Work

US Army Corps
of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/

ENVIRONMENTAL ASSESSMENT (SP-20)

POOL 8 ISLANDS PHASE II

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 8
UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN

MAY 1996

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

EXECUTIVE SUMMARY

The Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project is located in the lower portion of pool 8 of the Upper Mississippi River near Stoddard, Wisconsin. The primary study area is the 500-acre Stoddard Bay area. The habitat concerns in the study area center around the conversion of backwater habitat to more open riverine habitat. This has come about through the loss of islands, which in turn has contributed to the decline in aquatic vegetation and the exacerbation of conditions adversely affecting winter fish habitat, such as increased current velocities and lower water temperatures.

Since 1939, over 90 percent of the island acreage in the Stoddard Bay area has been lost to erosion. During the period 1975-91, acreage of aquatic vegetation declined by nearly 90 percent. Excessive current velocities and low water temperatures make the Stoddard Bay area uninhabitable during the winter by Centrarchids, the primary component of the backwater fish community.

The plan formulation process established project goals and objectives, and considered a number of alternatives for meeting these goals and objectives. The alternatives for the Stoddard Bay area involved reconstruction of islands to replace the island habitat lost to erosion, to reduce flows in the area, and to protect the area from the effects of wind and wave action.

One objective was to create additional nesting habitat for waterfowl in this general area of lower pool 8. The alternative of constructing a separate island specifically to provide waterfowl nesting habitat was evaluated.

In an area below Stoddard Bay, the right combination of hydraulic and sediment transport conditions exists to use an innovative, low cost technique (seed islands) to stimulate the creation of new islands by natural river forces. Construction of seed islands in 11 locations was evaluated.

The recommended plan for the Stoddard Bay area is the construction of seven islands (alternative G) in a configuration to reduce flows into Stoddard Bay and to protect the bay from southerly and northwesterly winds. Two low rock sills would be constructed to allow only low flows into the bay during the winter. The sills would be low enough to allow spring and summer high flow events to pass through the area, maintaining the scouring action of these high flows. The islands would be constructed at various elevations to provide topographic diversity, and would be planted with grasses, forbs, vines, shrubs, and/or trees, depending on the management objectives for a particular island.

The recommended plan for the nesting island is the no action alternative. It was determined that this feature would be too costly for the expected benefits.

The recommended plan for the seed islands is to construct islands in six of the 11 locations evaluated. The six sites selected offer the best combination of potential success and minimization of construction costs.

Total direct construction costs for the selected plan are $3,480,000. Costs for plans and specifications and construction management bring the total implementation cost to $4,057,000. Because the project is located entirely within the Upper Mississippi River National Wildlife and Fish Refuge, the construction cost of the project would be 100 percent Federal, in accordance with Section 906(e) of the Water Resources Development Act of 1986. Average annual operation and maintenance costs are estimated to be $3,000. The operation and maintenance requirements would be the responsibility of the U.S. Fish and Wildlife Service.

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN

TABLE OF CONTENTS

Section		Page
1.	INTRODUCTION	
	Authority	1
	Participants and Coordination	2
	Project Purpose	4
	Resource Problems/Opportunities	4
	Project Boundaries	4
2.	GENERAL PROJECT SELECTION PROCESS	
	Eligibility Criteria	5
	Project Selection	6
3.	ASSESSMENT OF EXISTING RESOURCES	
	Physical Setting	8
	Water Resources	8
	Upper Mississippi River	8
	Crosby Slough	9
	Raft Channel	9
	Geology and Soil/Substrate	9
	Water Quality	10
	Vegetation	10
	Fish and Wildlife	11
	Habitat Types and Distribution	13
	Cultural Resources	15

TABLE OF CONTENTS CONT'D

Section		Page
4.	PROJECT OBJECTIVES	
	Problem Identification	16
	Existing Habitat Conditions	18
	Historically Documented Changes in Habitat	23
	Factors Influencing Habitat Change	29
	Estimated Future Habitat Conditions	30
	Institutional Fish and Wildlife Management Goals	31
	Project Goals and Objectives	32
5.	ALTERNATIVES	
	Planning Opportunities	39
	Planning Constraints	39
	Institutional	39
	Engineering	39
	Environmental	39
	Cultural	40
	Socioeconomic/Recreational	40
	Alternatives Identified	41
	No Action	41
	Stoddard Bay	41
	Nesting Island	44
	Seed Islands	44
	Alternatives Eliminated During Planning	45
	Alternatives Considered in Detail	45
	No Action	45
	Stoddard Bay	45
	Alternative B	45
	Alternative C	49
	Alternative D	50
	Alternative E	51
	Alternative F	53
	Alternative G	54
	Nesting Island	56
	Seed Islands	58

TABLE OF CONTENTS CONT'D

Section		Page
6.	EVALUATION OF ALTERNATIVES	
	No Action	59
	Stoddard Bay Alternatives	59
	Meeting Project Objectives	59
	Costs and Benefits	66
	Incremental Analysis	71
	Summary Comparison of Alternatives	76
	Plan Selection and Justification	78
	Nesting Island	80
	Meeting Project Objectives	80
	Costs and Benefits	80
	Incremental Analysis	81
	Plan Selection and Justification	82
	Seed Islands	84
	Costs and Benefits	84
	Incremental Analysis	85
	Plan Selection and Justification	86
7.	SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS	
	Stoddard Bay	88
	Seed Islands	95
8.	ENVIRONMENTAL ASSESSMENT	
	Relationship to Environmental Requirements	96
	Natural Resource Effects	96
	Cultural Resource Effects	101
	Socioeconomic Effects	102
9.	SUMMARY OF PLAN ACCOMPLISHMENTS	103
10.	OPERATION, MAINTENANCE, AND REHABILITATION	
	General	104
	Operation	104
	Maintenance and Rehabilitation	104
11.	PROJECT PERFORMANCE EVALUATION	105

TABLE OF CONTENTS CONT'D

Section	Page
12. COST ESTIMATE	109
13. REAL ESTATE REQUIREMENTS	110
14. SCHEDULE FOR DESIGN AND CONSTRUCTION	110
15. IMPLEMENTATION RESPONSIBILITIES	111
16. COORDINATION, PUBLIC VIEWS, AND COMMENTS	112
17. CONCLUSIONS	114
18. RECOMMENDATION	115
FINDING OF NO SIGNIFICANT IMPACT	
BIBLIOGRAPHY	

TABLES

No.		Page
3-1	Mississippi River Discharge Frequencies	9
4-1	Island Loss in Lower Pool 8 (1939-89)	16
4-2	Depth Distribution in the Stoddard Area	18
4-3	Vegetation (1991) vs. Depth (1989) - Stoddard Area	20
4-4	1991 Aquatic Vegetation Stoddard Area - Percent by Depth	21
4-5	Island Loss in the Stoddard Area	23
4-6	Comparison of Post-impoundment and 1989 Water Depths in the Stoddard Area	24
4-7	Aquatic Vegetation Changes in the Stoddard Area (1975-1991)	25
4-8	Vegetation (1975) vs. Depth (1989) - Stoddard Area	26
4-9	1975 Aquatic Vegetation Stoddard Area - Percent by Depth	27
4-10	Change in Usable Habitat in the Stoddard Area (1975-1991)	28
5-1	Stoddard Bay Alternatives	41
5-2	Cost Estimate for Alternative B	47
5-3	Cost Estimate for Alternative C	49
5-4	Cost Estimate for Alternative D	51
5-5	Cost Estimate for Alternative E	52
5-6	Cost Estimate for Alternative F	54
5-7	Cost Estimate for Alternative G	55
5-8	Cost Estimate for Nesting Island A	57
5-9	Cost Estimate for Nesting Island B	57
5-10	Cost Estimate for Seed Islands	58
6-1	Estimated Area of Reduced Current Velocity	61
6-2	Meeting Project Objectives	65
6-3	Costs and Quantifiable Benefits	67
6-4	Incremental Analysis of Fish Habitat Benefits	72
6-5	Incremental Analysis of Diving Duck Habitat Benefits	73
6-6	Incremental Analysis using both Fish and Diving Duck Habitat Benefits	74
6-7	Summary of Costs and Quantifiable Benefits	77
6-8	Incremental Analysis of Nesting Island Alternatives	81
6-9	Incremental Analysis for Seed Islands	85
6-10	Sensitivity Analysis of the Seed Islands Incremental Analysis	86

TABLES CONT'D

No.		Page
7-1	Summary of Island Design	90
8-1	Environmental Assessment Matrix	97
10-1	Average Annual Operation and Maintenance Costs	104
11-1	Project Objectives and Enhancement Features	106
11-2	UMRS-EMP Monitoring and Performance Evaluation Matrix	107
11-3	Pre- and Post-Construction Monitoring	108
12-1	Cost Estimate	109
16-1	Coordination Meetings and Participants	112

ATTACHMENTS

1. Plates
   - 1 - Project Location
   - 2 - Lower Pool 8
   - 3 - Lower Pool 8 Island Loss
   - 4a - Stoddard Bay (May 1939)
   - 4b - Stoddard Bay (Aug 1973)
   - 5 - Stoddard Area Bathymetry
   - 6 - 1991 Vegetation Cover
   - 7 - 1975 Vegetation Cover
   - 8 - Alternative A
   - 9 - Alternative B
   - 10 - Alternative C
   - 11 - Alternative D
   - 12 - Alternative E
   - 13 - Alternative F
   - 14 - Alternative G
   - 15 - Rock Structures - Plans, Sections, and Profiles
   - 16 - Island Cross Sections
   - 17 - Nesting Island Study Area
   - 18 - Seed Island Study Area
   - 19 - Selected Plan for Stoddard Bay Area
2. Cost Estimate
3. Section 404(b)(1) Evaluation
4. Habitat Evaluation Appendix
5. Hydraulics Appendix
6. Geotechnical Appendix
7. Memorandum of Agreement
8. Project Performance Evaluation
9. Coordination/Correspondence

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN

INTRODUCTION

1.1 AUTHORITY

The authority for this report is provided by Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The proposed project would be funded and constructed under this authorization. Section 1103 is summarized as follows:

Section 1103. UPPER MISSISSIPPI RIVER PLAN

(a)(1) This section may be cited as the Upper Mississippi River Management Act of 1966.

(2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of the Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system....The system shall be administered and regulated in recognition of its several purposes.

(e)(1) The Secretary, in consultation with the Secretary of the Interior and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, is authorized to undertake, as identified in the Master Plan -

(A) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement....

1.2 PARTICIPANTS AND COORDINATION

Participants in the planning for the Pool 8 Islands Phase II project include the Upper Mississippi River National Wildlife and Fish Refuge and the Region 3 Offices of the U.S. Fish and Wildlife Service (USFWS), the Environmental Management Technical Center (EMTC) of the National Biological Service, the Wisconsin and Minnesota Departments of Natural Resources (Wisconsin DNR and Minnesota DNR), and the St. Paul District, Corps of Engineers.

The USFWS and the Wisconsin DNR were most heavily involved in project planning because the study area is located within the Upper Mississippi River National Wildlife and Fish Refuge and is located within Wisconsin. These agencies were equal partners with the Corps of Engineers in project planning. The Minnesota DNR input was primarily during project scoping and the development of project goals and objectives. The EMTC provided scientific and technical input in a variety of areas. The USFWS would be considered a cooperating agency under Federal regulations governing the implementation of the National Environmental Policy Act of 1969.

The following individuals played an active role in the planning and design of the Pool 8 Island Phase II project. For St. Paul District personnel, the discipline and contribution of the individual planning team members is listed. For resource agency personnel, the individual's position title is listed.

ST. PAUL DISTRICT, CORPS OF ENGINEERS

Name	Discipline	Contribution
Gary Palesh	Fishery Biologist	Study Manager
Randy Devendorf	Wildlife Biologist	Environmental analyses, NEPA doc., HEP eval.
Sissel Johannessen	Archaeologist	Cultural resources
Keith LeClaire	Cartographer	GIS analyses
Jon Hendrickson	Hydraulic Engineer	Hydraulic analyses
Aaron Buesing	Hydraulic Engineer	Hydraulic modeling
Joel Face	Civil Engineer	Geotechnical analyses
Jeff Gulan	Civil Engineer	Design and layout
Mike Dahlquist	Civil Engineer	Cost estimating

U.S. FISH AND WILDLIFE SERVICE

Name	Position
Keith Beseke	Habitat Projects Coordinator
Jim Nissen	Refuge District Manager
Pam Thiel	Refuge Fisheries Biologist

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Name	Position
Jeff Janvrin	Habitat Projects Coordinator
Ron Benjamin	Mississippi River Fisheries Supervisor
Mark Endris	Area Fisheries Manager
John Wetzel	Area Wildlife Manager
John Sullivan	Mississippi River Water Quality Specialist
Andy Bartels	Fisheries Specialist
Terry Dukerschein	RTA Station Team Leader
Jim Fischer	Water Resource Management Specialist
Heidi Langrehr	Vegetation Specialist

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Name	Position
Mike Davis	Habitat Projects Coordinator

NATIONAL BIOLOGICAL SERVICE (EMTC)

Name	Position
Bob Gaugush	Physical Scientist
Steve Gutreuter	Fisheries Scientist

1.3 PROJECT PURPOSE

1.3.1 RESOURCE PROBLEMS/OPPORTUNITIES

The purpose of this Definite Project Report is to document existing and predict future habitat conditions and deficiencies, define habitat goals and objectives, identify and evaluate alternative measures that would address the goals and objectives, and recommend a selected plan for habitat restoration and enhancement.

1.3.2 PROJECT BOUNDARIES

The Pool 8 Islands Phase II project is located in the lower reaches of pool 8, approximately 10 miles below La Crosse, Wisconsin (plate 1). Lower pool 8 is shown on plate 2. The Pool 8 Islands Phase II study focused on Stoddard Bay and on the area immediately below Trapping and Heron Islands. Stoddard, Wisconsin, is located on the shoreline of Stoddard Bay. Brownsville, Minnesota, is located approximately 3 miles northwest of the study area.

GENERAL PROJECT SELECTION PROCESS

2.1 ELIGIBILITY CRITERIA

A design memorandum (or implementation document) did not exist at the time of the enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP) in January 1986. The U.S. Fish and Wildlife Service, Region 3, and the five affected States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addendums.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addendums led to an examination of the Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Master Plan, completed by the Upper Mississippi River Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below:

a. (First Annual Addendum). The Master Plan report... and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. For habitat projects, the main eligibility criterion should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan; i.e., the sedimentation of backwaters and side channels of the UMRS. Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance....

b. (Second Annual Addendum).

(1) The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:

- backwater dredging
- dike and levee construction
- island construction
- bank stabilization

- side channel openings/closures
- wing and closing dam modifications
- aeration and water control systems
- waterfowl nesting cover (as a complement to one of the other project types)
- acquisition of wildlife lands

(2) A number of innovative structural and nonstructural solutions which address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects which include such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and the measures will be recommended only after consideration of system-wide effects.

2.2 PROJECT SELECTION

Projects are nominated for inclusion in the District's habitat program by the respective State natural resource agency or the U.S. Fish and Wildlife Service, based on agency management objectives. To assist the District in the selection process, the States and USFWS have agreed to use the expertise of the Fish and Wildlife Work Group (FWWG) of the River Resources Forum (RRF) to consider critical habitat needs along the Mississippi River and prioritize nominated projects on a biological basis.

