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January 21, 2004

Planning, Programs, and
Project Management Division

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The Rock Island District of the U.S. Army Corps of Engineers (Corps) has enclosed for your use the 12-Year Post-Construction Performance Evaluation Report (PER) for the Brown's Lake Habitat Rehabilitation and Enhancement Project (HREP). This report is a product of the post-construction field observations and monitoring data covering the period of August 1996 through April 2001. The next report is scheduled for completion in 2004.

Performance Evaluation Reports (PERs) are the Corps' primary mechanism for reviewing, documenting, and communicating the effectiveness of HREPs, which are a part of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP). The main purposes of PERs are to summarize project performance, as well as operation and maintenance efforts, based on the project goals/objectives, and to review the monitoring plan and performance criteria to aid in the design of future HREPs.

A draft PER was provided to project sponsors for their review and comment. Those comments were incorporated into the final PER. If you have any questions regarding this report, please call Mr. Brad Palmer in the Water Quality Branch, Engineering Division, telephone 309/794-5580.

Sincerely,

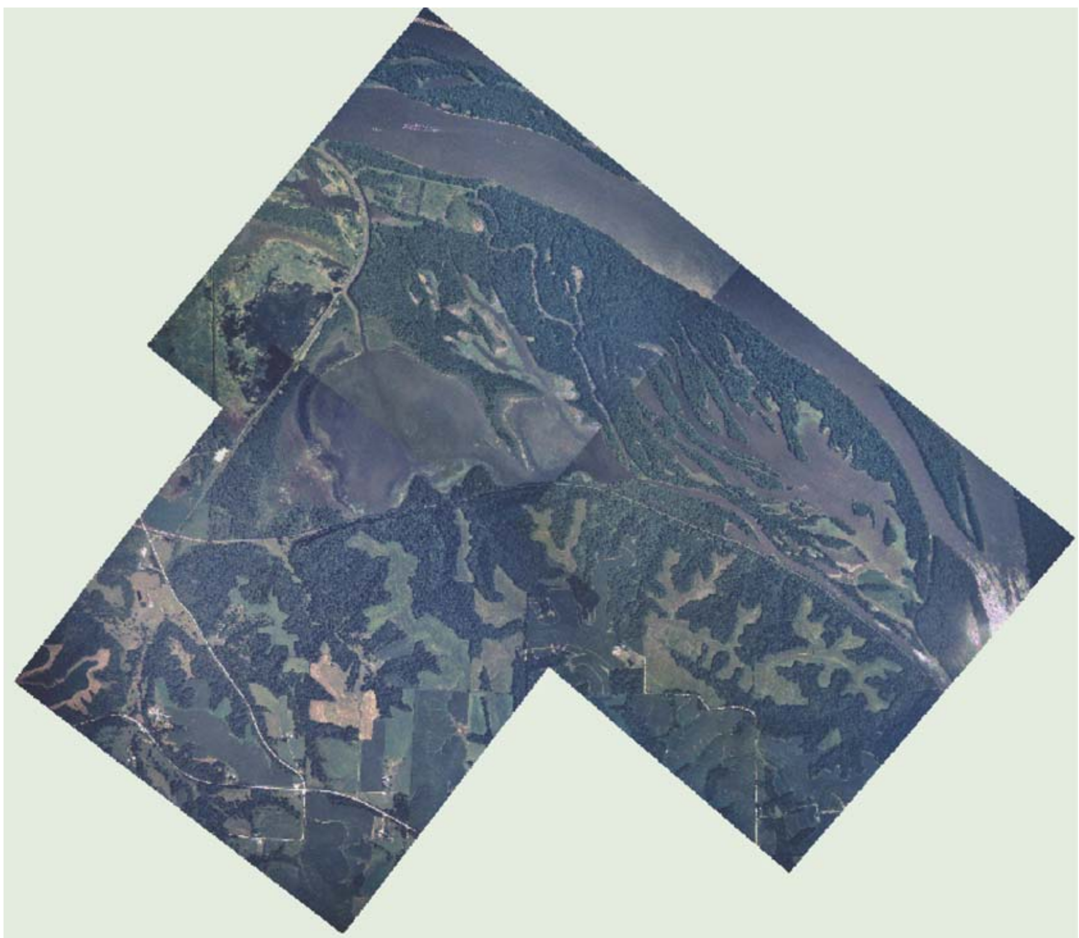
Gary L. Loss, P.E.
Chief, Planning, Programs, and Project
Management Division

U.S. CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT
SUPPLEMENT (12-Years Post Construction)

BROWN'S LAKE HABITAT REHABILITATION AND ENHANCEMENT PROJECT



POOL 13, MISSISSIPPI RIVER MILES 544.0 – 546.0
JACKSON COUNTY, IOWA

OCTOBER 2003

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EXECUTIVE SUMMARY

General. The Brown's Lake HREP is a valuable backwater area that had degraded from a lake environment that was up to 6-feet deep to a 12 to 18-inch deep marsh complex due to siltation. The continued siltation increased the probability of winter fish kills; and, negatively impacted what was an important migratory waterfowl area, fishery, and furbearer area. The ongoing siltation process would have transformed the area into lowland brush habitat, further reducing the available open water and submergent/emergent aquatic vegetation in Pool 13.

The HREP project has reduced the ongoing siltation. Dredging completed as part of the HREP project has provided refuge for fish in deeper water during winter and increased habitat diversity. Estimated angler effort and catch has increased 50% and 117%, respectively, in Lower Brown's Lake and Lainsville Slough following rehabilitation. Upper Brown's Lake has experienced an increase in angler effort and catch by a factor of 10 since project completion. The majority of the mast tree planting on the dredged material was lost due to flooding in 1993. The trees were not replanted.

Purpose. The purpose of this report is to provide a summary of the observations for the performance evaluation monitoring that has been ongoing since August 1996 through April 2001.

Goals. The two goals for the Brown's Lake project are:

1. Enhance Aquatic Habitat, and
2. Enhance Wetland Habitat

Past Performance Evaluation Reports. The first Performance Evaluation Report for the Brown's Lake HREP was completed in 1997. Concerns listed in the 1997 PER were:

1. The dredged channels and deep holes appeared to be filling at a faster rate than the undisturbed areas. A 50-year life may not be an achievable goal. Continued monitoring will better define life expectancies for the dredged channels and deep holes.

2. Rebuilding of two wing dams upstream of the inlet channel was scheduled during the summer of 1997. The existing wing dams were suspected of contributing to sediment accumulation in the inlet channel. The Corps is to investigate notching the rebuilt wing dams with the idea that flow will increase in the vicinity of the notch, resulting in a subsequent decrease in sediment accumulation in the vicinity of the inlet channel.

3. Evaluate the revegetation of dredged material placement sites with mast producing trees for future projects. This may include remedial work for the dredged material and/or a drainage system for the placement site, based on characteristics of the final in-place dredged materials. Otherwise, this evaluation may consider alternative approaches such as

planting the site with wet-soil adapted species to assist in dehydration and consolidation of the site prior to planting with mast trees.

Observations, Conclusions and Recommendations.

1. Project Goals, Objectives, and Management Plan. Based on data and observations collected for the report period of August 1996 through April 2001, the project goals and objectives for reducing sedimentation, improving water quality, increasing fish diversity with varied water depths are being met. Deep hole, vegetation transects, and bottomland hardwood information was not collected for this report but is scheduled for completion in FY04. Continued data collection will better define the degree of sedimentation rate reduction, water quality improvement, fish habitat and diversity improvement, and mast tree survival. The next survey of sediment transects is also scheduled for completion in FY04.

2. Post-Construction Evaluation and Monitoring Schedules. In general, most project monitoring efforts have been performed according to the Post-Construction Performance Evaluation Plan in Appendix A and the Resource Monitoring and Data Collection Summary in Appendix B, except where flood conditions or other obstacles have prevented monitoring tasks. Four new transects were added to help with the sedimentation analysis. A Post-Construction Performance Evaluation Supplement will be prepared annually. The next Post-Construction Performance Evaluation will be completed for 2003, 13 years after construction, for distribution in March 2004.

3. Project Operation and Maintenance. Project operation and maintenance has been conducted in accordance with the O&M Manual. The water control structure is operating and is maintained correctly. Annual site inspections by the Refuge Manager have resulted in proper corrective maintenance actions.

4. Project Design Enhancement. Discussions with USFWS and Corps personnel involved with operation, maintenance, and monitoring activities at the Brown's Lake Project have resulted in the following general conclusions regarding project features that may affect future project design:

a) Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper And Lower Brown's Lakes: The project sediment reduction is slightly less than the design reduction in sediment (assuming without project sediment rate of 0.5 inches/year). Upper Brown's Lake appears to be experiencing a greater sedimentation rate than Lower Brown's Lake. This would suggest that the increase in sediment deposition in Upper Brown's Lake might be due to Smith's Creek.

The next report will incorporate more detailed sediment transects information for evaluation of sedimentation trends in the Brown's Lake Project. Continued monitoring will better determine long-term sedimentation rates and patterns.

b) Improve Water Quality for Upper and Lower Brown's Lake by Decreasing Suspended Sediment Concentrations and Increasing Winter Dissolved Oxygen Concentrations: Results from the current evaluation period show that the ability to introduce oxygenated water into, and exclude sediment laden water from Brown's Lake are key elements in providing habitat for native fisheries. In general the water quality objectives are being met. The use of the inlet gate helps to control and improve dissolved oxygen concentration, especially during periods in the winter.

c) Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths: Vegetation transect information was not provided for this report but is scheduled for FY04. The LTRM Bellevue Field Station personnel are to sample 15 aquatic vegetation transects in the Upper and Lower Brown's lakes twice yearly during the growing season.

Based on the O&M Manual, the as-constructed lake volume at year 0 was 240 acre-feet. Sediment transects collected from 1997 to 2001 showed an average deposition rate in the Brown's Lake Project dredge cuts of 3.52 inches/year. If the deposition rate calculated for the 1997 to 2001 time period were to continue, the dredged channels would be expected to fill in after 29 years. Suspended sediment data has been collected on Smith's Creek between 1991 and 1998. The average sediment transport at the Smith's Creek monitoring station was calculated to be 6.0 acre-feet/year (excluding 1993), while the difference in sediment deposition between Upper Brown's Lake and Lower Brown's Lake from is 8.4 acre-feet/year. The sediment transported through Smith's Creek does not all settle out in Upper Brown's Lake, however, it is likely a major contributor to sediment deposition there. Continued monitoring will further define sedimentation rates and patterns.

d) Increase Habitat Available for Wintering Fish by Providing Deeper Water Areas: These holes were not surveyed for this report. Based on decreased sedimentation rates in the dredge cuts found in 2001, the expected depths for the deep holes may be maintained for a longer period than predicted in the 1997 PER. Surveys of the deep holes are scheduled for FY04.

e) Increase Bottomland Hardwood Diversity by Increasing Selected Terrestrial Elevations and Reducing Frequency of Flooding for Such Hardwoods: Wetland habitat objectives were not evaluated for this report but is scheduled for completion in FY04.

5. Project Monitoring and Evaluation. In general, water quality objectives are being met. There is a concern that the sedimentation rate is greater than expected that is somewhat attributed to sediment loads coming from Smith's Creek that enters Upper Brown's Lake. Further monitoring and sediment rate assessment is needed however to determine if the objective for increasing fish habitat and diversity is affected in Upper and Lower Brown's Lake. The deep holes for wintering fish habitat and wetland objectives still require evaluation and they are scheduled for completion in FY04.

ACKNOWLEDGMENT

Many individuals of the Rock Island District, U.S. Army Corps of Engineers; the U.S. Fish and Wildlife Service; and the Iowa Department of Natural Resources contributed to the development of this supplemental Post-Construction Performance Evaluation Report for the Brown's Lake Rehabilitation and Enhancement Project. These individuals are listed below:

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1. INTRODUCTION

The Brown’s Lake Habitat Rehabilitation and Enhancement Project (Brown's Lake HREP) is part of the Upper Mississippi River System (UMRS) Environmental Management Program (EMP). The Brown’s Lake project is located within the Upper Mississippi River National Wildlife and Fish Refuge. The Brown’s Lake HREP is a valuable backwater area that had gone from a lake that was up to 6-feet deep to a 12 to 18-inch deep marsh complex. The continued siltation increased the probability of winter fish kills; and, negatively impacted what was an important migratory waterfowl area, fishery, and furbearer area. The ongoing siltation process would have transformed the area into lowland brush habitat, further reducing the available open water and submergent/emergent aquatic vegetation in Pool 13.

The project has reduced the ongoing siltation. Dredging has provided refuge for fish in deeper water during winter and increased habitat diversity. Estimated angler effort and catch has increased 50% and 117%, respectively, in Lower Brown’s Lake and Lainsville Slough following rehabilitation. Upper Brown’s Lake had angler effort and catch increase by a factor of ten since project completion. The majority of the mast tree planting on the dredged material was lost due to flooding in 1993. The trees were not replanted.

a. Purpose. The purposes of this report are as follows:

(1) Supplement monitoring results and project operation and maintenance discussed in the April 1997 Post-Construction Evaluation Report;

(2) Summarize the performance of the Brown’s Lake project, based on the project goals and objectives;

(3) Review the monitoring plan for possible revision;

(4) Update project operation and maintenance efforts to date; and

(5) Review engineering performance criteria to aid in the design of future projects.

b. Scope. This report summarizes available project monitoring data, inspection records, and observations made by the U.S. Army Corps of Engineers (Corps), the U.S. Fish and Wildlife Service (USFWS), and the Iowa Department of Natural Resources (IADNR) for the period from August 1996 through April 2001.

c. Project References.

(1) *Post Construction Performance Evaluation Report (PERS2F), Brown’s Lake Rehabilitation and Enhancement, Pool 13, River Mile 545.8, Upper Mississippi River, Jackson County, Iowa, April 1997.* This document was prepared to summarize all

available monitoring data, project inspections, and project observations by the Corps, the USFWS, and the IADNR for the period June 1987 to August 1996.

(2) *Post Construction Performance Evaluation Report (PER2D), Brown's Lake Rehabilitation and Enhancement, Pool 13, River Mile 545.8, Upper Mississippi River, Jackson County, Iowa, September 1996.* This document was prepared to summarize all available monitoring data, project inspections, and project observations by the Corps, the USFWS, and the IADNR for the period June 1987 to February 1996.

(3) *Post Construction Performance Evaluation Report (PER2F), Brown's Lake Rehabilitation and Enhancement, Pool 13, River Mile 545.8, Upper Mississippi River, Jackson County, Iowa, February 1993.* This document was prepared to summarize all available monitoring data, project inspections, and project observations by the Corps, the USFWS, and the IADNR for the period June 1987 to October 1992.

(4) *Brown's Lake Habitat Rehabilitation and Enhancement Project, Great Flood of 1993 Damage Assessment, February 1994*. This document was prepared to summarize the Flood of 1993 damage, proposed corrective action, and estimated cost for repairs.

(5) *Report on the Revegetation of Fine-Grained Dredged Material with Mast-Producing Tree Species on the Upper Mississippi River in Jackson County, Iowa, December 1994.* This report summarizes the results of efforts to revegetate the fine-grained dredged material deposited in the containment area as a feature of the HREP project. The study was conducted for the Corps by Iowa State University researchers at the direction of the Iowa Cooperative Fish and Wildlife Unit. The objectives of the study were to determine optimal strategies for establishing mast-producing trees on fine-grained dredged material, and to establish a viable stand of mast-producing tree species at the Brown's Lake dredged material placement site.

(6) Letter from Mr. Robert Kelley, Corps, to Mr. William Hartwig, USFWS, June 19, 1995. This letter transmits the final report for the second phase of the project, revegetation of fine-grained dredged material with mast producing tree species, and formally transfers the Brown's Lake project to the USFWS.

(7) Letter from Mr. William F. Hartwig, USFWS, to Colonel Cox, Corps, July 20, 1995, accepting the transfer of the Brown's Lake project from the Corps to the USFWS. This letter noted that revegetation of the dredged material placement site was not successful and that maintenance to ensure survival of the tree seedlings was not applicable.

(8) Letter from Mr. Robert Kelley, Corps, to Mr. William Hartwig, USFWS, August 10, 1995. This letter formally deletes the paragraph in the O&M Manual describing maintenance of the dredged material placement site.

(9) Memorandum of Agreement between the USFWS and the Corps, July 8, 1994, to allow the USFWS and the Corps to work together on a mutually beneficial project

known as the Flood Damage Habitat Restoration Project. This project included several work orders funded by the USFWS, the first of which resulted in Plans and Specifications for the Brown's Lake Inlet Channel Excavation, River Mile 545.8, Pool 13, Upper Mississippi River System, Jackson County, Iowa, June 1995, Contract No. DACW25-95-C-0064. This document was prepared to provide sufficient detail of project features to allow clearing, stripping, and excavation of the inlet channel, and placement of the excavated material on the riverbank and levee adjacent to the inlet channel by a contractor. This project was in response to flood damage caused by the Great Flood of 1993, an above design flood event (i.e., greater than 50-year event) for the Brown's Lake project, which resulted in large sediment accumulations in the inlet channel, on the water control structure apron, and complete burial of the riprap adjacent to the water control structure.

(10) National Biological Service, Illinois Natural History Survey, Iowa Department of Natural Resources and Wisconsin Department of Natural Resources. Long-Term Resources Monitoring Program 1993 Flood Observations. National Biological Service, Environmental Management Technical Center (EMTC), Onalaska, Wisconsin, December 1994 (LTRMP 94-SO11). This publication is a compilation of reports of observations made during the 1993 flood on the Upper Mississippi River. It includes observations of pre- and post-flood aquatic macrophyte abundance in the Brown's Lake complex, field observations of tree mortality in Pool 13 resulting from the 1993 flood, observations of sedimentation along two transects in Brown's Lake, and water quality sampling in Brown's Lake during peak flood levels in July 1993.

(11) Largemouth Bass Response to Habitat and Water Quality Rehabilitation in a Backwater of the Upper Mississippi River, by Russell Gent, John Pitlo, Jr., and Tom Boland. North American Journal of Fisheries Management 15:784-793, 1995. This study includes additional data on suspended sediments and creek statistics from the study and was identified as reference (4) in the May 1993 Performance Evaluation Report (PER2F).

(12) Site Manager's Project Inspection and Monitoring Results - 6/19/95, 4/9/96. These reports outline the results of USFWS inspections of the deflection levee, water control structures, inlet channel improvements, side channel excavation, lake dredging, and the dredged material placement site.

2. PROJECT GOALS, OBJECTIVES, AND MANAGEMENT PLAN

a. General. The Brown's Lake project was initiated primarily because of rapid accumulation of sediment and deterioration of water quality that resulted in significant winter kills in the lake. Although water quality within the lake was adequate to sustain native fisheries during the summer months, ice and snow cover produced periods when dissolved oxygen (DO) became depleted to the point where fish kills occurred. Project construction was completed in September 1990.

b. Goals and Objectives. Goals and objectives were formulated during the project design phase and are summarized in Appendix A.

Table 1. Summary of Project Goals, Objectives, and Enhancement Features.

Goal	Objective	Enhancement Feature
Enhance Aquatic Habitat	Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes.	Deflection levee
	Increase fish habitat in Upper and Lower Brown's Lakes and increase fish diversity by providing varied water depths.	Dredging
	Increase habitat available for wintering fish by providing deeper areas.	Dredging
Enhance Wetland Habitat	Increase bottomland hardwood diversity by increasing selected terrestrial elevations and reducing frequency of flooding for such hardwoods.	Mast tree plantings on dredged material placement site

c. Management Plan. As discussed in the April 1997 (PER2F), a formal management plan was developed for the Brown's Lake Project by the USFWS and is shown in Table 2. The Brown's Lake project is operated as generally outlined in the O&M Manual.

Table 2. Project Management Plan

Annual Management Plan for Brown's Lake		
Time Frame	**Management Action**	**Purpose**
Winter	Open one water control structure 10 inches after ice cover.	Increase DO concentrations for overwintering fish in backwaters.
Spring	Close water control structure when turbidity levels reach 40 NTU in the main channel or 100 NTU in the Maquoketa River. All gates will be closed prior to spring runoff.	Improve water quality in important backwater habitat by decreasing suspended sediment concentrations.

3. PROJECT DESCRIPTION

a. Project Features. Plate 1 in Appendix G shows a general plan and vicinity map, and plate 2 shows project features. Table 1 above summarizes the project features provided in Appendix A and shows the enhancement features completed for the Brown's Lake project.

b. Construction and Operation. Following award of the levee/dredging construction contract on July 21, 1988, dredging began during late summer and was essentially completed in September 1990. Planting for the revegetation of the dredged material containment area was completed by May 1993. Excavation of the inlet channel to remove sediment deposited as a result of the Great Flood of 1993 (an above-design flood event greater than the 50-year event) began in August 1995 and was completed in September 1996. The inlet channel excavation work was funded by the USFWS.

Project operation and maintenance generally consists of: (1) operating the water control structure to ensure sufficient dissolved oxygen levels throughout the Brown's Lake Complex during critical times of the year; (2) maintaining the inlet channel to ensure that it is kept free of silt and debris; (3) maintaining the water control structure gates; (4) mowing and maintaining the sediment deflection levee and related revetment; and (5) maintaining the drainage ditch system in the mast tree planting area.

4. PROJECT PERFORMANCE MONITORING

a. General. Appendix A presents the Post-Construction Evaluation Plan. This plan was developed during the design phase and serves as a guide to measure and document project performance. Appendix B contains the Monitoring and Performance Evaluation Matrix and Resource Monitoring and Data Collection Summary. This schedule presents the types and frequency of data that have been collected to meet the requirements of the Performance Evaluation Plan.

b. Corps of Engineers. The success of the project relative to original project objectives shall be measured utilizing available data, field observations, and project inspections performed by the USFWS, IADNR, UMESC, and the Corps. The Corps has overall responsibility to measure and document project performance.

The physical locations of the sampling stations referenced in the Performance Evaluation Plan and the Resource Monitoring and Data Collection Schedule are presented on plates 3 and 4, 9A and Figure G1. The data collection stations and transects that the Corps are responsible for are listed in Table B-2. For this report, several sediment transects were not completed that included S-M 545.9H and S-M 546,3H. The deep hole transects were not completed. The Corps also has collected water quality data at six stations. Three stations are located within the dredged channel, two are off-channel, and one is in Lainsville Slough. Survey transects of the deep holes and profile areas were not completed for this report due to budget and scheduling conflicts. The data collection for these missing transects and surveys is scheduled for FY04.

c. U.S. Fish and Wildlife Service (USFWS). The USFWS is responsible for operating and maintaining the Brown's Lake project. Data collection and monitoring by the USFWS and the Upper Midwest Environmental Science Center (UMESC) is being performed under the Long-Term Resources Monitoring (LTRM) Program (Public Law 99-662). The USFWS transects were discontinued after the 1997 PER. UMESC collected transect data at 3 new locations in the Brown's Lake Project for this evaluation report. Figure 1 shows the new transect locations that are labeled UBN (Upper Brown's Lake North), UBS (Upper Brown's Lake South), LBN (Lower Brown's Lake North), and LBS

(Lower Brown's Lake South). The USFWS Refuge Manager is required to conduct annual inspections of the project and participate in periodic joint inspections of the project with the Corps. As Refuge Manager, the USFWS is also in a position to make regular field observations that aid in determining the relative success or failure of the Brown's Lake project.

d. Iowa Department of Natural Resources (IADNR). The IADNR collects data at five sedimentation transects and four fish stations. Two of these sedimentation transects were surveyed in the summer of 2000. Figure 1 shows the sediment transect locations and Figure 2 shows the IADNR sedimentation transect data. As manager of the adjacent Green Island Refuge, the IADNR is in a good position to make regular field observations of the Brown's Lake project to aid in determining the relative success or failure of the project.

5. EVALUATION OF AQUATIC HABITAT OBJECTIVES

a. Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes.

(1) Monitoring Results. Sedimentation transect locations and charts are shown on Plate 3 and Figure 1. The sediment data used to determine the average annual sediment volume for the 2002 12-year post construction PER was calculated from the UMESC and IADNR sediment transects shown in Figure 1. The technical calculations to assess sedimentation in the Brown's Lake Project are shown in Appendix E, Table 1.

The Brown's Lake deflection levee was designed to provide an annual sediment reduction of 0.35 inches/year over the Brown's Lake project. The without-project expected sediment rate detailed from the Brown's Lake Definite Project Report was determined to be 0.5 inches/year. Previous transects information prior to this report that is available to assess the sedimentation rate includes the periods 1929 – 1930, 1938, 1987, and 1989 - 1996. The annual sediment deposition calculated from the sediment transect information available in the 1997 PER was 0.3 inches/year over the entire Brown's Lake Project. Using all available transect information for the time period covered in this report, the deposition rate is 0.19 inches/year.

The average annual sediment deposition rates calculated from these transects between 1997 – 2002 were greatly varied as shown in Figures 2 and 3. A much higher level of deposition was shown in the dredge cut portions of the Brown's Lake Project. Table E2 shows that the rate of sediment deposition in the dredge cuts over the time period covered by this report was 3.52 inches per year while the sedimentation rate outside of the dredge cuts averaged -0.01 inches/year. Each of these transects shows a reduced rate of sedimentation for the time period from 2000 – 2001 as compared to the 1997 – 2000 time period (See Figure 2 through Figure 8). The 2001 survey did not, however, measure the effects of the flood of 2001, as the survey was performed before the flood event. Another noteworthy trend in Brown's Lake sedimentation patterns is that the Upper Brown's Lake shows a much higher level of sedimentation than the transects in Lower Brown's Lake. Table E2 shows that the average rate in Upper Browns Lake is 0.28 inches per year, which is substantially higher than the net rate in Lower Brown's Lake of 0.02 inches/year. This trend was also noted in the 1997 PER.

Smith's Creek may be affecting sedimentation patterns in Brown's Lake. Suspended sediment data has been collected at Smith's Creek between 1991 and 1998. This summary data is shown in Table E3. Table E3 shows that the calculated average suspended sediment transport over the time period from 1991 through 1998 (excluding 1993) was 6.0 acre-feet/year. The difference in calculated sediment deposition between Upper Brown's Lake and Lower Brown's Lake is approximately 8.4 acre-feet/year. While all of the sediment transported through Smith's Creek does not deposit in Upper Brown's Lake, the data in Tables E1 through E3 indicate that Smiths Creek may play a major role in sedimentation trends in Brown's Lake.

