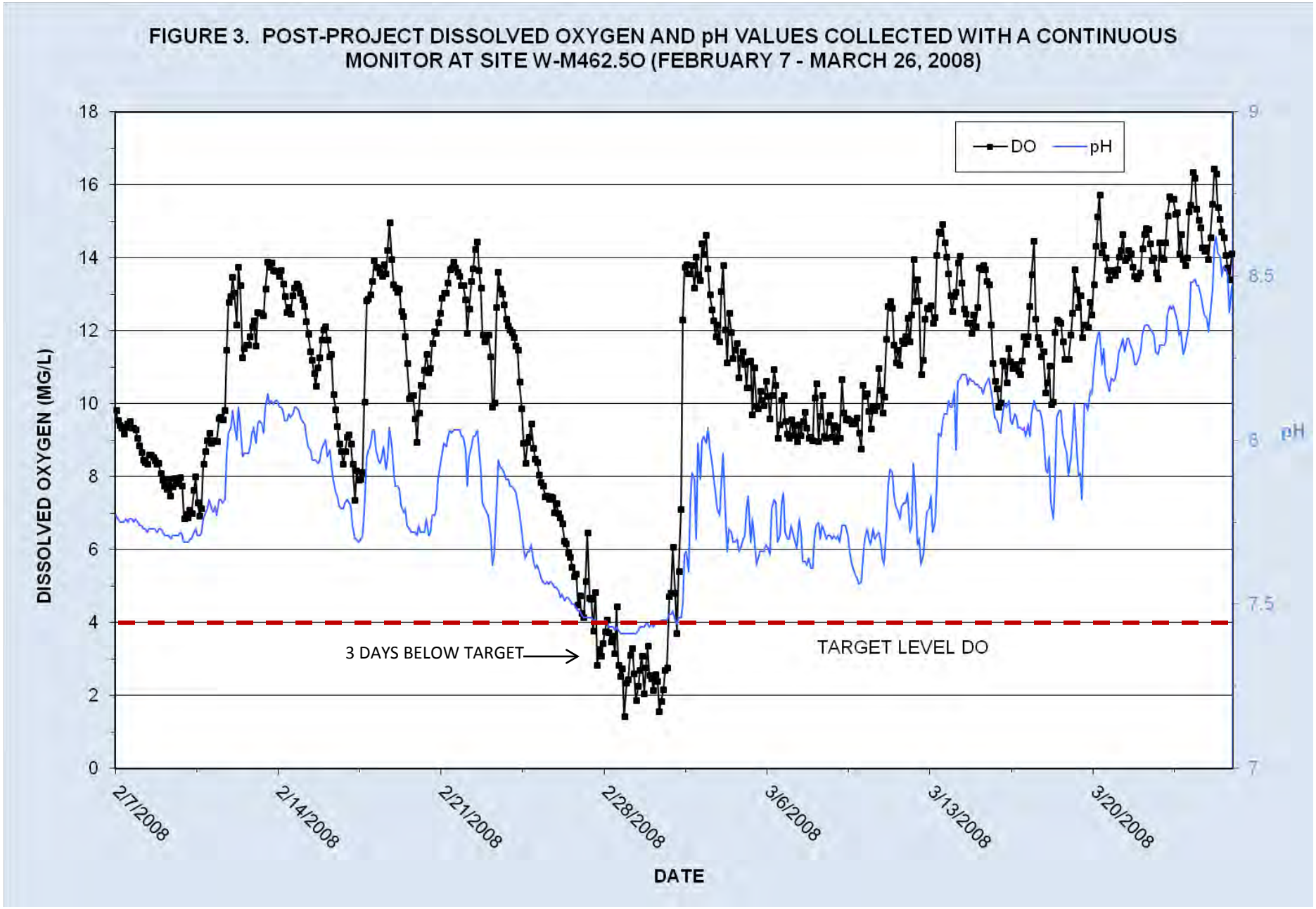


Figure 3. Worst case winter deployment during current monitoring period, February 7th to March 26th, 2008.