The FWWG consists of biologists responsible for managing the river for their respective agency. Meetings are held on a regular basis to evaluate and rank the nominated projects according to the biological benefits that they could provide in relation to the habitat needs of the river system. The ranking is forwarded to the RRF for consideration of the broader policy perspectives of the agencies involved. The RRF submits the coordinated ranking to the District, and each agency officially notifies the District of its views on the ranking. The District then formulates and submits a program that is consistent with the overall program guidance as described in the UMRS-EMP General Plan and Annual Addendums and supplemental guidance provided by the North Central Division.

Projects consequently have been screened by biologists closely acquainted with the river. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available is being used to optimize the habitat benefits

created at the most suitable locations.

The Pool 8 Islands project was initially identified by the U.S. Fish and Wildlife Service and Wisconsin Department of Natural Resources. Study on the project began in 1987. During the early stages of study it was recognized that the scope of the habitat problems in lower pool 8 were too large to address as part of a single project. At that time, the Pool 8 Islands project was divided into five phases. The initial study focused on Phase I (plate 2) and a Definite Project Report was completed in June 1989. Construction of Phase I was completed in 1993.

Phases II-V were evaluated in 1989 by the FWWG and ranked for inclusion in the District's FY 1992 program. In June 1989, Pool 8 Islands Phases II-V were ranked as the number 2 priority project for consideration in FY 1992. Due to other priorities, the project was not selected by the St. Paul District for inclusion in the FY 1992 program.

In June 1990, the FWWG ranked the Pool 8 Islands Phases II-V as the number one priority project for inclusion in the FY 1993 St. Paul District program. In response to this ranking, the Pool 8 Islands Phase II project was programmed by the St. Paul District for study initiation in fiscal year 1993. The Fact Sheet for the Pool 8 Islands Phase II project was approved in October 1993 and the study was initiated in November 1993.

ASSESSMENT OF EXISTING RESOURCES

3.1 PHYSICAL SETTING

Pool 8 is part of the Upper Mississippi River system and was created in 1937 by the completion of lock and dam 8. The entire pool is 23.3 miles long, extending from river mile 679.2 to river mile 702.5. The river valley in this pool is 2 to 3 miles wide and is bordered on either side by weathered bluffs. The lower 5 miles of pool 8 is open and lake-like, with few or no islands. Above this open portion of the pool is a 3- to 4-mile transition zone where the presence of islands becomes more frequent proceeding up the pool. The setting for the Pool 8 Islands Phase II project is in the lower reaches of the transition zone.

The navigation channel in lower pool 8 abuts the Wisconsin mainland from lock and dam 8 to about river mile 683 (the lower end of the study area). At that point, the navigation channel shifts northwesterly and begins to cross the pool. It completes its crossing to the Minnesota side at river mile 688. A major pre-lock and dam channel, Raft Channel, is still evident along the Minnesota mainland in lower pool 8.

As noted earlier, the Pool 8 Island Phase II study focused on Stoddard Bay and the area immediately below Trapping and Heron Islands (plate 2). The east boundary of Stoddard Bay is the Wisconsin mainland. The bay is bounded on the west by Crosby Slough. The study area below Heron and Trapping Islands focused on the main channel border areas lying west of the navigation channel.

3.2 WATER RESOURCES

3.2.1 UPPER MISSISSIPPI RIVER

Early summer (June) discharges at lock and dam 8 generally range from 30,000 to 55,000 cubic feet per second (cfs). By late summer, discharges usually decrease to a range of 15,000 to 30,000 cfs. Winter low flows are usually in the range of 13,000 to 20,000 cfs. Table 3-1 shows the discharges and stages associated with the various high runoff events for the Mississippi River at lock and dam 8.

Table 3-1
Mississippi River Discharge Frequencies - L/D 8

Event	Flow	Pool Stage
5-year (20% chance)	134,000 cfs	632.4
10-year (10% chance)	161,000 cfs	633.8
20-year (5% chance)	192,000 cfs	635.2
50-year (2% chance)	224,000 cfs	636.8
100-year (1% chance)	254,000 cfs	638.2

3.2.2 CROSBY SLOUGH

Crosby Slough branches off the navigation channel to the left at about river mile 690.6. From there it flows southeasterly across the pool. North of Stoddard, the slough swings in a southerly direction and rejoins the navigation channel at about river mile 685.7. Running Slough enters Crosby Slough at the upper end of the Stoddard Bay.

3.2.3 RAFT CHANNEL

Prior to inundation of pool 8, Raft Channel was a major channel of the Mississippi River, the near equal of Coon Slough (which became the main navigation channel). Raft Channel leaves the main channel at about river mile 688.0. It flows in a southerly direction roughly parallel to the Minnesota shoreline. At the lower end of the pool, it swings to the southeast and runs along the lock and dam 8 earthen dike. Raft Channel rejoins the navigation channel at about river mile 680.0, less than a mile above lock and dam 8.

3.3 GEOLOGY AND SOIL/SUBSTRATE

The most significant geological event explaining the nature of the Mississippi River within pool 8 occurred at the end of the Pleistocene glaciation approximately 10,000 years ago. Tremendous volumes of glacial meltwater, primarily from the Red River Valley's glacial Lake Agassiz, eroded the preglacial Minnesota and Mississippi River valleys. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Since post-glacial times, a anastomosing stream environment has dominated this reach of the Mississippi River, due to the river's low gradient and oversupply of sediment from its tributaries. Prior

to the impoundment of pool 8 in the 1930's, the broad floodplain of the river was characterized by a stream system that consisted of multiple channels, swampy depressions, sloughs, natural levees, islands, and shallow lakes.

3.4 WATER QUALITY

Richardson and Clemment (1993) summarize three years (1988-90) of water quality monitoring in pool 8 from 21 sites located in a wide variety of habitat types. This monitoring focused on basic parameters considered indicators of habitat quality.

Average weekly dissolved oxygen values during the study period ranged from 6 to 17 milligrams per liter (mg/l). Cold season values generally ranged above 10 mg/l while late summer values usually fell within the 6-10 mg/l range. Peak water temperatures in late summer were about 29 degrees Celsius (C).

Winter turbidity levels were low (2-4 Nephelometric turbidity units (NTU)), while summer values generally fell between 20 and 50 NTU. Some open river sites showed peak NTU levels near 200 during the spring thaw in 1990. Secchi disk transparency during the winter months generally ranged between 1.25 and 1.75 meters. During the summer months transparency was usually in the range of 0.25 to 0.50 meter.

The study found similar trends for all parameters in both vegetated and unvegetated habitats, with the backwater contiguous habitat exhibiting the greatest diversity in water quality.

3.5 VEGETATION

Terrestrial vegetation present on the remaining islands and island remnants in the lower pool 8 area is typical of the northern floodplain forest. Dominant tree species include silver maple (Acer saccharinum), cottonwood (Populus deltoides), American elm (Ulmus americana), river birch (Betula nigra), and green ash (Fraxinus pennsylvanica). Mixed stands of black willow (Salix nigra) and sandbar willow (Salix exigua) dominate areas along the water's edge. Common shrub species include button bush (Cephalanthus occidentalis), red osier dogwood (Cornus stolonifera), panicled dogwood (C. paniculata), silky dogwood (C. amomum), false indigo (Amorpha fruticosa), staghorn sumac (Rhus typhina), smooth sumac (R. glabra), and honeysuckle (Rhododendron sp.). Herbaceous layers, when present, are often dominated by

poison ivy (Rhus radicans) and stinging nettle (Urtica dioica). Reed canary grass (Phalaris arundinacea) occurs in areas where silt, deposited during high water, remains dry during most of the summer.

Aquatic vegetation within this reach of the river is varied. Common plant species present in the shallower areas include arrowhead (Sagittaria latifolia), water-lily (Nuphar sp. and Nymphaea sp.), river bulrush (Scirpus fluviatilis), giant bur-reed (Sparganium eurycarpum), lotus (Nelumbo lutea), coontail (Ceratophyllum demersum) and elodea (Elodea canadensis). Deeper areas are comprised of pondweeds (Potamogeton sp.), coontail, and wild celery (Vallisneria americana). The density and extent of vegetation within certain areas is limited due to the progressive loss of islands, the resultant increase of susceptibility to wind fetch and the associated increase in turbidity.

3.6 FISH AND WILDLIFE

The lower pool 8 area provides valuable habitat for wildlife including waterfowl, wading birds, muskrats (Ondatra zibethicus) and bald eagles (Haliaeetus leucocephalus). The area is especially important as a resting and feeding area for diving ducks, tundra swans (Cygnus columbianus), Canada geese (Branta canadensis) and other waterfowl during migration. Because of its importance to waterfowl, a large portion of the area has been designated by the U.S. Fish and Wildlife Service as a closed area during the hunting season. The importance of the area is emphasized by the designation of the upper Mississippi River as a waterfowl area of major concern in the North American Waterfowl Management Plan.

The mix of shallow water areas adjacent to running side channels and the main channel provides habitat for a wide variety of fish. Common species found in the area include black crappie (Pomoxis nigromaculatus), bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), sauger (Stizostedion canadense), walleye (S. vitreum vitreum), channel catfish (Ictalurus punctatus), flathead catfish (Pylodictis olivaris), shortnose gar (Lepisosteus platostomus), freshwater drum (Aplodinotus grunniens), carp (Cyprinus carpio), minnows, redhorse sucker (Moxostoma sp.) and white bass (Morone chrysops). Fish sampling was conducted from 1989 to 1993 by the Long Term Resource Monitoring (LTRM) program in shoreline areas and offshore areas in lower pool 8. The data indicated that, in general, the catch rates and species richness were low in the areas sampled when compared to other habitats on the river. Shoreline areas appear to have greater species richness than offshore areas.

Extensive mussel surveys have been conducted in Stoddard Bay and in Crosby Slough. The mussel beds are fairly diverse, although they are dominated by a few species. The most common mussel species present Stoddard Bay are the threeridge (Amblema plicata), mapleleaf (Quadrula quadrula) and the threehorn (Obliquaria reflexa). Other species present, but less abundant include; the giant floater (Anodonta grandis), pink heelsplitter (Proptera alata), pimpleback (Quadrula pustulosa), pocketbook (Lampsilis ovata ventricosa), white heelsplitter (Lasmigona complanata) and the deertoe (Truncilla truncata). The recent surveys in Stoddard Bay also reported extensive presence of Zebra mussels.

Surveys indicate a higher diversity of mussel species in Crosby Slough with the following species also being present in addition to those listed above: rockshell (Arcidens confragosus), fat mucket (Lampsilis radiata siliquoidea), hickorynut (Obovaria olivaria), pink papershell (Proptera laevissima), fragile papershell (Leptodea fragillis), washboard (Megalonaias gigantea), paper floater (Anodonta imbecellis) and the wartyback (Quadrula nodulata). The mussel beds in portions of Crosby Slough are fairly extensive and are indicative of a transition area between channel species and backwater species. The mussel beds appear to be concentrated on the eastern shelf and the sidelsopes of Crosby Slough. Surveys indicate that mussel beds in the upper portion of the slough are more diverse in species composition and in higher population densities.

Three Federally listed threatened or endangered species may occur in the area. The peregrine falcon (Falco peregrinus) and the bald eagle may be sighted in the area during migration. Bald eagles occasionally use trees on the islands and in the adjacent wooded floodplain areas for roosting. The nearest bald eagle nest upstream of the project area is located near RM 692 and downstream is located near RM 679.5 in Reno Bottoms in pool 9. One historical record and one recent record of the Higgins' eye pearly mussel (Lampsilis higginsi) are known in the general area. Mussel surveys conducted in the early 1980's adjacent to the navigation channel, in 1989 in the Pool 8 Islands Phase I project area, and in 1991 in Crosby Slough did not indicate the presence of Higgins' eye in the general project area.

Mussel surveys conducted in August/September 1994 near the Stoddard Boat ramp did not reveal the presence of Higgins' eye pearly mussel at this site. A mussel survey was conducted in Stoddard Bay and in the area below Heron and Trapping Islands in 1995. This survey did not reveal the presence of any Higgins' eye pearly mussels in Stoddard Bay. One Higgins' eye pearly mussel was located below Heron and Trapping Islands.

Fish sampling by the LTRM program has identified three Wisconsin-listed endangered fish species (pallid shiner (Notropis amnis), crystal darter (Ammocrypta asprella), and skipjack herring (Alosa chrysochloris)) and four Wisconsin-listed threatened fish species (speckled chub (Hybopsis aestivalis), blue sucker (Cycleptus elongatus), river redhorse (Moxostoma carinatum) and black buffalo (Ictiobus niger)) present in pool 8. In 1994, one young of the year blue sucker was collected near the Benover Slough opening in the Phase I project area.

3.7 HABITAT TYPES AND DISTRIBUTION

Habitat in the project area generally can best be characterized as floodplain shallow aquatic, as was described by Wilcox (1993). These areas are characterized as those areas that were portions of the former floodplain that were inundated by the construction of the navigation dams. Floodplain shallow aquatic areas contain a mosaic of open water and emergent vegetation interspersed among islands. As the islands in lower pool 8 have disappeared, open water has become a more dominant feature in the project area. For this project, it is more useful to be more specific in delineating the habitat types present within this floodplain shallow aquatic environment. Specific habitat types present in the study area include:

Islands - Low elevation islands, once fairly prevalent in the project area, have been reduced to a few scattered remnants. In Stoddard Bay, they are limited primarily to the upstream limits of the project adjacent to Crosby Slough and to East Island on the downstream end.

Side Channels/Slough - These are characterized as deeper aquatic areas (typically 6 to 18 feet) that were usually present before river impoundment, lack rooted vegetation except along margins, and usually have flow under normal pool conditions. Crosby Slough is representative of this habitat type. The other area with these characteristics is the slightly shallower channel area that runs along the east side of the Stoddard Bay. These channels are important for maintaining an interspersion and diversity of habitat types and contributing to the redistribution of organic matter and dissolved oxygen. Deeper holes in these channel areas provide important winter habitat for fish.

Shallow Aquatic Habitat - Shallow aquatic habitat is characterized as those areas with water depths 3 feet for less. Vegetation in these areas is a mix of emergent, rooted floating aquatic and submergent aquatic vegetation. Sheltered areas, those areas behind barrier islands, generally have lower water velocities than unsheltered areas and exhibit more vigorous and diverse

stands of aquatic vegetation. The upper half of the Stoddard Bay is primarily un-sheltered shallow aquatic area.

Deep Aquatic Habitat - This habitat is characterized as areas generally too deep to support emergent vegetation (typically 3 to 7 feet). Sheltered deep aquatic areas occur behind shallow ridges or islands and generally have higher flows than the protected shallow zones. Unsheltered deep aquatic areas generally occur in those areas that are similar in characteristics to sloughs/side channels but are not as visibly defined by extent and flow. These areas are subject to high flow and suspended sediment from the main channel and side channels and provide a means for suspended sediment to enter the off-channel areas. Vegetation in these areas is generally lacking or composed of pondweeds and water star-grass. Sheltered deep aquatic habitat in the project area is limited. Unsheltered deep aquatic habitat predominates the lower half of the Stoddard Bay area.