Overall, the average annual sediment deposition rate of 0.19 inches/year is approximately 0.04 inches greater than the design sediment deposition rate of 0.15 inch/year.

(2) Conclusions. The project sedimentation reduction rate is slightly greater than expectations; however, this does not indicate that this objective is not a success. Upper Brown's Lake appears to be experiencing a greater sedimentation rate than Lower Brown's Lake. The higher rate of sediment deposition in Upper Brown's Lake may be partly due to Smith's Creek.

Continued monitoring of these areas will better determine long-term sedimentation rates and patterns; and the overall success of this objective.

b. Improve Water Quality for Upper and Lower Brown's Lakes by Decreasing Suspended Sediment Concentrations and Increasing Winter Dissolved Oxygen Concentrations.

(1) Monitoring Results. The water quality objectives of the Brown's Lake project are to decrease sediment input to the lake and to increase winter dissolved oxygen (DO) concentrations. As shown in Appendix A, Table A-1, the project was designed to keep total suspended solids (TSS) concentrations at or below 50 mg/l and to maintain DO concentrations above 5 mg/l. No baseline water quality data were available for this project. It was presumed that fish kills observed during winters prior to project construction were likely due to low DO concentrations in conjunction with decreasing water depths due to sedimentation. In an effort to avoid future winter kills, a water control structure was constructed in the inlet channel to Brown's Lake. The gated structure was designed to allow oxygen rich water to flow into the lake during the critical winter months, while keeping sediment-laden waters from entering the lake the remainder of the year.

Water quality data presented in previous Brown's Lake performance evaluation reports covered the periods June 1987 through early 1993 and January 1994 through September 1996. Data presented in this report covers the period from December 4, 1996, through September 26, 2000.

During the study period, the Corps performed water quality monitoring at four Brown's Lake sites (W-M545.8F, W-M545.5C, W-M544.2C and W-M544.6F), while the Iowa Department of Natural Resources (IADNR) monitored one site (W-M545.5B) as part of the Long Term Resource Monitoring (LTRM) program. Sites W-M545.8F, W-M544.2C and W-M545.5B are located within dredged channels, while site W-M545.5C is located off-channel. Site locations are identified in Plate 4 in Appendix G.

Corps data were obtained through a combination of periodic grab samples and the use of *in-situ* continuous monitors. Grab samples were collected just below the surface on 50 occasions at sites W-M545.8F and W-M544.2C. The two sites were usually visited twice per month from June through September and monthly from December through March. Sampling was usually not performed during April, May, October and November. Site W-M545.5C was sampled only during the summer months, while site W-M544.6F was sampled only during the winter months. 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, TSS, chlorophyll (a, b and c) and pheophytin a. LTRM personnel collected grab samples approximately every other week at site W-M545.5B.

In-situ water quality monitors (YSI model 6000UPG or 6600UPG sondes) were deployed by Corps personnel on 21 occasions at site W-M545.8F, five occasions at site W-M544.6F and nine occasions at site W-M544.2C. Sondes were positioned 3 feet above the bottom during all deployments except on December 4, 1996 when sondes were deployed 3 and 6 feet above the bottom at both sites W-M545.8F and W-M544.6F. Deployments were typically for a period of two weeks during the summer months and four to five weeks during the winter months. The sondes were normally equipped to measure DO, water temperature, pH, specific conductance, depth and turbidity.

The results from water quality monitoring at all sites are found in Appendix D. Table D-1 gives the monitoring results for samples collected at site W-M545.8F. This site is located downstream from the water control structure in the inlet channel. DO concentrations here ranged from 1.61 mg/l – 21.40 mg/l. Twelve DO measurements were below 5 mg/l; however, none of these occurred during the winter months. The results from DO measurements taken at sites W-M545.5C, W-M544.2C, W-M544.6F and W-M545.5B are shown in Tables D-2 through D-5, respectively. The number of DO measurements less than or equal to 5 mg/l at each of these sites is as follows: W-M545.5C (9), W-M544.2C (7), W-M544.6F (1) and W-M545.5B (4). The results from these sites were similar to those observed at site W-M545.8F in that nearly all low values occurred during the summer months. Only two measurements taken during the winter months were below the target level: 4.99 mg/l at site W-M544.2C and 3.42 mg/l at site W-M544.6F, both on January 20, 1999. In response to a relatively low DO concentration (5.8 mg/l) measured by LTRM personnel at site W-M545.5B on January 11, 1999, one inlet gate to Brown's Lake was opened ten inches on January 12, 1999. The results from a sonde deployed on December 17, 1998 at site W-M545.8F that captured the effects of the opening of the inlet gate on January 12, 1999 are shown in Figure D-1. Prior to opening the inlet gate to Brown's Lake, the DO concentration fell below the target level of 5 mg/l for about four days. Within two days of opening one inlet gate, the DO concentration raised nearly 12 mg/l. DO concentrations were rarely below the target level during the winter and supersaturated conditions were common. The effect of the inflowing oxygenated water was observed at site W-M545.8F on January 20, 1999 when the DO concentration was 13.98 mg/l; however, the oxygenated water had not yet reached sites W-M544.2C or W-M544.6F. By the following sampling date (February 17, 1999) though, the DO concentration exceeded 15 mg/l at the two sites. The beneficial result of opening one inlet gate ten inches is shown dramatically in Figure D-1 On December 4, 1996 two sondes were deployed at site W-M544.6F: one 3 feet and one 6 feet above the bottom. As shown in Figure D-3, at the start of the deployment the DO concentration near the surface was about 2.5 mg/l greater than that shown at 3 feet off the bottom. The DO concentrations gradually approached each other until the end of the deployment (December 17, 1996) when they were about equal.

Figure D-4 is a rare example of a winter deployment when the DO concentration briefly fell below the target level. The snow cover was 5 inches deep when the sonde was deployed and 4 inches deep when it was retrieved. The rise in DO concentration starting on January 22, 1997 could be due to oxygenated water flowing through the inlet structure, which was opened on December 23, 1996. Apparently, snow cover limited photosynthesis because the rise was short lived. After about three days the DO concentration steadily declined until it fell below 5 mg/l on February 1 and 2, 1997 before increasing again for the remainder of the deployment.

Figure D-5 is an example of typical winter DO monitoring results from site W-M544.2C. The DO concentration remained well above the target level and supersaturated conditions were observed during the deployment. Data from summer deployments was occasionally not useable: once, the flotation mechanism failed and the sonde sank, and on other occasions the data were suspect. Sonde malfunction is probably responsible for some of the suspect data along with biofouling of the DO probe. It was not uncommon for the sonde to be covered with organisms (primarily chironomids) following a two-week deployment. During the summer months, nighttime DO concentrations often fell below the 5 mg/l target level; however, the DO concentration usually rose during the day. Figure D-2 is a graph showing DO data for the May 25 through June 15, 1999 deployment at site W-M545.8F. The DO concentration was below the target level for most of the deployment. Although the DO concentration did rise above 5 mg/l on several days, there was a nearly 7-day period from May 28 through June 4 when the DO concentration remained below the target level. The results from other summer deployments also indicated that occasionally the DO concentration remained below 5 mg/l for several consecutive days at this site.

Figure D-6 is an example of a typical summer deployment at site W-M544.2C. Although the DO concentration fell below 5 mg/l on several occasions, it always recovered within 24 hours. Supersaturated conditions were often observed during the deployment. In fact, the maximum DO concentration on July 7, 1999 was 21.94 mg/l! Intense algal photosynthesis was most likely responsible for the large daily DO concentration oscillations (pH values followed a similar pattern). As shown in Table D-3, chlorophyll *a* concentrations were high in the grab samples collected when the sonde was deployed (July 1, 1999) and retrieved (July 20, 1999). The proximity of this site to Lainsville Slough could be one reason why extended periods of low DO concentrations were not observed here.

The project was designed to keep TSS concentrations at or below 50 mg/l. TSS samples were collected at sites W-M545.8F, W-M545.5C, W-M544.2C, W-M544.6F and W-M545.5B. TSS concentrations were less than or equal to the 50 mg/l objective the majority of the time (see Tables D-1 through D-5). The TSS concentration exceeded 50 mg/l on eight occasions: 60.0 mg/l on March 18, 1999 and 61.0 mg/l on March 28, 2000 at site W-M545.8F; 110.0 mg/l on August 4, 1998 at site W-M545.5C; 57.0 mg/l on June 10, 1997, 86.0 mg/l on March 18, 1999 and 53.0 mg/l on March 28, 2000 at site W-M544.2C; 67.0 mg/l on March 18, 1999 at site W-M544.6F and 58.8 mg/l on November 30, 1998 at site W-M545.5B. The March 18, 1999 and March 28, 2000 exceedances occurred on windy days when the lake level was relatively low and apparently bottom sediments were being resuspended. Algal biomass contributed to the remaining exceedances, as chlorophyll *a* concentrations were considerably higher than the period averages. The period average TSS concentrations at sites W-M545.8F, W-M545.5C, W-M544.2C, W-M544.6F and W-M545.5B were 18.1 mg/l, 26.4 mg/l, 22.8 mg/l, 17.8 mg/l and 17.7 mg/l, respectively.

In summary, the results from the current evaluation period show that the Brown's Lake project continues to have a positive impact on water quality. The first Brown's Lake performance evaluation report addressed the results from post-project water quality monitoring performed through early 1993. In this initial performance evaluation summary, DO concentrations (ranging from 8.47 mg/l to 11.42 mg/l) during the winter months were more than sufficient to sustain aquatic life. Additionally, studies performed in 1990/1991 by the IADNR showed that DO levels increased rapidly throughout the lake when the water control structure gates were opened and radio-tagged largemouth bass responded to changes in the DO concentration. The second Brown's Lake performance evaluation report addressed the results from post-project water quality monitoring performed from January 1994 through September 1996. Only one DO and one TSS concentration failed to meet the project objective.

Comparisons of periodic grab sample data collected at the five Brown's Lake monitoring sites during the two most recent performance evaluation periods are summarized in Tables 1-5. The tables indicate that during both post-project evaluation periods, DO concentrations below the target level were relatively rare during the winter months. Nearly all DO concentrations below the target level occurred during the summer months. Except for site W-M545.5C, the summary statistics (minimum, maximum and average values) for each site are comparable for the two evaluation periods. At site W-M545.5C the maximum and average DO concentrations were considerably lower during the current evaluation period. The reason for this is that during the previous evaluation period, samples were collected during both the winter and summer months; whereas, during the current evaluation period samples were collected only during the summer months at this site. One other notable difference in the summary statistics is the average DO concentrations at site W-M544.6F (10.25 mg/l versus 13.20 mg/l). The reason for this could be that the average DO concentration of the previous evaluation period was based on only five samples.

(2) Conclusions. The water quality objectives are being met. The first Brown's Lake performance evaluation report addressed the results from post-project water quality monitoring performed through early 1993. In this initial performance evaluation summary, DO concentrations (ranging from 8.47 mg/l to 11.42 mg/l) during the winter months were more than sufficient to sustain aquatic life. Additionally, a study performed in 1990/1991 by the IADNR showed that DO levels increased rapidly throughout the lake when the water control structure gates were opened and radio-tagged largemouth bass responded to changes in the DO concentration. The second Brown's Lake performance evaluation report addressed the results from post-project water quality monitoring performed from January 1994 through September 1996. Only one DO and one TSS concentration failed to meet the project objective. Results from the current evaluation period show that the Brown's Lake project continues to have a positive impact on water quality. During the critical winter months, only two grab sample DO concentrations were below 5 mg/l. Nearly all of the low DO concentrations observed during the evaluation period occurred during the summer months. Recovery of low night time DO concentrations typically occurred during the day; although, there were occasions when extended periods of low DO were observed. However, according to Mike Steuck, LTRM biologist with the Bellevue, Iowa field station, no unusual fish kills were reported. On the few instances when the TSS value exceeded 50 mg/l, high winds caused resuspension of bottom sediments or high algal biomass contributed to the TSS concentration. Closure of the water control structure during high water periods effectively protected the lake from high TSS loads in the main channel. The beneficial effects of opening the gated structure a few inches to improve DO concentration were observed in 1999. Results from the current evaluation period show that the ability to introduce oxygenated water into and exclude sediment-laden water from Brown's Lake are key elements in providing habitat for native fisheries.

c. Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths.

(1) Monitoring Results. As shown in Appendix A, Table A-1, the Brown's Lake dredging was designed to increase fish habitat in Upper and Lower Brown's Lakes and increase fish diversity by providing varied water depths by 8 acre-feet at year 50. The assumed as-constructed lake volume was 240 acre-feet at year 0 (O&M Manual, Plate C-13, Details and Dredging Schedule). The additional lake volume at year 6 calculated in the 1997 PER was 179 acre-feet using sediment transect data and 190 acre-feet using sediment profile data (see Table 5-5 and Appendix E, Table E-2). Using the same assumptions as the 1997 PER, the additional lake volume calculated at year 11 was 140 acre-feet (see Table 3[1]).

Table 3. Brown's Lake Dredge Cut Average Annual Sediment Accretion [1]

Year	Additional Lake Volume, Acre-Feet[1,2/]		
	Design	Actual/Projected	
		Sediment Transects	Channel Profile
0	240	240	240
6	238	179	185
11	237	140	
28	232	6	
29	232	0	
50	227		

[1/] Assumes an annual sedimentation rate
Design: S = 0.15 inches (0.01 foot)/year. Ref. DPR, page A-5.
Actual: Sediment Transects: S =4.6 inches (0.38 foot)/year (1997 PER)
Sediment Transects: S = 3.8 inches (0.31 foot)/year (this report)

The dredge cuts have performed as sediment traps with the calculated rate between 1997 and 2000 of 3.8 inches/year. The rate of sediment deposition in the dredge cuts appears to be decreasing. Comparing past PER information with this report, shows that dredge cut deposition has been decreasing from 7.4 in./yr through 1993 to 4.6 in./yr over the 1997 PER time period to 3.52 in./yr for the time period between 1997 and 2001.

Associated with these dredge cut deposition rates, the average depth has decreased substantially. The assumed as-built depth of the dredge cuts at flat pool was 9 feet. The average depth of the sediment transect dredge cuts at flat pool was 7.2 feet at year 6, and the 1997 - 2001 transects showed an average dredged depth of 5.2 feet at year 10 and 4.3 feet at year 11. The Upper Brown's Lake average depth was 3.3 feet and the Lower Brown's Lake average depth was 5.1 feet at Year 11.

As discussed in section 5a., analysis of the data available for this report shows higher sediment deposition rates in Upper Brown's Lake as compared to Lower Brown's Lake in both dredge channels and shallow areas. This suggests that Smith Creek may be playing a major role in Brown's Lake sedimentation. Other factors such as wind fetch and associated sediment resuspension also affect sediment distribution in the lake (see Figures 3 through 8 in Appendix G). However, the net amount of sedimentation in Upper Brown's Lake (0.28 inches/year) is substantially higher than that of Lower Brown's (0.02 inches/year) for the time period covered from 1997 to 2001 (refer to Table E2).

Fish habitat is being monitored by observing changes in sedimentation transect depths over time, monitoring water quality, and monitoring aquatic (macrophytic) vegetation. Aquatic plant communities in backwater areas provide an important link to the productivity of Upper Mississippi River backwaters. Fisheries literature has recorded some 84 species of fish that utilize aquatic macrophytes in their life cycle, and 44 of these species utilize plants during spawning activity. Aquatic plants also provide benefits related to chemical balance, oxygen production, hydrology, and food sources. Aquatic vegetation (submersed and floating-leafed) in backwater areas of Pool 13 is monitored by staff of the LTRMP Field Station at Bellevue, Iowa. A total of 20 transects was established in Upper and Lower Brown's Lakes (Appendix C). A detailed review of aquatic vegetation and fisheries information will be provided in the next performance evaluation report.

(2) Conclusions. Based on the O&M Manual, the as-constructed lake volume at year 0 with project was 240 acre-feet. Sediment transects collected from 1997 to 2001 showed an average deposition rate in the Brown's Lake Project dredge cuts of 3.52 inches/year. If the deposition rate calculated for the 1997 to 2001 time period were to continue, the dredged channels would be expected to fill in after 29 years. As discussed in paragraph 5a, analysis of the data available for this report shows higher sediment deposition rates in Upper Brown's Lake as compared to Lower Brown's Lake in both dredge channels and shallow areas. This suggests that Smith Creek may be playing a major role in Brown's Lake sedimentation. Other factors such as wind fetch and associated sediment resuspension also affect sediment distribution in the lake as shown Figures 2 through 8 in Appendix G. However, the net amount of sediment in Upper Brown's Lake (0.28 inches/year) is substantially higher than that of Lower Brown's (0.02 inches/year) from 1997 to 2001 (refer to table E2). Suspended sediment data has been collected on Smith's Creek between 1991 and 1998. The average sediment transport at the Smith's Creek monitoring station was calculated to be 6.0 acre-feet/year (excluding 1993), while the difference in sediment deposition between Upper Brown's Lake and Lower Brown's Lake from 1997 to 2001 is 8.4 acre-feet/year. The sediment transported through Smith's creek does not all settle out in Upper Brown's Lake, however, it is likely a major contributor to sediment deposition there. Continued monitoring will further define sedimentation rates and patterns.

d. Increase Habitat Available for Wintering Fish by Providing Deeper Water Areas. The Brown's Lake project was designed to increase by 8 acre-feet habitat available for wintering fish by providing deeper water areas. The project includes 5 deep holes, 130 feet in diameter, dredged to an elevation of 566 (17 feet below Pool 13 flat pool). The 1997 PER showed that at year 6 the average depth of the deep holes was 14.5 feet with an average sedimentation rate of 5 inches/year. Based on the calculated sedimentation rate in the 1997 PER, the deep holes were expected to maintain depths of 6 to 8 feet through year 40 of the project. These holes were not surveyed for this report due to equipment problems and scheduling. However, based on decreased sedimentation rates in the dredge cuts presented in paragraph 5a of this report, the expected depths for the deep holes may be maintained for a longer period than predicted in the 1997 PER. Surveys of the deep holes are scheduled for FY04.

6. EVALUATION OF WETLAND HABITAT OBJECTIVES

Increase Bottomland Hardwood Diversity by Increasing Selected Terrestrial Elevations and Reducing Frequency of Flooding for Such Hardwoods. Wetland habitat objectives were not evaluated for this report due to funding and scheduling efforts being focused on sedimentation analysis. This objective will be assessed in FY04. The 1997 PER discusses the limited success of the seeding and lack of drainage at the dredged material placement site.

7. OPERATION AND MAINTENANCE SUMMARY

a. Operation. Project operations are detailed in the O&M Manual and generally consist of: (1) inspecting the sediment deflection levee during flood periods; (2) closing the water control structure during high water periods; (3) opening the water control structure during periods of low DO conditions in Brown's Lake; and (4) inspecting the inlet channel and side channel following each flood event for removal of flood carried debris, repair of sloughing banks, etc.

The project has been operating successfully in this manner since its completion in the fall of 1989. As described in the Annual Management Plan (Table 2-2), one gate of the water control structure should be opened approximately 10 inches after ice cover of Brown's Lake. This will allow water to thermally stratify under the ice when the colder main channel water enters the system later in the winter. This stratification is beneficial as it allows fish to select optimal zones of oxygen, temperature, and current by moving 4 to 6 feet vertically in the water column.

The control structure is manipulated to allow low flows during winter when oxygen levels drop below the minimum (5 mg/l) needed for overwintering fish. One gate was raised and closed, respectively, about 10 inches on the following dates: opened on January 5, 1998 and closed on February 20, 1998; opened on January 12, 1999 and closed February 12, 1999; opened on November 16, 1999 and closed February 22, 2000.

Due to USFWS concerns that opening a screw gate after freeze-up could damage the stem mechanism, several methods were researched to keep the water within the gate area (of the water control structure) open for 2 to 3 weeks after freeze-up. It is during this time period when stratification of water temperatures occurs and warmer water is located near the bottom. A concrete drying blanket was placed on the structure on November 20, 2000 to prevent the water in the pit from freezing before the lakes water column stratified. On this date, the lake was ice covered but the pit was not frozen. On December 21, the oxygen in Brown's Lake had dropped to 2 mg/l and water in the pit had not frozen. One gate was opened ten inches to allow oxygenated water into the lake. The USFWS will continue to use the concrete drying blanket in future years.

b. Maintenance. Inspections of the Brown's Lake project are to be made by the USFWS Savanna District Manager of the Upper Mississippi River National Wildlife and Fish Refuge (Site Manager) at least annually and follow inspection guidance presented in the O&M Manual. A copy of the completed project inspection checklist should be furnished to the Corps. For this report, the Site Manage emailed his observations from his inspection, so his comments have been used in the discussion of the operation and maintenance of this report rather than a copy of the inspection checklist. Other project inspections should occur as necessary after high water events or as scheduled by the Site

Manager. Joint inspections of the Brown's Lake project are to be conducted periodically by the USFWS and the Corps. These inspections are necessary to determine maintenance needs.

The screw gate water control structure is serviced annually, usually in the fall. Service includes: operation of gates to ensure they are functional; greasing of operational parts; and flushing of sediment buildup adjacent to gates. Servicing occurred on the following dates: November 5 1997; October 7, 1998; July 20, 1999; and September 29, 2000.

The levee is mowed twice annually in early summer and late fall. A visual inspection of the levee is conducted in the spring to identify washouts/erosion, woody encroachment, or animal burrows. Each spring, logs and other flood debris are cleared from the levee.

Overall, operation and maintenance efforts are performed correctly and no problems have been identified.

8. CONCLUSIONS AND RECOMMENDATIONS

a. Project Goals, Objectives, and Management Plan. Based on data and observations collected since project completion in 1990, the project goals and objectives for reducing sedimentation, improving water quality, increasing fish diversity with varied water depths are being met. Deep hole, vegetation transects, and bottomland hardwood information was not collected for this report but is scheduled for completion in FY04. Continued data collection will better define the degree of sedimentation rate reduction, water quality improvement, fish habitat and diversity improvement, and mast tree survival. The next survey of sediment transects is also scheduled for completion in FY04.

b. Post-Construction Evaluation and Monitoring Schedules. In general, project monitoring efforts have been performed according to the Post-Construction Performance Evaluation Plan in Appendix A and the Resource Monitoring and Data Collection Summary in Appendix B. Four new transects were added to help with the sedimentation analysis. A Post-Construction Performance Evaluation Supplement will be prepared annually. The next Post-Construction Performance Evaluation will be completed for 2003, 13 years after construction, for distribution in March 2004.

c. Project Operation and Maintenance. Project operation and maintenance has been conducted in accordance with the O&M Manual. The water control structure is operating and is maintained correctly. Annual site inspections by the Refuge Manager have resulted in proper corrective maintenance actions.

d. Project Design Enhancement. Discussions with USFWS and Corps personnel involved with operation, maintenance, and monitoring activities at the Brown's Lake project have resulted in the following general conclusions regarding project features that may affect future project design:

(1) Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper And Lower Brown's Lakes: The project sediment reduction is slightly less than the design reduction in sediment (assuming without project sediment rate of 0.5 inches/year). Upper Brown's Lake appears to be experiencing a greater sedimentation rate than Lower Brown's Lake. This would suggest that the increase in sediment deposition in Upper Brown's Lake might be due to Smith's Creek.

The next report will incorporate more detailed sediment transects information for evaluation of sedimentation trends in the Brown's Lake Project. Continued monitoring will better determine long-term sedimentation rates and patterns.

(2) Improve Water Quality for Upper and Lower Brown's Lake by Decreasing Suspended Sediment Concentrations and Increasing Winter Dissolved Oxygen Concentrations: Results from the current evaluation period show that the ability to introduce oxygenated water into, and exclude sediment laden water from Brown's Lake are key elements in providing habitat for native fisheries. In general the water quality objectives are being met. The use of the inlet gate helps to control and improve dissolved oxygen concentration, especially during periods in the winter.

(3) Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths: Vegetation transect information was not provided for this report but is scheduled for FY04. The LTRM Bellevue Field Station personnel are to sample 15 aquatic vegetation transects in the Upper and Lower Brown's lakes twice yearly during the growing season.

Based on the O&M Manual, the project as-constructed lake volume at year 0 was 240 acre-feet. Sediment transects collected from 1997 to 2001 showed an average deposition rate in the Brown's Lake Project dredge cuts of 3.52 inches/year. If the deposition rate calculated for the 1997 to 2001 time period were to continue, the dredged channels would be expected to fill in after 29 years. Suspended sediment data has been collected on Smith's Creek between 1991 and 1998. The average sediment transport at the Smith's Creek monitoring station was calculated to be 6.0 acre-feet/year (excluding 1993), while the difference in sediment deposition between Upper Brown's Lake and Lower Brown's Lake is 8.4 acre-feet/year. The sediment transported through Smith's Creek does not all settle out in Upper Brown's Lake, however, it is likely a major contributor to sediment deposition there. Continued monitoring will further define sedimentation rates and patterns.

(4) Increase Habitat Available for Wintering Fish by Providing Deeper Water Areas: These holes were not surveyed for this report. Based on decreased sedimentation rates in the dredge cuts found in 2001, the expected depths for the deep holes may be maintained for a longer period than predicted in the 1997 PER. Surveys of the deep holes are scheduled for FY04.

(5) Increase Bottomland Hardwood Diversity by Increasing Selected Terrestrial Elevations and Reducing Frequency of Flooding for Such Hardwoods: Wetland habitat objectives were not evaluated for this report but is scheduled for completion in FY04.

e. Project Monitoring and Evaluation. In general, water quality objectives are being met. There is a concern that the sedimentation rate is greater than expected that is somewhat attributed to sediment loads coming from Smith's Creek that enters Upper Brown's Lake. Further monitoring and sediment rate assessment is needed however to determine if the objective for increasing fish habitat and diversity is affected in Upper and Lower Brown's Lake. The deep holes for wintering fish habitat and wetland objectives still require evaluation and they are scheduled for completion in FY04.

APPENDIX A

POST-CONSTRUCTION EVALUATION PLAN

Table A 1.