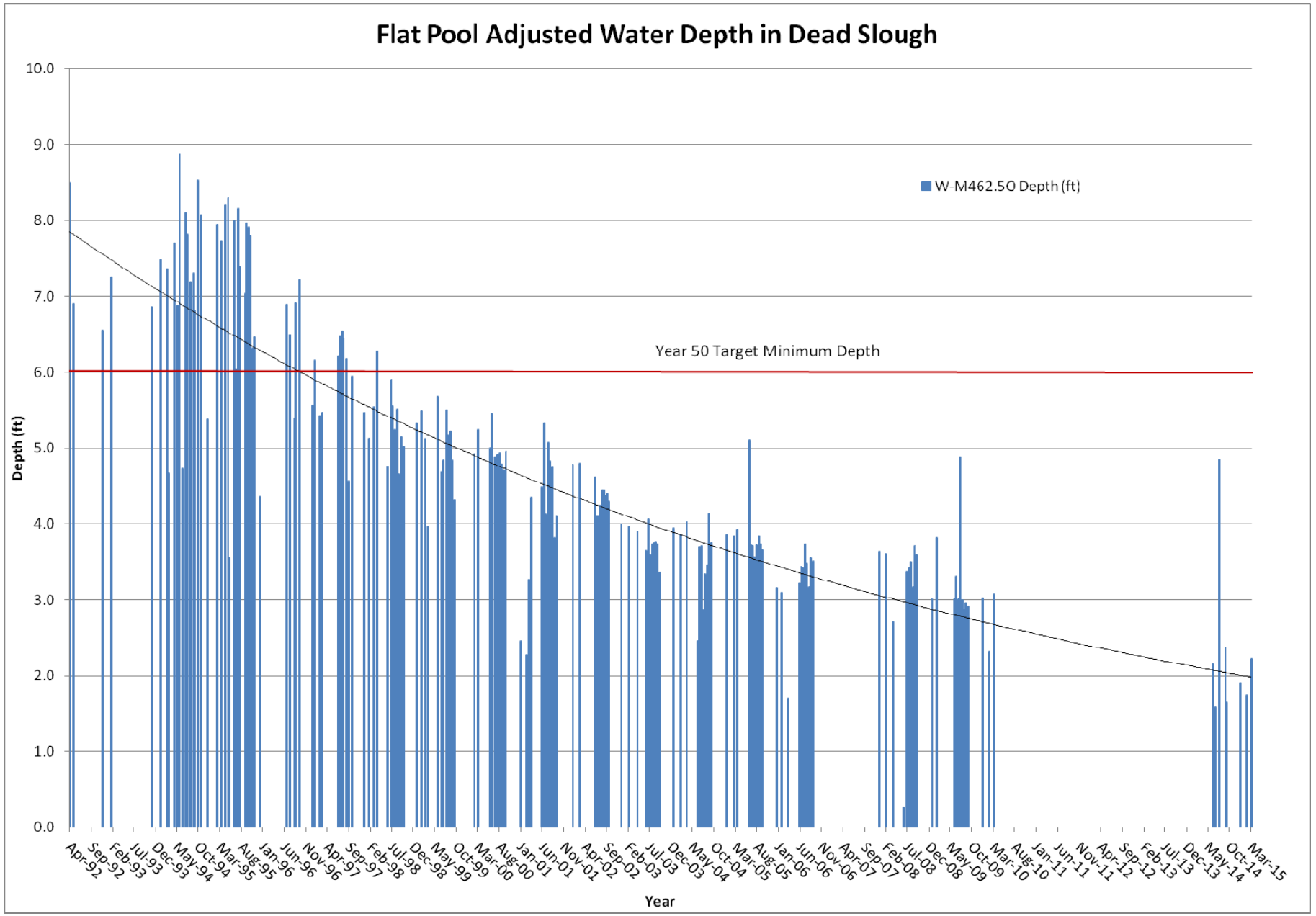


Figure 4. Water Depths Adjusted to Flat Pool at Site W-M462.5O in Dead Slough

Depths were adjusted to flat pool using water depth values observed at the sampling site during a monitoring event and water surface elevations obtained from the Rivergages website at the Fairport, IA gage.

Table 2. Average Annual Water Depth and Sediment Accumulation at Site W-M462.5O

Year	Water Depth (ft)	Sediment Accumulation (in)
1992	7.32	
		3.13
1993	7.06	
		-0.83
1994	7.12	
		0.64
1995	7.07	
		7.93
1996	6.41	
		6.16
1997	5.90	
		6.71
1998	5.34	
		4.25
1999	4.98	
		0.06
2000	4.98	
		10.90
2001	4.07	
		-4.06
2002	4.41	
		7.68
2003	3.77	
		2.84
2004	3.53	
		-3.44
2005	3.82	
		7.07
2006	3.23	
		-2.52
2007	3.44	
		4.8
2008	3.04	
		-2.88
2009	3.28	
		7.08
2010	2.69	
		3.36
2014	2.41	

Ave Sedimentation = 3.1inches per year

Table 3. Record High Stages at the Fairport, IA gage on the Mississippi River

Record High Stages For Mississippi River near Fairport, IA	
Stage	**Date**
19.40	04/28/1951
19.70	04/27/1952
19.72	05/09/1975
19.85	10/07/1986
20.00	04/26/1969
20.11	04/26/1973
20.35	04/20/1997
20.60	04/22/2013
21.32	04/23/2011
22.46	07/05/2014
23.12	06/17/2008
23.34	04/25/2001
23.60	04/28/1965
24.74	07/09/1993

Stream Name: Mississippi River
Gage Zero: 535.16 Ft. MSL 1912
Flood Stage:14 Ft.
Record High Stage:24.74 Ft.

Longitude: -90.89361000
Latitude: 41.43778000
Flat Pool : 9.80
River Mile: 463.5 miles above of the mouth of the Ohio River
Record High Stage Date: 07/09/1993

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APPENDIX B

WATER QUALITY MONITORING
GRAB SAMPLE RESULTS

Summary of current reporting period (Dec 07 - Mar 15) water quality monitoring results from surface samples collected at site W-M462.5O

Date	Water Depth (m)	Velocity (cm/s)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	pH (SU)	Chlorophyll a (mg/m^3)
12/20/07	1.11	-	0.3	14.56	7.9	1.7
02/07/08	1.27	0.21	-0.1	13.98	7.8	1.6
03/26/08	1.05	1.04	5.7	14.42	8.0	13
06/10/08	1.30	1.44	21.8	6.13	7.7	15
07/01/08	2.17	3.26	22.2	5.59	7.7	22
07/15/08	1.30	2.23	24.2	6.15	7.8	24
07/29/08	1.19	2.37	25.7	9.46	8.3	69
08/12/08	1.20	0.84	23.8	10.36	8.6	79
08/26/08	1.17	2.3	22.4	9.8	8.6	83
09/09/08	1.20	0.37	17.8	6.71	-	40
12/29/08	1.16	0.26	0	12.89	7.6	-
01/29/09	1.34	0.45	0.1	14.83	7.8	-
06/02/09	1.11	0.31	19.7	8.4	8.1	31
06/16/09	1.24	2.03	20.8	8.44	8.3	58
06/30/09	1.07	2.12	23.3	9.77	8.2	33
07/14/09	1.60	1.69	22.9	NA	8.5	97
07/28/09	0.99	0.84	24.7	9.27	8.1	48
08/11/09	1.09	2.08	25.3	11	8.3	109
08/25/09	0.97	0.88	23.4	25.9	8.8	245
09/09/09	0.96	1.11	22.1	17.29	8.3	171
12/21/09	1.06	0.93	-0.1	14.11	8.1	-
02/04/10	1.16	0.13	-0.1	13.01	7.8	-
03/10/10	1.13	0.47	1	11.99	8.1	-
06/10/14	1.24	1.78	22.5	4.46	7.9	4.6
06/24/14	2.23	24.96	32.6	4.68	7.7	<1.0
07/08/14	Could not access river. High water					
07/24/14	1.74	0.44	24.9	13.51	8.5	-
08/05/14	Could not access river. Low water					
09/03/14	0.96	0.44	25	6.95	8.5	21.2
09/16/14	0.82	0.95	16	5.58	8.2	7.5
12/19/14	0.69	1.1	2.8	17.95	8.9	-
02/03/15	0.61	0.83	3	13.48	7.6	-
03/10/15	0.71	0.47	2.1	19.36	8.0	-

Min.	0.61	0.13	-0.1	4.46	7.6	1.6
Max.	2.23	24.96	32.6	25.90	8.9	245.0
Ave.	1.19	1.94	15.3	11.33	8.1	55.9