3.8 CULTURAL RESOURCES

The completion of lock and dam 8 at Genoa, Wisconsin, in the 1930's caused permanent inundation of vast tracts of floodplain that formerly would have been above water, although subject to seasonal or periodic flooding. Little cultural resource survey has been performed for the floodplain area of lower pool 8, and thus, cultural resources directly in the project area are largely unknown. However, study of adjacent terraces at Stoddard and Goose Island along the Wisconsin shoreline, and mound surveys along the Minnesota and Wisconsin bluff lines reveal a number of prehistoric and historic sites along the margins of lower pool 8. These include mounds, camps, villages, and structures representing some 10,000 years of human presence.

The pre-lock and dam configuration of the lower end of pool 8 suggests that it was a strategic location for prehistoric and historic activities, associated either with nearby sites or with transportation. Island 120 in this location split the river channel into two sub-channels, "Raft Channel" on the west and "Coon Slough" on the east. Crosby Slough connected Coon Slough and the Stoddard terrace upland area. Early accounts describe Coon Slough as deeper and swifter than Raft Channel, and used as the principal channel by historic boat traffic. The crooked Coon Slough is known to have resulted in at least two steamboat wrecks -- those of the Lady Franklin in 1856 and the Northern Light in 1866. An 1842 fur trade post, as well as two somewhat later posts, are known for the foot of Coon Slough, south of the project area.

The island remnants of the Pool 8 Islands Phase I project were surveyed for cultural resources in 1989 by the Mississippi Valley Archaeology Center (Reports of Investigations No. 101). The survey found that the remnants of Island 120 are covered by well over a meter of post-settlement (1850) alluvium, suggesting that buried pre-1850 deposits may exist within the project area, although these may be at or below water level. The only cultural resources located during the survey were recent historic remains.

The island remnants in the Stoddard study area were formerly high areas of floodplain near Crosby Slough. As such, they have considerable potential for containing unknown prehistoric and historic sites chronicling the past of the Mississippi River.

PROJECT OBJECTIVES

4.1 PROBLEM IDENTIFICATION

Prior to inundation, the area now occupied by lower pool 8 consisted of two major channels, Raft Channel and Coon Slough (the present-day navigation channel), and a floodplain dominated by islands intertwined with sloughs, ponds, and marshes. Completion of lock and dam 8 and the creation of pool 8 in 1939 inundated low-lying areas, creating a wide variety of aquatic habitats. Higher areas remained as wooded islands.

As soon as the pool was formed, natural processes began that have altered the character of lower pool 8. Wave and current action began eroding away the islands. Table 4-1 shows the progressive loss of islands in lower pool 8 as measured from aerial photographs. Plate 3 illustrates this loss.

Table 4-1
Island Loss in Lower Pool 8 (1939-89)

Year	Acres	Acres Lost	Percent Remaining
1939	624	-	-
1947	400	224	64
1954	345	55	55
1961	317	28	51
1967	274	44	44
1983	112	162	18
1989	129	(+17)[1]	21

source: EMTC

[1] In some instances it is difficult to accurately define the boundary between islands and emergent aquatic vegetation. It is believed that the gain in island acreage between 1983 and 1989 is actually the result of emergent aquatic vegetation being interpreted as island.

At the same time as the islands were eroding away, sediments carried by the river and sediments eroded from the islands began to fill in some of the newly created aquatic habitats.

Over time, the loss of islands exposed aquatic plant beds to the increased wind and wave action. In addition, it is believed that increased wind fetches coupled with inputs of unconsolidated fine sediments led to a general increase in water turbidity. The combination of the physical actions of wind and waves and a general increase in turbidity is believed to be the primary cause for the general decline in aquatic vegetation in lower pool 8 that has been observed over the last two decades.

The loss of terrestrial habitat and the habitat diversity provided by the islands, and the decline in aquatic vegetation has significantly reduced habitat values in lower pool 8 for a wide variety of wildlife, especially for ducks, geese, swans, shorebirds, wading birds, and aquatic furbearers.

The resuspension and deposition of sediments by wind and current has resulted in a homogenization of water depths and a loss of the bathymetric diversity important to fish. This, coupled with the decline in aquatic vegetation, has significantly reduced fish habitat values in lower pool 8. The loss of islands and deep backwater habitats has resulted in the loss of protected deep habitats important to the overwinter survival of backwater fish species.

4.1.1 EXISTING HABITAT CONDITIONS

The overall Stoddard study area is approximately 1,100 acres, including Crosby Slough. Plates 4a and 4b are air photos of the Stoddard Bay area from 1939 and 1973, respectively. These photos, in comparison with the 1992 air photo (plate 2), visually illustrate the changes to the Stoddard Bay area that have occurred since the 1930's.

4.1.1.1 Water Depths

Table 4-2 shows the depth distribution for that portion of the study area lying between Crosby Slough and the Wisconsin mainland. Nearly 50 percent of the area is 3 to 5 feet deep and approximately 90 percent of the area is 6 feet deep or less. Most of the deeper water is located in the lower reaches of the study area and is associated with submerged channels. Plate 5 is a bathymetric map of the upper 500 acres of the Stoddard Bay area that eventually became the focus of the study effort.

Table 4-2
Depth Distribution in the Stoddard Area (1989)

Depth Range	Acres*	Percent of Area	Cumulative Percentage
< 1	49	5	5
1-2	107	11	16
2-3	145	15	31
3-4	256	27	58
4-5	194	20	78
5-6	116	12	90
6-7	43	4	94
7-8	26	3	97
> 8	30	3	100
	966		

source: LTRM data

---

* It should be noted here and elsewhere within this report that a number of the analyses displayed in tabular form were conducted using GIS techniques either at the Environmental Management Technical Center or within the St. Paul District Office. The delineation of study area boundaries in an open river situation such as exists in lower pool 8 is not exact. Therefore, the total acreage displayed for the study area in the various tables will vary somewhat depending upon how the study area boundaries were delineated for the analysis.

4.1.1.2 Winter Current Velocity, Dissolved Oxygen, and Water Temperature

One of the habitat concerns identified for the Stoddard area is the lack of winter habitat for fish. An LTRM water quality monitoring station (M686.1V) is located within the Stoddard Bay area. Current velocities at this station during the winters of 1989-91 ranged from 0-8 cm/sec. The average current velocity for 38 sampling dates was about 2.5 cm/sec. Dissolved oxygen levels ranged from a low reading of 1.5 mg/l in early March 1989 to 16 mg/l in early March 1991. However, for the most part, winter dissolved oxygen readings fell within the 3-7 mg/l range. Water temperatures at this station during all three winters were at or near 0 degree C.

In February 1994, the Wisconsin DNR conducted monitoring along two transects across the Stoddard Bay area. Stations were established every 70 feet along one transect and every 125 feet along the other. Current velocity measurements were variable, ranging from 0.0 to 14 cm/sec. The shallow areas (< 1 foot of water under the ice) had the lower current velocities, while the deeper flowing channels had the higher velocities. Most areas with over 2 feet of water under the ice had current velocities greater than 3 cm/sec, while the shallow areas generally had velocities of around 1 cm/sec.

Dissolved oxygen levels were good, in the 10-12 mg/l range. Water temperatures were very low, recorded at 0 degree C at all locations. High dissolved oxygen levels and low water temperatures are typical of backwater areas with high water exchange rates during the winter.

4.1.1.3 Aquatic Vegetation

Aquatic vegetation in the Stoddard area in 1991 covered approximately 77 acres*, less than 10 percent of the aquatic area (plate 6). Submergents and rooted floating aquatic plants were the predominant vegetation types present. The most common species of submergents were sago pondweed, curly-leafed pondweed, and water milfoil.

---

* Aerial photography is limited in its use in identifying the presence of submersed vegetation. Water transparency, light conditions, wind, species, and other factors affect the ability to detect the presence of submerged aquatic plant beds. The reader is reminded to keep these limitations in mind when reviewing the aquatic plant coverage and distribution data presented in this report.

An analysis was conducted comparing the presence of aquatic vegetation in the Stoddard area in 1991 with water depths. Tables 4-3 and 4-4 summarize those results. The key indicator group is the submergents. Nearly 99 percent of the submergents were growing in 4 feet of water or less. However, even in the shallow waters, total aquatic vegetation coverage was less than 25 percent of the area.

Table 4-3
Vegetation (1991) vs. Depth (1989) - Stoddard Area

Depth (feet)	Open Water (acres)	Submergents (acres)	Rooted Floating Aquatics (acres)	Emergents (acres)	Total (acres)
0-1	30.5	4.9	5.3	1.6	42.3
1-2	67.2	13.9	20.7	4.3	106.1
2-3	128.8	10.5	4.6	0.6	144.5
3-4	245.5	9.7	0.5	0.1	255.8
4-5	193.6	0.4	0.0	0.0	194.0
5-7	159.7	0.1	0.0	0.0	159.8
> 7	55.8	0.0	0.0	0.0	55.8
	881.1	39.5	31.1	6.6	958.3
(feet)	(%)	(%)	(%)	(%)	(%)
0-1	72.1	11.6	12.5	3.8	100.0
1-2	63.3	13.1	19.5	4.1	100.0
2-3	89.1	7.3	3.2	0.4	100.0
3-4	96.0	3.8	0.2	0.0	100.0
4-5	99.8	0.2	0.0	0.0	100.0
5-7	99.9	0.1	0.0	0.0	100.0
> 7	100.0	0.0	0.0	0.0	100.0
all depths	91.9	4.1	3.2	0.7	99.9

sources: LTRM bathymetric and vegetation data, COE GIS analysis

Table 4-4
1991 Aquatic Vegetation Stoddard Area
Percent by Water Depth

Depth (feet)	Submergents	Rooted Floating Aquatics	Emergents	All Aquatic Vegetation
0-1	12.4	17.0	24.2	15.3
1-2	35.2	66.6	65.2	50.4
2-3	26.6	14.8	9.0	20.3
3-4	24.6	1.6	1.5	13.3
4-5	1.0	0.0	0.0	0.5
5-7	0.3	0.0	0.0	0.1
> 7	0.0	0.0	0.0	0.0

sources: LTRM bathymetric and vegetation data, COE GIS analysis

4.1.1.4 Habitat Conditions

Summer habitat conditions in the Stoddard area for common backwater fish species (primarily Centrarchids) would be considered below average for Upper Mississippi River backwater habitat. The significant limiting factors appear to be water depths and lack of aquatic vegetation. There is a relative lack of deep water and it is concentrated in a few locations. Aquatic plant coverage would be considered below optimum. Habitat models indicate that minimum optimum percent cover for largemouth bass is about 40 percent (Stuber, et al. 1982a), for black crappie about 25 percent (Edwards, et al. 1982), and for bluegill about 15 percent (Stuber, et al. 1982b).

There is enough water exchange such that summer diel dissolved oxygen depletion is probably not a problem, especially considering the sparsity of aquatic plant growth.

Spawning, rearing and juvenile habitat in the Stoddard area for backwater species may be limiting due to the lack of vegetation, cover, or suitable substrate.

Winter habitat conditions in the Stoddard area for backwater fish species are considered poor due to excessive current velocities and low water temperatures. Recent studies are indicating that water temperatures need to be above 1 degree C and current velocities less than 0.1 cm/sec to provide

winter habitat suitable for use by backwater fish species (Barko, et al., 1993; Welke, 1993). As noted above, monitoring by the Wisconsin DNR in February 1994 showed winter water temperatures to be 0 degree C throughout the area and current velocities were greater than 3 cm/sec in areas greater than 2 feet deep. Most current velocity readings in the shallow areas were around 1 cm/sec.

Habitat conditions for wildlife in the Stoddard area are generally considered only fair. Valuable nesting habitat for waterfowl, nesting habitat for turtles, songbird habitat and roosting areas for raptors have been lost as the islands have disappeared. The loss of island habitat and the accompanying decline in the extent of aquatic vegetation has resulted in an area that is primarily open water in nature with little wildlife habitat value other than for short-term resting areas for migrating waterfowl or other water birds. The remaining island habitat may be considered fair to good in habitat quality for some species such as turtles and songbirds. The protected shallow areas associated with the island remnants generally provide good habitat for wading birds such as herons and other shorebirds. However, it is declining rapidly as the island remnants shrink in size.

4.1.2 HISTORICALLY DOCUMENTED CHANGES IN HABITAT

4.1.2.1 Island Loss

The loss of islands in the Stoddard area has paralleled that for lower pool 8 as a whole. Table 4-5 shows the loss of islands that has occurred in the Stoddard area.

Table 4-5
Island Loss in the Stoddard Area

Year	Acres	Acres Lost	Acres Lost/YR	Percent Remaining
1939	92	-	-	-
1954	42	50	3.3	46
1967	47	(5)	(0.4)	51
1989	6	41	1.9	7

source: EMTC

During the period 1939-54, over 50 percent of the islands in the Stoddard area disappeared. The period 1954-67 was more stable, with the acreage of islands even increasing slightly. The period 1967-89 was again a period of substantial erosion. In 1989, less than 10 percent of the island acreage remained from that which was present in 1939. The lower rate of island loss during the period 1967-89 as compared to the period 1939-54 may partially be attributable to the fact that there was less island mass available to be lost during the 1967-89 period. In addition, as islands erode, flatter more stable slopes may be formed, which in turn can reduce the rate of erosion.

4.1.2.2 Bathymetric Change

The analysis of bathymetric change is limited by the sparseness of historic data. A comparison of immediate post-impoundment and 1989 water depths is shown in table 4-6. The immediate post-impoundment water depths are based on pre-impoundment surveys.

Though the depth ranges are crude, this information does reflect the observations of resource managers that there has been a loss of bathymetric diversity as shallow areas have scoured and the deeper areas have filled in.

Table 4-6
Comparison of Post-impoundment and 1989 Water Depths
in the Stoddard Area

Depth Range	Post-impoundment Acres	1989 Acres
< 1 foot	92	35
1-6 feet	582	813
> 6 feet	357	182

source: EMTC

4.1.2.3 Vegetation Changes

The loss of islands resulted in the loss to the bottomland forest vegetation that occurred on these islands. In addition, there have been changes in the aquatic vegetation in the area.

Vegetation mapping conducted in 1975 shows aquatic vegetation covering about 65 percent of the Stoddard area (plate 7). Most of the unvegetated areas were side channels or sloughs that would likely have been too deep to support aquatic vegetation. Predominant submergent vegetation present in 1975 consisted of pondweeds and coontail. At that time, arrowhead was the predominant emergent plant and water lilies were the predominant floating-leaf plants.

Aquatic vegetation in the Stoddard area declined precipitously in the late 1980's, concurrent with the general decline of aquatic vegetation exhibited in other portions of the Upper Mississippi River. The amount of area supporting aquatic vegetation declined by about 90 percent during the period 1975-1991 (table 4-7). Resource managers indicate that the decline in aquatic vegetation during the period 1975 through 1991 was not linear (Wetzel, 1994). Good aquatic vegetation growth persisted in the Stoddard area into the mid-1980's.