Brown's Lake Habitat Rehabilitation and Enhancement Project
Post-Construction Evaluation Plan [1/]
Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 With Alternative (As-Built)	Year 11 With Alternative	Year 50 Target With Alternative [2/]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Aquatic Habitat	Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes.	Basic development- Upper and Lower Brown's Lake Dredging	Deflection levee	ac-ft of annual sediment reduction	0			20	Evaluate data per Note[5/]. Perform hydrographic soundings of transects	Observe by pole soundings or depth gauges.
		Basic development- Upper and Lower Brown's Lake Dredging	Deflection levee	in./yr sedimentation rate	0.5		0.19	0.15		
	Improve Water Quality for Upper and Lower Brown's Lakes by Decreasing Suspended Sediment Concentrations and Increasing Winter DO Concentrations.	Basic development- Upper and Lower Brown's Lake Dredging	Water control structure and inlet channel improvement	mg/l suspended solids	300		≤ 50	50	Evaluate Water Quality per Note [3/]	Observe water clarity differences between blocked river flows and lake water
		Basic development- Upper and Lower Brown's Lake Dredging	Water control structure and inlet channel improvement	mg/l DO	≤5	≥ 5	≥ 5	5	Evaluate Water Quality per Note [3/]	Observe effects of low DO (fish kills)

TABLE A-1 (Continued)

Brown's Lake Habitat Rehabilitation and Enhancement Project
Post-Construction Evaluation Plan [1/ 8]
Enhancement Potential

Goal	Objective	Alternative	Enhancement Feature	Unit	Year 0 (1991) Without Alternative	Year 0 With Alternative (As-Built)	Year 11 With Alternative	Year 50 Target With Alternative [2/]	Feature Measurement	Annual Field Observations by Site Manager
Enhance Aquatic Habitat (Continued)	Increase fish habitat in Upper and Lower Brown's Lakes	Basic development-Upper and Lower Brown's Lake Dredging	Dredging	ac-ft of additional lake volume	0	240	140	~~8~~ TBD	Evaluate data per Note [5/] __	Observe/record fish changes and observe by pole soundings or depth gauges sedimentation in excavated channel
	Increase fish diversity by pro-viding varied water depths	Basic development-Upper and Lower Brown's Lake Dredging	Dredging	acre			15		Perform aquatic vegetation transects per Note [6]	Observe vegetation development
	Increase habitat available for wintering fish by providing deeper areas	Basic development-Upper and Lower Brown's Lake Dredging	Dredging	number of deep holes (D>6'-8')	0	5	5	5	Evaluate data per Note [5/] __	Observe/record fish changes and observe by pole soundings or depth gauges sedimentation in excavated channel
Enhance Wetland Habitat	Increase bottomland hardwood diversity by increasing selected terrestrial elevations and reducing frequency of flooding for such hardwoods.	Basic development-Upper and Lower Brown's Lake Dredging	Mast tree plantings on dredged material placement site	acres of mast trees	0				Evaluate data per Note [7/]	Observe/record planted mast survivability

TABLE A-1 (Cont'd)

Brown's Lake Habitat Rehabilitation and Enhancement Project

1/ See plate 3 of this report for active monitoring sites.

2/ Year 50 Target with Alternative information was updated from the 1997 PER

3/ Corps/USFWS/LTRM Water Quality Stations	Remarks
W-M545.8 F	Corps site
W-M545.5 B	USFWS/LTRM site
W-M545.5 C	Corps site
W-M544.7 F	Corps winter only site
W-M544.6 F	Corps winter only site
W-M544.1 D	Corps winter only site
W-M544.2 C	Corps site
Corps Suspended Sediment Station	
W-M546.0A	Smith's Creek

4/ IADNR Fish Stations
- F-M545.5 C
- F-M545.4 B
- F-M545.1 J
- F-M544.3 C

5/ Sedimentation Transects (See Table A-2)

6/ USFWS/LTRM Vegetation Transect	
V-M545.0 B	15 of the 20 historic aquatic vegetation transects

7/ Corps Vegetation Transects	
V-M545.8 H	Vegetation transects are discontinued.
V-M545.5 H	Mast tree assessment will be monitored at 5-year intervals.

Note: There have been some additional transects added as performed by the UMESC while the four transects listed here for the USFWS have been discontinued.

Table A 2

Brown's Lake Habitat Rehabilitation and Enhancement Project Sedimentation Transect Project Objectives Evaluation

Transect	Project Objectives to Be Evaluated		
	Retard the Loss of Fish and Wildlife Aquatic Habitat by Reducing Sedimentation in Upper and Lower Brown's Lakes	Increase Fish Habitat in Upper and Lower Brown's Lakes and Increase Fish Diversity by Providing Varied Water Depths 3/	Increase Habitat Available for Wintering Fish by Providing Deeper Areas 3/
Corps			
S-M545.8H (Upper Brown's Lake)	X		
S-M545.7H (Upper Brown's Lake)	X 1/	4/	
S-M545.3H (Upper Brown's Lake)	X 1/	X	
Profile No. 1 (Upper Brown's Lake)		X	
Profile No. 2 (Upper Brown's Lake)		X	
Deep Hole A1 (Upper Brown's Lake)			
Deep Hole A2 (Upper Brown's Lake)			
S-M544.6H (Lower Brown's Lake)	2/	X	
S-M544.3H (Lower Brown's Lake)	X 1/	X	
S-M544.1E (Lower Brown's Lake)	2/	X	
Profile No. 3 (Lower Brown's Lake)		X	
Profile No. 4 (Lower Brown's Lake)		X	
Profile No. 5 (Lower Brown's Lake)		X	
Profile No. 6 (Lower Brown's Lake)		X	
Profile No. 7 (Lower Brown's Lake)		X	
Profile No. 8 (Lower Brown's Lake)		X	
Deep Hole B1 (Lower Brown's Lake)			X
Deep Hole B2 (Lower Brown's Lake)			X
Deep Hole C1 (Lower Brown's Lake)			X
Deep Hole C2 (Lower Brown's Lake)			X
Deep Hole D1 (Lower Brown's Lake)			X
Deep Hole D2 (Lower Brown's Lake)			X
Deep Hole E1 (Lower Brown's Lake)			X
Deep Hole E2 (Lower Brown's Lake)			X
S-M545.9H (Access Channel)		2/	
S-M546.3H (Inlet Channel)		X	
USFWS[5]			
S-M545.5A (Upper Brown's Lake)	X	X	
S-M545.4 C (Upper Brown's Lake)	X	X	
S-M544.2C (Lower Brown's Lake)	X	X	
S-M544.1D (Gainesville Slough)			
UMESC			
LBN (Lower Brown's Lake North)	X		
LBS (Lower Brown's Lake South)	X		
UBN (Upper Brown's Lake North)	X		
UBS (Upper Brown's Lake South)	X		
IADNR			
S-M545.8E (Upper Brown's Lake)	X		
S-M545.6B (Upper Brown's Lake)	X		
S-M544.9E (Lower Brown's Lake)	X		
S-M 545.0C (Upper Brown's Lake)	2/		

1/ Does not include dredge cut.
2/ Insufficient or questionable data.
3/ Dredged channel only.
4/ Because the area of the dredge cut in Corps transect S-M 545.7H was so much greater than the remaining transects (due to a wider bottom width), it was not used to determine the acre-feet of additional lake volume.
5/ The 4 USFWS transects have been eliminated while 4 additional transects have been added by UMESC as shown on Figure1

APPENDIX B

MONITORING AND PERFORMANCE EVALUATION MATRIX
AND
RESOURCE MONITORING AND DATA COLLECTION SUMMARY

Table B 1

Brown's Lake Habitat Rehabilitation & Enhancement Project
Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions.	USGS	USGS (EMTC)	LTRMP 1/	--
	Pre-Project Monitoring	Identifies and defines problems at HREP site. Establishes need of proposed project features.	USFWS	USFWS	USFWS	--
	Baseline Monitoring	Establishes baselines for performance evaluation.	Corps	Corps	HREP 2/	See Table B-2
Design	Data Collection for Design	Includes quantification of project objectives, design of project, and development of performance evaluation plan.	Corps	Corps	HREP	See Table B-2
Construction	Construction Monitoring	Assesses construction impacts; assures permit conditions are met.	Corps	Corps	HREP	See State Section 401 Stipulations
Post-Construction	Performance Evaluation Monitoring	Determines success of project as related to objectives.	Corps (quantitative) Sponsor (field observation)	Corps USFWS	HREP	See Table B-2
	Analysis of Biological Responses to Projects	Evaluates predictions and assumptions of habitat unit analysis. Studies beyond scope of performance evaluation, or if projects do not have desired biological results.	Corps	USGS (EMTC)	HREP	--

1/ Long-Term Resources Monitoring Program is a component of the UMRS-EMP.
2/ Habitat Rehabilitation and Enhancement Projects

Table B 2
Brown's Lake Habitat Rehabilitation & Enhancement Project
Resource Monitoring and Data Collection Summary [1/]

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
<u>POINT MEASUREMENTS</u>														
Water Quality Stations [1]													Corps/ USFWS/ LTRM	
Turbidity						*								
Secchi Disk Transparency						*								
Suspended Solids					*	*								Corps only
Dissolved Oxygen					*	*								
Specific Conductance					*	*								
Water Temperature					*	*								
pH					*	*								
Total Alkalinity					*	*M								Corps only
Chlorophyll					*	*								Corps only
Velocity					*	*								
Water Depth					*	*								
Percent Ice Cover						*								USFWS/ LTRM only
Ice Depth						*								
Percent Snow Cover						*								USFWS/ LTRM only
Snow Depth						*								
Substrate Hardness					*	*								USFWS/ LTRM only
Wind Direction					*	*								Corps only
Wind Velocity					*	*								Corps only
Wave Height					*	*								Corps only
Air Temperature					*	*								Corps only
Percent Cloud Cover					*	*								Corps only

TABLE B-2 (Continued)

Type Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const. Phase		Pre-Project Phase	Design Phase	Post-Const. Phase	Pre-Project Phase	Design Phase	Post-Const. Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar								
POINT MEASUREMENTS (Cont'd)														
Sediment Test Stations [1/]													Corps	
Suspended Solids				1	D	D								
Water Depth					D	D								
Discharge Measurement					D	D								
Boring Stations													Corps	
Geotechnical Borings - See Construction Drawings								1						
Fish Stations [1/]														
Creel Survey Electrofish/Netting Radio Telemetry										1 1 -	1 1 1	6M 4M Y	IADNR	
TRANSECT MEASUREMENTS														
Sedimentation Transects [1]													Corps	
Hydrographic Soundings								1	**				Corps/ USFWS/ UMESC/ IADNR	
Vegetation Transects [1]												Twice yearly	UMESC	Assess during growing season
Mast Tree Survey												5Y	Corps	
AREA MEASUREMENTS														
Mapping [1]														
Aerial Photography										1		5Y	Corps	

Legend

* = Sampling performed every other week at the USFWS/LTRM site. At the Corps sites, sampling was performed monthly from October through March, and every other week from April through September.
** = Every 5 years by the Corps, annually by USFWS/LTRM and IADNR
D = Daily
W = Weekly
M = Monthly
Y = Yearly
nW = n-Week interval
nY = n-Year Interval
1,2,3,.... = Number of times data was collected within designated project phase
1/ See plate 3 of this report for locations of post-construction phase sampling points, transects, and area measurements. See Table A-2 for sampling station information
See DPR for locations of design phase sampling locations.

APPENDIX C

COOPERATING AGENCY CORRESPONDENCE

No new correspondence available for this report.

APPENDIX D

WATER QUALITY DATA

Table D 1. Summary of Grab Sample Data from Site W-M545.8F

Site W-M545.8F	Post-Project 1/25/94–9/26/96	Post-Project 12/4/96–9/26/00
Number of Samples	34	48
October – March Samples	12	16
April - September Samples	22	32
DO Concentrations ≤ 5 mg/l	8 (23.5%)	12 (25.0%)
DO Concentrations ≤ 5 mg/l (October – March Samples)	1 (8.3%)	0 (0.0%)
DO Concentrations ≤ 5 mg/l (April - September Samples)	7 (31.8%)	12 (37.5%)
Minimum DO Concentration (mg/l)	2.58	1.61
Maximum DO Concentration (mg/l)	18.72	21.40
Average DO Concentration (mg/l)	8.41	8.26

Table D 2. Summary of Grab Sample Data from Site W-M545.5C

Site W-M545.5C	Post-Project 1/25/94–9/26/96	Post-Project 6/10/97–9/26/00
Number of Samples	34	32
October – March Samples	12	0
April - September Samples	22	32
DO Concentrations ≤ 5 mg/l	5 (14.7%)	9 (28.1%)
DO Concentrations ≤ 5 mg/l (October – March Samples)	0 (0.0%)	0 (0.0%)
DO Concentrations ≤ 5 mg/l (April - September Samples)	5 (22.7%)	9 (28.1%)
Minimum DO Concentration (mg/l)	1.08	0.78
Maximum DO Concentration (mg/l)	22.30	12.52
Average DO Concentration (mg/l)	10.03	6.50

Table D 3. Summary of Grab Sample Data from Site W-M544.2C

Site W-M544.2C	Post-Project 1/25/94–9/26/96	Post-Project 12/4/96–9/26/00
Number of Samples	34	48
October – March Samples	12	16
April - September Samples	22	32
DO Concentrations ≤ 5 mg/l	2 (5.9%)	7 (14.6%)
DO Concentrations ≤ 5 mg/l (October – March Samples)	0 (0.0%)	1 (6.2%)
DO Concentrations ≤ 5 mg/l (April - September Samples)	2 (9.1%)	6 (18.8%)
Minimum DO Concentration (mg/l)	4.10	2.18
Maximum DO Concentration (mg/l)	21.30	20.63
Average DO Concentration (mg/l)	10.11	9.33

Table D 4. Summary of Grab Sample Data from Site W-M544.6F

Site W-M544.6F	Post-Project 1/25/94–2/21/95	Post-Project 12/4/96–3/28/00
Number of Samples	5	16
October – March Samples	5	16
April - September Samples	0	0
DO Concentrations $\leq$ 5 mg/l	1 (20.0%)	1 (6.2%)
DO Concentrations $\leq$ 5 mg/l (October – March Samples)	1 (20.0%)	1 (6.2%)
DO Concentrations $\leq$ 5 mg/l (April - September Samples)	0 (0.0%)	0 (0.0%)
Minimum DO Concentration (mg/l)	4.03	3.42
Maximum DO Concentration (mg/l)	20.90	21.87
Average DO Concentration (mg/l)	10.25	13.20

Table D 5. Summary of Grab Sample Data from Site W-M545.5B

Site W-M545.5B	Post-Project 1/11/94-12/28/95	Post-Project 12/19/96-9/21/00
Number of Samples	51	98
October – March Samples	25	47
April - September Samples	26	51
DO Concentrations $\leq$ 5 mg/l	3 (5.9%)	4 (4.1%)
DO Concentrations $\leq$ 5 mg/l (October – March Samples)	0 (0.0%)	0 (0.0%)
DO Concentrations $\leq$ 5 mg/l (April - September Samples)	3 (11.5%)	4 (7.8%)
Minimum DO Concentration (mg/l)	3.0	3.7
Maximum DO Concentration (mg/l)	20.0	25.0
Average DO Concentration (mg/l)	12.2	11.4

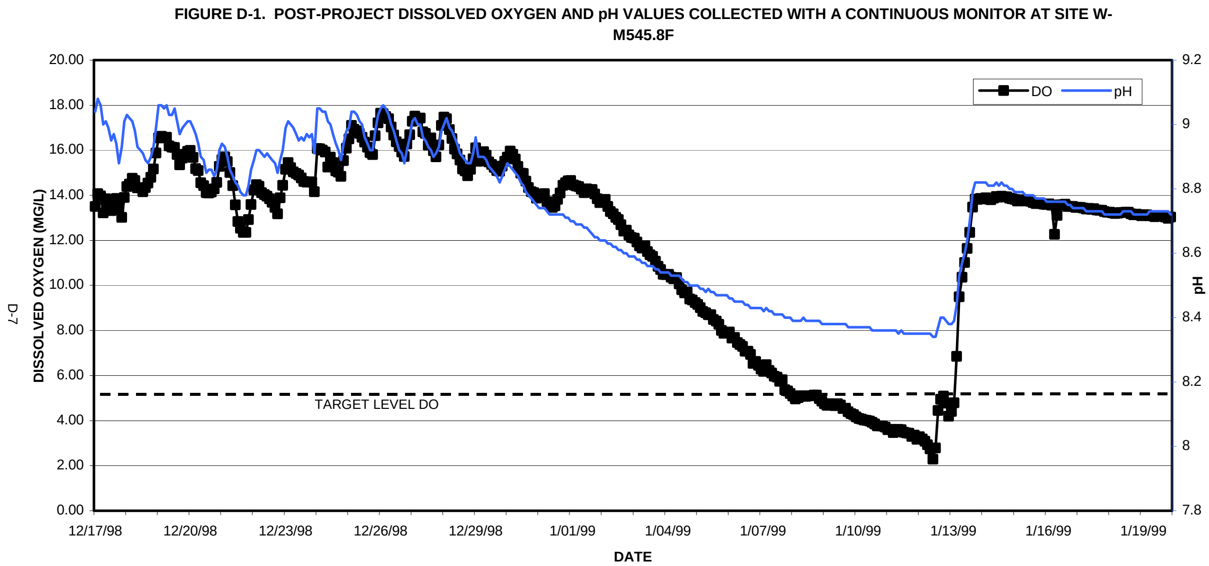

Figure D 1. Post-Project Dissolved Oxygen and pH Values Collected With A Continuous Monitor At Site W-M545.8F

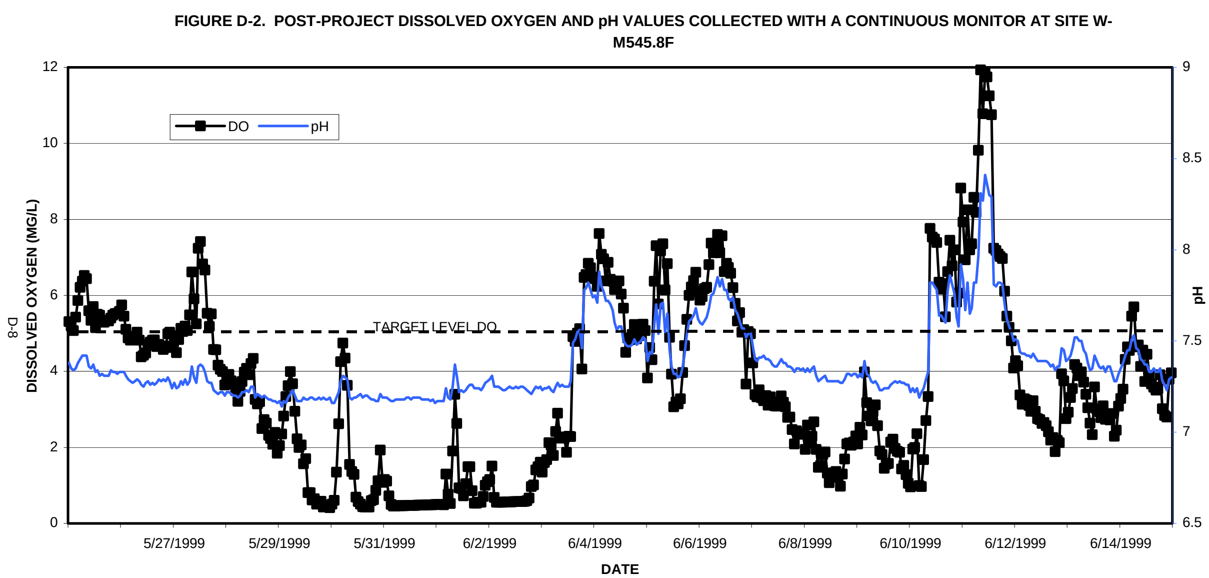

Figure D 2. Post-Project Dissolved Oxygen and pH Values Collected With A Continuous Monitor At Site W-M545.8F.

FIGURE D-3. POST-PROJECT DISSOLVED OXYGEN VALUES COLLECTED WITH CONTINUOUS MONITORS DEPLOYED AT TWO DEPTH LEVELS AT SITE W-M544.6F

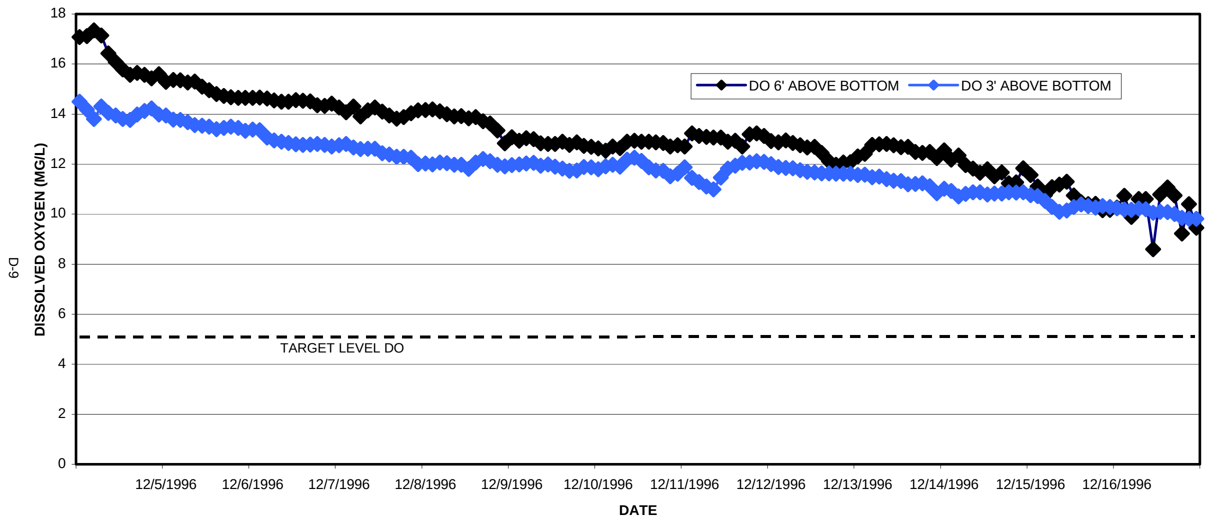

Figure D 3. Post-Project Dissolved Oxygen Values Collected With Continuous Monitors Deployed At Two Depth Levels At Site @-M544.6F.

FIGURE D-4. POST-PROJECT DISSOLVED OXYGEN AND pH VALUES COLLECTED WITH A CONTINUOUS MONITOR AT SITE W-M544.6F

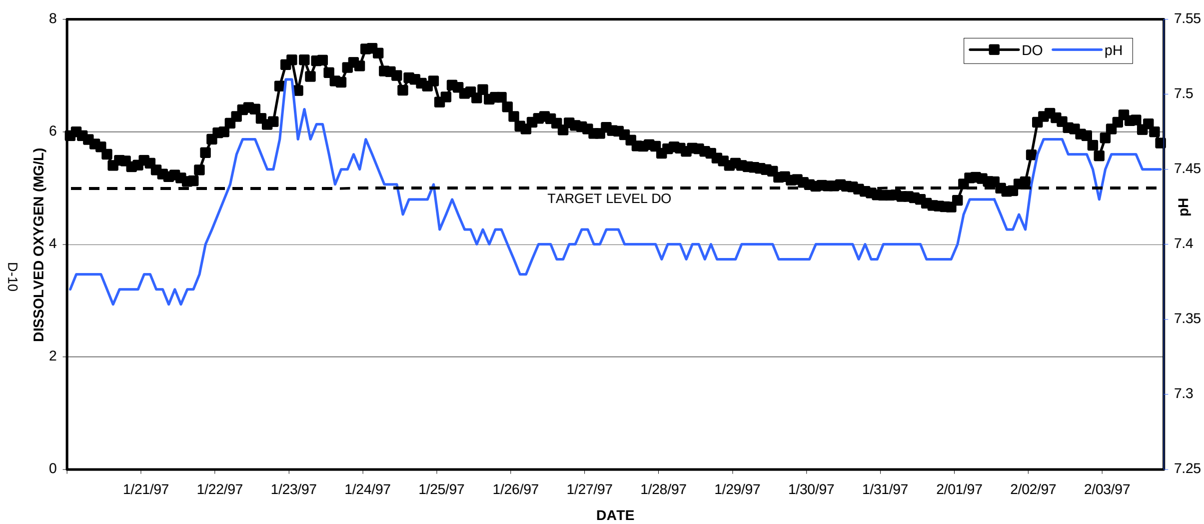

Figure D 4. Post-Project Dissolved Oxygen and pH Values Collected With A Continuous Monitor At Site W-M544.6F.

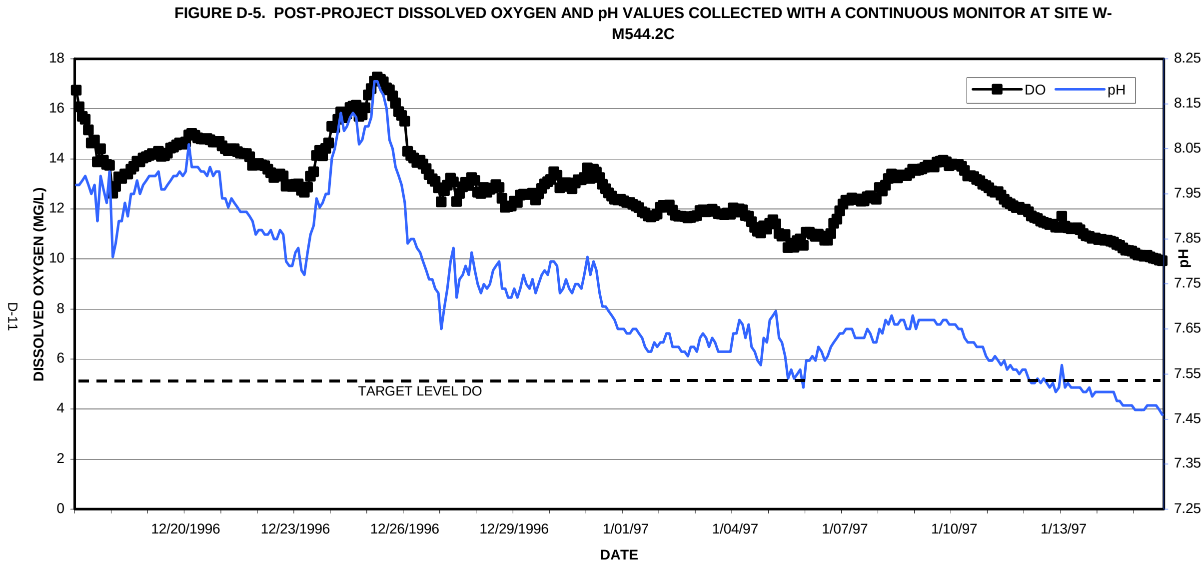

Figure D 5. Post-Project Dissolved Oxygen and pH Values Collected With A Continuous Monitor At Site W-M544.2C.