Water quality monitoring results from samples collected at site W-M462.5O							
	WATER	VELOCITY	WAVE	AIR	CLOUD	WIND SPEED	WIND
DATE	DEPTH (M)	(CM/SEC)	HEIGHT (CM)	TEMP. (°C)	COVER (%)	(MPH)	DIRECTION
12/20/2007	1.11	-	-	-1	95	2	SE
2/7/2008	1.27	0.21	-	-6	100	3	W
3/26/2008	1.05	1.04	0	-1	65	2	SW
6/10/2008	1.30	1.44	7	17	10	4	W
7/1/2008	2.17	3.26	1	18	10	3	W
7/15/2008	1.30	2.23	1	20	20	2	SW
7/29/2008	1.19	2.37	0	20	30	3	E
8/12/2008	1.20	0.84	0	17	80	0	-
8/26/2008	1.17	2.30	6	16	20	5	E
9/9/2008	1.20	0.37	0	8	0	0	-
12/29/2008	1.16	0.26	-	0	5	6	W
1/29/2009	1.34	0.45	-	-3	65	12	W
6/2/2009	1.11	0.31	8	16	100	5	NE
6/16/2009	1.24	2.03	1	20	100	3	E
6/30/2009	1.07	2.12	5	19	95	3	NW
7/14/2009	1.60	1.69	0	20	100	4	SE
7/28/2009	0.99	0.84	0	24	80	1	E
8/11/2009	1.09	2.08	0	22	0	3	W
8/25/2009	0.97	0.88	0	23	40	3	S
9/9/2009	0.96	1.11	0	21	5	3	N
12/21/2009	1.06	0.93	-	-3	100	5	NW
2/4/2010	1.16	0.13	-	-2	100	2	S
3/10/2010	1.13	0.47	-	11	100	0	-
6/10/2014	1.24	1.78	3	15	100	2	SE
6/24/2014	2.23	24.96	1	20	15	3	NW
7/8/2014	Could not access river. High water						
7/24/2014	1.74	0.44	0	18	1	1	SE
8/5/20214	Could not access river. Low water						
9/3/2014	0.96	0.44	0	17	2	0	-
9/16/2014	0.82	0.95	0	6	0	1	S
12/19/2014	0.69	1.10	-	0	20	1	NW
2/3/2015	0.61	0.83	-	-3	100	3.7	SE
3/10/2015	0.71	0.47	-	11	0	0	-
	<- Green color denotes winter sampling season						

Water quality monitoring results from samples collected at site W-M462.5O						
	WATER	**DISSOLVED**	**pH**	**TOTAL ALKALINITY**	**SPECIFIC CONDUCTANCE**	**SECCHI DISK**
DATE	**TEMP. (°C)**	**OXYGEN (MG/L)**	**(SU)**	**(MG/L as CaCO3)**	**(µMHOS/CM @ 25°C)**	**DEPTH (CM)**
12/20/2007	0.3	14.56	7.90	290	660	-
2/7/2008	-0.1	13.98	7.80	278	608	-
3/26/2008	5.7	14.42	8.00	225	620	57.0
6/10/2008	21.8	6.13	7.70	241	603	38.5
7/1/2008	22.2	5.59	7.70	226	538	27.5
7/15/2008	24.2	6.15	7.80	221	520	19.5
7/29/2008	25.7	9.46	8.30	253	625	29.5
8/12/2008	23.8	10.36	8.60	264	642	36.0
8/26/2008	22.4	9.80	8.60	227	607	22.0
9/9/2008	17.8	6.71	-	225	594	25.0
12/29/2008	0.0	12.89	7.60	145	336	-
1/29/2009	0.1	14.83	7.80	300	635	-
6/2/2009	19.7	8.40	8.10	250	661	18.2
6/16/2009	20.8	8.44	8.30	-	674	10.3
6/30/2009	23.3	9.77	8.23	246	625	18.0
7/14/2009	22.9	Removed*	8.51	241	613	15.2
7/28/2009	24.7	9.27	8.10	222	582	17.8
8/11/2009	25.3	11.00	8.30	228	599	20.3
8/25/2009	23.4	25.90	8.80	210	564	22.6
9/9/2009	22.1	17.29	8.30	256	602	21.4
12/21/2009	-0.1	14.11	8.10	292	602	-
2/4/2010	-0.1	13.01	7.80	293	584	-
3/10/2010	1.0	11.99	8.10	159	307	-
6/10/2014	22.5	4.46	7.90	252	551	21.0
6/24/2014	32.6	4.68	7.71	180	500	31.5
7/8/2014						
7/24/2014	24.9	13.51	8.46	216	577	25.0
8/5/20214						
9/3/2014	25.0	6.95	8.45	219	566	12.0
9/16/2014	16.0	5.58	8.19	196	497	11.0
12/19/2014	2.8	17.95	8.86	243	520	-
2/3/2015	3.0	13.48	7.58	289	613	-
3/10/2015	2.1	19.36	8.02	201	343	-
	Min DO	4.46				
	Max DO	25.90		* - Data was removed due to judgment that DO value was erroneously high		
	Ave DO	11.33			<- Green color denotes winter sampling season	

Water quality monitoring results from samples collected at site W-M462.5O						
	TURBIDITY	**SUSPENDED**	**CHLOROPHYLL a**	**CHLOROPHYLL b**	**CHLOROPHYLL c**	**PHEOPHYTIN a**
DATE	**(NTU)**	**SOLIDS (MG/L)**	**(MG/M3)**	**(MG/M3)**	**(MG/M3)**	**(MG/M3)**
12/20/2007	7.31	3.0	1.7	<1	<1	<1
2/7/2008	5.71	4.0	1.6	1.4	<1	1.2
3/26/2008	24.00	14.0	13.0	<1	1.4	4.5
6/10/2008	25.00	21.0	15.0	1.6	1.9	5.3
7/1/2008	38.40	43.0	22.0	<1	1.5	4.6
7/15/2008	58.20	36.0	24.0	1.1	1.1	6.5
7/29/2008	32.50	30.0	69.0	<1	<1	<1
8/12/2008	32.00	32.0	79.0	<1	3.0	16.0
8/26/2008	32.90	35.0	83.0	<1	1.7	9.3
9/9/2008	44.00	32.0	40.0	1.3	3.5	14.0
12/29/2008	109.00					
1/29/2009	5.22					
6/2/2009	82.40	86.0	31.0	3.0	1.0	11.0
6/16/2009	63.60	79.0	58.0	1.0	3.0	11.0
6/30/2009	51.70	60.0	33.0	1.0	2.0	5.0
7/14/2009	46.70	56.0	97.0	1.0	7.0	8.0
7/28/2009	51.30	36.0	48.0	2.0	3.0	10.0
8/11/2009	44.10	50.0	109.0	3.0	7.0	11.0
8/25/2009	30.40	49.0	245.0	0.0	21.0	8.0
9/9/2009	39.00	44.0	171.0	0.0	13.0	12.0
12/21/2009	11.10					
2/4/2010	9.00					
3/10/2010	160.00					
6/10/2014	71.20	77.6	4.6	8.1	9.0	<1.0
6/24/2014	37.00	40.2	<1.0	1.8	2.7	<1.0
7/8/2014						
7/24/2014	33.90	42.6	-	-	-	-
8/5/20214						
9/3/2014	58.70	60.7	21.2	33.8	28.3	9.8
9/16/2014	93.40	66.0	7.5	14.0	10.0	<1.0
12/19/2014	17.60					
2/3/2015	5.81					
3/10/2015	41.60					
		<- Green color denotes winter sampling season				

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APPENDIX C

PHOTOS

Photo 1. View from Dead Slough toward south end of access channel.

Photo 2. View from Mississippi River toward north end of access channel.

Photo 3. View from access channel toward Dead Slough.