Table 4-7
Aquatic Vegetation Changes in the
Stoddard Area (1975-1991)

Vegetation	1975 Acres	1991 Acres	Acreage Change	Percent Change
Submergents	326	9	- 317	- 97
Submergents/rooted floating aquatics	233	31	- 202	- 87
Submergents/rooted floating aquatics/ emergents	5	0	- 5	-100
Rooted floating aquatics	7	27	+ 20	+286
Rooted floating aquatics/emergents	0	5	+ 5	+500
Emergents	72	2	- 70	- 97
Total	643	74	- 573	- 89

source: U.S. Fish and Wildlife Service data

Tables 4-8 and 4-9 compare 1975 vegetation with 1989 water depths in the Stoddard area. There undoubtedly was some bathymetric change between 1975 and 1989. However, it is not believed that these changes have been significant enough across the entire Stoddard area as to make this comparison invalid.

Table 4-8
Vegetation (1975) vs. Depth (1989) - Stoddard Area

Depth	Open Water	Submergents	Rooted Floating Aquatics	Emergents	Total
(feet)	(acres)	(acres)	(acres)	(acres)	(acres)
0-1	2.4	20.4	0.0	6.7	29.5
1-2	3.7	75.4	3.6	15.3	98.0
2-3	18.4	100.3	0.5	17.6	136.8
3-4	49.1	184.4	1.2	18.7	253.4
4-5	74.2	113.6	0.7	4.6	193.1
5-7	100.5	53.7	0.7	4.0	158.9
> 7	48.2	5.5	0.3	0.9	54.9
	296.5	553.3	7.0	67.8	924.6
(feet)	(%)	(%)	(%)	(%)	(%)
0-1	8.1	69.2	0.0	22.7	100.0
1-2	3.8	76.9	3.7	15.6	100.0
2-3	13.5	73.3	0.4	12.7	99.9
3-4	19.4	72.8	0.5	7.4	100.1
4-5	38.4	58.8	0.4	2.4	100.0
5-7	63.2	33.8	0.4	2.5	99.9
> 7	87.8	10.0	0.5	1.6	99.9
all depths	32.1	59.8	0.8	7.3	100.0

sources: LTRM bathymetric and U.S. Fish and Wildlife Service vegetation data, COE GIS analysis

Table 4-9
1975 Aquatic Vegetation Stoddard Area
Percent by Water Depth

Depth (feet)	Submergents	Rooted Floating Aquatics	Emergents	All Aquatic Vegetation
0-1	3.7	0.0	9.9	4.3
1-2	13.6	51.4	22.6	15.0
2-3	18.1	7.1	26.0	18.9
3-4	33.3	17.1	27.6	32.5
4-5	20.5	10.0	6.8	18.9
5-7	9.7	10.0	5.9	9.3
> 7	1.0	4.3	1.3	1.0

sources: LTRM bathymetric and U.S. Fish and Wildlife Service vegetation data, COE GIS analysis

Two things stand out when comparing the information in tables 4-8 and 4-9 with that in tables 4-3 and 4-4. The first is the difference in overall percent of aquatic vegetation coverage, approximately 65 percent in 1975 vs. <10 percent in 1991. The second is the depth of submergent aquatic plant growth. In 1991, 99 percent of the aquatic vegetation was growing in water less than 4 feet deep. In 1975, over 30 percent of the submergent aquatic plant growth was in water greater than 4 feet deep.

4.1.2.4 Changes in Habitat

An analysis was conducted of the available habitat in the Stoddard area in 1975 and 1991 based on vegetation mapping conducted in those two years. The basic assumption made was that a habitat type provided habitat for a species group if the species used that habitat for any life cycle function. Table 4-10 summarizes these findings.

It is readily evident from the table that the decline in aquatic vegetation has resulted in a significant decline in usable habitat for a wide variety of fish and wildlife. The greatest decline in usable habitat was for waterfowl, turtles, and fish that require aquatic vegetation such as Centrarchids and Esocids. It should be noted that for the fish families this analysis only looked at summer habitat availability and did not consider overwintering habitat.

Table 4-10
Change in Usable Habitat in the
Stoddard Area (1975-1991)

Species Group		1975 Acres	1991 Acres	Acreage Change	Percent Change
Waterfowl	Puddle Ducks	674	86	- 588	- 87
	Diving Ducks	648	73	- 575	- 89
	Geese	648	78	- 570	- 88
	Swans	648	78	- 570	- 88
	Coots/Grebes	648	73	- 575	- 89
Shorebirds	Terns	79	7	- 72	- 90
	Sandpipers	3	5	+ 2	+ 67
	Rails	79	7	- 72	- 90
Cormorants/Pelicans		1041	1034	- 7	- 1
Herons/Egrets		105	14	- 91	- 87
Raptors	Eagles/Hawks	28	13	- 15	- 46
	Owls	28	13	- 15	- 46
Resident/Neotr. Birds					
	Grassland	0	5	+ 5	+500
	Woodland	26	8	- 18	- 31
Reptiles	Turtles	592	57	- 535	- 90
	Snakes	29	13	- 16	- 55
Mammals	Mink/Musk/Beaver	108	19	- 89	- 82
	Microtines	28	13	- 15	- 46
Fish	Centrarchids	643	73	- 570	- 89
	Cyprinids	1010	1026	+ 16	+ 2
	Ictalurids	936	1020	+ 84	+ 9
	Esocids	646	73	- 573	- 89

source: U.S. Fish and Wildlife Service

4.1.3 FACTORS INFLUENCING HABITAT CHANGE

A number of factors have been identified that are believed to be influencing habitat changes in the Stoddard area. Many of these factors are synergistic, combining to affect both the physical and biological environment.

4.1.3.1 Wind/Wave Action

Wind generated waves are believed to be one of the erosive forces that have led to the loss of islands in the Stoddard area. The islands in the Stoddard area are exposed to considerable wind fetch from those directions that produce the most frequent and highest velocity winds during the open water season, the northwest and south (SE to SW).

Wave action is believed to be one of the factors contributing to the general loss of aquatic vegetation in the area. Wind generated waves suspend material in the water, increasing turbidity and reducing light penetration, and the waves exert a physical force on aquatic vegetation. The fact that aquatic vegetation does not thrive at water depths it once did (see earlier discussion under "4.1.2.3 Vegetation Changes") indicates that reduced light penetration may be an important factor behind the decline in aquatic vegetation. In addition, the effects of wind generated waves on aquatic vegetation have probably increased over recent time as the islands and the protection they afforded have decreased.

4.1.3.2 Flows and Current

The islands at Stoddard are exposed to flows coming down Crosby Slough. These flows also exert an erosive force that has likely contributed to some of the island loss. Given the pattern of island loss that has occurred in the Stoddard area, i.e., from south to north, it does not appear that flows have contributed to island loss as much as wind generated wave action.

Flows entering the Stoddard area have a current velocity that affects habitat quality. During the summer, the effect is not particularly significant. However, current velocities during the winter season are higher than tolerable for most backwater fish species, Centrarchids in particular.

Flows entering the Stoddard area during the winter also have the effect of cooling the water temperature to suboptimum conditions. These cold water temperatures, coupled with the current velocities noted above, make winter habitat conditions in the Stoddard area inhospitable for fish.

4.1.4 ESTIMATED FUTURE HABITAT CONDITIONS

If no action is taken, it is expected that the remaining islands in the Stoddard area will eventually erode away. Based on the rate of historic island loss, it is expected that the remaining islands will be lost within 10 years. With the loss of these islands, there will be a loss of the habitat values they provide and their contribution to habitat diversity in the Stoddard Bay area.

It is not known if the decline of aquatic vegetation seen in the later 1980's is a permanent change or if the vegetation will recover. If the protection afforded by the remaining islands is lost, it is unlikely that the vegetation would ever recover to the extent present prior to the mid-1980's.

As the islands erode away, additional flow is likely to enter the Stoddard area. This will further aggravate the already poor winter habitat conditions for fish.

Over the long term, the decline in bathymetric diversity is expected to continue as islands erode, shallow areas are scoured and deeper areas fill in with sediment. This will result in a further decline in quality of fish habitat in Stoddard Bay.

4.2 INSTITUTIONAL FISH AND WILDLIFE MANAGEMENT GOALS

Fish and wildlife management goals and objectives for the area fall under those defined more broadly for the Upper Mississippi River National Wildlife and Fish Refuge, and those designated specifically in the Refuge Master Plan.

The management objectives of the Upper Mississippi River National Wildlife and Fish Refuge which apply most directly to the study area include:

Environmental Quality

+ Reduce the adverse impacts of resuspension and movement of sediments within the project area.

+ Eliminate or reduce adverse impacts of water quality degradation.

Migratory Birds

+ Restore species that are in critical condition (such as canvasbacks) and achieve national population or distribution objectives.

+ Maintain or improve habitat of migrating waterfowl using the Upper Mississippi River.

+ Contribute to the achievement of national population and distribution objectives identified in the North American Waterfowl Management Plan and flyway management objectives.

+ Maintain or improve habitat for other migratory birds.

Fisheries and Aquatic Resources

+ Maintain and enhance, in cooperation with the States, the habitat of fish and other aquatic life (furbearers, reptiles, amphibians, and invertebrates) on the Upper Mississippi River.

Because the study area is within the Upper Mississippi River National Wildlife and Fish Refuge, these management objectives, together with input from State and Federal agency natural resource managers, were used to guide the development of specific project objectives. However, this study is only one part of a larger cooperative natural resource management effort on the river. The long-term effectiveness of any project will eventually be evaluated from such a system-wide perspective.

4.3 PROJECT GOALS AND OBJECTIVES

Earlier sections of this report discussed in detail existing habitat conditions and problems (see "Assessment of Existing Resources" and "Problem Identification"). The habitat goals and objectives were developed as part of a coordinated effort on the part of all of the resource agencies involved in the study. Important factors considered in the development of the goals and objectives were:

a. Management objectives of the Upper Mississippi River National Wildlife and Fish Refuge

b. Management objectives of the Wisconsin and Minnesota Departments of Natural Resources

c. Historic and existing fish and wildlife habitat conditions

d. Resource capabilities, opportunities, and constraints

e. Species groups and individual species habitat requirements

f. Habitat deficiencies, now and in the future for both the Stoddard Bay area and lower pool 8 in general.

The goals are listed in relative priority. That is, measures generally will not be undertaken to meet a lower priority goal at the expense of a higher priority goal.

4.3.1 GOAL 1: Improve habitat conditions for backwater fish species with an emphasis on habitat for Centrarchids.

Habitat conditions for fish in the Stoddard area are considered suboptimal during the winter, spawning, and summer growing seasons. Improving overall habitat conditions for backwater fish species in this area is a high priority goal of the Wisconsin DNR. The emphasis was placed on improving conditions for Centrarchids because these species are the major component of backwater fisheries of the Upper Mississippi River.

4.3.1.1 OBJECTIVE 1A: Create 200 acres of overwintering habitat meeting the following criteria:

(1) Dissolved oxygen levels > 3 mg/l

(2) Current velocity < 0.3 cm/sec over 80% of the area

(3) Water temperature as follows:

4° C over 35% of the area

2-4° C over 30% of the area

0-2° C over 35% of the area

(4) Water depths > 4 feet over 40% of the wintering area in year 25

The lack of overwintering habitat for backwater fish species has been identified by the Wisconsin DNR as a critical habitat problem in the lower portion of lower pool 8. The Stoddard area has been identified as a location where the opportunity exists to provide this critical habitat due to the physical characteristics of the area, i.e., deeper water bounded on the upstream side by a zone of shallow water.

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what would be desirable to provide suitable overwintering habitat for backwater fish species, coupled with the results of monitoring efforts conducted by the Wisconsin DNR in pool 10 (Welke, 1993) and of the biological response monitoring being conducted in association with the Finger Lakes project in pool 5 (Barko, et al., 1993).

When this goal was established during early planning, it appeared from a review of the physical characteristics of the Stoddard area that approximately 200 acres of overwintering habitat would be the maximum amount that could be realistically created in this area. Subsequent planning efforts indicate that this was a conservative estimate and that more than 200 acres could possibly be benefited.

4.3.1.2 OBJECTIVE 1B: Enhance and/or create Centrarchid summer habitat meeting the following criteria:

(1) Dissolved oxygen levels > 5 mg/l

(2) Aquatic vegetation cover in the range of 25-50%

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what is considered critical to providing suitable summer habitat for Centrarchids in Mississippi River backwaters. Maintaining adequate dissolved oxygen levels is critical for fish survival. Aquatic vegetation is a significant habitat component because it provides food and cover for a wide variety of species. Habitat models indicates that providing aquatic vegetation cover in the range of 25-50 percent would create high quality habitat conditions for the Centrarchid species commonly found in backwater habitats, i.e., largemouth bass, bluegill, and crappie.

4.3.1.3 OBJECTIVE 1C: Enhance and/or create spawning, rearing, and juvenile Centrarchid habitat in three locations, each approximately 5 acres in size, meeting the following criteria:

(1) Dissolved oxygen levels > 5 mg/l

(2) Current velocity < 0.5 cm/sec

(3) Aquatic vegetation cover of approximately 80%

(4) Substrates of sand and/or gravel available for spawning

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what is required to provide suitable spawning, rearing, and juvenile habitat for Centrarchids. Maintaining adequate dissolved oxygen levels is critical to fish survival. Low or nonexistent current velocities are important for spawning of most Centrarchids. In addition, little or no current is important for the survival of most Centrarchids during early life stages.

Relatively dense aquatic vegetation is important for the survival of young fish, primarily as protection from predators. Aquatic vegetation is also important as a substrate for food organisms. Most Centrarchids are adaptable in their spawning habits, though they do prefer sand and/or gravel substrates. Providing preferred substrates would be expected to enhance spawning success.

4.3.2 GOAL 2: Increase high quality waterfowl habitat to 600 acres and then maintain.

The Stoddard area formerly provided high quality habitat for ducks, geese, swans, and coots, covering the entire annual cycle including habitat for spring and fall migrants, nesting, brood rearing, and molting. With a loss of islands, there has been a loss of suitable nesting habitat for ducks (primarily mallards with limited use by blue-winged teal) and for Canada geese in the Stoddard area. The general decline in the quantity and quality of habitat for migratory waterfowl in lower pool 8 was discussed earlier in this report. From a system wide perspective, it is important to increase the amount of habitat available.

The Stoddard area currently contains fewer than 50 acres of habitat considered high quality waterfowl habitat. The goal of restoring 600 acres of high quality habitat for migratory waterfowl was based on the habitat that existed in the Stoddard area in 1975. This is the earliest time period for which there is specific quantifiable habitat information (aquatic vegetation mapping). The conditions that existed in 1975 in terms of habitat diversity and aquatic plant coverage were considered excellent for migratory waterfowl.

4.3.2.1 OBJECTIVE 2: Increase and then maintain 600 acres of habitat meeting the following:

(1) Aquatic plant growth covering approximately 60 percent of the area with a mix and interspersion similar to conditions that existed in 1975.

(2) Create 2 to 3 acres of nesting habitat isolated (0.5 mile) from land-based predators and with a vegetative cover having an average obscurity rating of 1.5 dm within 2 years.

(3) Protected sites (i.e., beaches, mudflats, and logs) for birds to get out of the water to loaf and rest totaling approximately 6 acres.

These specific habitat conditions were identified by Federal and State wildlife biologists as those needed to have high quality waterfowl habitat in the Stoddard area. Aquatic plant growth covered about 60 percent of the Stoddard area in 1975. Restoration to the 1975 condition in terms of aquatic plant coverage and interspersion would provide high quality waterfowl habitat.