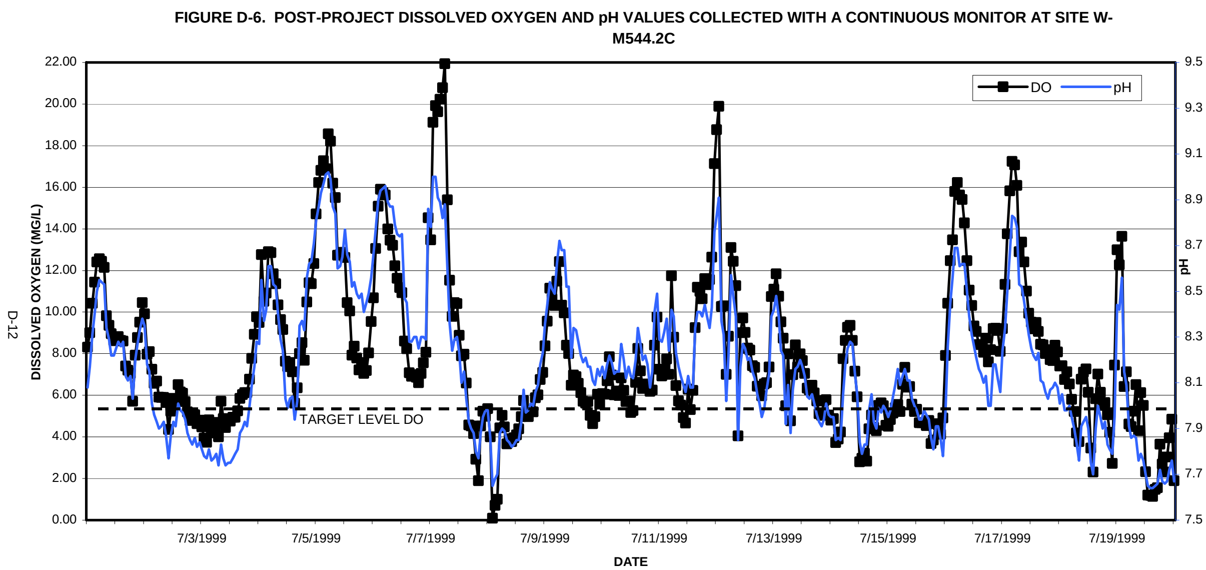

Figure D 6. Post-Project Dissolved Oxygen and pH Values Collected With A Continuous Monitor At Site W-544.2C.

APPENDIX E

TECHNICAL COMPUTATIONS

Table E 1. Technical computations of Sedimentation for time period 1997-2001

		97-00				
SURVEYOR	TRANSECT	LOCATION	IN DREDGE CUT INFLUENCE?	LINEAL FEET	AREA OF DEP./SCOUR	DEP. IN./YR
UMESC	UBS	UPPER BROWNS EAST PART	NO	2175	473.3	0.22
UMESC	UBS	UPPER BROWNS EAST PART	YES	100	472.5	4.73
UMESC	UBN	UPPER BROWNS WEST PART	NO	3225	462	0.14
UMESC	UBN	UPPER BROWNS WEST PART	YES	75	370.5	4.94
UMESC	LBS	LOWER BROWNS SOUTH PART	NO	1505	59.8	0.04
UMESC	LBS	LOWER BROWNS SOUTH PART	YES	150	432	2.88
UMESC	LBN	LOWER BROWNS NORTH PART	NO	610	-297.4	-0.49
UMESC	LBN	LOWER BROWNS NORTH PART	YES	175	503	2.87
		97-01				
SURVEYOR	TRANSECT	LOCATION	IN DREDGE CUT INFLUENCE?	LINEAL FEET	AREA OF DEP./SCOUR	DEP. IN./YR
UMESC	UBS	UPPER BROWNS EAST PART	NO	2075	136.25	0.07
UMESC	UBS	UPPER BROWNS EAST PART	YES	100	442.5	4.43
UMESC	UBN	UPPER BROWNS WEST PART	NO	2925	159.375	0.05
UMESC	UBN	UPPER BROWNS WEST PART	YES	75	345.375	4.61
UMESC	LBS	LOWER BROWNS SOUTH PART	NO	1510	-317.1	-0.21
UMESC	LBS	LOWER BROWNS SOUTH PART	YES	150	402.375	2.68
UMESC	LBN	LOWER BROWNS NORTH PART	NO	615	-253.725	-0.41
UMESC	LBN	LOWER BROWNS NORTH PART	YES	175	475.125	2.72
IA DNR	Station 1	UPPER BROWNS EAST PART	NO	190	262.2	1.38
IA DNR	Station 9	LOWER BROWNS SOUTH PART	NO	150	4.5	0.03
		Total 97-00				
		UPPER BROWNS	NO	5590	1197.5	0.21
		UPPER BROWNS	YES	175	843	4.82
		LOWER BROWNS	NO	2265	-233.1	-0.10
		LOWER BROWNS	YES	325	935	2.88
		Total 97 - 01				
		UPPER BROWNS	NO	5190	557.8	0.11
		UPPER BROWNS	YES	175	787.9	4.50
		LOWER BROWNS	NO	2275	-566.3	-0.25
		LOWER BROWNS	YES	325	877.5	2.70

Table E 2. Summary of Technical Computations for Brown's Lake for time period 1997-2001

location	Area (acres)
Upper Browns Area	374
Lower Browns Area	196
Total Area Browns	570
Dredge Area Upper Browns	15
Dredge Area Lower Browns	18

		1997 - 2000	
	Area (acres)	deposition rate (inches/year)	deposition rate (Acre-feet/year)
UPPER BROWNS IN DREDGE CUT	15	4.82	6.05
UPPER BROWNS OUTSIDE OF DREDGE CUT	359	0.21	6.41
LOWER BROWNS IN DREDGE CUT	18	2.88	4.35
LOWER BROWNS OUTSIDE OF DREDGE CUT	178	-0.10	-1.53
			total deposition (ac.ft/yr)
			15.28

		1997 - 2001	
	Area (acres)	deposition rate (inches/year)	deposition rate (Acre-feet/year)
UPPER BROWNS IN DREDGE CUT	15	4.50	5.66
UPPER BROWNS OUTSIDE OF DREDGE CUT	359	0.11	3.22
LOWER BROWNS IN DREDGE CUT	18	2.70	4.08
LOWER BROWNS OUTSIDE OF DREDGE CUT	178	-0.25	-3.70
			total deposition (ac.ft/yr)
			9.26

	1997 - 2000 deposition rate (inches/year)
net deposition rate in all of Brown's Lake	0.32
Net deposition rate in Upper Browns	0.40
Net deposition rate in Lower Browns	0.17
Net deposition rate in dredge cuts	3.76
Net deposition rate outside of dredge cuts in all of Brown's Lake	0.11

	1997 - 2001 deposition rate (inches/year)
net deposition rate in all of Brown's Lake	0.19
Net deposition rate in Upper Browns	0.28
Net deposition rate in Lower Browns	0.02
Net deposition rate in dredge cuts	3.52
Net deposition rate outside of dredge cuts in all of Brown's Lake	-0.01

Table E 3. Smith's Creek Sediment Transport Summary Data 1991 - 1998

year	91	92	93	94	95	96	97	98
total load (tons)	8683	2838	24201	6453	6380	9994	3251	3206
total volume (acre-ft.)	10	3	28	7	7	11	4	4
% in 1 day	44	48	38	21	23	37	29	10
% in 5 days	90	69	57	61	60	76	66	37
% in 10 days	97	75	69	83	68	83	82	49
% in 50 days	98	86	93	95	86	91	92	68
average volume transport over POR (91-98) (acre-ft/year)								
	9							
average volume transport (97,98)	4							

APPENDIX F

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APPENDIX G

FIGURES

&

PLATES

Figure G 1. Overview of Sediment Transects

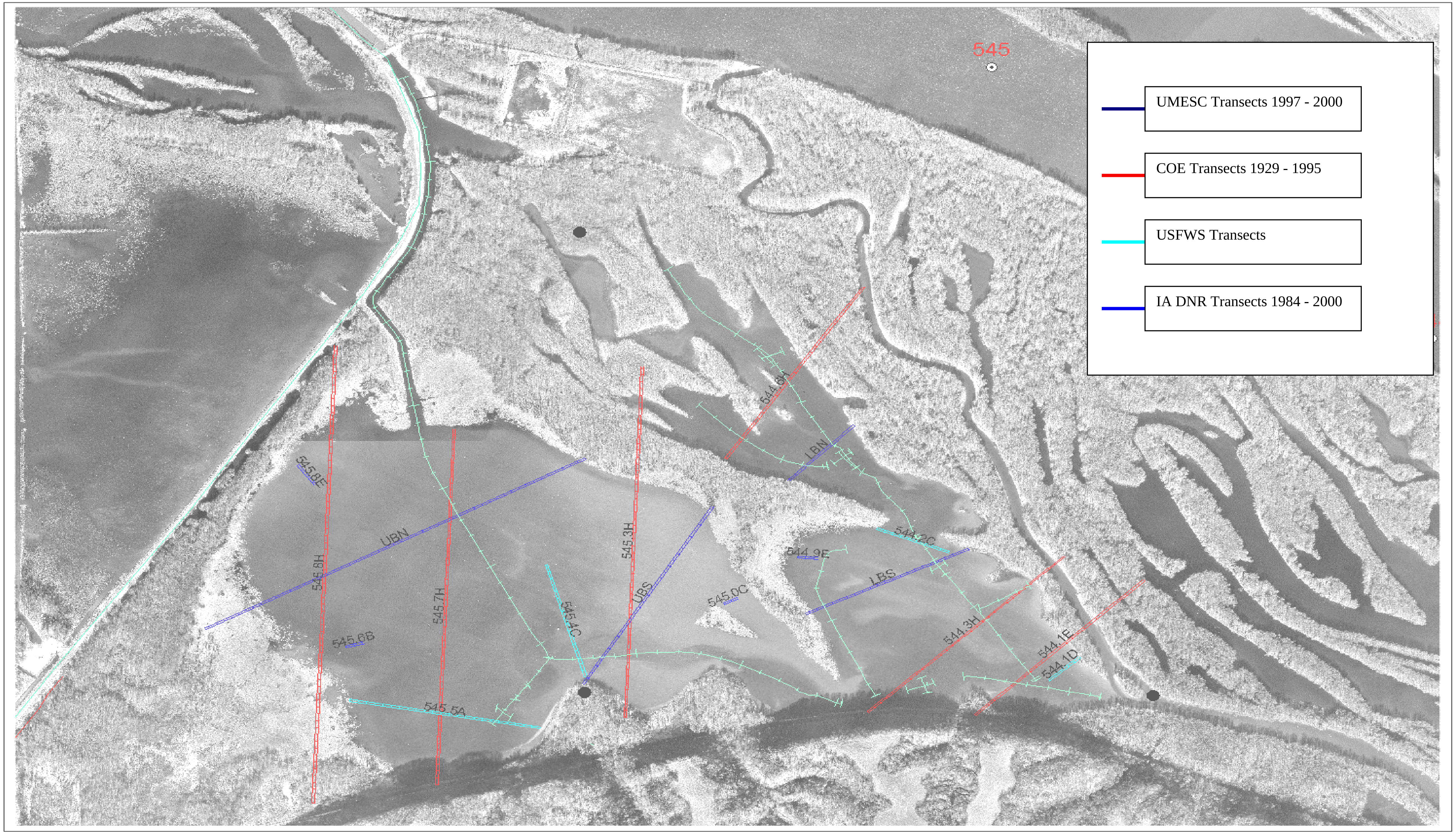


Figure G 2. Overview of Sediment Calculations for 2000 PER time period 1997 – 2001

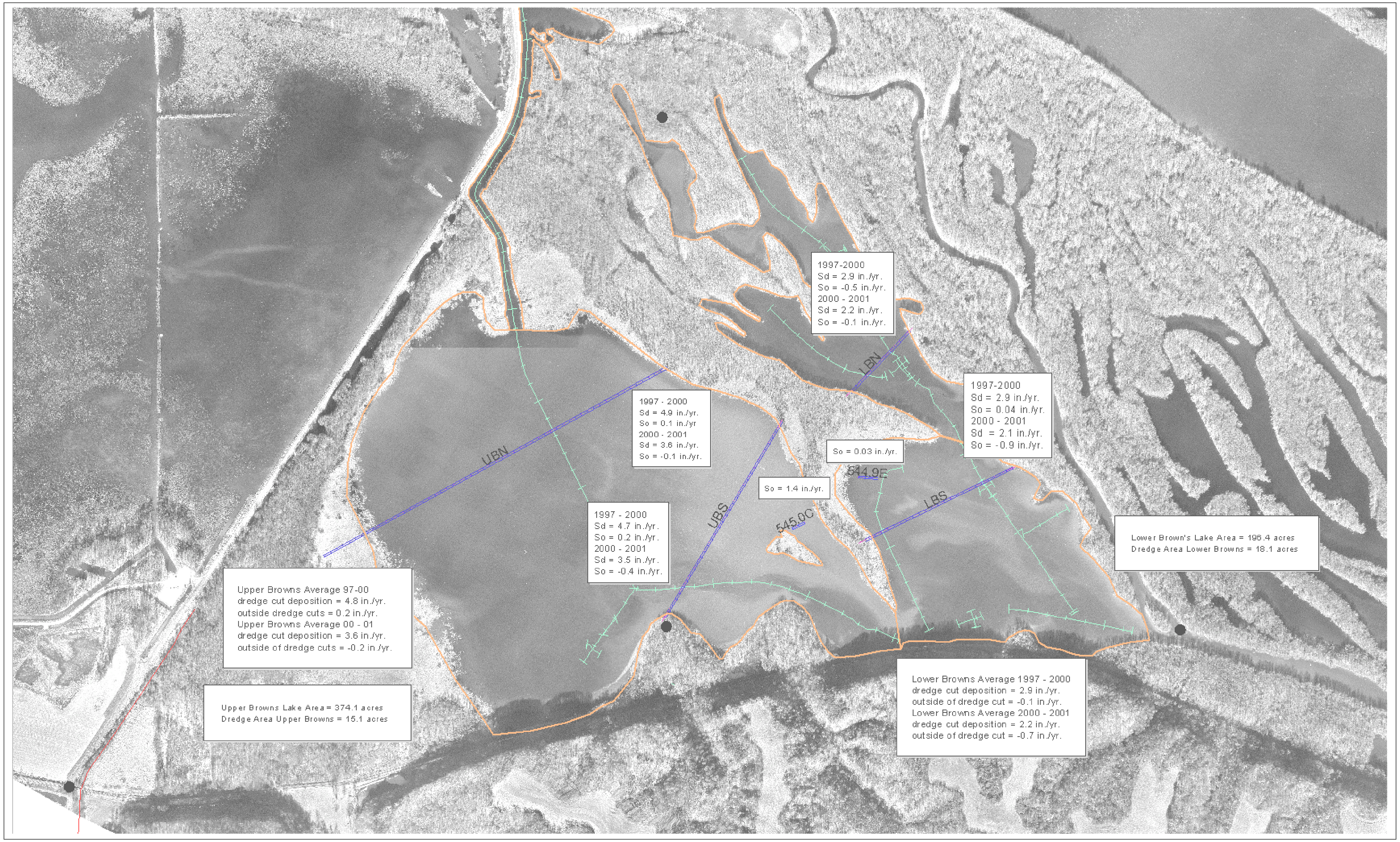


Figure G 3. Example Sediment Deposition Rates (inches/year) for time period 1997 - 2000

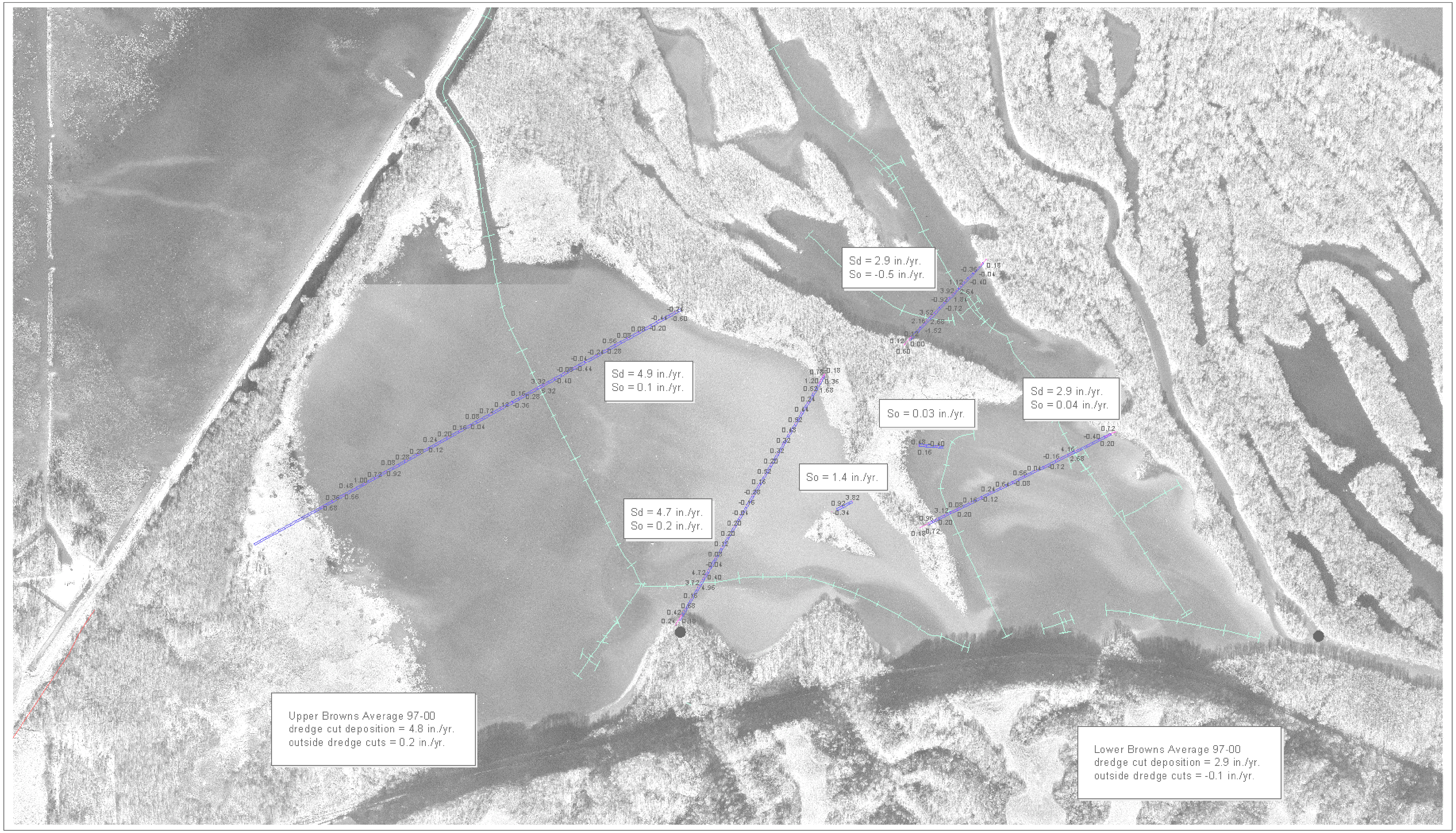
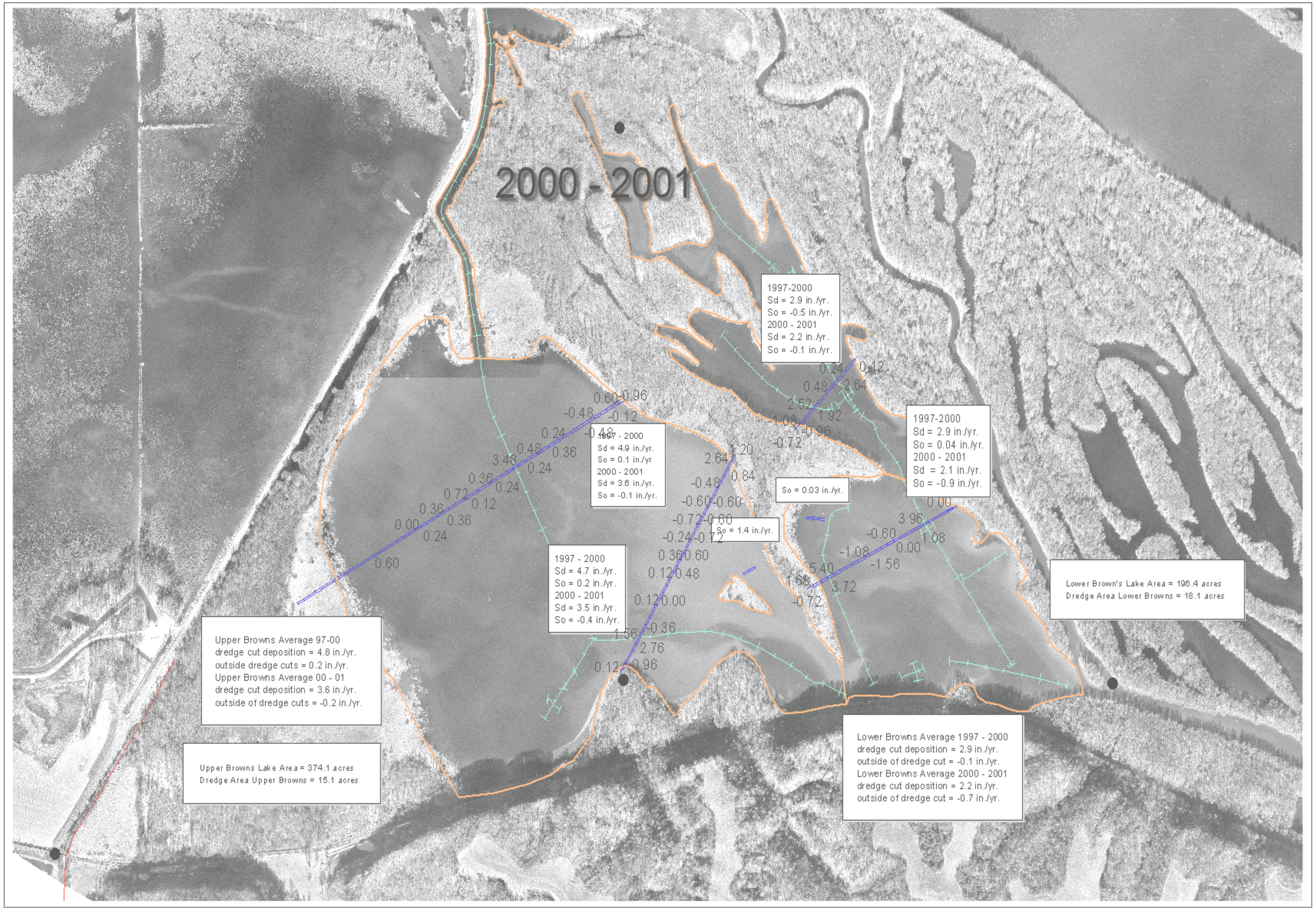


Figure G 4. Example Sediment Deposition Rates (inches/year) for 2002 PER time period 2000 - 2001



2000 - 2001
1997-2000
Sd = 2.9 in./yr.
So = -0.5 in./yr.
2000 - 2001
Sd = 2.2 in./yr.
So = -0.1 in./yr.
1997 - 2000
Sd = 4.9 in./yr.
So = 0.1 in./yr.
2000 - 2001
Sd = 3.6 in./yr.
So = -0.1 in./yr.
1997-2000
Sd = 2.9 in./yr.
So = 0.04 in./yr.
2000 - 2001
Sd = 2.1 in./yr.
So = -0.9 in./yr.
So = 0.03 in./yr.
So = 1.4 in./yr.
1997 - 2000
Sd = 4.7 in./yr.
So = 0.2 in./yr.
2000 - 2001
Sd = 3.5 in./yr.
So = -0.4 in./yr.
Lower Brown's Lake Area = 196.4 acres
Dredge Area Lower Browns = 18.1 acres
Upper Browns Average 97-00
dredge cut deposition = 4.8 in./yr.
outside dredge cuts = 0.2 in./yr.
Upper Browns Average 00 - 01
dredge cut deposition = 3.6 in./yr.
outside of dredge cuts = -0.2 in./yr.
Upper Browns Lake Area = 374.1 acres
Dredge Area Upper Browns = 15.1 acres
Lower Browns Average 1997 - 2000
dredge cut deposition = 2.9 in./yr.
outside of dredge cut = -0.1 in./yr.
Lower Browns Average 2000 - 2001
dredge cut deposition = 2.2 in./yr.
outside of dredge cut = -0.7 in./yr.