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ANDALUSIA REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

2015

APPENDIX D

SITE MANAGER PROJECT INSPECTION REPORTS

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

April 06, 2010

Anthony Huddlesten
Dept. Of the Army
Rock Island District Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61201-2004

Dear Anthony,

Please find enclosed the 2009 annual report for the Andalusia Waterfowl Refuge. Our FEMA project for the refuge has been completed; the only issues yet are the ones discussed at our August 2009 meeting. Steve Moser has since retired but I continue to oversee the project and look forward to working with and hearing from you in the future.

Sincerely,

Tom Vandemore

Tom Vandemore, Site Assistant Superintendent II
Hennepin Canal Parkway
16006 - 875 East Street
Sheffield, IL 61361
815/454-2328
email: Tom.Vandemore@illinois.gov

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom VANDEMORE Date 4-6-10
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
( ) Settlement, sloughs, or loss of section.	SAME BREAK IN LEVY FROM 08 FLOOD
( ) Seepage, saturated areas, sand boils.	NONE
( ) Wave-wash, scouring.	SOME BUT VERY MINOR
( ) Overtopping erosion.	SOME ON FAR EAST END FROM 08 FLOOD
( ) Vegetative cover (mowing).	MOWED 2 TIMES IN 09
( ) Displaced/missing riprap.	IN SPOTS NEEDED
( ) Burrowing animals.	VERY MINOR AMOUNT, FIXED AS NEEDED
( ) Unauthorized grazing or traffic.	A FEW 4-WHEELERS
( ) Encroachments.	NONE
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms.	O.K.
( ) Concrete.	O.K.
( ) Displaced/missing riprap.	WHERE NEEDED
( ) Blockage of inlet and outlet channels.	INLET TO PUMP IN REFUGE SILTED IN AS DISCUSSED AT STAFF. 09 MEETING
( ) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
( ) Debris.	SOME BEAVER DEBRIS
( ) Waste materials/unauthorized structures.	NONE
( ) Bank Erosion.	SOME BUT MINOR

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
3-9-09	10:45AM	549.6	545.8	OPEN	GRAVITY VALVE TO DRAIN TO 547.0
3-10-09	11:07AM	549.2	547.6	RIVER	RISING FAST. GRAVITY VALVE
INDE	OPEN TO	EQUALIZE	PRESSURE	ON	LEVY'S.
3-14-09	11:30A.M	548.6	546.0	GRAVITY	VALVE STILL OPEN.
3-16-09	10:45AM	547.4	546.4	CLOSE	VALVE AND HOLD AT 547.0
3-24-09	11:07AM	548.0	545.2	OPEN	VALVE TO DRAIN BACK TO 547.0
3-25-09	11:15AM	547.8	545.6	CLOSE	VALVE 1/2 WAY
3-27-09	10:50AM	547.0	546.0	CLOSE	VALVE TO HOLD AT 547.0
3-30-09	11:30A.M	548.0	546.8	OPEN	VALVE TO DRAIN BACK TO 547.0
RAIN	2 DAYS	BEFOLE	RAISED	REFUGE	ALMOST A FOOT
3-31-09	12:15A.M	547.1	546.8	CLOSED	VALVE TO HOLD AT 547.1
4-25-09	10:45A.M	548.8	545.8	OPEN	VALVE TO DRAIN BACK TO 547.1
4-26-09	10:00A.M	547.8	545.8	VALVE	STILL OPEN
4-27-09	11:13A.M	547.2	545.4	CLOSED	VALVE TO HOLD AT 547.2
4-30-09	10:30A.M	548.8	546.0	OPEN	VALVE TO DRAIN BACK TO 547.0
5-1-09	10:50A.M	547.2	546.6	CLOSED	VALVE ALL THE DOWN FOR
WEEKEND.	RIVER	CAME	UP	1 FOOT	OVERNITE
5-15-09	11:00A.M	548.5	545.6	OPENED	VALVE TO DRAIN BACK TO
547.0	HEAVY	RAIN	THE	LAST	2 DAYS & MORE EXPECTED.
ALOT	OF	WATER	RUNNING	OVER	ROAD & FORD.
5-16-09	548.8	546.5	VALVE	OPEN	TO DRAIN BACK TO 547.0
5-17-09	547.8	546.0	VALVE	STICK	OPEN.
5-18-09	11:15A.M	547.2	545.6	CLOSED	VALVE TO HOLD AT 547.2

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
6-26-09	11:00A.m	548.6	545.8	OPENED VALVE TO DRAIN REFUGE	
TO START MOIST SOIL CYCLE. AND ALSO ELEC. TO					
CHECK FLOATS ON PUMPS.					
6-30-09	8:00A.m	ART-O-LITE FIXED SENSOR LITES ON PANEL. ALSO			
CONCLUDED THAT LAST YEARS PUMP PROBLEM WAS NOT FLOATS					
BUT NOT ENOUGH WATER TO KEEP PUMPS RUNNING BECAUSE					
OF SILTATION.					
7-17-09	11:05A.m	CLEANED WEED & BEAVER DEBRIS FROM CERATE			
TO DRAIN TO RIVER LEVEL.					
7-24-09	9:30A.m	545.6	545.6	PUMP ON AT 2384.3 ALSO DUG OUT	
BEAVER DAMN IN FRONT OF CERATE					
7-25-09	10:00Am	545.8	545.6	PUMP TRIPPED OFF CERATE PLUGGED	
7-27-09	9:45Am	545.6	545.8	CLEANED CERATE, PUMP STILL RUNNING	
RAN 24 HOURS STRAIGHT WITHOUT TRIPPING.					
7-29-09	9:45A.m	544.8	545.8	PUMP STIL RUNNING. HAS NOW	
RUN 72 HOURS WITH OUT TRIPPING.					
7-31-09	10:00Am	543.8	545.4	TURNED PUMP OFF AT 2515.1 FOR	
8-3-09	10:45Am	543.8	545.8		WEEKEND.
TURNED PUMP BACK ON AT 2515.1 TO FINISH DRAINING REFUGE					
8-4-09	11:15A.m	543.0	545.6	PUMP OFF AT 2539.5 155 HOURS PUMPING	
	TO DRAIN REFUGE				
8-8-09	11:20A.m	544.0	545.8	PUMP ON AT 2539.5 REFUGE CAME UP	
1 FOOT AFTER HEAVY RAIN.					