The objective of creating 2 to 3 acres of nesting habitat was selected based on the need for this type of habitat in the Stoddard area, coupled with consideration of constraints associated with establishing successful nesting habitat in this area.

Protected loafing sites for waterfowl are an important component of high quality waterfowl habitat. Providing 6 acres or 1 percent of the total habitat area as high quality resting/loafing habitat should be sufficient to meet habitat needs.

4.3.3 GOAL 3: Create habitat for migratory birds other than waterfowl (Neotropical migrants, marsh and water birds, and shorebirds); increase turtle nesting habitat; restore habitat for mammals (primarily beaver, mink, and muskrats), reptiles, and amphibians; and improve conditions for the reestablishment of roosting habitat for species such as bald eagles, peregrine falcons, and other raptors.

With the loss of islands and associated shallow water and shoreline zones in the Stoddard area, there has been a near total loss of habitat suitable for Neotropical migrants, marsh and water birds (grebes, white pelicans, double-crested cormorants, bitterns, herons, egrets, rails, and terns), and shorebirds.

With a loss of islands, there has been a loss of suitable nesting habitat for turtles in the Stoddard area. With the loss of islands and associated marsh habitat in the Stoddard area, there has been a near total loss of suitable habitat for aquatic or semi-aquatic mammals, many reptile species, and amphibians.

With a loss of islands in the Stoddard area, there has been a loss of trees for roosting habitat for species such as bald eagles, peregrine falcons, and other raptors.

This goal was established to create habitat for these groups of species in the Stoddard area following a review of the overall need for this type of habitat in lower pool 8, and in the Stoddard area in particular.

No numerical habitat goal for these particular species groups has been established for the Stoddard area. For all of these species groups, there are no specific thresholds identifying how much habitat is required within the river corridor or the Stoddard area in particular to meet the needs of these species. Any restoration of habitat for these species would benefit their overall population levels.

4.3.3.1 OBJECTIVE 3: When planning/designing habitat features for the Stoddard area, the following habitat types or conditions should be provided.

(1) For Neotropical migrants (grassland and woodland), provide islands seeded to grass and/or planted to trees.

(2) For marsh and water birds, provide habitat consisting of an interspersion of submergent, rooted floating aquatics, emergent plants, and open water, in proximity to islands.

(3) For shorebirds provide gradual sloping beaches and/or shallow backwater lagoons.

(4) For nesting turtles, provide isolated islands having gently sloping beaches with sparse vegetation and a substrate capable of maintaining soil moisture suitable for turtle egg incubation.

(5) For aquatic and semi-aquatic mammals, reptiles, and amphibians, provide wetland habitat consisting of an interspersion of submergent, rooted floating aquatics, emergents, and open water in proximity to islands.

(6) For raptors, maintain existing mature trees and accelerate succession on new islands to mature trees.

These basic habitat conditions were identified by Federal and State wildlife biologists as those most limiting in the Stoddard area for the various species groups. Their findings were based on a review of the habitat requirements of the wide variety of species that would be expected to use the area. In addition, the biologists identified specific criteria to be used in the design of specific project features that would promote the development of the diverse habitat conditions necessary to benefit the wide variety of species found in the study area.

ALTERNATIVES

5.1 PLANNING OPPORTUNITIES

In the Stoddard area, remnants of past eroded islands still exist just beneath the surface of the water. These underwater remnants provide a solid base upon which to reconstruct islands. In addition, constructing new islands on top of these remnants reduces material requirements, thereby reducing costs.

5.2 PLANNING CONSTRAINTS

5.2.1 INSTITUTIONAL

The Pool 8 Islands Phase II project lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge. As such, Refuge management goals and objectives must be complied with, as well as the laws and regulations governing Refuge management.

5.2.2 ENGINEERING

Because of shallow water depths, access for construction equipment would be difficult in many areas without dredging. Construction access had to be considered in the planning and design of habitat restoration features.

Project features should be designed with a minimum 50-year project life, with operation and maintenance requirements kept to the minimum. The latter is in recognition that the availability of operation and maintenance funds in the future may be limited.

5.2.3 ENVIRONMENTAL

Many portions of the overall study area, most specifically Crosby Slough, support healthy mussel populations. The design of project features and selection of potential borrow areas should avoid impacting productive mussel beds.

5.2.4 CULTURAL

Given the high potential for unknown prehistoric and historic sites in the project area, a cultural resources survey should be done for any area to be affected by the project. This includes any excavation or burial of island shores or surfaces, as well as dredging or other substantial bottom disturbing activities outside of maintenance dredged areas. The cultural resources of any selected borrow or disposal areas associated with the project must also be considered.

5.2.5 SOCIOECONOMIC/RECREATIONAL

A popular public boat access is located in Stoddard, Wisconsin, on the eastern border of the Stoddard study area. Fishermen, hunters, and other recreational boaters use this access point and traverse the Stoddard Bay area to reach Crosby Slough, the main navigation channel, and points beyond. Impacts on existing recreational boat travel routes had to be considered during the planning and design of habitat features for Stoddard Bay.

5.3 ALTERNATIVES IDENTIFIED

5.3.1 NO ACTION

The no action alternative is defined as no implementation of a project to modify habitat conditions in the study area.

5.3.2 STODDARD BAY

The primary focus of Pool 8 Island Phase II planning is on the Stoddard Bay area. A number of alternatives were identified to meet the habitat goals and objectives for the Stoddard Bay area. They are described here in abbreviated form as most of them are discussed in more detail later in this report. Table 5-1 summarizes the features associated with each of the alternatives.

Table 5-1
Stoddard Bay Alternatives

Plan	Rock Sill A	Island A	Rock Sill B	Island B	Island C	D Islands	E Islands
A	x	x					
B	x	x	x	x			
C	x	x	x	x	x		
D	x	x	x	x		x	
E	x	x	x	x	x	x	
F	x	x	x	x		x	x
G	x	x	x	x	x	x	x

5.3.2.1 Alternative A

Alternative A (plate 8) would involve construction of a rock sill closure across the head of Stoddard Bay (rock sill A) and island construction (island A) extending down to the lowest extent of the remnant Stoddard Bay islands. The primary purposes of this alternative would be to:

a. reduce flows into the upper reaches of Stoddard Bay to assist in meeting habitat objective 1A.

b. reduce the effects of northwesterly winds on Stoddard Bay to reduce wind induced turbidity and promote recolonization of the bay by aquatic plants to meet habitat objectives 1B, 1C, 2, and 3.

c. recreate habitat diversity provided by islands to assist in meeting habitat objectives 1B, 1C, 2, and 3.

5.3.2.2 Alternative B

Alternative B (plate 9) would involve construction of a second island (island B) below island A, with a rock sill (rock sill B) connecting the two islands. Alternative B would be constructed for the same general purposes as Alternative A, only with a larger area benefited.

5.3.2.3 Alternative C

Alternative C (plate 10) would involve constructing an additional island below island B. Though not a separate island, this added increment is labelled "island C." The primary purpose of island C would be to increase the area protected from northwest winds and create additional diversity by increasing the area of island in Stoddard Bay.

5.3.2.4 Alternative D

Alternative D (plate 11) would involve constructing two islands within Stoddard Bay. As with island C, island D1 would not be a separate island, though it is labeled as such for planning purposes. The primary purpose of islands D1 and D2 would be to:

a. reduce the effects of southerly winds on Stoddard Bay to reduce wind induced turbidity and promote recolonization of the bay by aquatic plants to meet habitat objectives 1B, 1C, 2, and 3.

b. recreate habitat diversity provided by islands to assist in meeting habitat objectives 1B, 1C, 2, and 3.

5.3.2.5 Alternative E

Alternative E (plate 12) would be a combination of alternatives C and D.

5.3.2.6 Alternative F

Alternative F (plate 13) is similar to alternative D, with two additional islands created (E1 and E2) to further break up wind fetch in the interior of Stoddard Bay, increase habitat diversity, and assist in maintaining deeper channels by focusing flows and increasing scouring during high water events.

5.3.2.7 Alternative G

Alternative G (plate 14) would be a combination of alternatives C and F.

5.3.3 NESTING ISLAND

The construction of a waterfowl nesting island in areas northwest or north of Stoddard Bay was identified as desirable because of the general lack of waterfowl nesting habitat in this area. This feature would help meet project objective 2(2), creation of waterfowl nesting habitat. This island was evaluated as an independent feature.

5.3.4 SEED ISLANDS

During the study process, it was recognized that the loss of islands and the habitat values they provided was not a problem restricted to the Stoddard Bay area, but encompassed much of lower pool 8. It has been observed in various locations along the Upper Mississippi River that obstructions located in areas with the right hydraulic and sediment transport conditions fostered the accretion of sediment and the natural formation of islands. It was also identified that the right combination of hydraulic and sediment transport conditions for island formation were present in an area adjacent to the right descending bank of the main channel below Heron and Trapping Islands (plate 2). The feasibility of taking advantage of these conditions was incorporated into the study.

The technique evaluated involves placing an obstruction in an area of high sand transport, which stimulates deposition of sand behind the obstruction. The obstructions placed in the river to stimulate formation of islands have been dubbed "seed islands."

The seed islands were evaluated as independent features, separate from the alternatives for the Stoddard Bay area. The seed islands would primarily serve to meet project objective 3, creating islands and associated shallow water habitat that would provide habitat for a variety of wildlife.

5.4 ALTERNATIVES ELIMINATED DURING PLANNING

5.4.1 ALTERNATIVE A

Alternative A was the only alternative eliminated from consideration early in the planning process. It became readily evident that this plan would not adequately address the habitat goals and objectives for Stoddard Bay.

5.5 ALTERNATIVES CONSIDERED IN DETAIL

5.5.1 NO ACTION

The no action alternative would be no implementation of a project to modify habitat conditions in the study area.

5.5.2 STODDARD BAY

The following is a description of the action alternatives for Stoddard Bay. None of the alternatives contain features specific to preserving the few remaining islands in Stoddard Bay because it is believed that they have become too small and fragmented to warrant the cost that would be associated with trying to preserve them. As noted below, the construction of island A would be expected to increase the longevity of these island remnants.

5.5.2.1 Alternative B

Alternative B would consist of the following features, rock sill A, island A, rock sill B, and island B (plate 9).

5.5.2.1.1 Rock Sill A

Rock sill A would be a 1,500-foot rock sill constructed across the upper end of Stoddard Bay. This rock sill would be trapezoidal in cross section with a top width of 12 feet, a 1V:4H upstream slope and a 1V:2H downstream slope (plate 15). The top of the sill would be at elevation 632.0 (normal pool in this area is approximately elevation 630.5). Rock sill A would have a 12-foot-wide notch (bottom width) set at elevation 628.0 for low flow purposes. This feature would require about 8,300 cubic yards of rock to construct.

5.5.2.1.2 Island A

Island A would be constructed in the area of the few remaining emergent islands in Stoddard Bay. The island would be about 2,900 feet long. A portion of island A would be placed external of the upper emergent island and the remainder placed internal of the lower two emergent islands. The portion of island A that would be placed internal of the lower emergent islands is to avoid filling the deeper water on the Crosby Slough side of these islands. The layout also avoids building over the existing emergent islands. This preserves what habitat value these islands still retain, and avoids constructibility problems with building over these islands, e.g. clearing woody materials and snags. Island A should prolong the life of the few remaining natural islands by providing protection from wind and wave action along one side.

A typical cross section of island A is shown on plate 16. The island would be constructed with a sand base and a cap of fine materials. It would have a 50-foot top width, and 30-foot sand berms on either side. The island would be constructed to an elevation of 635.0. The external side and a portion of the internal side of this island would be protected using groins spaced approximately 180 feet apart. The groin design is shown on plate 15.

Island A would require approximately 42,000 cubic yards of sand, 30,000 cubic yards of fines, and 1,160 cubic yards of rock to construct.

The island would be seeded to a mixture of grasses and herbaceous plants. Willows would be planted along the berms for stabilization and habitat purposes. Trees, shrubs, and vines would also be planted on the island.

5.5.2.1.3 Rock Sill B

Rock sill B would be a 1,300-foot rock sill constructed from the lower end of island A to the upper end of island B. This sill would be trapezoidal in cross section with a top width of 12 feet, a 1V:4H upstream slope and a 1V:2H downstream slope (plate 15). The top of this sill would be at elevation 631.8. Rock sill B would not have a low flow notch. This feature would require about 2,940 cubic yards of rock to construct.

5.5.2.1.4 Island B

Island B would extend from the lower end of rock sill B about 1,600 feet to a high spot that was at one time the location of an island. The top width of this island would be 30 feet, as compared to a top width of 50 feet for

island A (plate 16). The island would be constructed to elevation 634.0.

The external and internal sides of the island would be protected with groins spaced approximately 180 feet apart. Island B would be vegetated in a manner similar to island A.

Island B would require approximately 19,000 cubic yards of sand, 8,000 cubic yards of fines, and 560 cubic yards of rock to construct.

5.5.2.1.5 Material Requirements and Sources

Alternative B would have the following approximate material requirements:

sand	61,000 cubic yards
fines	38,000 cubic yards
rock	14,100 cubic yards

The sand material for island construction would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project (plate 19). All of the fine material for islands A and B would be obtained from access dredging.

5.5.2.1.6 Costs

The estimated implementation cost for alternative B is $2,292,000 as summarized in table 5-2.

Table 5-2
Cost Estimate for Alternative B

Construction Features	
Mob/Demob/Prep	$ 316,000
Rock Sill A	368,000
Island A	825,000
Rock Sill B	131,000
Island B	297,000
Plans and Specifications	197,000
Construction Management	158,000
Total	$2,292,000

5.5.2.2 Alternative C

Alternative C would be comprised of all of the features of alternative B, with the addition of island C (plate 10).

5.5.2.2.1 Island C

Island C would extend from the lower end of island B about 2,150 feet to a high spot that is the remains of former islands. The top width of this island would be 30 feet, the same as for island B (plate 16). The first 1,150 feet of island C would be constructed to elevation 633.5, while the lower 1,000 feet would be constructed to elevation 633.0.

The external and internal sides of this island would be protected using groins spaced approximately 180 feet apart. Island C would be vegetated in a manner similar to that described for islands A and B, except that trees, shrubs, and vines would not be planted on this island due to its lower elevation.

Island C would require approximately 26,000 cubic yards of sand, 8,000 cubic yards of fines, and 1,110 cubic yards of rock to construct.

5.5.2.2.2 Material Requirements and Sources

Alternative C would have the following approximate material requirements:

sand	87,000 cubic yards
fines	46,000 cubic yards
rock	15,210 cubic yards

The sand material for island construction would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project (plate 19).

All of the fine material for islands A, B, and C would be obtained from access dredging.

5.5.2.2.3 Costs

The estimated implementation cost for alternative C is $2,659,000 as summarized in table 5-3.

Table 5-3
Cost Estimate for Alternative C

Construction Features	
Mob/Demob/Prep	$ 316,000
Rock Sill A	368,000
Island A	825,000
Rock Sill B	131,000
Island B	297,000
Island C	325,000
Plans and Specifications	212,000
Construction Management	185,000
Total	$2,659,000

5.5.2.3 Alternative D

Alternative D would be comprised of all of the features of alternative B, with the addition of islands D1 and D2 (plate 11).