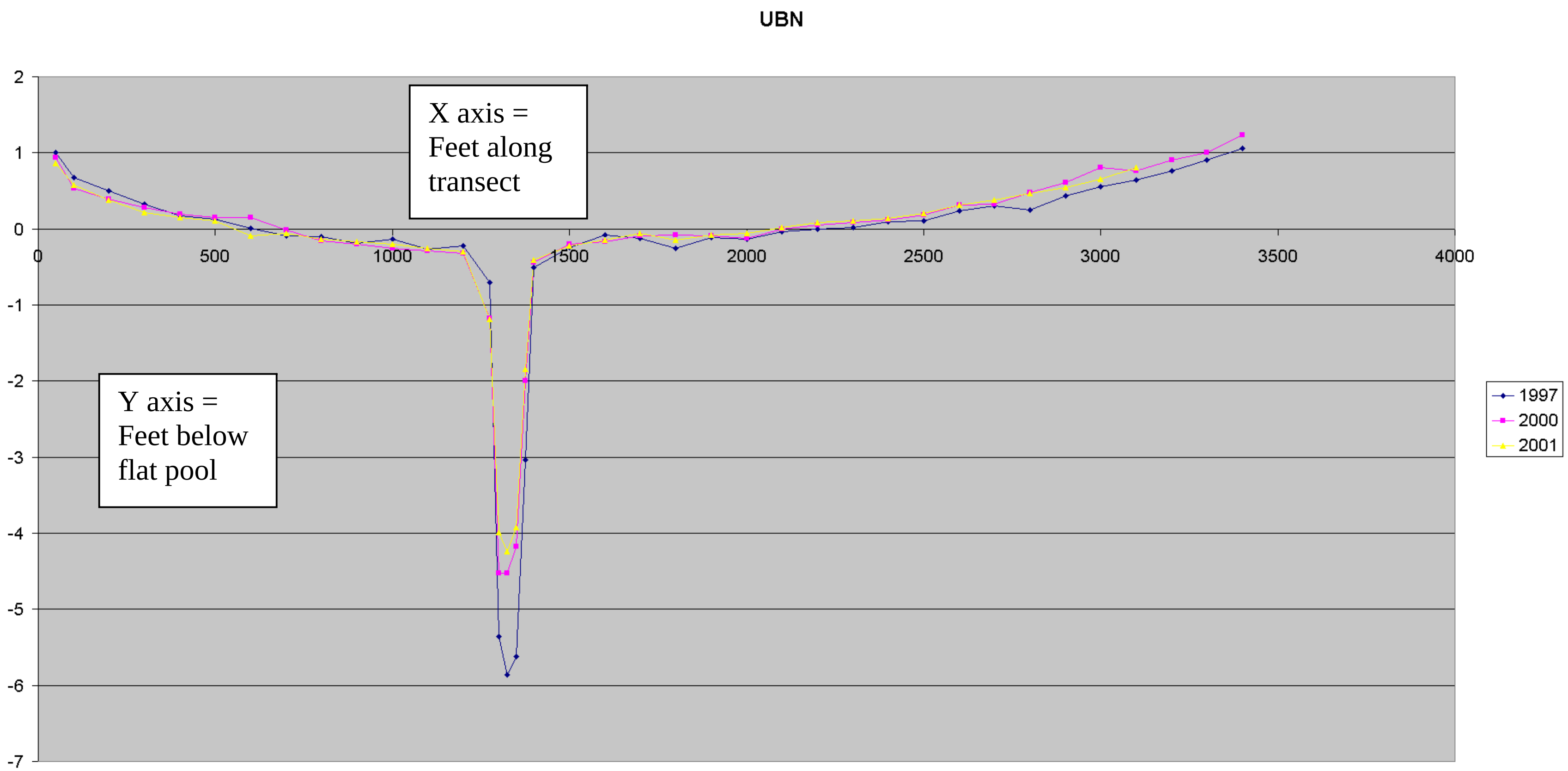


Figure G 5. UMESC Upper Brown's North Transect

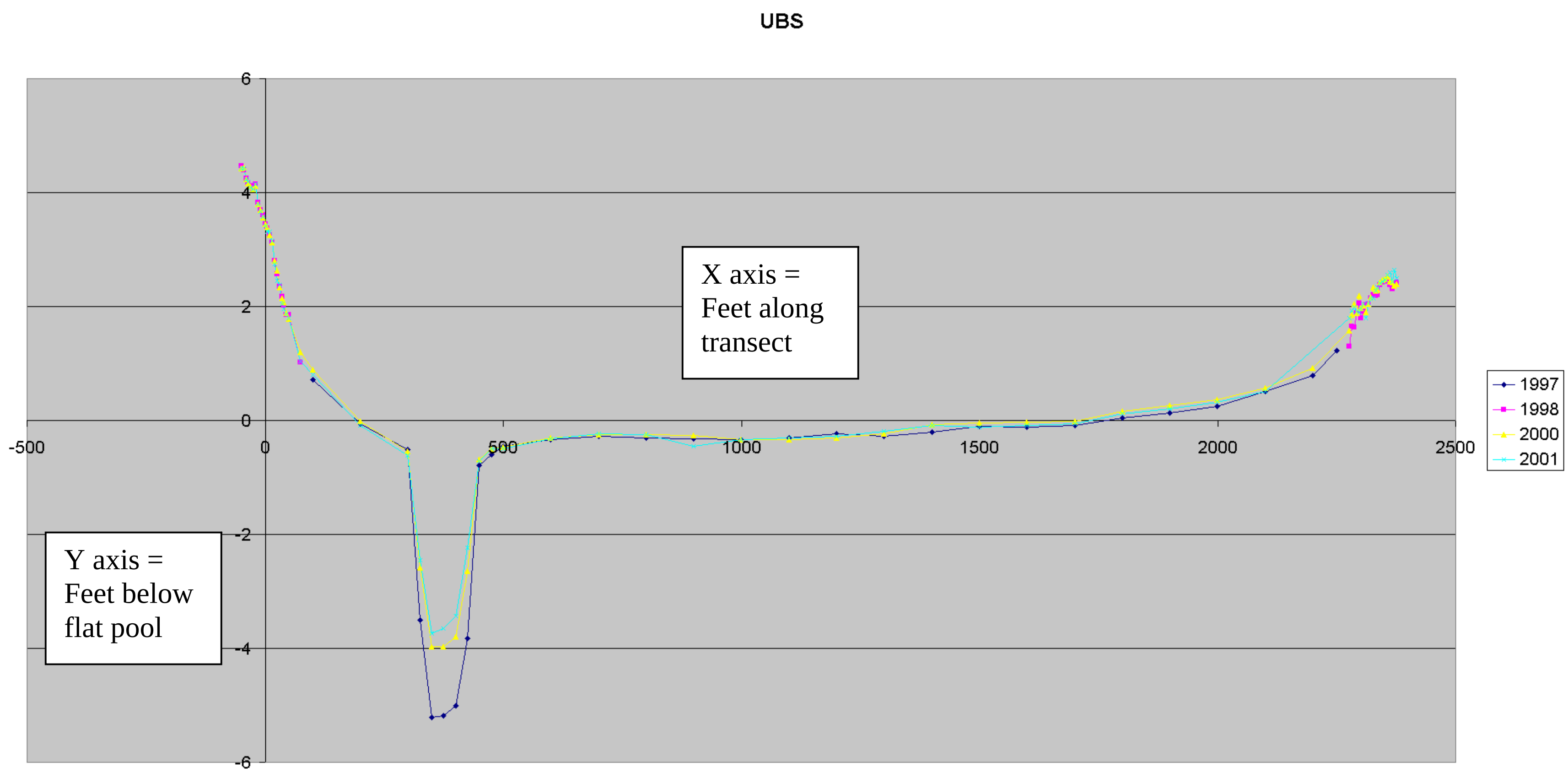


Figure G 6. UMESC Upper Brown's South Transect

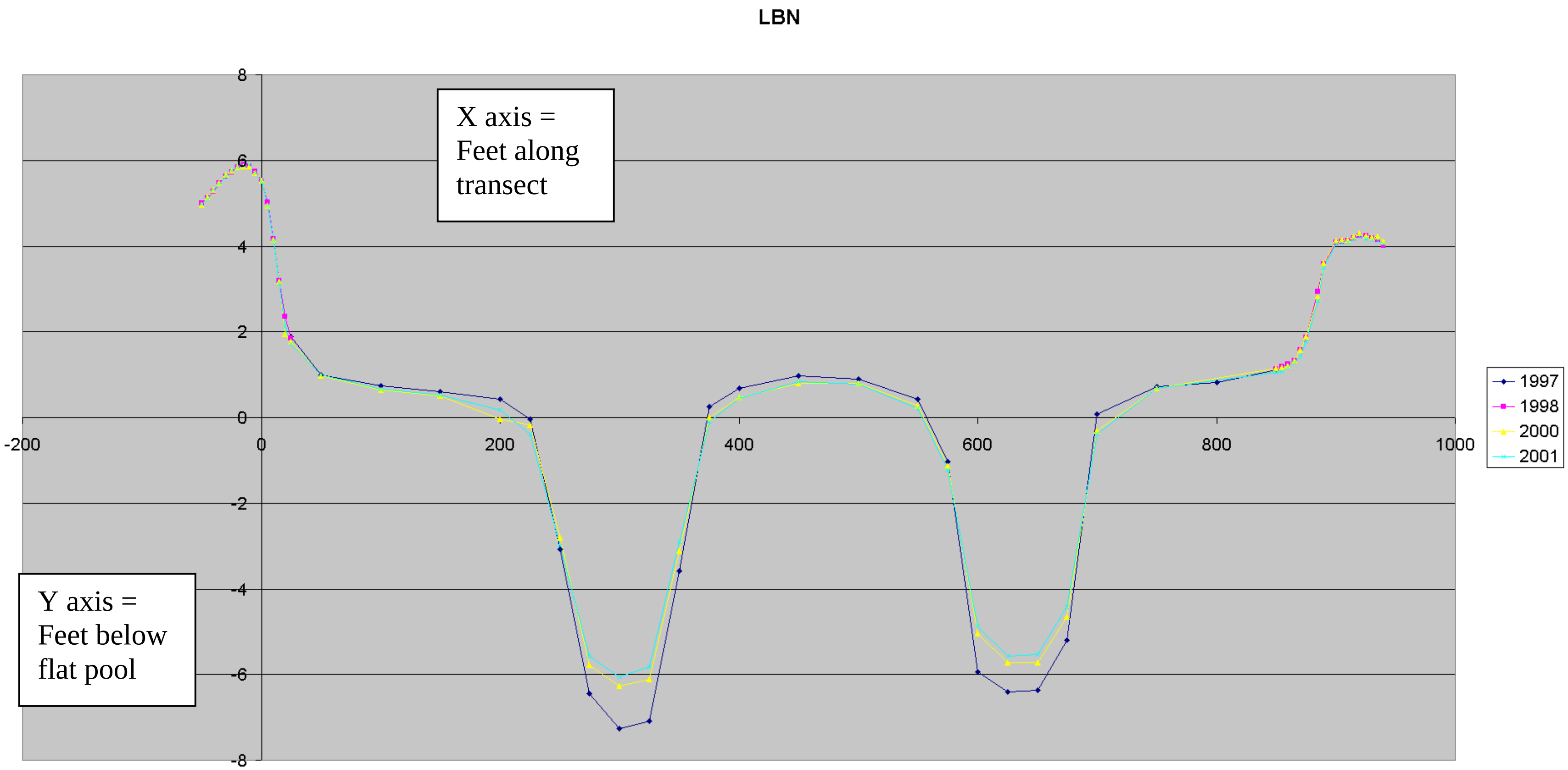


Figure G 7. UMESC Lower Brown's North Transect

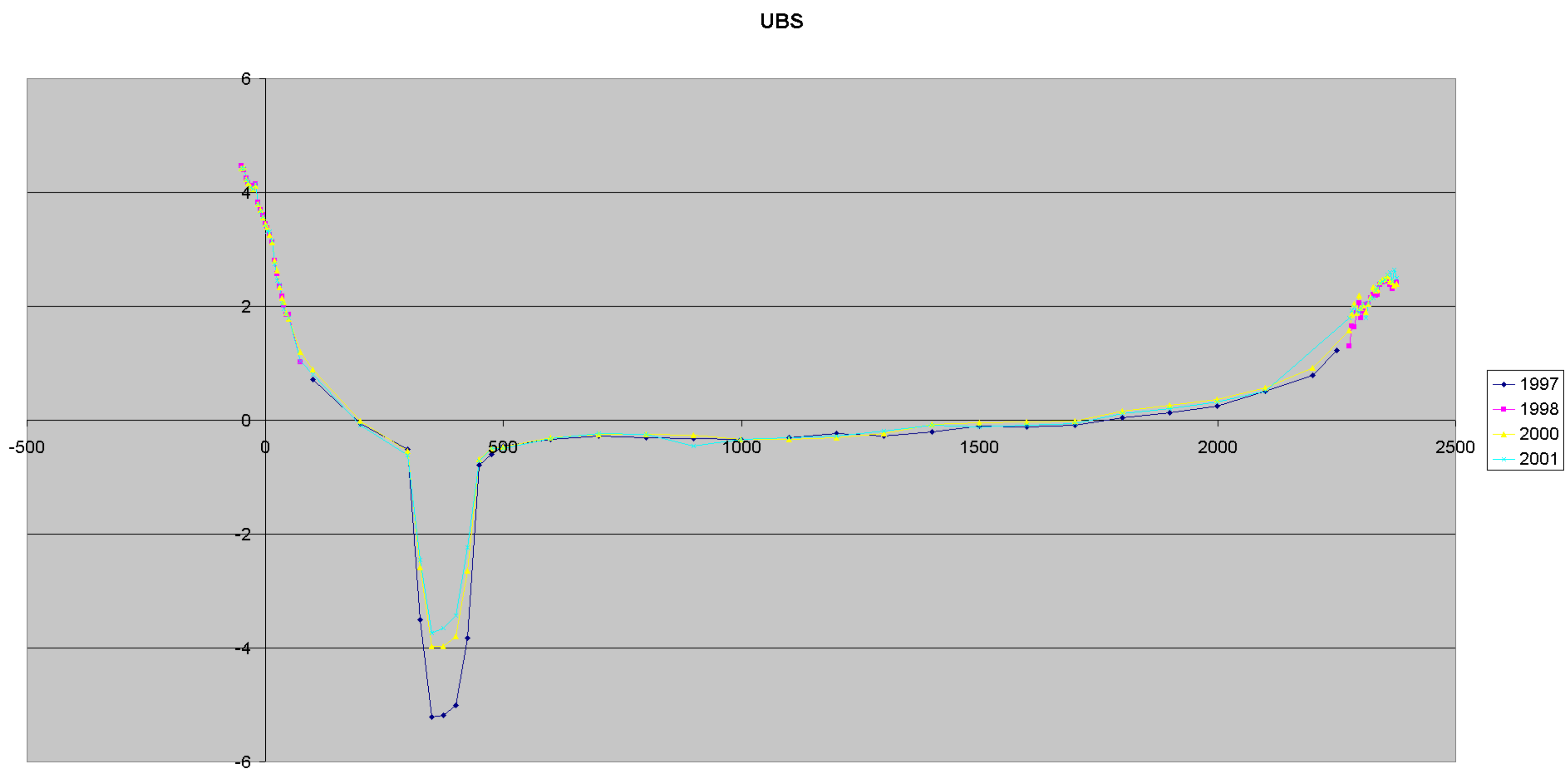


Figure G 8. UMESC Lower Brown's South Transect

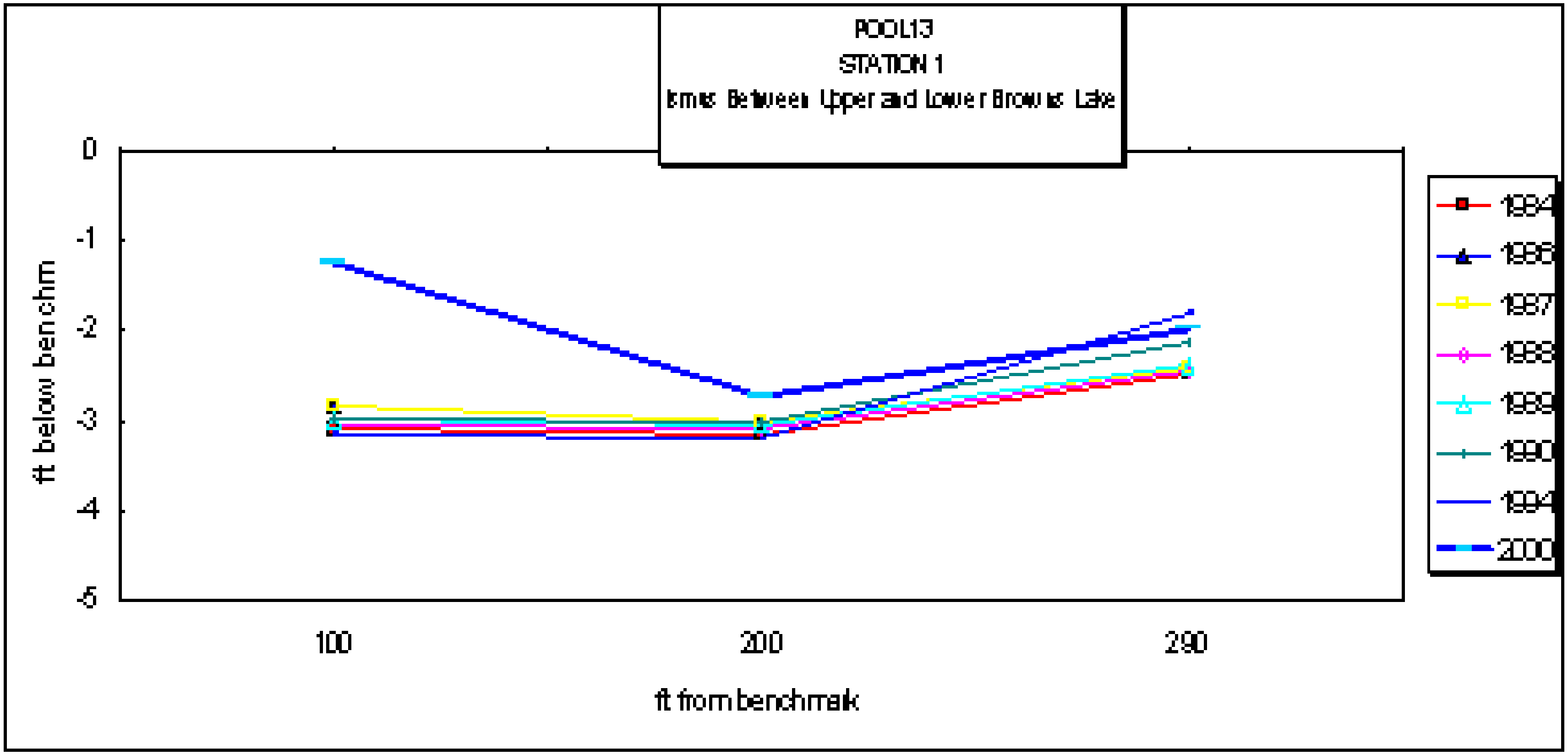


Figure G 9. IA DNR Station 1 at 545.0C

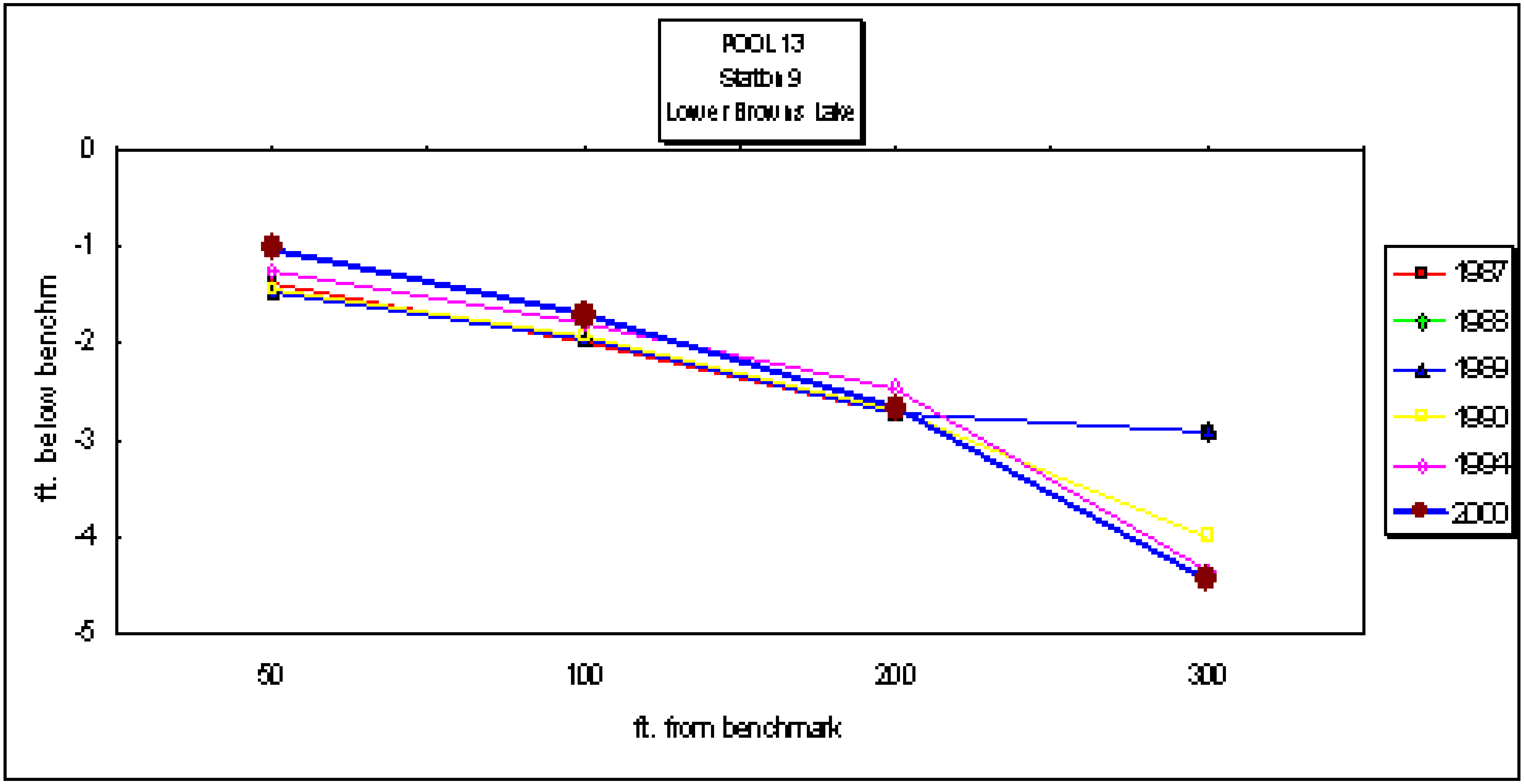
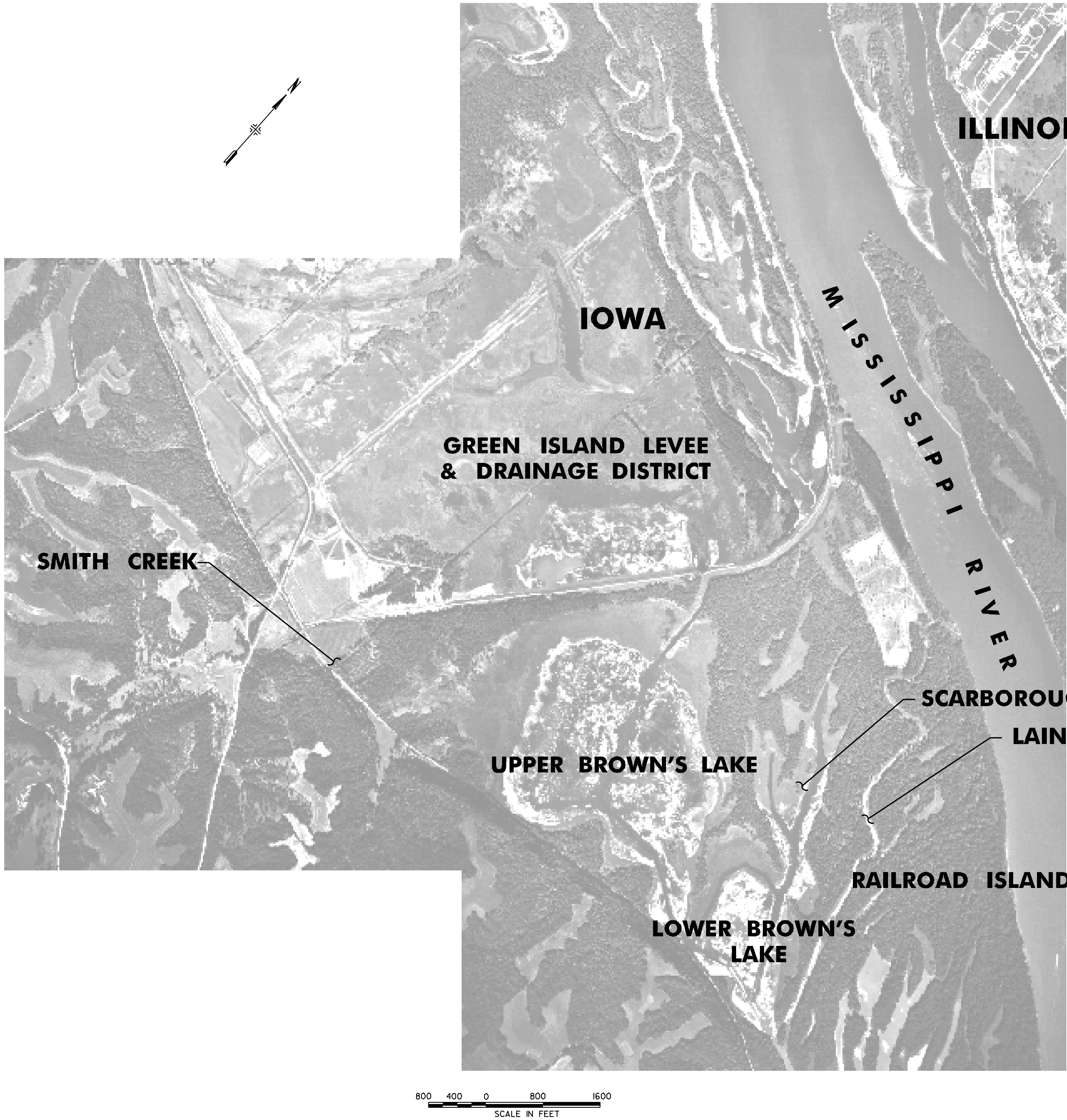
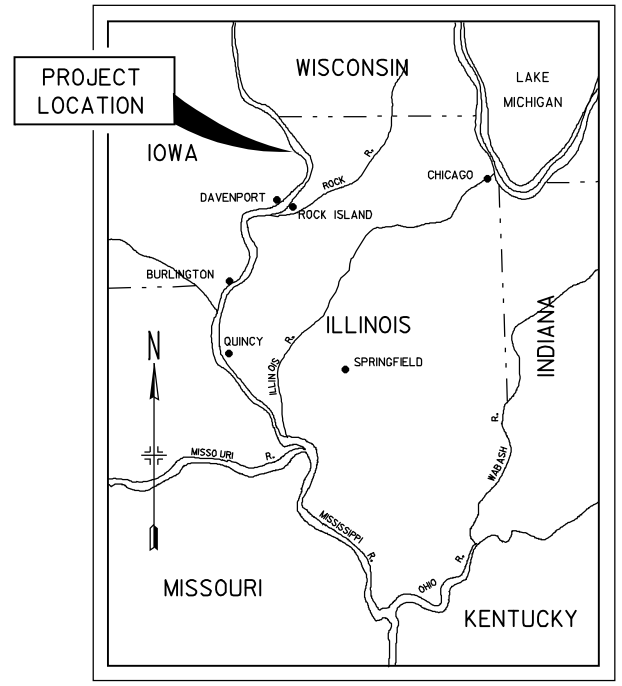