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
8-9-09	11:30A.m	543.0	545.4	Pump	off at 2553.7 Hold Refuge
					At 543.0
8-10-09	10:45Am	543.6	545.8	Came	up 6inch's after Heavy
P.m.	Rain.	Nite	Before	Pump	Back on @ 2553.7 Cleaned
Debris From Beavers &			Weeds	Blocking	Drain Crate
8-11-09	10:00A.m	543.0	546.0	Pump	off at 2565.6 Refuge
Again	Drained	To	Moist	Soil	Level. Met with Corps
Personell	and	Art	Metz	From	Springfield Eng. To
Asses	Damage	From	08	Flood.	
8-17-09	9:45Am	543.8	545.8	Pump	on at 2565.6
8-18-09	543.6	545.6	Pump	Still	Running. Cleaned Crate
8-19-09	542.6	545.6	Pump	Tripped	off at 2597.9 Hold at 542.6
8-28-09	9:35Am	546.4	546.2	Pump	on at 2597.9 Refuge Came
up	3½	Feet	After	Heavy	Rain For 3 Days. After Had
	over	5"			
8-29-09	9:15Am	546.2	545.8	Pump	Ran for 24 Hours to Drop
Refuge	2".	Don't	Know	If	we Can Pump Fast Enough
	To	Save	Moist	Soil	Production.
8-30-09	Kyle	G.	Checked	Pump	and Cleaned Crate. Pump
					Still Running.
8-31-09	9:40Am	545.2	545.8	Pump	Still Running.
9-1-09	9:20A.m	543.2	545.4	Pump	Tripped off. Crate Plugged
				Cleaned	and Restarted Pump.

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
9-4-09	11:40A.m.	543.2	545.4	PUMP	TRIPPED OFF. CLEANED
				GRATE	AND RESTARTED PUMP
9-5-09	9:40A.M	543.0	545.4	PUMP	OFF AT 2757.0 TO MUCH
		COONTAIL WEED TO			TRY TO PUMP ANYMORE.
9-6-09	10:05AM	542.8	545.0	PUMP	TRIPPED OFF. CLEANED AND
					RESTARTED.
9-7-09		542.8	545.2	PUMP	TRIPPED OFF, SHUT POWER OFF
10-6-09	9:40A.m	542.6	545.6	OPENED	GRAVITY VALVE TO FILL
			REFUGE TO RIVER LEVEL.		
10-10-09	11:15AM	546.4	546.6	TURNED	PUMP ON TO FILL REFUGE
				AT	1756.9 ALSO ADJISTED FLOAT
10-11-09	9:40AM	546.6	546.6	PUMP	OFF, HOLD THIS LEVEL 1 WEEK
10-13-09	10:40AM	545.6	545.4	PUMP	ON AT 1779.9 FLOOD TO 546.0
10-14-09	11:05AM	545.8	545.4	PUMP	STILL RUNNING
10-15-09	10:10A.m	546.0	545.2	PUMP	OFF AT 1827.4 HOLD 1 WEEK
10-21-09	10:00AM	545.6	545.2	TURNED	PUMP ON AT 1827.4 FLOOD
10-22-09	9:50A.m	546.4	545.2		TO 548.0
		PUMP TRIPPED			OFF. CLEANED RIVER GRATE
					AND RESTARTED PUMP.
10-23-09	9:50A.M.	547.2	545.8	PUMP	TRIPPED OFF AT 1869.0 HOLD
AT	547.0	FOR 1 WEEK.		HEAVY	RAIN OVERNIGHT HELPED
	RAISE REFUGE TO ALMOST FULL POOL				
10-30-09	10:20A.M	548.0	546.0	HEAVY	RAIN OVERNIGHT REFUGE
AT FULL POOL FOR NOW.					

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
11-7-09	9:45Am	548.2	546.3	HOLD	REFUGE AT THIS LEVEL
11-21-09	10:45A.m.	548.4	545.8	HOLD	REFUGE AT THIS LEVEL
12-4-09	11:15A.m.	548.5	545.6	HOLD	REFUGE AT THIS LEVEL
12-18-09	10:30A.m.	549.0	546.5	HOLD	REFUGE AT THIS LEVEL
12-28-09	11:40A.m.	550.6	546.8	OPEN	GRAVITY VALVE TO DRAIN
	REFUGE BACK TO			548.0	
12-29-09	11:50A.m.	548.6	CLOSE	GRAVITY VALVE AND HOLD	
	REFUGE		AT THIS LEVEL.		

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom VANDEMORE Date 4-21-11
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
( ) Settlement, sloughs, or loss of section.	LOSS OF PART OF LEVY IN SAME AREA
( ) Seepage, saturated areas, sand boils.	O.K.
( ) Wave-wash, scouring.	SOME BUT MINOR
( ) Overtopping erosion.	3 TIMES IN LAST YEAR BY PUMPHOUSE
( ) Vegetative cover (mowing).	BURNED EVERY SPRING TRY TO MOW ANNUALLY
( ) Displaced/missing riprap.	O.K.
( ) Burrowing animals.	O.K.
( ) Unauthorized grazing or traffic.	O.K.
( ) Encroachments.	NONE
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms.	O.K.
( ) Concrete.	O.K.
( ) Displaced/missing riprap.	O.K.
( ) Blockage of inlet and outlet channels.	SILTATION MAKING IT HARD TO PUMP
( ) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
( ) Debris.	SOME BEAVER DEBRIS
( ) Waste materials/unauthorized structures.	NONE.
( ) Bank Erosion.	SOME BUT MINOR

d Dead Slough Excavation.

( ) Debris. ALOT OF BEAVER DEBRIS AND BLOCKAGE
( ) Waste materials/unauthorized structures. NONE
( ) Bank Erosion. MINIMAL

e. Refuge Drainage/Islands.

( ) Debris. ALOT OF BRUSH
( ) Waste materials/unauthorized structures. NONE
( ) Bank Erosion. MINOL

f. Pump Station.

( ) Building. O.K.
( ) Gates. O.K.
( ) Pumps. O.K. EXCEPT FOR HAVING TO READJUST FLOATS
( ) Control Panel. O.K.
( ) Trash Racks. BEEN PLUGGED FROM FLOODS BUT O.K.

g. Dredge Material Placement Site.

( ) Mowing/herbicide treatment. O.K.

h. Access Road.

( ) Ditches. CLEANED ANUALLY FROM BLUFF RUNOFF
( ) Culverts. O.K.
( ) Stone Surface. RE ROCKED AFTER FLOODING
( ) Riprap. O.K.
( ) Entrance gate. O.K.

i. Additional Comments.

BREAK AREA IN LEVY IS STILL AN ISSUE. WE HAVE ROBBED DIRT FROM BOTH SIDES. TO MAINTAIN POOL IN REFUGE.