5.5.2.3.1 Island D1

Island D1 would be about 1,600 feet long and would be connected to the lower end of island B. The top width of the island would be 30 feet, the same as for island B (plate 16). The sand berm width on this island would be 20 feet. Island D1 would be constructed to elevation 634.0. The exposed or southern side of this island would be protected using groins spaced approximately 180 feet apart. Island D1 would be vegetated in a manner similar to that described for islands A and B.

Island D1 would require approximately 23,000 cubic yards of sand, 8,000 cubic yards of fines, and 870 cubic yards of rock to construct.

5.5.2.3.2 Island D2

Island D2 would be constructed about 1,500 feet east of island D1. Island D2 would be about 1,000 feet long. The top width of the island would be 30 feet, the same as for island B (plate 16). The sand berm width on this island would be 20 feet. Island D2 would be constructed to elevation 635.0. The exposed or southern side of this island would be protected using groins spaced approximately 180 feet apart. Island D2 would be vegetated in a manner similar to that described for islands A and B.

Island D2 would require approximately 18,000 cubic yards of sand, 7,000 cubic yards of fines, and 1,140 cubic yards of rock to construct.

5.5.2.3.3 Material Requirements and Sources

Alternative D would have the following approximate material requirements:

sand	102,000 cubic yards
fines	53,000 cubic yards
rock	15,680 cubic yards

The sand material for islands A, B, and D1 (84,000 c.y.) would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project. The sand material for island D2 (18,000 c.y.) would come from the Stoddard landing area (plate 19).

All of the fine material for islands A, B, and part of island D1 would be obtained from access dredging (about 38,000 cubic yards). The balance of the fine material for island D1 and island D2 (about 15,000 cubic yards) would come from within Stoddard Bay (plate 19).

Under alternative D, groins would not be required on the interior side of island B.

5.5.2.3.4 Costs

The estimated implementation cost for alternative D is $2,974,000 as summarized in table 5-4.

Table 5-4
Cost Estimate for Alternative D

Construction Features	
Mob/Demob/Prep	$ 329,000
Rock Sill A	368,000
Island A	825,000
Rock Sill B	131,000
Island B	278,000
Island D1	335,000
Island D2	278,000
Plans and Specifications	225,000
Construction Management	205,000
Total	$2,974,000

5.5.2.4 Alternative E

Alternative E consists of the features of alternatives C and D (plate 12).

5.5.2.4.1 Material Requirements and Sources

Alternative E would have the following material requirements:

sand	128,000 cubic yards
fines	61,000 cubic yards
rock	16,790 cubic yards

The sand material for islands A, B, C, and D1 (110,000 c.y.) would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project. The sand material for island D2 (18,000 c.y.) would come from the Stoddard landing area.

All of the fine material for islands A, B, and part of island D1 would be obtained from access dredging (about 41,000 cubic yards). The balance of the fine material for island D1 and island D2 (about 20,000 cubic yards) would come from within Stoddard Bay (plate 19).

Under alternative E, groins would not be required on the interior side of island B.

5.5.2.4.2 Costs

The estimated implementation cost for alternative E is $3,370,000 as summarized in table 5-5.

Table 5-5
Cost Estimate for Alternative E

Construction Features	
Mob/Demob/Prep	$ 329,000
Rock Sill A	368,000
Island A	825,000
Rock Sill B	131,000
Island B	278,000
Island C	353,000
Island D1	335,000
Island D2	278,000
Plans and Specifications	239,000
Construction Management	234,000
Total	$3,370,000

5.5.2.5 Alternative F

Alternative F consists of the features of alternative D, plus islands E1 and E2 (plate 13).

5.5.2.5.1 Islands E1 and E2

Island E1 would be about 650 feet long, while island E2 would be about 725 feet long. The top elevation of these islands would be 635.0. The top width of these islands would be 30 feet, the same as for island B (plate 16). The exposed or southern side of island E1 would be protected using groins spaced approximately 180 feet apart. No bank protection would be placed on island E2.

Island E1 would require approximately 11,000 cubic yards of sand, 5,000 cubic yards of fines, and 930 cubic yards of rock to construct. Island E2 would require approximately 13,000 cubic yards of sand and 5,000 cubic yards of fines to construct.

These islands would be vegetated in a manner similar to the previously described islands.

5.5.2.5.2 Material Requirements and Sources

Alternative F would have the following material requirements:

sand	126,000 cubic yards
fines	63,000 cubic yards
rock	15,900 cubic yards

The sand material for islands A, B, D1, E1, and E2 (108,000 c.y.) would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project. The sand material for island D2 (18,000 c.y.) would come from the Stoddard landing area (plate 19).

About 44,000 cubic yards of fine material for islands A and B and parts of islands D1 and D2 would be obtained from access dredging. The balance of the fine material for islands D1, D2, E1, and E2 (19,000 c.y.) would come from within Stoddard Bay (plate 19).

Under alternative F, groins would not be required on the interior sides of islands A and B.

5.5.2.5.3 Costs

The estimated implementation cost for alternative F is $3,397,000 as summarized in table 5-6.

Table 5-6
Cost Estimate for Alternative F

Construction Features	
Mob/Demob/Prep	$ 329,000
Rock Sill A	368,000
Island A	793,000
Rock Sill B	131,000
Island B	278,000
Island D1	335,000
Island D2	278,000
Island E1	207,000
Island E2	193,000
Plans and Specifications	252,000
Construction Management	233,000
Total	$3,397,000

5.5.2.6 Alternative G

Alternative G consists of the combined features of alternatives C and F (plate 14).

5.5.2.6.1 Material Requirements and Sources

Alternative G would have the following material requirements:

sand	152,000 cubic yards
fines	71,000 cubic yards
rock	17,010 cubic yards

The sand material for islands A, B, C, D1, E1, and E2 (134,000 c.y.) would come from Crosby Slough in the area immediately above the area dredged in 1992 for sand borrow for the Pool 8 Islands Phase I project. The sand material for island D2 (18,000 c.y.) would come from the Stoddard landing area (plate 19).

About 47,000 cubic yards of fine material for islands A, B, and C, and portions of island D2, would be obtained from access dredging. The balance of the fine material for the remaining islands (24,000 c.y.) would come from within Stoddard Bay (plate 19).

Under alternative G, groins would not be required on the interior sides of islands A and B.

5.5.2.6.2 Costs

The estimated implementation cost for alternative G is $3,797,000 as summarized in table 5-7.

Table 5-7
Cost Estimate for Alternative G

Construction Features	
Mob/Demob/Prep	$ 331,000
Rock Sill A	368,000
Island A	793,000
Rock Sill B	131,000
Island B	278,000
Island C	353,000
Island D1	335,000
Island D2	278,000
Island E1	207,000
Island E2	193,000
Plans and Specifications	267,000
Construction Management	263,000
Total	$3,797,000

5.5.3 NESTING ISLAND

A nesting island could be placed anywhere in the open expanses north and/or northwest of Stoddard Bay (plate 17). The Wisconsin DNR identified two preferred locations for a nesting island. Initial cost estimates indicated that constructing a one acre island in either of these preferred locations would cost in excess of $400,000. This cost was considered excessive for the benefits that would likely be obtained.

Alternative designs were developed in an attempt to minimize costs as much as possible. These designs are designated as nesting islands "A" and "B."

5.5.3.1 Nesting Island A

No specific location was identified for nesting island A. The criteria used in the development of the cost estimate for this island were:

a. the island would have to be accessible for construction equipment with minimal or no access dredging

b. the island itself would have to be located in water 4 feet deep or shallower to minimize material requirements

c. the island would have the basic design of the interior Stoddard Bay islands in terms of top elevation, top width, berm width, etc.

d. the island would be constructed entirely of sand

e. the island would have erosion protection in the form of groins

f. vegetation plantings would be willows and beach grass

g. the island would be one acre in size

Nesting island A would require approximately 14,200 cubic yards of sand and 1,360 cubic yards of rock to construct. The sand would be obtained from Crosby Slough.

The estimated implementation cost for nesting island A is $260,000 as summarized in table 5-8.

Table 5-8
Cost Estimate for Nesting Island A

Construction	$ 215,000
Plans and Specifications	30,000
Construction Management	15,000
Total	$ 260,000

5.5.3.2 Nesting Island B

Nesting island B would have all of the same criteria described for nesting island A, except that it would be only one-half acre in size. Nesting island B would require approximately 7,100 cubic yards of sand and 1,170 cubic yards of rock to construct. The sand would be obtained from Crosby Slough.

As would expected, sand requirements for a one-half acre island are about one-half those of a one acre island. However, rock requirements do not decrease proportionally because the ends of the islands still require protection regardless of how long the island is.

The estimated implementation cost for nesting island B is $166,000 as summarized in table 5-9.

Table 5-9
Cost Estimate for Nesting Island B

Construction	$ 137,000
Plans and Specifications	19,000
Construction Management	10,000
Total	$ 166,000

5.5.4 SEED ISLANDS

An evaluation of the hydraulic and sediment transport patterns along the right descending bank of the navigation channel below Heron and Trapping Islands identified 11 locations where seed islands could be placed with a good chance of success (plate 18). Further screening narrowed the selection process to six preferred sites (SI-5, SI-6, SI-7, SI-9, SI-10, and SI-11).

The selection of the six preferred sites was based on a number of factors. An important consideration was the presence of the proper substrate (sand) to stimulate the formation of the islands. Another consideration was the presence of underwater features such as remnant sloughs, depressions, etc., that may become avenue of flow once the seed islands are constructed. This would stimulate scouring of these areas and improve bathymetric diversity. A third factor was construction access. The goal was to minimize access dredging and its associated costs and disposal problems. Another factor was the location of the seed islands constructed by the U.S. Fish and Wildlife Service in 1995. Construction of these islands reduced the viability of some of the other seed islands under consideration. Finally, it was deemed desirable to construct the seed islands in some semblance of groups to take advantage of the synergistic habitat benefits associated with islands in close proximity to each other versus widely scattered islands.

The seed islands would be low rock berms 200 feet long, with a top width of 3 feet (plate 15). The berms may be notched, flat, or peaked to test the effectiveness of alternative designs. The seed islands would be constructed to elevation 633.5, or about 3 feet over normal pool elevation. Approximately 4,380 cubic yards of rock would be required for the six seed islands.

The estimated implementation cost for the seed islands is $260,000 as summarized in table 5-10.

Table 5-10
Cost Estimate for Seed Islands

Construction	$ 213,000
Plans and Specifications	32,000
Construction Management	15,000
Total	$ 260,000

EVALUATION OF ALTERNATIVES

6.1 NO ACTION

By definition, no action would entail no expenditure of Federal funds under the UMRS-EMP HREP program to address habitat concerns in the Pool 8 Phase II project area. If the habitat concerns are not addressed under the UMRS-EMP program, it is unlikely that any substantive habitat restoration measures would be undertaken by the U.S. Fish and Wildlife Service or the Wisconsin Department of Natural Resources due to fiscal constraints.

The no action alternative would not satisfy any of the project objectives. Habitat conditions would change as described under an earlier section of this report, "Estimated Future Habitat Conditions."

6.2 STODDARD BAY ALTERNATIVES

The Stoddard Bay alternatives consist of a number of islands and closures that increase incrementally from the smallest plan (alternative B) to the largest (alternative G). The features can be separated in two categories, external or barrier features (the two rock sills and islands A, B, and C), and internal features (islands D1, D2, E1, and E2).

The two categories of features have different functions. The primary function of the barrier features is to reduce flows into Stoddard Bay during low flow conditions. These features have a secondary function of protecting Stoddard Bay from northerly and westerly winds. The primary function of the internal features is to protect Stoddard Bay from southerly winds. These features have a secondary function of directing high flows within Stoddard Bay to maintain the scouring action of these flows.

6.2.1 MEETING PROJECT OBJECTIVES

Each alternative was evaluated in terms of meeting key project objectives. Given the diverse nature of the project objectives, it was not expected that any of the alternatives would fully meet all of the objectives. However, certain objectives are of higher priority.

The criteria contained in the project goals and objectives were established for planning purposes. They are the "targets" of the planning

process, based on what habitat conditions resource managers would like to achieve, tempered by the reality of what actually may be practical to accomplish. Not fully achieving a planning goal and/or objective or not fully meeting a criteria does not mean that an alternative does not provide any habitat benefits. Partial achievement of a goal and/or objective may still produce habitat benefits warranting implementation of an alternative.

6.2.1.1 Winter Fish Habitat

Objective 1A is the highest priority of the project objectives. Most of the project planning and design effort centered on meeting this objective. The objective is stated as:

"Create 200 acres of overwintering habitat meeting the following criteria:

(1) Dissolved oxygen levels > 3 mg/l

(2) Current velocity < 0.3 cm/sec over 80 % of the area

(3) Water temperature as follows:

4° C over 35% of the area

2-4° C over 30% of the area

0-2° C over 35% of the area

(4) Water depths > 4 feet over 40% of the wintering area in year 25"

All of the alternatives should meet or exceed the 200 acre criteria. The alternatives will affect areas ranging from 300 to 500 acres.

6.2.1.1.1 Dissolved Oxygen

The notch in rock sill A is designed to provide a minimum of 50 cfs of flow during the winter months. This flow should be more than sufficient to maintain dissolved oxygen levels greater than 3 mg/l over much of Stoddard Bay during the winter. It is recognized that there may be isolated areas where dissolved oxygen levels may fall below this level. However, fish will be able to find areas of sufficient dissolved oxygen throughout the winter.

6.2.1.1.2 Current Velocity

Hydraulic modeling indicates that post-construction flows during the critical winter period should be less than 0.5 cm/sec over 80 percent or greater of the area protected. The difference between the alternatives is in the amount of area affected. Table 6-1 shows the approximate area (rounded to nearest 25 acres) of reduced current velocities for each alternative.

Table 6-1
Estimated Area of Reduced Current Velocities

Alternative	Acres
B	300
C	500
D	325
E	500
F	325
G	500

The modeled current velocity of 0.5 cm/sec was based on a flow of 70 cfs and late winter conditions (18 inches of ice). Modeling with a flow of 70 cfs and for an ice-free condition (which would be more applicable to early winter conditions with thin ice) indicates current velocities would be in the range of 0.2-0.4 cm/sec over much of the protected area. While no model runs have been conducted for a flow of 50 cfs, it is believed that current velocities over 80 percent of the protected area would be less than 0.3 mg/l at this flow rate.

6.2.1.1.3 Water Temperature

It is not possible to model water temperature conditions without the use of thermodynamic models. Winter water temperature is related to current velocities, water densities, mixing, and hydraulic retention times. It is not possible to predict whether any of the alternatives will fully meet the winter water temperature objective.

Thermal refuges in backwaters have two basic characteristics, sufficient water volume (depth) to store "heat" and a lack of water exchange so that the slightly warmer water is not displaced by colder river water. Bathymetric data provides information on water volume and the hydraulic modeling provides an indicator of the potential for displacement.

All of the flow entering Stoddard Bay during the winter will enter through the notch in rock sill A. Hydraulic modeling shows that most of this flow should follow the channel below the notch down to island E1. At that point, the flows will tend to split and flow around either side of island E1, and then rejoin and pass between islands D1 and D2. The modeling indicates there is not likely to be much exchange between this colder flowing water and the deep hole downstream of the Wisconsin end of rock sill A. There is probably only going to be minor exchange with the area below island D1 and with the waters along the Wisconsin shoreline north of island D2. The area below the Wisconsin end of rock sill A has significant water depths (up to 40 feet), and should provide a thermal refuge all winter. The areas along the Wisconsin shoreline and below island D1 also have deeper water which should serve as thermal refuges.