Figure G 10. IA DNR Station 9 at 544.9C





VICINITY MAP

25 0 25 50 75
SCALE IN MILES

US Army Corps of Engineers Rock Island District

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	Revisions		

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

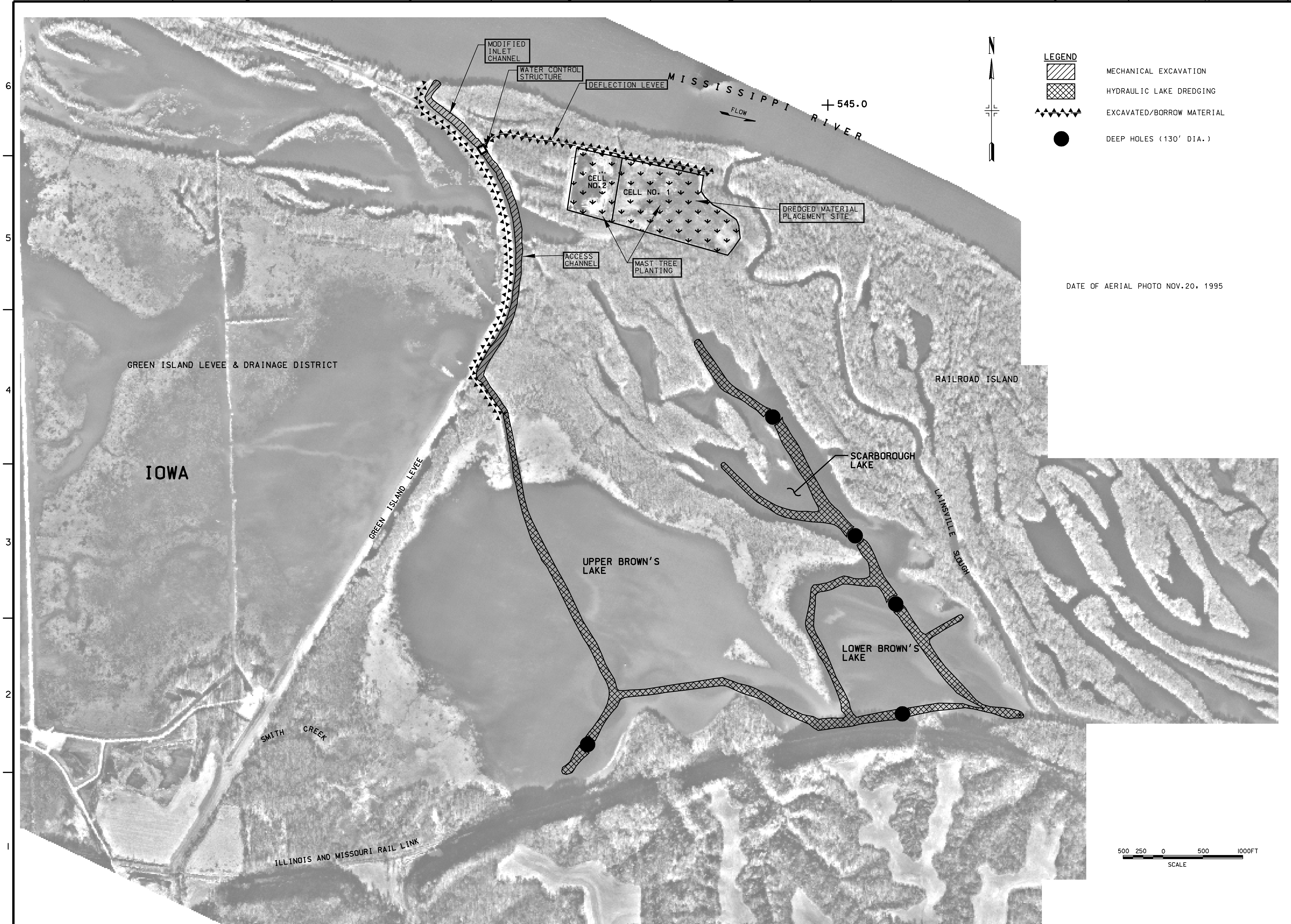
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

GENERAL PLAN AND VICINITY MAP

Sheet Reference Number:

Sheet of XX

PLATE 1



US Army Corps of Engineers Rock Island District

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

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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

PROJECT FEATURES

Sheet Reference Number:

Sheet of XX

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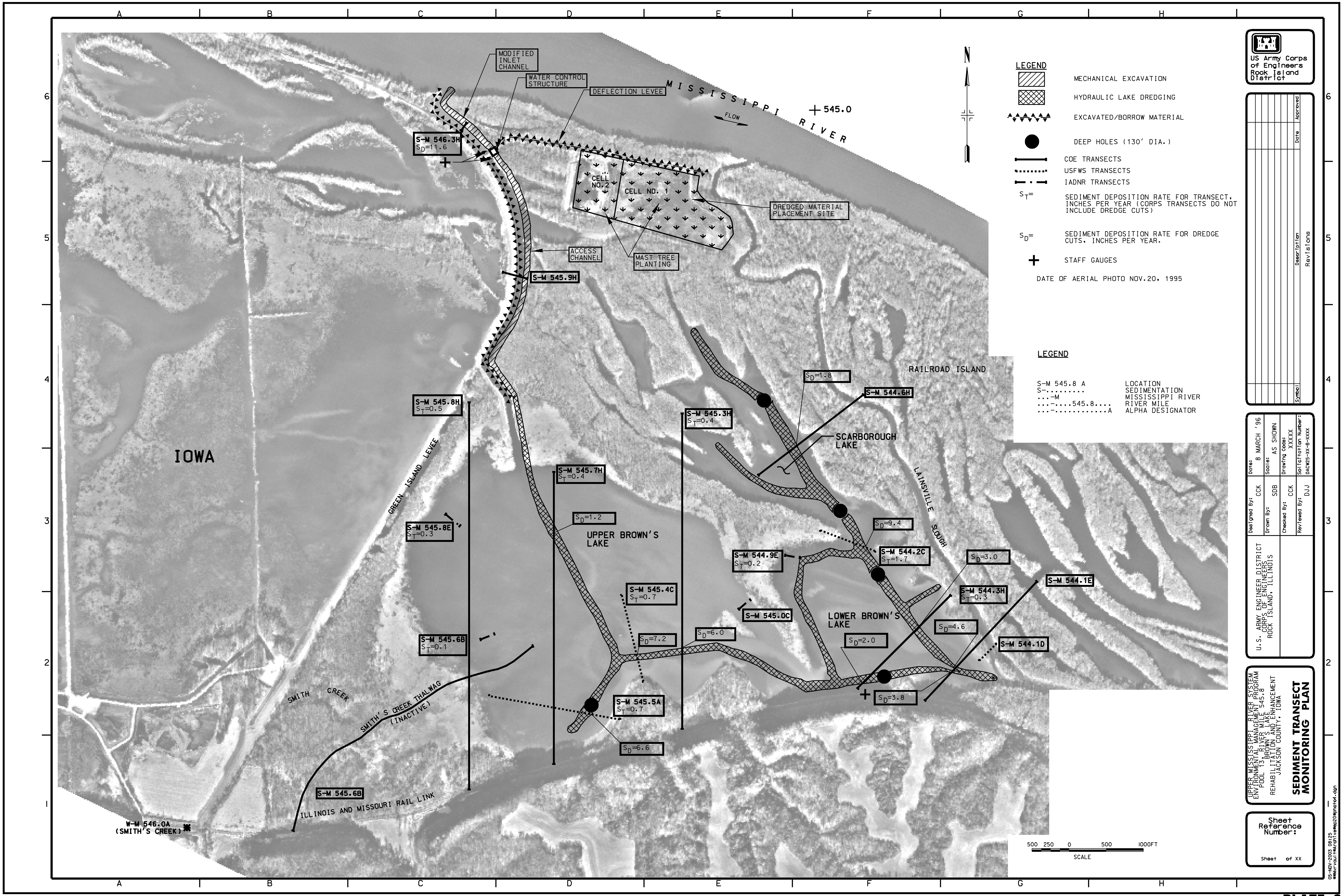
PLATE 2


MODIFIED INLET CHANNEL
WATER CONTROL STRUCTURE
DEFLECTION LEVEE
MISSISSIPPI RIVER
FLOW
545.0
S-M 546.3H
SD=11.6
CELL NO. 2
CELL NO. 1
DREDGED MATERIAL PLACEMENT SITE
ACCESS CHANNEL
MAST TREE PLANTING
S-M 545.9H
IOWA
GREEN ISLAND LEVEE
S-M 545.8H
ST=0.5
S-M 545.7H
ST=0.4
S-M 545.3H
ST=0.4
SD=1.8
S-M 544.6H
SCARBOROUGH LAKE
RAILROAD ISLAND
LAINSVILLE SLOUGH
S-M 545.8E
ST=0.3
SD=1.2
UPPER BROWN'S LAKE
SD=9.4
S-M 544.2C
ST=1.7
S-M 544.9E
ST=0.2
SD=3.0
S-M 544.1E
S-M 545.4C
ST=0.7
S-M 544.3H
ST=0.3
S-M 545.0C
LOWER BROWN'S LAKE
S-M 545.6B
ST=0.1
SD=7.2
SD=6.0
SD=4.6
SD=2.0
S-M 544.1D
SMITH CREEK
SMITH'S CREEK THALWAG (INACTIVE)
S-M 545.5A
ST=0.7
SD=3.8
SD=6.6
S-M 545.6B
ILLINOIS AND MISSOURI RAIL LINK
W-M 546.0A (SMITH'S CREEK)
LEGEND
MECHANICAL EXCAVATION
HYDRAULIC LAKE DREDGING
EXCAVATED/BORROW MATERIAL
DEEP HOLES (130' DIA.)
COE TRANSECTS
USFWS TRANSECTS
IADNR TRANSECTS
ST= SEDIMENT DEPOSITION RATE FOR TRANSECT, INCHES PER YEAR (CORPS TRANSECTS DO NOT INCLUDE DREDGE CUTS)
SD= SEDIMENT DEPOSITION RATE FOR DREDGE CUTS, INCHES PER YEAR.
STAFF GAUGES
DATE OF AERIAL PHOTO NOV.20, 1995
LEGEND
S-M 545.8 A LOCATION
S-......... SEDIMENTATION
...-M MISSISSIPPI RIVER
...-....545.8.... RIVER MILE
...-............A ALPHA DESIGNATOR
500 250 0 500 1000FT
SCALE
US Army Corps of Engineers Rock Island District
Symbol Description Date Approved
Revisions
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Drawn By: SDB
Checked By: CCK
Reviewed By: DJJ
Date: 8 MARCH '96
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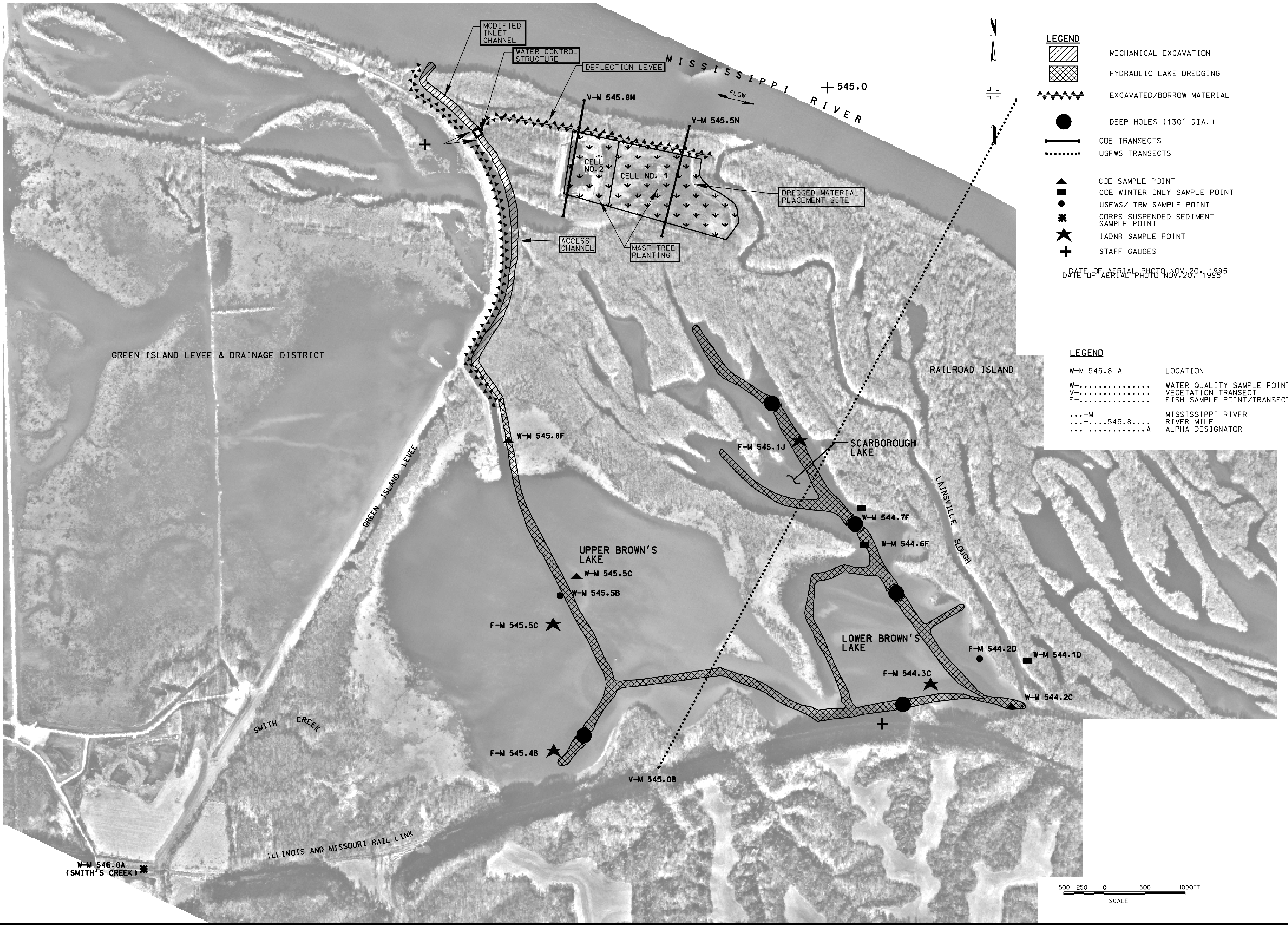
Drawing Code: XXXXX
Solicitation Number: DACW25-XX-B-XXXX
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 13, RIVER MILE 545.8 BROWN'S LAKE REHABILITATION AND ENHANCEMENT JACKSON COUNTY, IOWA
SEDIMENT TRANSECT MONITORING PLAN
Sheet Reference Number:
Sheet of XX

PLATE 3



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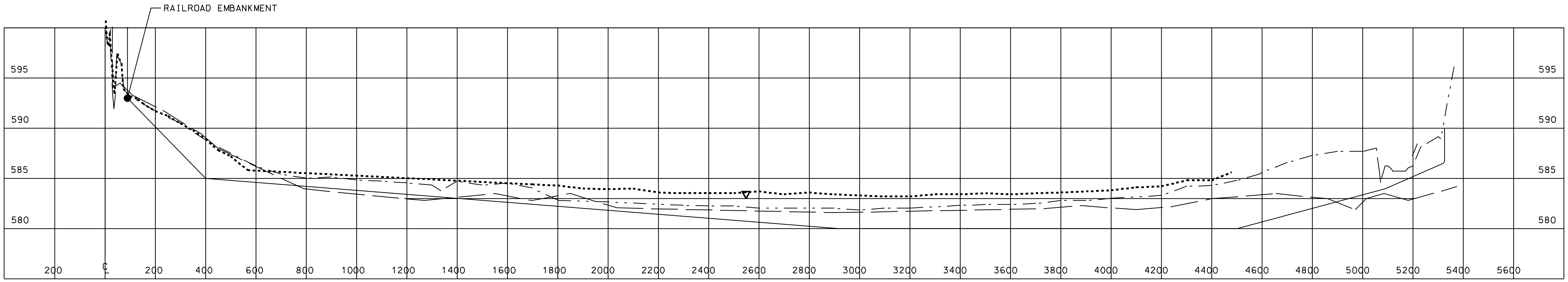
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

WATER QUALITY, VEGETATION & FISH MONITORING PLAN

Sheet Reference Number:

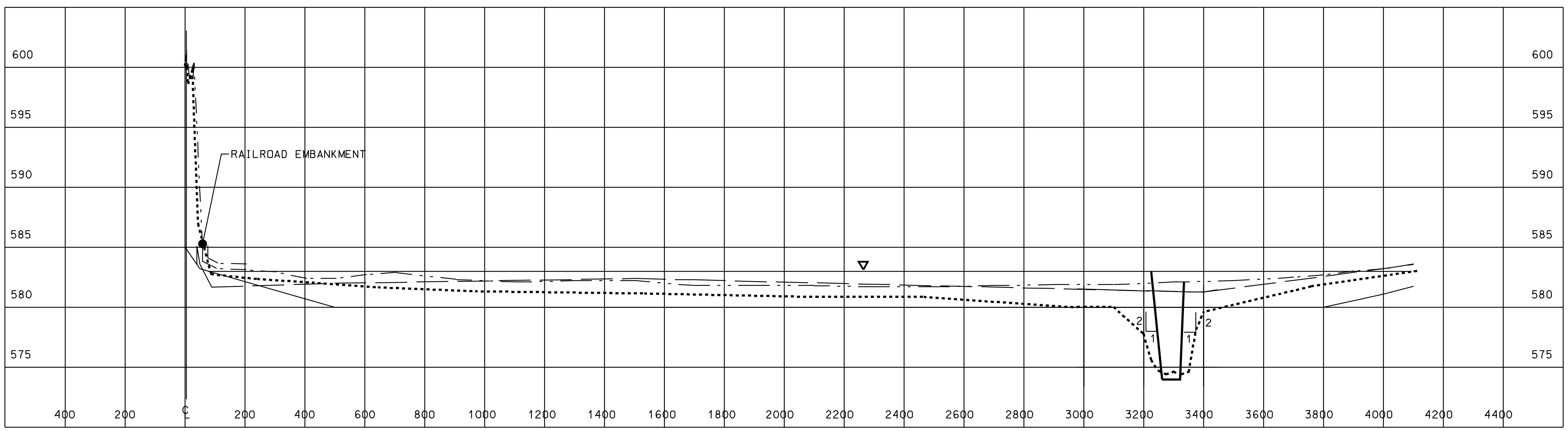
Sheet of XX

PLATE 4



UPPER BROWN'S LAKE

S-M 545.8H



UPPER BROWN'S LAKE

S-M 545.7H

LEGEND:

- MARCH & AUGUST 1995
- APRIL 1987
- DEC 1938 / FEB 1939
- 1929 / 1930
- FLAT POOL = EL. 583.0
- DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

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

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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

CORPS SEDIMENTATION TRANSECTS

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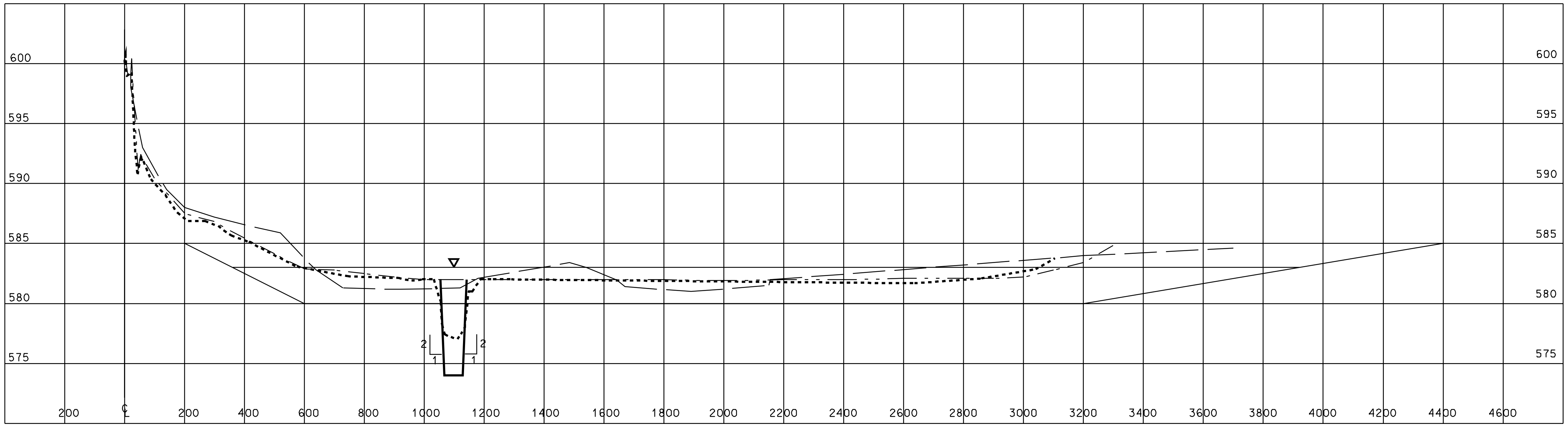
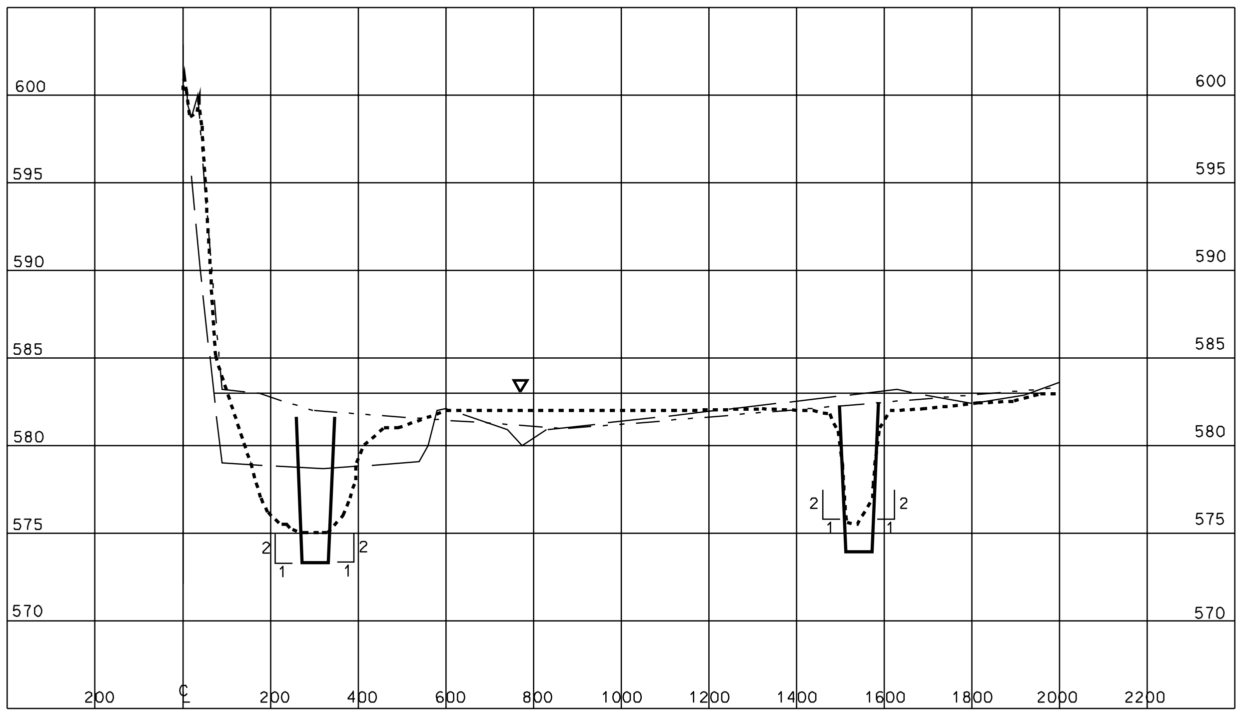
PLATE 5



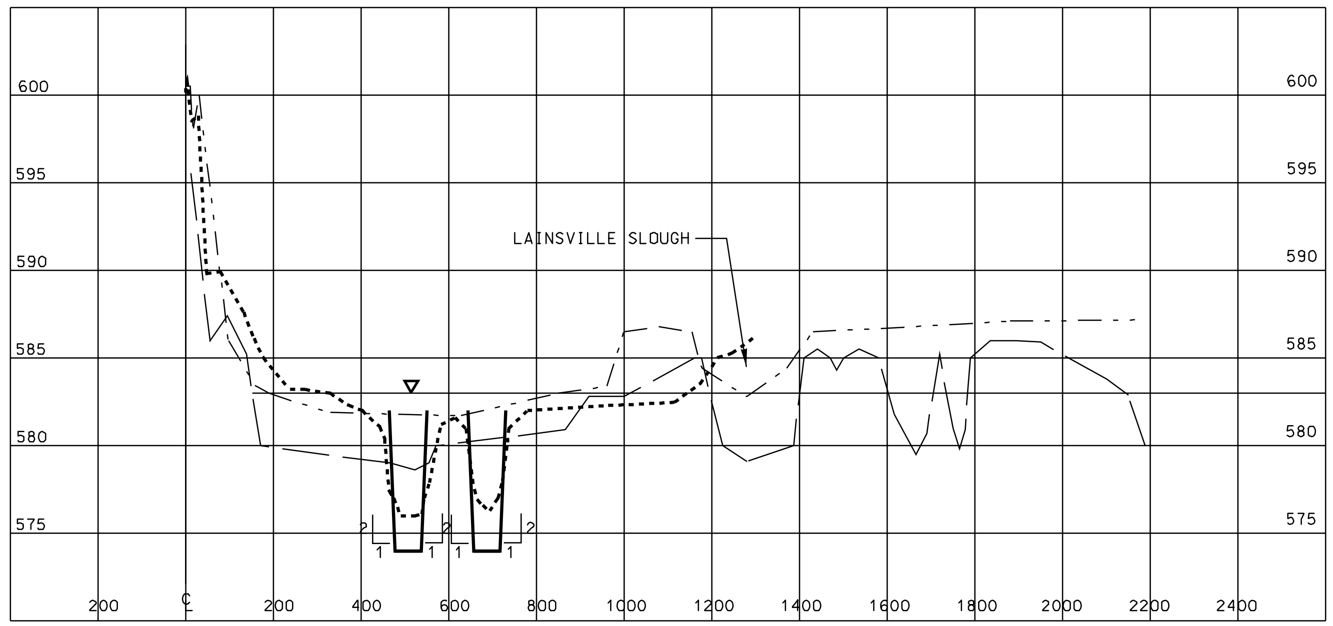
UPPER BROWN'S LAKE

S-M 545.3H



LOWER BROWN'S LAKE

S-M 544.3H



LOWER BROWN'S LAKE

S-M 544.1E

LEGEND

MARCH & AUGUST 1995

APRIL 1987

DEC 1938 / FEB 1939

1929 / 1930

FLAT POOL = EL. 583.0

DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

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Solicitation Number: DACW25-XX-B-XXXX