Tom VanDyke
Site Manager

Andalusia Refuge

Tom Vandemoke Report 206

Date	Time	Inside	Outside	Fairport	Comment
3-9-10		548.2	545.8	Here To Do Annual Inspec. For Cors	
3-17-10		551.0	547.8	Open Valve To Drain To River Level	
3-18-10		549.6	547.8	Gate Valve Left Open River Level	
		Expected Rise Another 1 1/2'			
3-19-10		549.0	548.4	Closed Valve Gate For Weekend	
3-22-10		549.0	548.4	Opened Valve To Drain To River Level	
3-23-10		548.6	548.6	Closed Valve Hold At 548.6	
4-29-10		549.8	545.6	Opened Gravity Valve Gate To	
			Drain Back To 548.0		
4-30-10		548.8	545.4	Closed Valve Hold At 548.8	
5-11-10		549.6	545.6	Opened Gravity Valve To Drain To 548.0	
6-21-10		548.4	546.0	Opened Valve To Draw Down	
6-22-10		549.0	547.0	Left Drain Valve Open River	
					Rising.
6-26-10		549.0	547.8	Closed Valve Gate Plugged With	
		Weeds & Beaver Debris. Need Old Backhoe			
7-13-10		549.6	547.0	Opened Valve To Drain For	
			Moist Soil Production.		
7-27-10	Mississippi Flooded Over Refuge Levy. Bad Wind				
	And Heavy Rains. Large Cottonwoods Across Entrance				
	Road Need Dozer To Get Back To Refuge.				
7-30-10	Me And Art R. With Dozer And Saws Got Road				
	Cleared. River Still Flooding Refuge.				

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
8-2-10	FINISHED	CLEARING	TREE'S	FROM	SORM. CLEANED
	DRAIN	CRATE	TO LET	REFUGE	DROP WITH RIVER
8-5-10		549.0	547.2	CLEANED	DRAIN CRATE TO KEEP
		DRAINING	REFUGE	FOR	MOIST SOIL PRODUCTION
8-16-10		546.0	546.0	PUMP	ON AT 2757.2 TO DRAIN
		REFUGE			
8-17-10		546.2	546.0	PUMP	STILL RUNNING
8-18-10		546.0	545.8	PUMP	STILL RUNNING
8-19-10		545.2	545.6	PUMP	STILL RUNNING
8-20-10		545.2	545.6	TURNED	OFF PUMP AT 2850.3 FOR WEEKEND
8-23-10		545.8	545.6	PUMP	BACK ON AT 2850.3 TO DRAIN REFUGE
8-25-10		544.8	546.2	PUMP	STILL RUNNING
8-26-10		543.8	546.2	PUMP	STILL RUNNING
8-27-10		543.2	546.2	PUMP	TRIPPED AT 2941.0
9-4-10		544.6	546.4	TURNED	ON PUMP TO DRAIN TO 543.0
9-5-10		543.2	546.0	TURNED	OFF PUMP FOR WEEKEND
9-7-10		543.6	545.6	PUMP	ON AT 2966.9 TO DRAIN
9-8-10		543.0	545.8	PUMP	TRIPPED AT 2981.4 HOLD AT 543.0
10-5-10	OPENED	GRAVITY	VALVE	TO	EQUALIZE PRESSURE ON LEVY.
	RIVER	RISING	FAST	EXPECTED	TO TOP LEVY.
10-6-10		550.+	550.+	WATER	GOING THRU BREAK IN
	REFUGE	LEVY	AND	RUNNING	OVER LEVY BY PUMPHOUSE
10-16-10	RIVER	STARTING	TO	RECEED	TO NORMAL. FLOOD WATER

AT LEAST 1 TO 2 FEET OVER BREAK IN REFUGE LEVY.

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
11-19-10		543.8	543.8	CLOSED	GRAVITY VALVE AND TURNED
	ON	PUMP	TO FILL	REFUGE	TO 548.0 PER CALL
	FROM	CORPS.			
11-22-10		546.6	544.0	PUMP	STILL RUNNING TO FILL REFUGE
11-24-10		546.10	544.6	TURNED	OFF PUMP FOR THANKSGIVING
		WEEKEND.	REFUGE	FULL OF	DUCKS & GEESE.
11-29-10		546.10	545.0	PUMP	ON TO FINISH FILLING REFUGE
12-1-10		547.8	544.8	PUMP	TRIPPED OFF. REFUGE FULL TO
			FLOAT	LEVEL	ON PUMP.
3-10-11		549.6	545.5	OPENED	DRAIN VALVE TO DRAIN BACK
					TO 548.0
3-12-11		548.2	545.5	CLOSED	GRAVITY VALVE. MET WITH
			JIM	DEREV	ON DITCH JOB
3-27-11		548.4	548.8	RIVER	RISING. MOVED DOZER TO PUT
					MORE DIRT IN BREAK AREA
3-28-11		548.4	549.2	RIVER	RISING. MOVED DOZER TO
					HIGH GROUND
3-29-11		548.4	549.6	RIVER	STILL COMING UP
3-30-11		548.4	550.2	STILL	NOT OVERTOPPING REFUGE
4-4-11		548.4	550.8	STILL	NOT OVER TOPPING REFUGE
					BUT CLOSE
4-8-11		548.6	551.5	WATER	AT TOP OF REFUGE LEVY
					ALMOST GOING OVER
4-14-11		552.+	552.+	EVERYTHING	FLOODED.

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom VANDEMORE Date 4-30-12
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
( ) Settlement, sloughs, or loss of section.	STILL NEEDS REPAIR FROM 08&09 FLOOD
( ) Seepage, saturated areas, sand boils.	O.K.
( ) Wave-wash, scouring.	O.K.
( ) Overtopping erosion.	STILL NEEDS REPAIR FROM 08&09 FLOODING
( ) Vegetative cover (mowing).	MOWED IN FALL OF 2011
( ) Displaced/missing riprap.	O.K.
( ) Burrowing animals.	SOME BEAVER ACTIVITY EVERYWHERE
( ) Unauthorized grazing or traffic.	NONE
( ) Encroachments.	NONE
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms.	O.K.
( ) Concrete.	O.K.
( ) Displaced/missing riprap.	O.K.
( ) Blockage of inlet and outlet channels.	O.K.
( ) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
( ) Debris.	SOME BEAVER DEBRIS BUT NOT BAD
( ) Waste materials/unauthorized structures.	NONE
( ) Bank Erosion.	NONE

Andalusia Refuge

FALL 2011

Date	Time	Inside	Outside	Fairport	Comment
10/6/11	PUMP ON 11:20AM	544.2	545.5	10.42'	PUMP HOURS 01995.4 @ 11:20 AM LEAVE PUMP ON
10/7/11	PUMP OFF 2:00PM	545.0	545.5	10.41'	TURN OFF PUMP @ 2PM - 02021.9 HRS.
10/11/11	PUMP ON 10:30AM	545.0	545.5	10.35'	ALL LEVELS SAME AS ENDING 10/7/11
10/12/11	CHECKED 12:50PM	545.5	545.5	10.34'	PUMP HOURS 02048.2 @ 12:50 PM
10/14/11	PUMP OFF 2:00PM	546	545.5	10.21'	TURN PUMP OFF @ 2 PM - 02097.3 HRS.
10/25/11	PUMP ON 10:30AM	545.9	545.5	10.23'	PUMP ON 10:30AM @ 02097.3 PUMP HOURS.
10/27/11	CHECKED 10:40AM	546.4	545.5	10.24'	PUMP HRS. 02145.5 @ 10:40AM
10/28/11	PUMP OFF 2PM	546.6	545.5	10.15	TURNED OFF PUMP @ 2pm w/ 02172.9 HRS.
10/31/11	PUMP ON 11:25AM	546.5	545.2	10.08	PUMP ON 11:25AM @ 02172.9 HRS.
11/1/11	CHECKED 10:45AM	546.8	545.2	10.10	PUMP HRS. 02196.2 @ 10:45 AM.
11/2/11	PUMP OFF 2PM	547	545.2	10.15	PUMP OFF 2PM @ 02223.4 HRS.