As stated, the winter water temperature criteria is to have 65 percent of the area with water temperatures greater than 2 degrees C. This would be about 325 acres of the 500-acre Stoddard Bay. Based on the available data and analysis, it is unlikely these water temperatures can be provided over this large an area. Fully meeting this criteria is desirable, but may not be critical. During the winter, fish tend to concentrate in areas of suitable habitat. It is unlikely that the fish in Stoddard Bay would require 325 acres of area with water temperatures greater than 2 degrees C to survive over winter. The Federal and State fishery biologists participating in the study believe sufficient thermal refuges will be created within Stoddard Bay to insure fish survival.

6.2.1.1.4 Water Depths

Those portions of Stoddard Bay that would be affected by the various alternatives do not currently meet the water depth criteria. Only about 25 percent of the upper 300 acres of the bay that would be protected by alternatives B, D, and F are greater that 4 feet deep. For the larger 500-acre area protected by alternatives C, E, and G, about 30 percent is greater than 4 feet deep. Under future without conditions, it is expected that the areas greater than 4 feet deep would decrease due to sedimentation.

Alternatives B and C would have no appreciable effect on meeting this criterion as these alternatives have no dredging in Stoddard Bay. Alternatives D through G would all provide some minor benefits towards meeting this objective as they all involve dredging in Stoddard Bay for sand and fine material. However, the amount of area dredged under even the largest alternative (G) would be less than 15 acres. Therefore, none of the alternatives would fully meet the winter water depth criteria.

Meeting the water depth criteria would require dredging 45 to 60 acres of Stoddard Bay, requiring the removal of 150,000 to 200,000 cubic yards of sediment at a minimum cost of $750,000 to $1,000,000. Aside from the problem of finding a disposal area for this sediment (most of which would be fine sediments requiring containment), an evaluation of the probable benefits associated with providing this amount of additional deeper water indicates they could not be justified at these costs.

6.2.1.1.5 Summary

In summary, all of the alternatives would meet the 200 acre criteria. All of the alternatives should meet the dissolved oxygen and current velocity criteria. It is unknown to what extent the alternatives would meet the water temperature criteria. However, it is assumed the criteria would be partially met because of the reduced flow conditions. None of the alternatives would fully meet the water depth criteria.

6.2.1.2 Aquatic Vegetation

Restoring aquatic vegetation to Stoddard Bay is key to a number of objectives. Predicting the effects of the various alternatives on aquatic vegetation is difficult because all of the factors leading to the decline of aquatic vegetation in Stoddard Bay are not known. Loss of islands, increased wind and wave action, water turbidity, water levels, drought, and floods all may have had an impact, with the relative importance of each subject to debate. Nothing can be done about climatic extremes, and water level management is beyond the purview of this study. The project alternatives focused on addressing the other factors that are believed to have contributed to the decline of aquatic vegetation in Stoddard Bay.

Alternatives that only result in restoration of the barrier islands west and north of Stoddard Bay would not make a significant improvement in conditions for aquatic plant growth. While these islands (A, B, and C) would protect Stoddard Bay from northwesterly winds, they would provide no protection from southerly winds. Protection from southerly winds is considered important to restoring conditions conducive to aquatic plant growth because southerly winds are the more prevalent during the growing season, and tend to be of greater force during the summer than the northwesterly winds.

Alternatives that include the "D" islands (alternatives D through G) are those that would do the most towards establishing conditions more conducive to aquatic plant growth in the upper portions of Stoddard Bay. Those

alternatives including the "E" islands (alternatives E and G) would do even more by providing additional islands to break up wind and waves.

None of the alternatives are expected to result in the return of aquatic plant growth to the level present in 1975 (objective 2(1) - 60 percent coverage). Those alternatives involving construction of interior islands should improve conditions such that a return to aquatic plant coverage in the range of 25 to 35 percent in the upper portion of Stoddard Bay is considered a reasonable expectation.

6.2.1.3 Summary

Table 6-2 summarizes how each of the alternatives would contribute to meeting the various project objectives. The larger the alternatives become, in terms of numbers of islands and size of area affects, the more project objectives are met. The most notable break is between alternatives C and D. Alternative D (and all subsequent alternatives) include islands D1 and D2 which are considered important in meeting many of the goals and objectives relating to aquatic vegetation. The differences between alternatives D, E, F, and G are considered minor from the overview of meeting project objectives.

Table 6-2
Meeting Project Objectives

Objective	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G
1A(1)	3	3	3	3	3	3
1A(2)	3	3	3	3	3	3
1A(3)	1	2	2	2	2	2
1A(4)	0	0	0	1	1	2
subtotal	7	8	8	9	9	10
1B(1)	3	3	3	3	3	3
1B(2)	1	1	3	3	3	3
subtotal	4	4	6	6	6	6
1C(1)	3	3	3	3	3	3
1C(2)	3	3	3	3	3	3
1C(3)	2	2	3	3	3	3
1C(4)	3	3	3	3	3	3
subtotal	11	11	12	12	12	12
2(1)	1	1	2	2	2	2
2(2)	0	0	0	0	0	0
2(3)	1	2	2	3	3	3
subtotal	2	3	4	5	5	5
3(1)	3	3	3	3	3	3
3(2)	1	1	2	2	2	2
3(3)	2	2	3	3	3	3
3(4)	3	3	3	3	3	3
3(5)	1	1	2	2	2	2
3(6)	3	3	3	3	3	3
subtotal	13	13	16	16	16	16
total	37	39	48	50	50	51

Key: 3 - will or is expected to meet
2 - should partially meet
1 - will marginally meet
0 - will not meet

6.2.2 COSTS AND BENEFITS

6.2.2.1 Quantifiable Benefits

Estimated habitat benefits were quantified using habitat evaluation procedures. The habitat evaluation is described in detail in attachment 4. Benefits were quantified using two models. The selection of models was based on the primary habitat goals and objectives for Stoddard Bay. The fish community that would be expected to use Stoddard Bay is a backwater community characterized by a predominance of Centrarchids, i.e., largemouth bass, black crappie, and bluegill. After a review of the available species models, the U.S. Fish and Wildlife Service bluegill model (Stuber, et al., 1982b) was selected to quantify the fish habitat benefits of the alternatives. This model was selected because it has been modified by the St. Paul District (Palesh and Anderson, 1990) to include winter habitat variables. This was an important factor in model selection because the most important project objective is to improve winter habitat conditions for Centrarchids and associated species.

An important goal of the project was to improve conditions for migratory waterfowl. The highest projected waterfowl use of the area is as migratory habitat for diving ducks. A diving duck model developed by the St. Paul District (Devendorf, 1995) in cooperation with the U.S. Fish and Wildlife Service and Wisconsin Department of Natural Resources was used to quantify waterfowl habitat benefits.

Table 6-3 summarizes the costs and quantifiable benefits for the Stoddard Bay alternatives.

The quantifiable benefit analysis indicates that 175 AAHU of fish habitat benefits would accrue in Stoddard Bay from construction of alternative B. This is because this alternative meets most of the winter fish habitat objectives for the upper portion of Stoddard Bay, modifying those winter conditions viewed as significant limiting factors on the quality of fish habitat. Adding island C (alternative C) provides about 112 AAHU of increased benefit, primarily from enlarging the area benefited from about 300 to about 500 acres.

Adding the "D" islands provides an additional 17 to 40 AAHU of fish habitat benefits, depending on whether or not the island C is constructed. Most of these benefits are associated with the projected aquatic vegetation response associated with the addition of the "D" islands.

Table 6-3
Costs and Quantifiable Benefits

Alt.	Cost	Average Annual Cost[1]	Annual O&M Cost	Evaluation Species	AAHU Gain	Acres[2]	Island Acres
B	$2,292,000	$179,234	$2,200	Centrarchids	175	306	12.5
				diving ducks	0		
C	$2,659,000	$207,934	$2,300	Centrarchids	287	492	17.4
				diving ducks	0		
D	$2,974,000	$232,567	$2,300	Centrarchids	192	306	18.4
				diving ducks	37		
E	$3,370,000	$263,534	$2,700	Centrarchids	327	492	23.3
				diving ducks	53		
F	$3,397,000	$265,645	$2,600	Centrarchids	189	306	21.6
				diving ducks	48		
G	$3,797,000	$296,925	$2,800	Centrarchids	325	492	26.5
				diving ducks	64		

[1] based on current discount rate of 7 5/8 %

[2] approximate acres within Stoddard Bay benefited by the alternative

Adding the "E" islands is not expected to provide any quantifiable fish habitat benefits. Construction of the "E" islands would be expected to provide some increased fish habitat benefits by adding structural diversity and littoral area. However, the model used to quantify the habitat benefits is not sensitive enough to reflect these changes. Because the "E" islands will result in the conversion of about 5 acres of aquatic habitat to island habitat, the quantifiable Centrarchid habitat unit benefits actually decline by 2-3 AAHU with the construction of the "E" islands. This is a function of the habitat unit calculation process and has little or no bearing on the overall habitat quality for Centrarchids.

The quantifiable benefits using the diving duck model are associated with the construction of the "D" islands and the "E" islands, as these are the project features considered necessary for any appreciable aquatic vegetation improvements in Stoddard Bay. The "D" islands are projected to provide 37 to 53 AAHU of benefits depending on whether or not island C is constructed. Addition of the "E" islands would provide an estimated additional 11 AAHU of quantifiable diving duck benefits.

6.2.2.2 Unquantifiable Benefits

There are other project benefits not quantified by the habitat models. Some of the more important of these are the habitat provided by the islands themselves, accretion of sediments to form mudflats, the benefits to other wildlife from increases in aquatic vegetation growth, and fish habitat benefits outside of Stoddard Bay. Generally, the project would result in an increase in community diversity within the project area. Due to the size and location of the project area, it is anticipated there would be subtle, unmeasurable effects on the overall habitat quality of lower Pool 8.

6.2.2.2.1 Fish Habitat Benefits

The quantifiable fish habitat benefits discussed above are for Stoddard Bay proper, i.e., the area inside or protected by the islands and rock sills. Construction of the islands and rock sills and excavation of borrow material from Crosby Slough will also provide fish habitat benefits outside of Stoddard Bay. The rock sills and the islands will provide fish habitat on their exterior or Crosby Slough sides. The rock in the rock sills will provide habitat for invertebrates and structure and cover for fish. The exterior littoral zone of the islands will provide additional fish habitat.

Alternative B would provide an estimated 2,800 linear feet of rock substrate with a cumulative underwater area of 1 to 2 acres. This alternative would provide 4,500 linear feet of island associated littoral zone exterior to Stoddard Bay. Alternative C would provide an additional 2,150 linear feet of littoral habitat.

Construction of islands A, B, and C (alternative C only) would require excavation of borrow material from Crosby Slough. The borrow will be configured to provide as much deep protected fish habitat in Crosby Slough as practical.

Most of the fish habitat benefits exterior to Stoddard Bay would accrue from construction of the barrier islands and the rock sills. Construction of

interior islands would provide some additional fish habitat benefits outside of Stoddard Bay as some of the material for interior island construction would come from Crosby Slough.

Studies conducted in Pool 12 (Pitlo, 1994) have indicated that adequate winter habitat for fish may be a critical limiting habitat component on a pool-wide basis. His studies of tagged largemouth bass demonstrated that, while some individuals may restrict their movements to an area that meets their year-round requirements, in some instances individuals would travel from 2 to 11 miles each season to seek out winter habitat. The establishment of winter fish habitat in this part of Pool 8 may contribute to maintaining healthy fish populations, not only for Centrarchids, but for other fish species as well.

6.2.2.2.2 Wildlife Habitat Benefits

Numerous other wildlife benefits, not quantified by the habitat model used, would accrue with project construction. Some of these benefits are identified through the objectives identified under habitat goals #2 and #3, which address creating habitat conditions for a variety of species through project design. These goals and design criteria were identified by Federal and State biologists as the most limiting habitat factors in the Stoddard area. No numerical goals were established as there are no identified thresholds of these habitat components, but it was recognized that any restoration of these habitat components would benefit overall wildlife habitat conditions in lower Pool 8.

Island construction would result in the restoration of approximately 26 acres of upland habitat. Vegetation on these islands would range from bottomland woods, primarily on islands A and B, to shrub/scrub and grasslands, primarily along the shoreline, and on the islands C, D and E. These conditions would provide roosting habitat to raptors, provide habitat for neotropical migrant bird species, and create nesting habitat for turtles.

The establishment of islands and the associated shallow water and shoreline zones would provide habitat suitable for marsh and water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and a variety of shorebirds. The increased aquatic vegetation and associated marsh conditions around the islands would provide habitat for aquatic and semi-aquatic mammals, such as muskrats, and many species of reptiles and amphibians.

Over the past decade, many islands and their associated protected side channel habitats have disappeared, resulting in large, unprotected open water areas. These conditions have contributed in some degree to the loss of large stands of aquatic vegetation, and resulted in the simplification of the mosaic of habitat types within the corridor. The result has been a gradual decline in the quality and integrity of wildlife habitat along the river. On a pool-wide basis, the restoration of islands and their associated side channel habitat may be considered as one of the key components in maintaining the integrity of the existing river corridor community.

6.2.3 INCREMENTAL ANALYSIS

The Stoddard Bay alternatives start with a base alternative (alternative B), and then incrementally add features to this base plan. Some of the features are dependent upon others, which affects the structure of the incremental analysis. Some of the alternatives are mutually exclusive. The following are the relationships for Stoddard Bay features and alternatives.

a. Alternative B (rock sill A, island A, rock sill B, island B) is the base or minimum plan, and must be constructed for any of the other features (or alternatives) to be considered viable.

b. Construction of island C is not dependent upon construction of any of the interior islands.

c. Construction of any of the interior islands is not dependent upon the construction of island C.

d. Construction of the "E" islands is dependent upon construction of the "D" islands.

e. Alternatives C and D are mutually exclusive alternatives.

f. Alternatives E and F are mutually exclusive alternatives.

6.2.3.1 Fish Habitat Benefits

The incremental analysis first evaluated the incremental cost of the fish habitat benefits because the highest priority project goal for the Stoddard Bay area is to improve fish habitat conditions. The base plan, alternative B, will provide an estimated 175 AAHU of benefits at an average annual cost of $179,234. The cost/AAHU of achieving these benefits would be approximately $1,024.

The next increment that could be constructed would be either island C (alternative C) or the "D" islands (alternative D). The incremental analysis for these two alternatives is shown as the first two comparisons in table 6-4. This analysis shows that the incremental cost of the fish habitat benefits achieved with island C would be $256/AAHU, while the incremental cost of the "D" islands would be $3,137/AAHU. Thus, from a fish habitat perspective, island C is a more cost effective feature than the "D" islands and would be considered "next in place" after the base plan.