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

CORPS SEDIMENTATION TRANSECTS

Sheet Reference Number:

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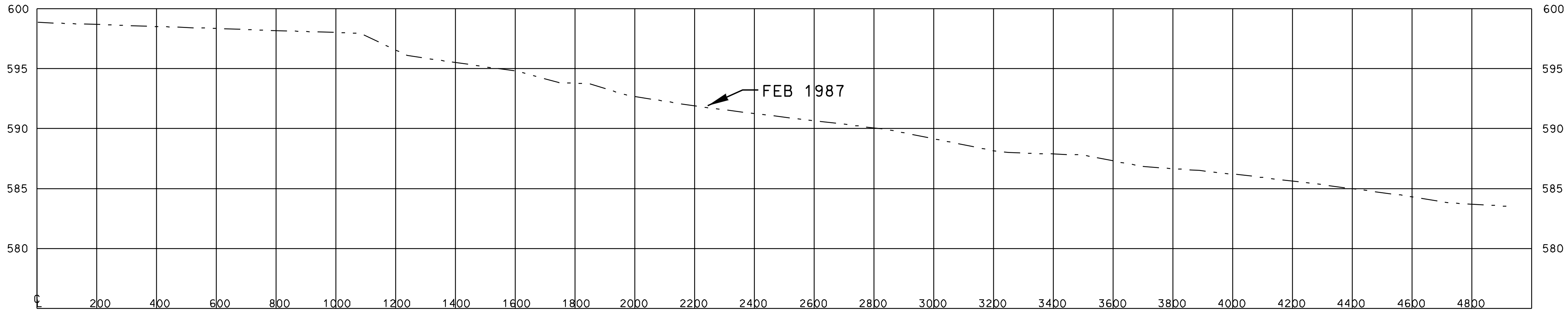
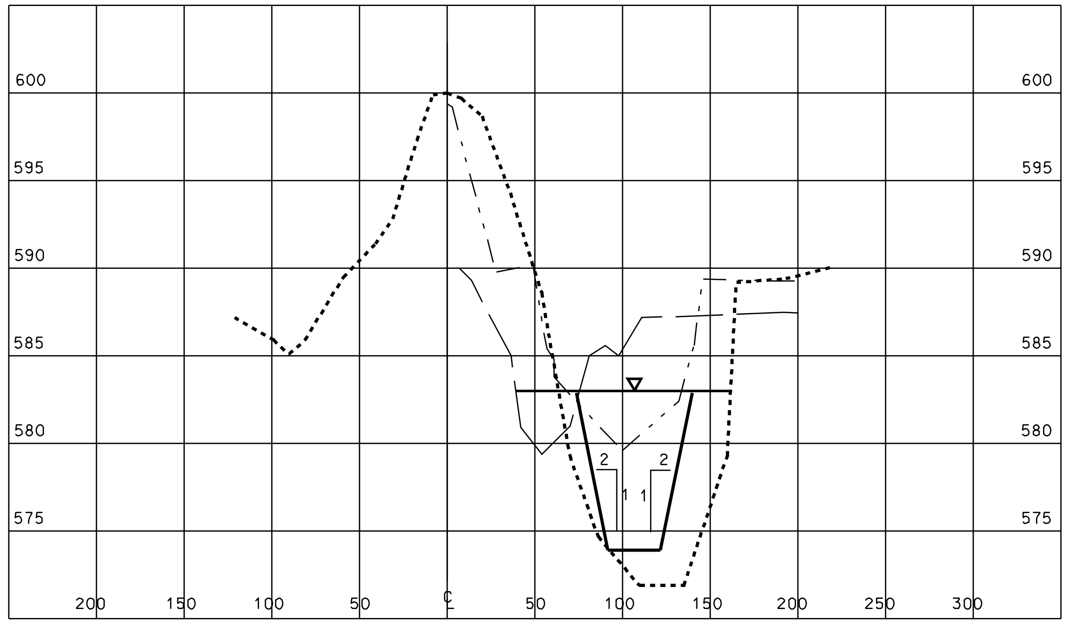
PLATE 6



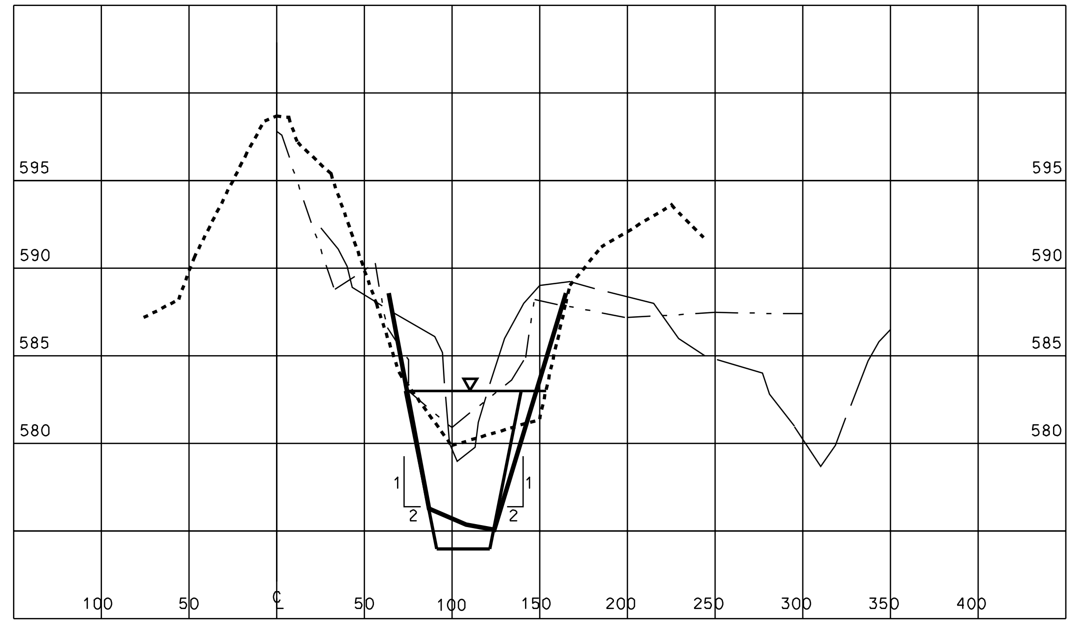
SMITH'S CREEK THALWEG (INACTIVE)

S-M 545.6B



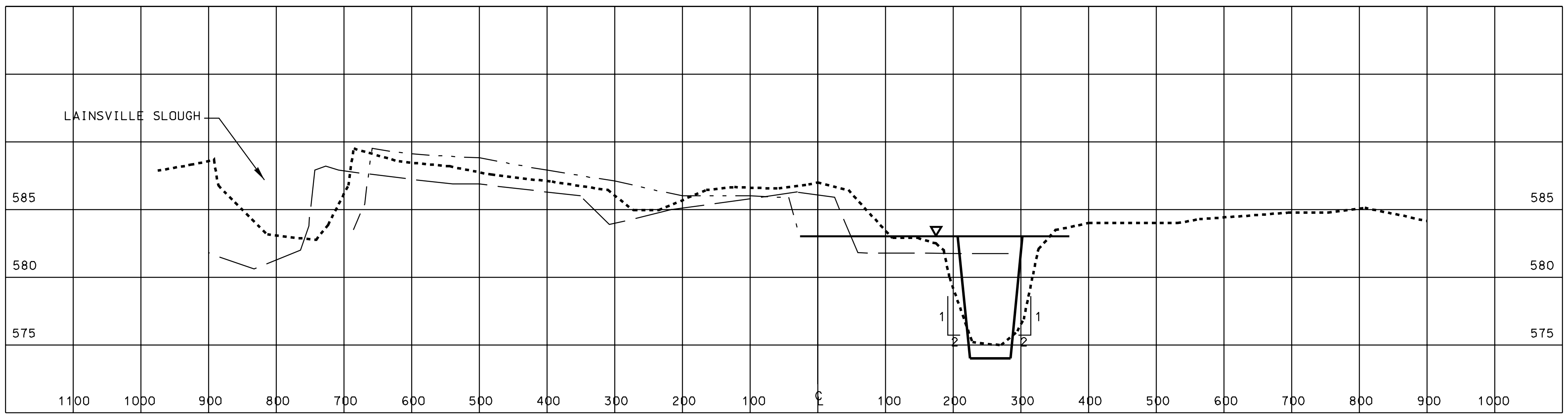
ACCESS CHANNEL ADJACENT TO GREEN ISLAND LEVEE

S-M 546.9H



INLET CHANNEL

S-M 546.3H



SCARBOROUGH LAKE

S-M 544.6H

LEGEND

- MAY 23 1996
- MARCH / AUGUST 1995
- FEBUARY / APRIL 1987
- DEC 1938 / FEB 1939
- 1929 / 1930
- FLAT POOL = EL. 583.0
- DREDGE CUT AS DESIGNED

US Army Corps of Engineers Rock Island District

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

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

CORPS SEDIMENTATION TRANSECTS

Sheet Reference Number:

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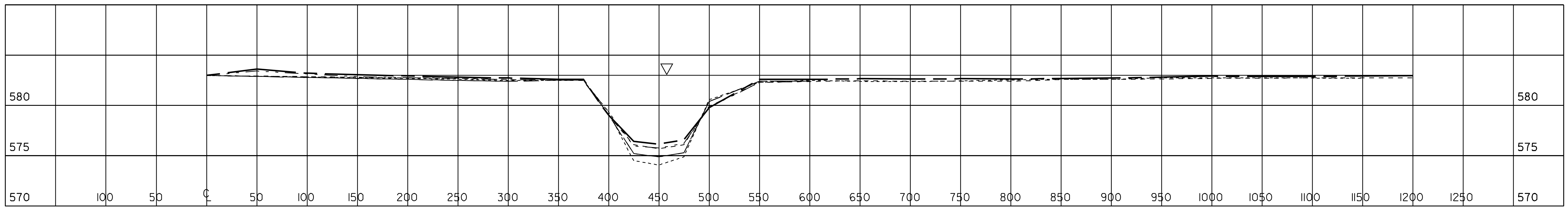
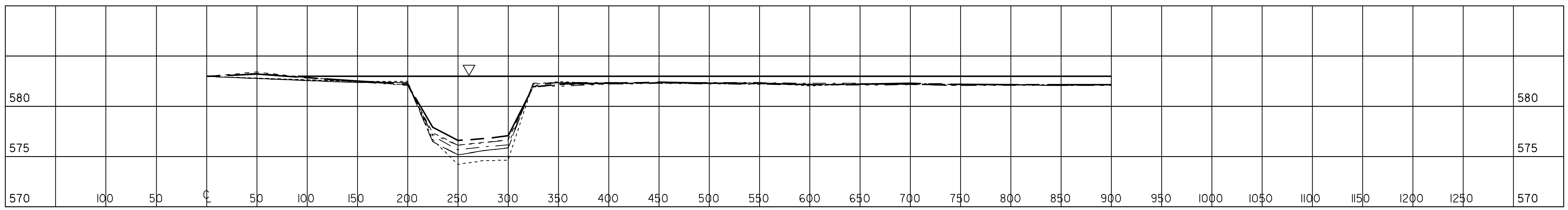
PLATE 7



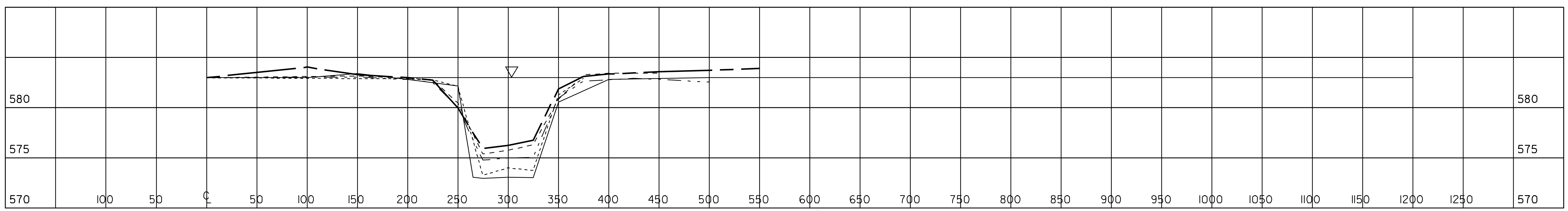
UPPER BROWN'S LAKE

S-M 545.5A



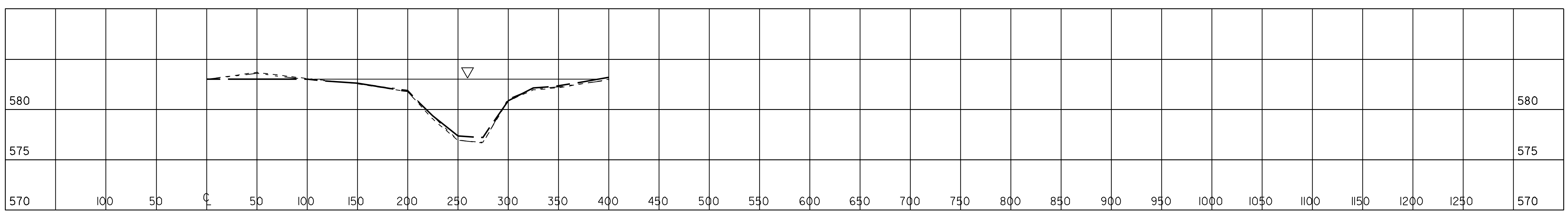
UPPER BROWN'S LAKE

S-M 545.4C



LOWER BROWN'S LAKE

S-M 544.2C



LAINSVILLE SLOUGH

S-M 544.1D

1989
1990
1991
1992
1993
1994
1995
FLAT POOL = EL. 583.0

US Army Corps of Engineers Rock Island District

Revisions

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Date: 8 MARCH '96
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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

USFWS SEDIMENTATION TRANSECTS

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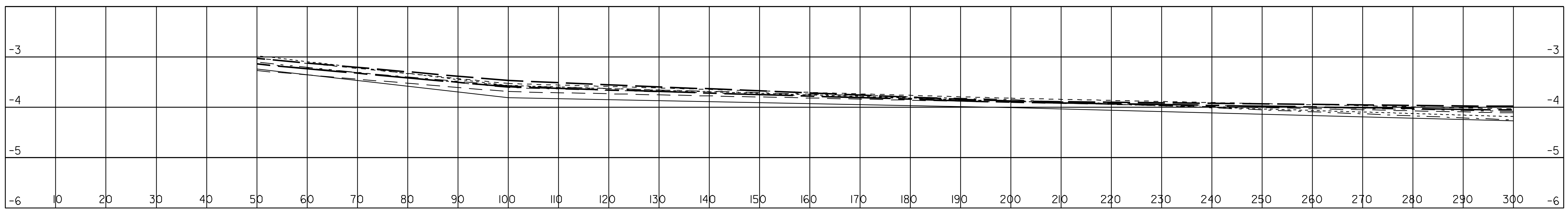
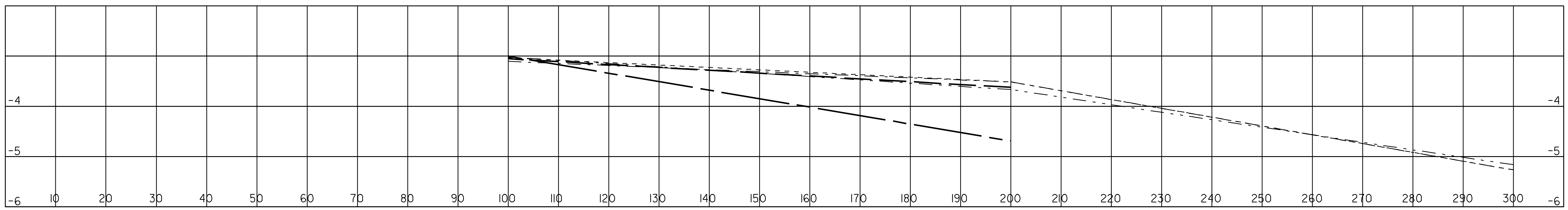
PLATE 8



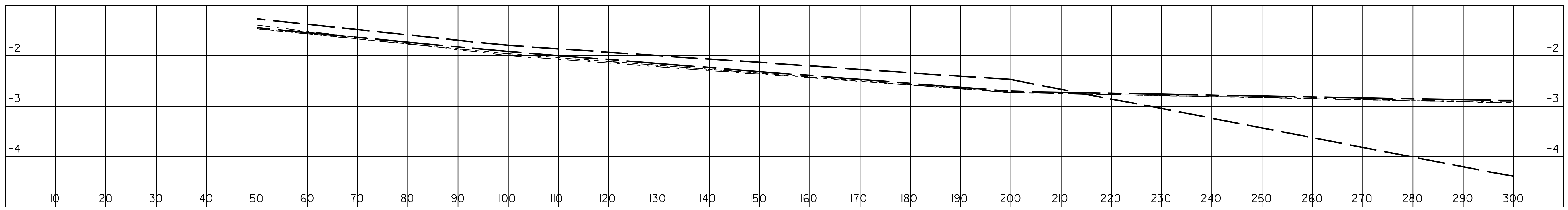
UPPER BROWN'S LAKE

S-M 545.8E



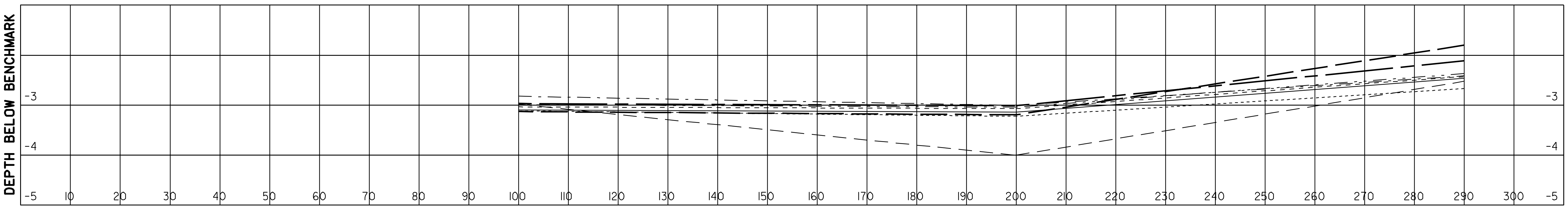
UPPER BROWN'S LAKE

S-M 545.6B



UPPER BROWN'S LAKE

S-M 545.0C



1984
1985
1986
1987
1988
1989
1990
1994

LOWER BROWN'S LAKE

S-M 544.9E

US Army Corps of Engineers Rock Island District

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

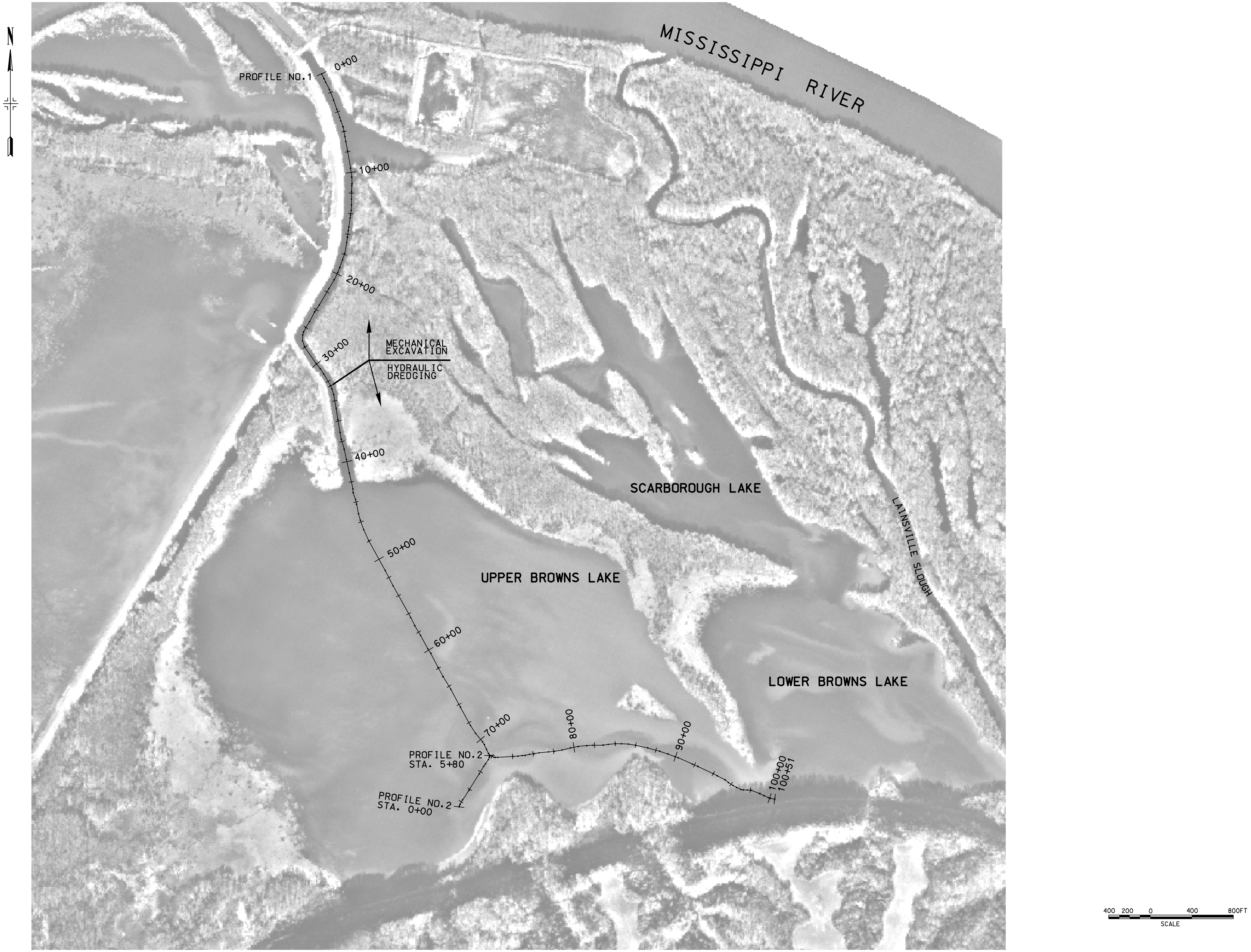
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

IADNR SEDIMENTATION TRANSECTS

Sheet Reference Number: **C7**

Sheet of XX

PLATE 9



US Army Corps of Engineers Rock Island District

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

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UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

UPPER BROWN'S LAKE DREDGED CHANNEL PLAN

Sheet Reference Number:

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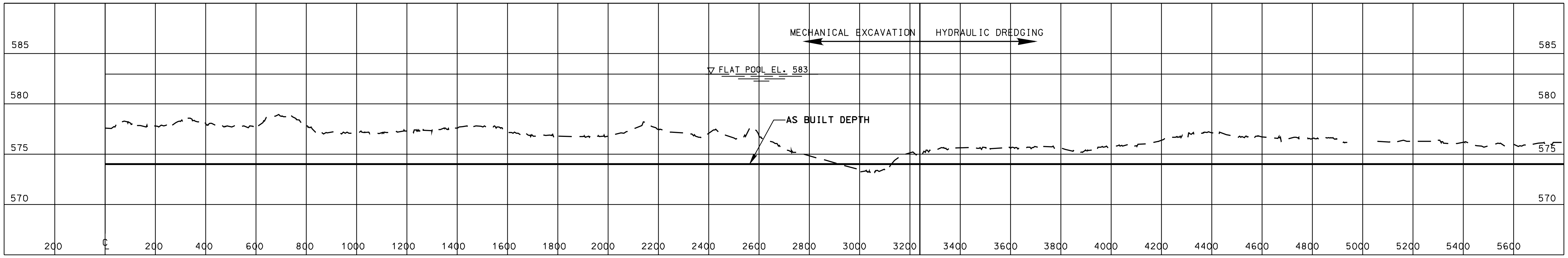
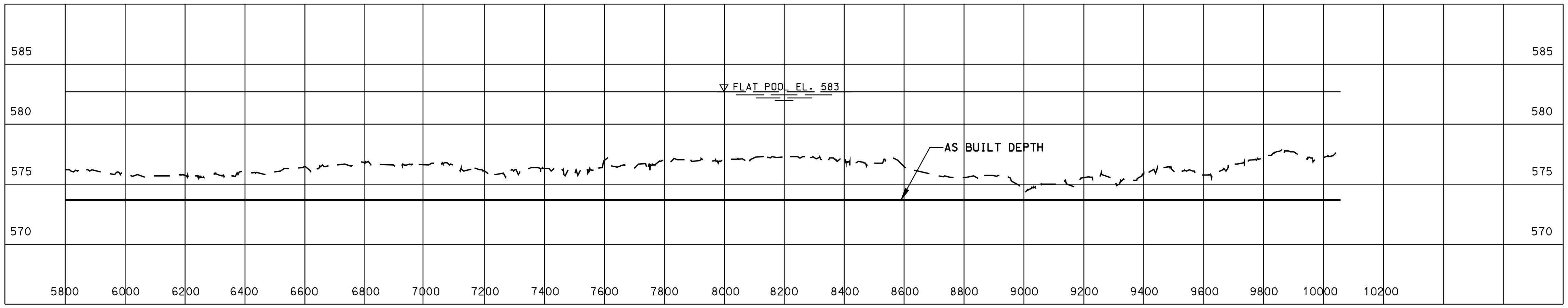
PLATE 9A



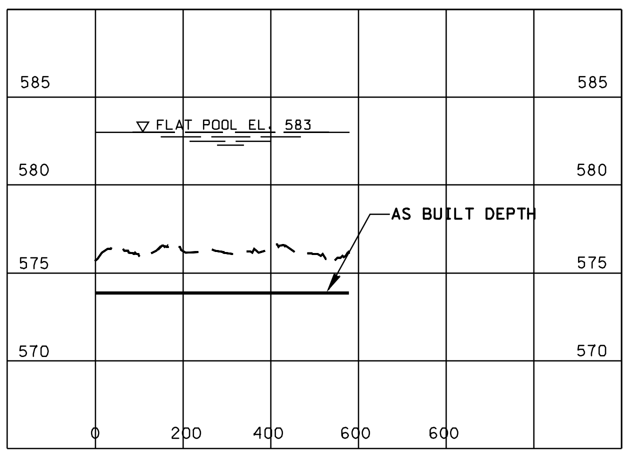
UPPER BROWN'S LAKE

PROFILE NO.1



UPPER BROWN'S LAKE

PROFILE NO.1 CONTINUED



UPPER BROWN'S LAKE

PROFILE NO.2

NOTE: PROFILE STARTS APPROXIMATELY 270 FEET DOWNSTREAM OF THE WATER CONTROL STRUCTURE.