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom VANDEMORE Date 4-4-2013
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
(X) Settlement, sloughs, or loss of section.	IN THE PROCESS OF REPAIRING
(X) Seepage, saturated areas, sand boils.	FROM 2009 FLOOD
(X) Wave-wash, scouring.	OK
(X) Overtopping erosion.	OK
(X) Vegetative cover (mowing).	MOWED FALL OF 2012
(X) Displaced/missing riprap.	OK
(X) Burrowing animals.	SOME BUT REPAIRED
(X) Unauthorized grazing or traffic.	OCASIONAL 4-WHEELERS
(X) Encroachments.	NONE
b. Water Control Structure.	
(X) Pipes, gates, and operating mechanisms.	OK
(X) Concrete.	OK
(X) Displaced/missing riprap.	SOME BUT REPAIRED SUMMER 2012
(X) Blockage of inlet and outlet channels.	NONE
(X) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
(X) Debris.	SOME BEAVER ACTIVITY, BLOCKAGE DOWN BY RIVER
(X) Waste materials/unauthorized structures.	NONE
(X) Bank Erosion.	OK

Andalusia Refuge

FY 2012 → Tom Vandemore

Date	Time	Inside	Outside	Fairport	Comment
5-4-12	10:30am	549.6	547.0		OPENED GRAVITY GATE TO DRAIN
					DOWN TO 547.0 AFTER HEAVY RAIN
5-9-12	10:40AM	548.8	547.0		BEAVERS TRYING PLUG GRATE
					CLEANED GRATE TO DRAIN
5-10-12	10:00A.m	547.5	547.2		CLOSED GATE TO HOLD WATER
6-25-12	10:00A.m	547.9	547.0		OPENED GRAVITY GATE TO DRAIN
6-27-12	10:30 am	547.0	546.5		CLEANED GRATE BEAVERS TRYING
					TO PLUG TO HOLD WATER BACK
6-27-12	10:35AM	546.5	546.8		CLEANED GRATE BEAVERS STILL
					PLUGGIN
6-28-12	10:20AM	546.0	545.2		BACKHOE TO CLEAN GRATES
7-1-12	10:30AM	546.0	545.0		CLEAN BEAVER DEBRIS
7-2-12	10:20AM	545.5	544.0		CLEAN BEAVER DEBRIS
7-6-12	10:30AM	545.0	544.0		CLEAN BEAVER DEBRIS
7-9-12	10:25AM	545.8	545.8		PUMP ON AT 3192.6
7-11-12	10:35AM	544.4	545.6		PUMP STILL RUNNING
7-12-12	10:20AM	544.0	545.8	PUMP	TRIPPED BEAVERS PLUGGED
7-13-12	10:30A.M	543.4	545.8	TURNED	OFF PUMP FOR WEEKEND
7-14-12	10:15AM	543.4	545.6	PUMP	ON TO DRAIN REFUGE
7-15-12	10:30AM	542.2	545.6	PUMP	TRIPPED REFUGE DRAINED
9-30-12	10:15AM	541.8	545.2	PUMP	ON AT 2224.1 FOR 1ST PHASE TO 546.0
10-1-12	10:30AM	542.0	545.0	PUMP	TRIPPED AND COULDNT GET STARTED
				CALLED	ELECTRICIAN.

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
10-4-12	9:20Am	542.0	545.6	ELECTRICIAN	HERE BAD FUSE AND
					CHECKED FLOATS PUMP ON
10-5-12	10:30Am	543.0	545.0	Pump	STILL RUNNING
10-6-12	10:20Am	543.5	545.0	Pump	STILL RUNNING
10-7-12	10:30Am	544.0	544.4	Pump	OFF TO HOLD
10-16-12	10:20Am	544.0	544.1	Pump	ON TO GO TO 546.0
10-17-12	10:30Am	544.5	544.1	Pump	STILL RUNNING.
10-18-12	10:00Am	545.2	544.1	Pump	TRIPPED WAITING FOR BACKHOE
TO DIG	SUMP	AREA	IN	FRONT	OF PUMP HOUSE.
10-27-12	9:45Am	545.2	544.8	Pump	ON TO FILL REFUGE TO 547.0
10-29-12	10:30Am	546.0	544.0	Pump	OFF FOR WEEKEND
11-7-12	10:40Am	546.0	544.1	Pump	ON AT 2412.0
11-8-12	10:25Am	546.2	544.6	Pump	STILL RUNNING
11-9-12	10:30Am	546.4	545.0	Pump	STILL RUNNING
11-10-12	10:20Am	546.6	545.0	Pump	OFF FOR WEEKED
11-18-12	10:30Am	546.4	544.2	Pump	ON AT 2384.2 TO FILL REFUGE
11-19-12	10:35Am	546.6	544.0	Pump	RUNNING
11-20-12	10:38Am	546.7	544.2	Pump	RUNNING
11-21-12	10:25Am	546.7	544.2	Pump	RUNNING
11-22-12	10:30Am	546.8	544.0	Pump	RUNNING
11-23-12	10:25Am	546.8	543.8	Pump	OFF FOR WEEKEND.
11-26-12	10:15Am	546.6	544.0	Pump	ON TO FILL
11-27-12	10:40Am	546.7	543.8	Pump	STILL RUNNING

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
11-28-12	10:40AM	546.8	544.0	PUMP	STILL RUNNING
12-1-12	10:30AM	547.0	544.0	PUMP	TRIPPED OFF FOR FULL REFUGE
12-10-12	10:25AM	546.8	544.1	PUMP	ON TO FILL BACK TO 547.0
12-11-12	10:30AM	547.0	544.1	PUMP	TRIPPED OFF AT 2490.6
				REFUGE	FULL TO 547.0

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

June 25, 2014

Anthony Huddleston
Department of the Army
Rock Island District Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61201 – 2004

Dear Anthony,

Enclosed please find the 2013 Annual Report for the Andalusia Refuge. Should you have any questions, please don't hesitate to contact us.

Sincerely,

Dave

Dave Hahne, Site Superintendent
Hennepin Canal Parkway
16006 – 875 East Street
Sheffield, IL 61361
8158/454-2328

cc: enclosure
file

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom VANDEMORE Date 6-24-14
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
( ) Settlement, sloughs, or loss of section.	WAS PARTIALLY REPAIRED THEN SPRING
( ) Seepage, saturated areas, sand boils.	2013 WASHED OUT AGAIN & NEED'S REPAIR
( ) Wave-wash, scouring.	SOME
( ) Overtopping erosion.	OVERTOPPED SPRING 2013 & 2014 BY PUMP HOUSE
( ) Vegetative cover (mowing).	ONCE IN 2013, NEED'S REPAIRED
( ) Displaced/missing riprap.	OK
( ) Burrowing animals.	OK
( ) Unauthorized grazing or traffic.	SOME BUT VERY LITTLE
( ) Encroachments.	NONE
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms.	OK
( ) Concrete.	OK
( ) Displaced/missing riprap.	NONE
( ) Blockage of inlet and outlet channels.	NONE
( ) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
( ) Debris.	SOME FROM FLOODING
( ) Waste materials/unauthorized structures.	NONE
( ) Bank Erosion.	SOME BUT NORMAL

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
7-20-13	10:00Am	546.0	546.0		CLOSED GRAVITY GATE AND
					STARTED TO PUMP OUT REFUGE
7-21-13	10:00A.m	544.6	546.0		STILL PUMPING
7-22-13	9:45A.m	543.8	546.2		STILL PUMPING
7-23-13	10:45Am	542.6	546.2		PUMP TRIPPED REFUGE DRAINED
9-27-13	10:00Am	542.6	546.8		OPENED GRAVITY GATE TO START
					FILLING REFUGE
10-1-13	9:40A.m	544.2	544.2		CLOSED GRAVITY GATE AND
					TURNED ON PUMP
10-2-13	11:00A.m	544.6	544.2		PUMP STILL RUNNING
10-3-13	9:40A.m	545.0	544.2		TURNED OFF PUMP REFUGE
					AT 1ST STAGE.
10-23-13	00:05A.m	545.0	544.2		PUMP ON TO TAKE REFUGE
					TO 546.0
10-24-13	9:40A.m	545.4	544.0		PUMP RUNNING
10-25-13	10:00A.m	545.6	544.6		PUMP RUNNING
10-26-13	10:45A.m	546.0	544.6		PUMP OFF REFUGE AT STAGE 2
10-30-13	9:30A.m	545.8	544.2		PUMP ON TO FILL TO 546.0
10-31-13	10:15A.m	546.0	544.2		TURNED OFF PUMP ME ON
					VACATION 1 WEEK.
11-12-13	9:30A.m	545.8	544.8		TURNED ON PUMP
11-13-13	9:15A.m	545.8	544.8		PUMP TRIPPED OFF
					BEAVERS PLUGGED INTAKE

Andalusia Refuge

Date	Time	Inside	Outside	Fairport	Comment
11-14-13	9:40 A.m.	545.8	544.2		TURNED ON PUMP
11-15-13	10:15 A.m	546.4	544.0		PUMP RUNNING
11-16-13	9:45 A.m	546.6	544.4		TURNED OFF PUMP FOR
					WEEKEND.
PUMP	OFF FOR	THANKSGIVING			WEEK
12-2-13	10:00 A.m	546.6	544.6		PUMP ON
12-3-13	9:30 A.m	546.8	544.2		PUMP RUNNING
12-4-13	10:15 A.m	547.0	544.0		PUMP TRIPPED REFUGE FULL
12-18-13	9:40 A.m.	546.8	545.0		PUMP ON
12-14-13	10:15 A.m	547.0	545.0		PUMP TRIPPED REFUGE
			FULL		DID WINTER MAINTENANCE
			ON PUMP		SYSTEM.

ANDALUSIA REFUGE REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 16, RIVER MILES 462 THROUGH 463
ROCK ISLAND, ILLINOIS

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected by Tom Vanderwiele Date 12-23-15
Type of Inspection (annual) (emergency-disaster) (other)

1. PROJECT INSPECTION.

Item	Comment/Condition
a. Perimeter Levee.	
( ) Settlement, sloughs, or loss of section.	OK ⇒ NONE
( ) Seepage, saturated areas, sand boils.	OK ⇒ NONE
( ) Wave-wash, scouring.	VERY MINOR
( ) Overtopping erosion.	NONE
( ) Vegetative cover (mowing).	MOWED LEVY SEPT OF 2015
( ) Displaced/missing riprap.	NONE
( ) Burrowing animals.	MINOR
( ) Unauthorized grazing or traffic.	SOME ILLEGAL 4-WHEELER ACCESS
( ) Encroachments.	NONE
b. Water Control Structure.	
( ) Pipes, gates, and operating mechanisms.	OK
( ) Concrete.	OK
( ) Displaced/missing riprap.	NONE
( ) Blockage of inlet and outlet channels.	NONE
( ) Erosion adjacent to structure.	NONE
c. Diversion Drainage Ditch.	
( ) Debris.	SOME FROM BEAVER ACTIVITY
( ) Waste materials/unauthorized structures.	NONE
( ) Bank Erosion.	MINOR

d. Dead Slough Excavation.

( ) Debris. SOME FROM BEAVER LODGE
( ) Waste materials/unauthorized structures. NONE
( ) Bank Erosion. MINOR

e. Refuge Drainage/Islands.

( ) Debris. YES ⇒ TREE'S GROWING RANDOMLY
( ) Waste materials/unauthorized structures. NONE
( ) Bank Erosion. SOME ALONG BOTTOM OF ISLANDS

f. Pump Station.

( ) Building. OK
( ) Gates. OK
( ) Pumps. REFUGE DRAIN PUMP TO BE PULLED FOR REPAIR IN 2016
( ) Control Panel. OK
( ) Trash Racks. OK

g. Dredge Material Placement Site.

( ) Mowing/herbicide treatment. NONE

h. Access Road.

( ) Ditches. CLEANED OUT NOV & DEC 2015 FROM HEAVY RAIN
( ) Culverts. OK
( ) Stone Surface. SOME CA-6 ADDED WHERE NEEDED
( ) Riprap. MISPLACED FROM HEAVY RAIN
( ) Entrance gate. OK

i. Additional Comments.

DITCH ALONG ENTRANCE ROAD CONTINUES TO REQUIRE ALOT OF MAINTENANCE TO MAINTAIN BECAUSE OF RAIN COMING OFF BLUFF

Tom Vandenberg
Site Manager

Photo 1: Perimeter Levee damage, prior to repair, looking east.

Photo 2: Perimeter Levee damage, prior to repair, looking west.

Photo 3: Pump removal for repair, winter 2016.

Photo 4: Pumphouse, winter 2016, preparing for pump removal.