DATE OF SURVEY: AUGUST 29, 1996

US Army Corps of Engineers Rock Island District

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Date: 8 MARCH '96 | Scale: AS SHOWN | Drawing Code: XXXXX | Solicitation Number: DACW25-XX-B-XXXX

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

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POOL 13, RIVER MILE 545.8 BROWN'S LAKE REHABILITATION AND ENHANCEMENT JACKSON COUNTY, IOWA

UPPER BROWN'S DREDGED CHANNEL PROFILES

Sheet Reference Number:

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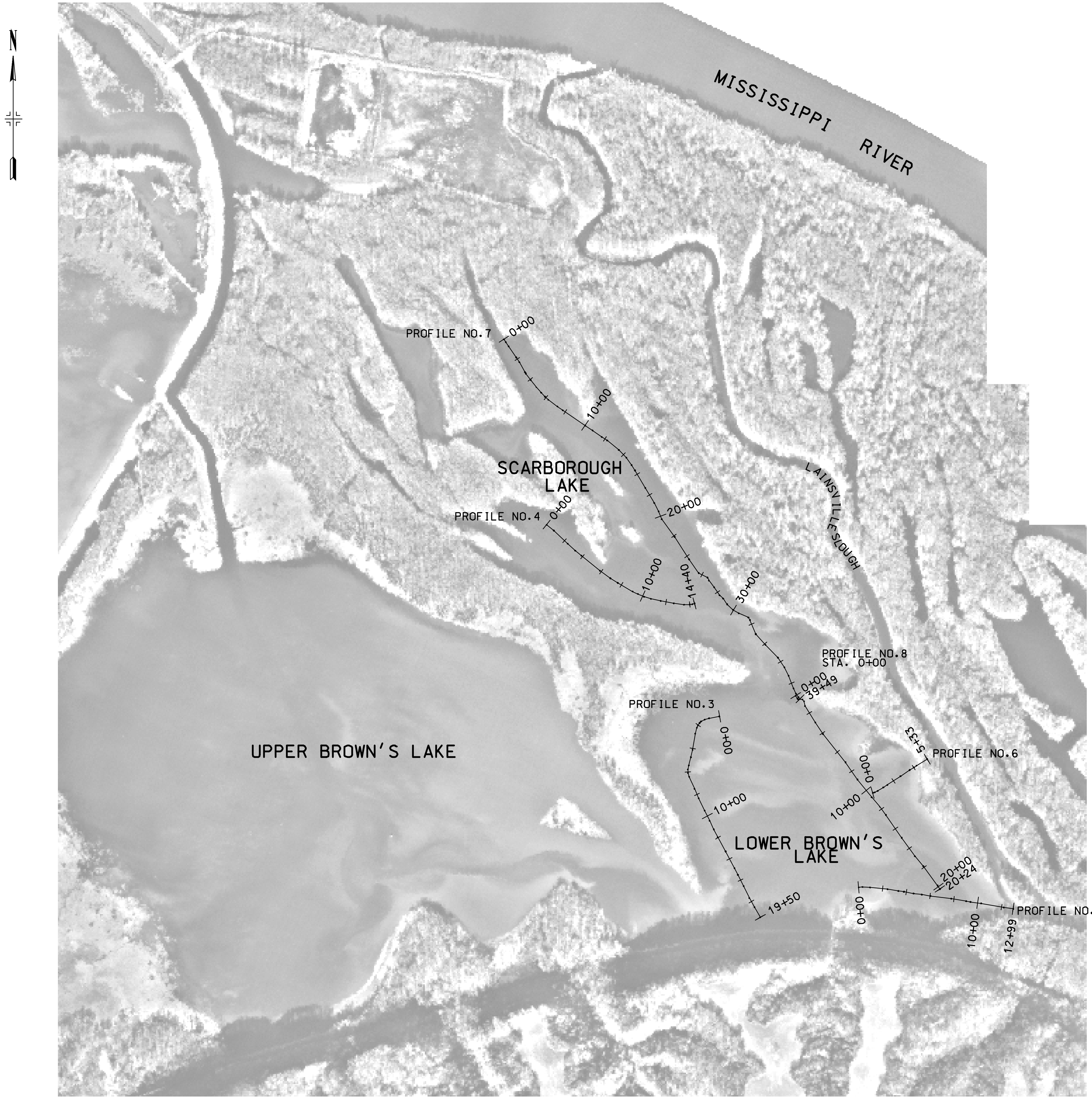
PLATE 9B



US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS	Designed By: CCK	Date: 8 MARCH '96
	Drawn By: SDB	Scale: AS SHOWN
	Checked By: CCK	Drawing Code: XXXXX
	Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

LOWER BROWN'S LAKE DREDGED CHANNEL PLAN

Sheet Reference Number:

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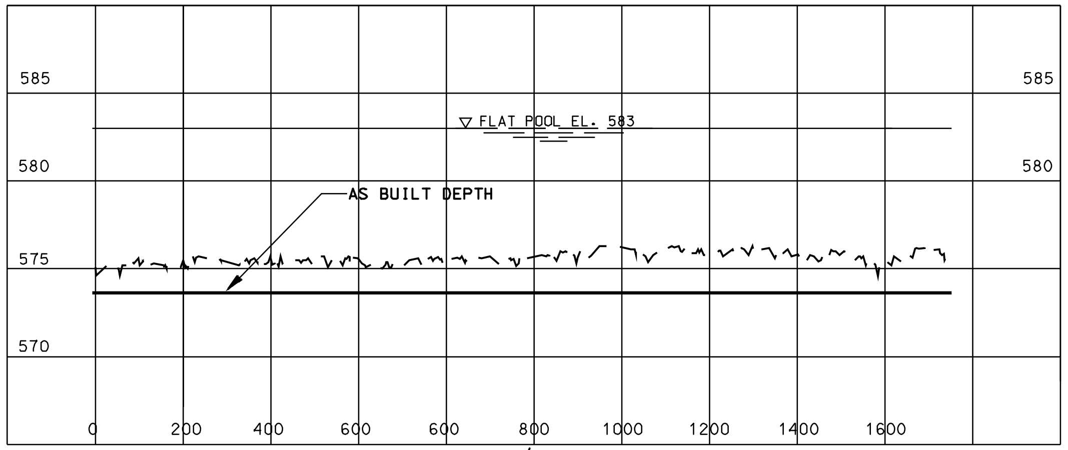
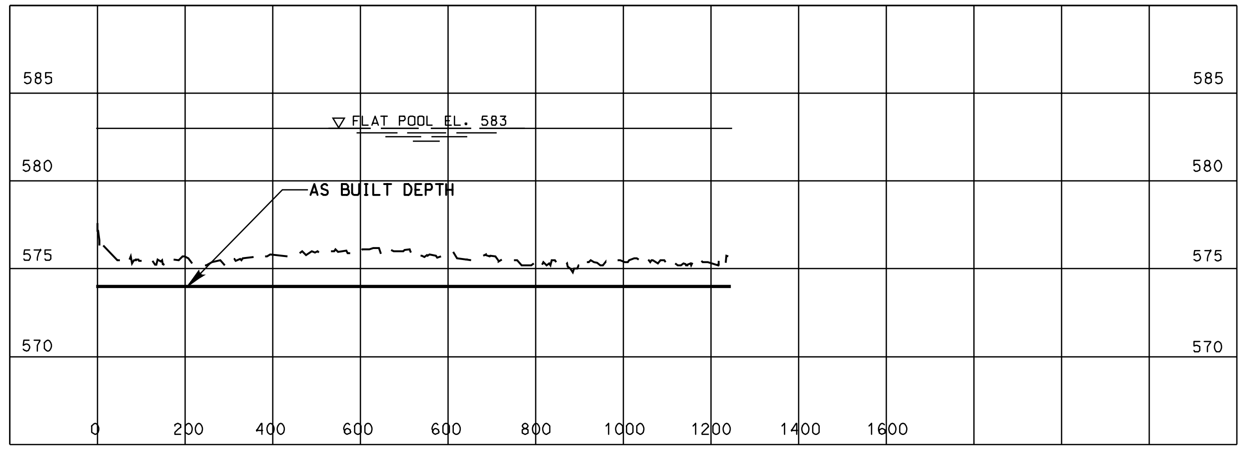
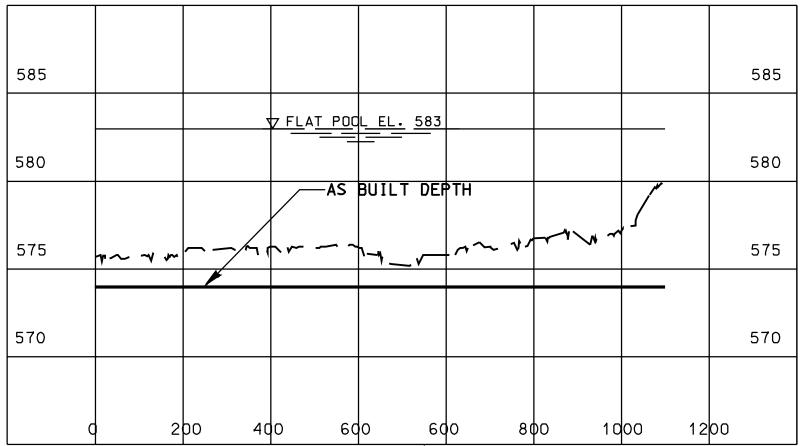
PLATE 9C



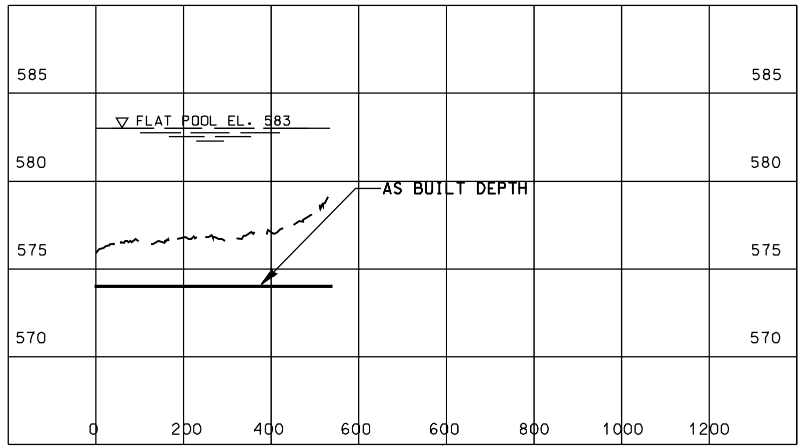
LOWER BROWN'S LAKE
PROFILE NO.3



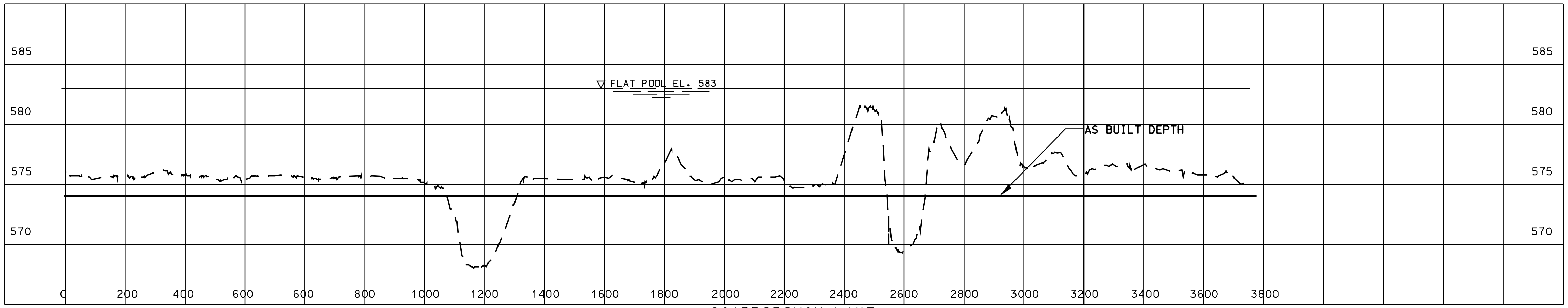
SCARBOROUGH LAKE
PROFILE NO.4



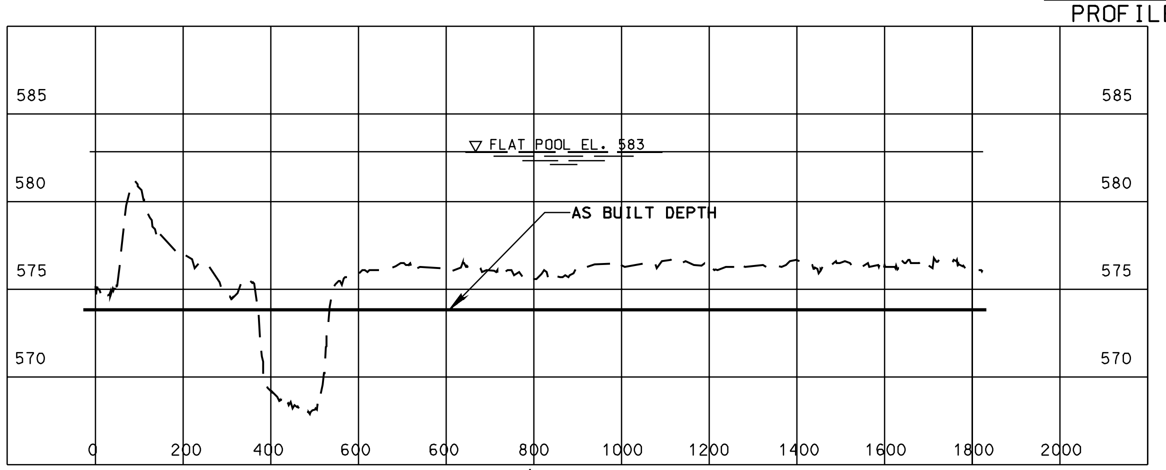
LOWER BROWN'S LAKE
PROFILE NO.5



LOWER BROWN'S LAKE
PROFILE NO.6



SCARBOROUGH LAKE
PROFILE NO.7



LOWER BROWN'S LAKE
PROFILE NO.8

DATE OF SURVEY: AUGUST 29, 1996

US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDB	Scale: AS SHOWN
Checked By: CCK	Drawing Code: XXXXX
Reviewed By: DJJ	Solicitation Number: DACW25-XX-B-XXXX

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

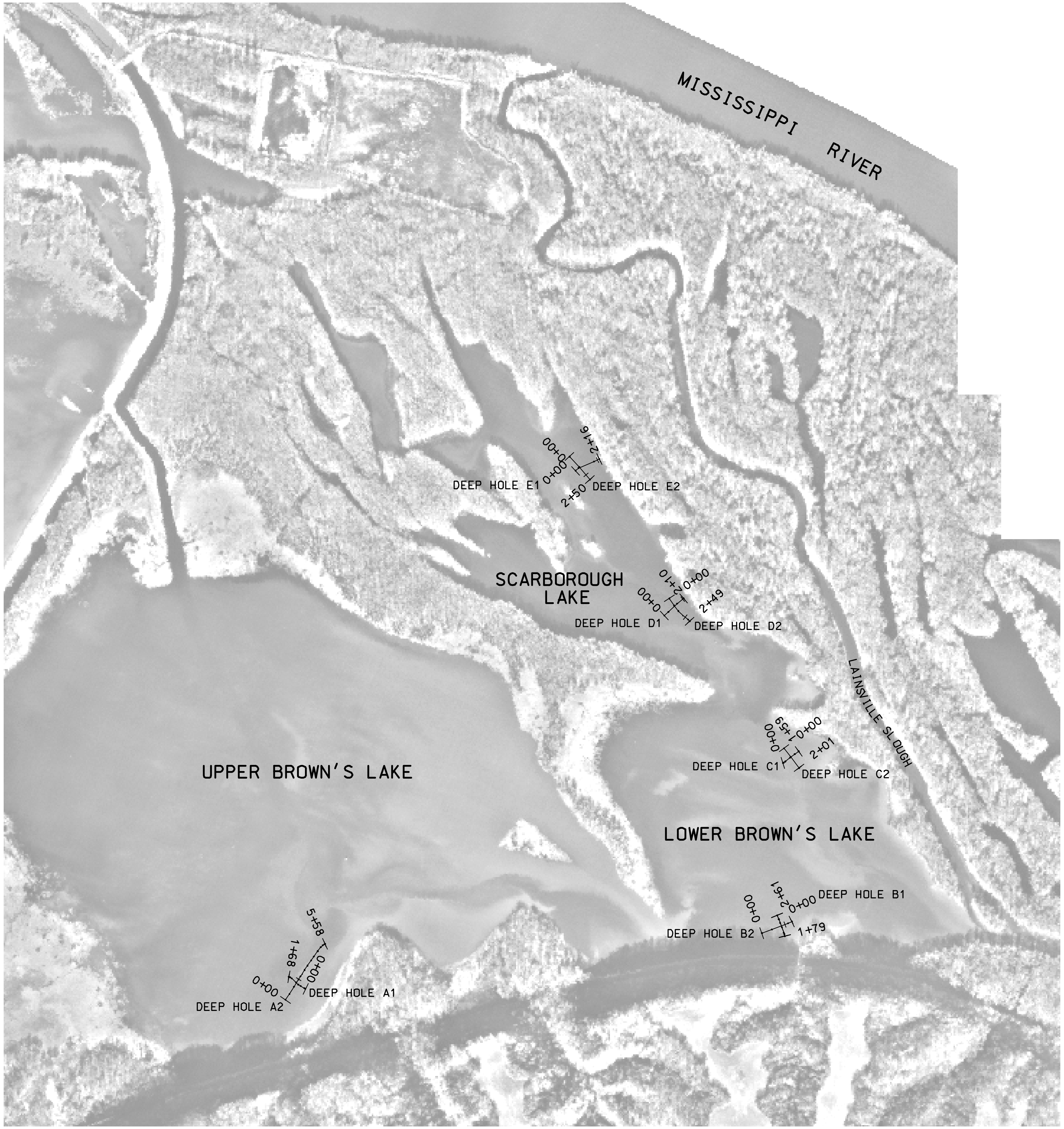
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

LOWER BROWN'S DREDGED CHANNEL PROFILES

Sheet Reference Number:

Sheet of XX

PLATE 9D



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SCALE

US Army Corps of Engineers Rock Island District

Symbol	Description	Date	Approved

Revisions

Designed By: CCK	Date: 8 MARCH '96
Drawn By: SDB	Scale: AS SHOWN
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U.S. ARMY ENGINEER DISTRICT
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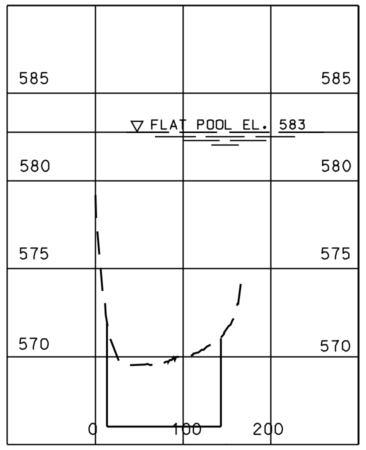
POOL 13, RIVER MILE 545.8
BROWN'S LAKE
REHABILITATION AND ENHANCEMENT
JACKSON COUNTY, IOWA

BROWN'S LAKE DEEP HOLE ALIGNMENTS

Sheet Reference Number:

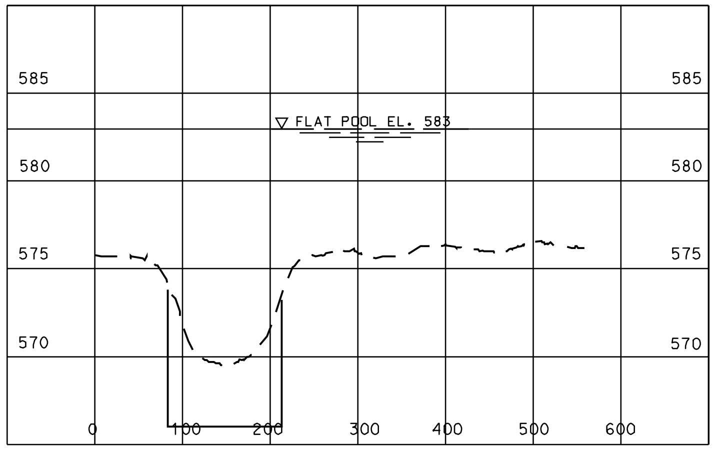
Sheet of XX

PLATE 9E



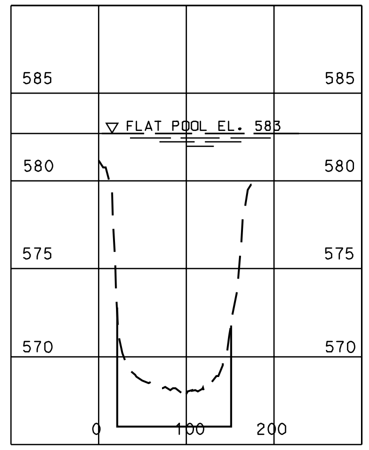
UPPER BROWN'S LAKE

DEEP HOLE A1



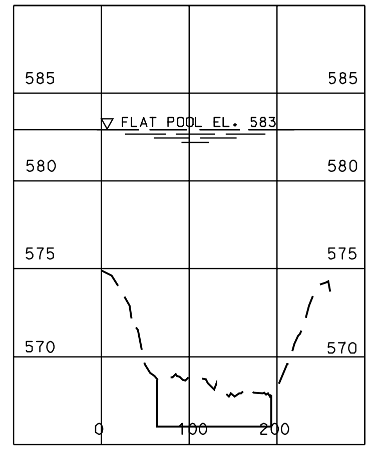
UPPER BROWN'S LAKE

DEEP HOLE A2



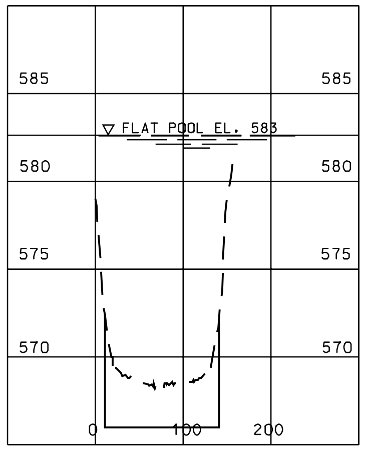
LOWER BROWN'S LAKE

DEEP HOLE B1



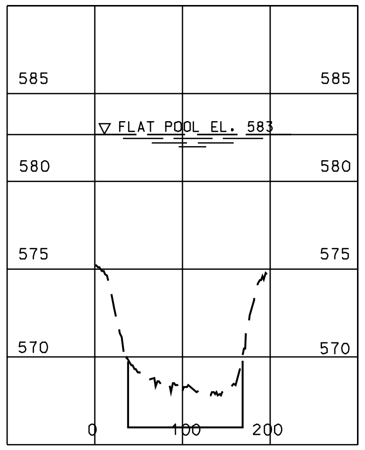
LOWER BROWN'S LAKE

DEEP HOLE B2



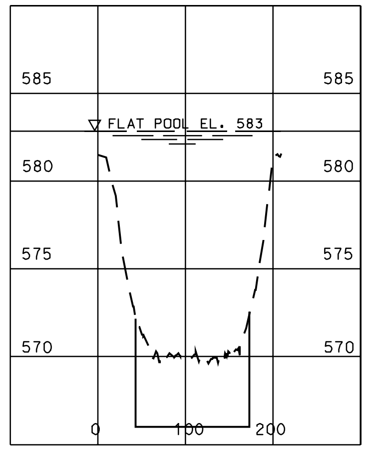
LOWER BROWN'S LAKE

DEEP HOLE C1



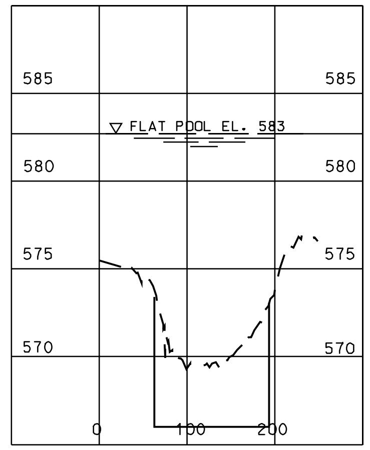
LOWER BROWN'S LAKE

DEEP HOLE C2



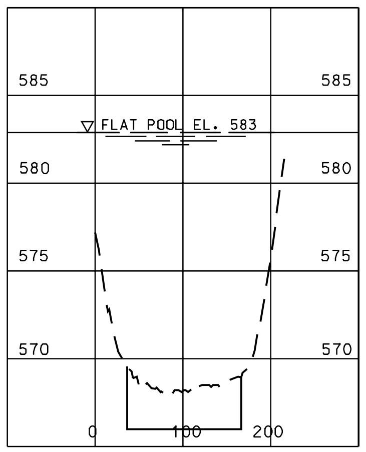
SCARBOROUGH LAKE

DEEP HOLE D1



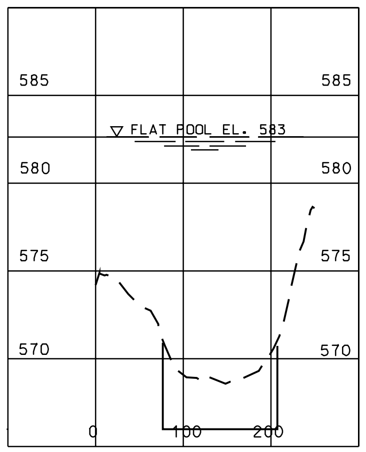
SCARBOROUGH LAKE

DEEP HOLE D2



SCARBOROUGH LAKE

DEEP HOLE E1



SCARBOROUGH LAKE

DEEP HOLE E2

DATE OF SURVEY: AUGUST 29, 1996

US Army Corps of Engineers Rock Island District

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U.S. ARMY ENGINEER DISTRICT
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ROCK ISLAND, ILLINOIS

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DEEP HOLE TRANSECTS

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PLATE 9F