The third step of the incremental analysis (also shown in table 6-4) is to add the "D" and "E" islands with island C in place (alternatives E and G). As noted previously, construction of the "E" islands is dependent upon construction of the "D" islands. It should be noted that, since from a fish habitat perspective alternative C is much more cost effective than alternative D (and by default, alternative F), alternatives D and F are removed from further consideration under this incremental analysis as inefficient alternatives.

Table 6-4
Incremental Analysis of Fish Habitat Benefits

Alt.	Total Cost	Ave. An. Cost	Incr. Cost	Incr. Ave. An. Cost	AAHU Gain	Incr. AAHU Gain	Incr. Cost/ AAHU
B	$2,292,000	$179,234	$2,292,000	$179,234	175	175	$1,024
C	$2,659,000	$207,934	$ 367,000	$ 28,700	287	112	$ 256
B	$2,292,000	$179,234	$2,292,000	$179,234	175	175	$1,024
D	$2,974,000	$232,567	$ 682,000	$ 53,333	192	17	$3,137
B	$2,292,000	$179,234	$2,292,000	$179,234	175	175	$1,024
C	$2,659,000	$207,934	$ 367,000	$ 28,700	287	112	$ 256
E	$3,370,000	$263,534	$ 711,000	$ 55,600	327	40	$1,390
G	$3,797,000	$296,925	$ 427,000	$ 33,391	325	-2	infinite

This third step of the incremental analysis of fish habitat benefits indicates that alternative E would provide 40 AAHU of additional benefits at an incremental cost of about $1,390/AAHU. Alternative G would provide no additional quantifiable fish habitat benefits.

The conclusions drawn from the incremental analysis of quantifiable fish habitat benefits are as follows:

a. If the benefits accruing from alternative B are determined to be justified, then the incremental benefits from alternative C are also justified because they are similar and can be provided at about 25% of the cost on a per unit basis.

b. Alternative E would have to be incrementally justified because the incremental costs/AAHU are greater than for alternative B or C.

c. Alternative G is not justified from a fish habitat perspective because it provides no quantifiable fish habitat benefits.

6.2.2.2 Diving Duck Habitat Benefits

An incremental analysis of the alternatives was conducted based solely on diving duck habitat benefits. As noted in table 6-5, alternatives B and C are not expected to provide any appreciable quantifiable diving duck habitat benefits. Therefore, alternative D could be considered the base plan for the incremental analysis of diving duck habitat benefits. The cost of constructing alternative D solely for diving duck benefits would be approximately $6,286/AAHU. The next increment that could be constructed would be either island C (alternative E) or the "E" islands (alternative F). The incremental analysis for these two alternatives is shown as the first two comparisons in table 6-5.

Table 6-5
Incremental Analysis of Diving Duck Habitat Benefits

Alt.	Total Cost	Ave. An. Cost	Incr. Cost	Incr. Ave. An. Cost	AAHU Gain	Incr. AAHU Gain	Incr. Cost/ AAHU
D	$2,974,000	$232,567	$2,974,000	$232,567	37	37	$6,286
E	$3,370,000	$263,534	$ 396,000	$ 30,967	53	16	$1,935
D	$2,974,000	$232,567	$2,974,000	$232,567	37	37	$6,286
F	$3,397,000	$265,645	$ 423,000	$ 33,078	48	11	$3,007
E	$3,370,000	$263,534	$3,370,000	$263,534	53	53	$4,972
G	$3,797,000	$296,925	$ 427,000	$ 33,391	64	11	$3,036

The conclusions drawn from this first incremental analysis of quantifiable diving duck habitat benefits are as follows:

a. If the benefits accruing from alternative D are determined to be justified, then the incremental benefits from alternatives E and F are also justified because they provide similar benefits at 30 percent to 50 percent of the cost on a per unit basis.

b. If the incremental benefits of alternatives E and F are determined to be justified, then alternative G is justified because that alternative is just a combination of alternatives E and F.

If it were determined that benefits of alternative D were not justified at a cost of $6,286/AAHU, alternative E could be considered the base plan. An analysis was conducted using alternative E as the base plan, with alternative G as the added increment. This analysis is shown as the third comparison in table 6-5. The conclusion drawn from this second incremental analysis of quantifiable diving duck habitat benefits is as follows:

a. If the diving duck habitat benefits accruing from alternative E are determined to be justified, then the incremental benefits from alternative G are also justified because they are similar benefits that can be provided at about 60 percent of the cost on a per unit basis.

6.2.3.3 Evaluation of Fish and Diving Duck Habitat Benefits Combined

It was readily apparent from previous analyses that construction of the barrier features provide primarily fish habitat benefits, the "D" islands provide both fish and diving duck habitat benefits, and the "E" islands provide primarily diving duck habitat benefits. An incremental analysis was conducted using fishery benefits for the base plan (alternative B) and for the incremental addition of island C (alternative C). Waterfowl benefits were used for the addition of the "D" and "E" islands. The fish habitat incremental analysis previously showed island C to be a very cost effective feature. Therefore, alternatives E (adding the "D" islands) and G (adding the "E" islands) are used in this analysis. As noted earlier, alternatives D and F are mutually exclusive with alternatives C and E, respectively. The analysis is summarized in table 6-6.

Table 6-6
Incremental Analysis using both Fish and Diving Duck Habitat Benefits

Alt.	Total Cost	Ave. An. Cost	Incr. Cost	Incr. Ave. An. Cost	AAHU Gain	Incr. AAHU Gain	Incr. Cost/ AAHU
B	$2,292,000	$179,234	$2,292,000	$179,234	175	175	$1,024
C	$2,659,000	$207,934	$ 367,000	$ 28,700	287	112	$ 256
E	$3,370,000	$263,534	$ 711,000	$ 55,600	340	53	$1,049
G	$3,797,000	$296,925	$ 427,000	$ 33,391	351	11	$3,036

The conclusions drawn from this incremental analysis are as follows:

a. If the fish habitat benefits accruing from alternative B are determined to be justified, then the incremental fish habitat benefits accruing from alternative C would also be justified because they are similar and can be provided at about 25 percent of the cost on a per unit basis.

b. Unless a relative value indexing procedure is used, the basic assumption is that all habitat units are of equal value. Thus, if the habitat benefits accruing from alternative B are determined to be justified, then the incremental habitat benefits accruing from alternative E should also be justified because they can be provided at about the same cost per unit of benefit.

c. The incremental diving duck habitat benefits of alternative G would have to be incrementally justified.

6.2.3.4 Summary of Incremental Analysis

The summary conclusions of the incremental analysis are as follows.

a. Construction of the base plan (alternative B) has to be justified on quantifiable fish habitat benefits and other unquantifiable fish and wildlife habitat benefits. This plan does not provide any quantifiable diving duck habitat benefits.

b. If construction of alternative B is determined to be justified, the construction of island C as an additional increment would also be justified because this island would provide quantifiable habitat benefits at a much lower cost on a cost/AAHU basis.

c. If construction of alternative B is determined to be justified, the construction of the "D" as an additional increment should also be justified because these islands would provide quantifiable habitat benefits at about the same cost on a cost/AAHU basis.

d. Construction of the "E" islands has to be justified on quantifiable diving duck habitat benefits and other unquantifiable fish and wildlife habitat benefits. These islands do not provide any quantifiable fish habitat benefits.

6.2.4 SUMMARY COMPARISON OF ALTERNATIVES

6.2.4.1 Meeting Project Objectives

None of the alternatives will meet all of the project objectives for Stoddard Bay. The project objectives were established at the beginning of the study, and as information was developed and alternatives analyzed, it became apparent that fully meeting all of the objectives would not be practicable or cost effective. In addition, the objectives were established to benefit as wide a variety of fish and wildlife as possible, recognizing that certain objectives were of higher priority than others. From a practical standpoint, it would be impossible to create optimum conditions for all of the fish and wildlife species of interest because certain species or groups of species have conflicting habitat requirements.

For the primary fishery objective (objective 1A), all of the alternatives would meet the dissolved oxygen criteria, should meet the current velocity criteria, and partially meet the temperature and water depth criteria. The primary difference being that the larger alternatives will affect larger areas. Because of the uncertainities involved in meeting some of the criteria, the larger the area that can be affected, the greater the likelihood that the objective will be met over a sufficiently large enough area to provide adequate winter fish habitat in Stoddard Bay.

For the remaining objectives, the larger scale alternatives (D through G) meet more of the project objectives than the smaller scale alternatives (B and C). When comparing alternatives D through G with each other, there is no significant difference in their ability to meet project objectives.

6.2.4.2 Costs and Benefits

Table 6-7 summarizes the costs and quantifiable benefits of the alternatives for Stoddard Bay. Alternatives B and C provide primarily fish habitat restoration benefits, with some wildlife habitat benefits provided by the islands that would be constructed. Alternative D provides additional fish habitat benefits, but the primary benefit of this alternative is the benefits that would be provided to diving ducks and other wildlife from the restoration of aquatic plant growth in Stoddard Bay.

Alternative E is just a combination of alternatives C and D and the costs and benefits reflect that. Alternative F, when compared to alternative E, is not a cost effective alternative. It costs approximately the same, but would provide considerably less benefits.

Alternative G is the largest alternative is terms of cost and scope. Alternative G is alternative E with the addition of the "E" islands. These islands provide primarily diving duck benefits and some unquantifiable benefits to other fish and wildlife that would benefit from additional island habitat and improved aquatic vegetation growth.

Table 6-7
Summary of Costs and Quantifiable Benefits

Altern.	Cost	Evaluation Species	AAHU Gain	Acres
B	$2,292,000	Centrarchids	175	306
		diving ducks	0	
C	$2,659,000	Centrarchids	287	492
		diving ducks	0	
D	$2,974,000	Centrarchids	192	306
		diving ducks	37	
E	$3,370,000	Centrarchids	327	492
		diving ducks	53	
F	$3,397,000	Centrarchids	189	306
		diving ducks	48	
G	$3,797,000	Centrarchids	325	492
		diving ducks	64	

6.2.5 PLAN SELECTION AND JUSTIFICATION

Because the Stoddard Bay alternatives are structured incrementally, the plan selection and justification process can follow an incremental process. The first decision to be made is whether or not the construction of alternative B is justified. Alternative B is the first increment in an overall Stoddard Bay plan, and if it cannot be justified, none of the other alternatives could be implemented.

Alternative B will provide an estimated 175 AAHU of quantifiable fish habitat benefits at an approximate cost of $1,024/AAHU. In and of itself, this is considered a reasonable cost for the benefits provided. In addition, this alternative would provide many of the additional unquantifiable fish and wildlife habitat benefits discussed earlier in sections 6.2.2.2.1 and 6.2.2.2.2. The conclusion is that alternative B is justified by the quantifiable and unquantifiable fish and wildlife habitat benefits it would provide.

If alternative B is justified, the next decision to be made is whether or not the addition of island C (alternative C) is justified. The incremental analysis shows that the incremental quantifiable fish habitat benefits of island C could be obtained at an approximate cost of $256/AAHU. In addition, island C would provide additional unquantified benefits of the type described earlier. Therefore, the construction of island C (and alternative C) is considered justified.

If the construction of island C is justified, alternatives D and F would be eliminated from further consideration because these alternatives do not include island C. In addition, previous analysis has indicated that alternative F is not a cost effective alternative, i.e., it would cost about the same as alternative E, but would provide substantially less benefit.

The next increment to consider is the construction of the "D" islands (alternative E). The "D" islands are considered necessary to accomplish any appreciable restoration of aquatic plant growth to the upper reaches of Stoddard Bay. Addition of the "D" islands would provide an estimated 53 AAHU of quantifiable diving duck habitat benefits at an estimated cost of $1,049/AAHU. This cost is considered a reasonable cost for the quantifiable diving duck habitat benefits provided. This does not take into account the 40 AAHU of quantifiable fish habitat benefits associated with addition of the "D" islands, the 7 AAHU of shorebird benefits that would accrue with addition of the "D" islands (see attachment 4), or the other unquantifiable fish and wildlife habitat benefits that would be associated with island construction,

similar to those discussed earlier for alternatives B and C. Therefore, construction of alternative E is considered justified by the incremental benefits that would be provided by the "D" islands.

The final increment of construction would be the "E" islands (alternative G). The "E" islands would provide an estimated 11 AAHU of quantifiable diving duck habitat benefits at a cost of about $3,036/AAHU. Viewed strictly from a cost/AAHU basis, this cost would be on the high end of what would be considered justified. However, the "E" islands provide other unquantifiable habitat benefits discussed earlier in sections 6.2.2.2.1 and 6.2.2.2.2. With consideration of the other unquantifiable fish and wildlife habitat benefits that would be associated with construction of the "E" islands, the cost of $3,036/AAHU is considered justified.

The conclusion of the plan selection process for Stoddard Bay is that alternative G is justified and is therefore, the recommended plan.

6.3 NESTING ISLAND

6.3.1 MEETING PROJECT OBJECTIVES

Construction of a nesting island would contribute towards meeting one of the subobjectives of project objective 2, i.e., providing 2 to 3 acres of nesting habitat. Nesting island A would provide 1 acre of nesting habitat, while nesting island B would provide 1/2 acre of nesting habitat.

6.3.2 COST AND BENEFITS

Construction of nesting island A (1.0 acre) would cost $260,000, while construction of nesting island B (0.5 acre) would cost $166,000. The average annual costs would be $23,581 and $15,056, respectively.

The nesting island would provide waterfowl nesting habitat in an area that is close to necessary brood habitat. Because of its size, the island would likely be free of mammalian predators. A habitat model was not used to quantify the habitat benefits of the nesting island alternatives. No available model is sensitive enough to identify the increase in habitat quality that would be associated with a 0.5- to 1-acre increase in nesting habitat. As a result the benefits associated with these alternatives focused on quantifying potential waterfowl production associated with this feature.

Studies conducted by the Wisconsin Department of Natural Resources (Wetzel, et al., 1989) indicate that small, isolated islands in the river can be very productive, with nest densities reaching as high as 100 nests per acre in some cases. Nest densities on larger islands in Lake Onalaska have reached as high as 28 nests per acre when the islands are predator free. Based on the above information, biologists from the Fish and Wildlife Service and the Wisconsin Department of Natural Resources have indicated that a reasonable nest density that could be expected on the proposed nesting island would be around 30 nest starts/acre/year. In addition, a production rate of 8 eggs/nest, with a hatching success rate of 75 percent, and a fledgling rate of 35 percent have been identified by these agencies as reasonable assumptions. Based on these assumptions, a 0.5-acre island would produce (fledge) about 32.5 ducks per year, while a 1-acre island would produce about twice that amount, or 63 ducks per year.

It should be noted that 30 nest starts per year may be an optimistic assumption of expected average annual production. Long term monitoring studies of nesting mallards in pools 7 and 8 on the UMR (Nelson and Wetzel,

1995) have indicated that nesting intensity and success can be highly variable from year to year. Water conditions on the UMR and in surrounding habitat at critical periods, brood habitat condition, nesting vegetation conditions and weather conditions at critical periods, can all play a factor in any yearly observed nesting intensity or nesting success. The monitoring studies indicate that somewhere between 10-20 nests/acre/year, with a 60% hatching success rate, may be a more reasonable expectation of average annual production on the proposed island. However, lacking a detailed analysis of the data collected to date for the monitoring project, the assumptions provided by the resource agencies were used as the basis for evaluation.

It is anticipated that willow growth will develop on the island and provide habitat for other species of birds such as neotropical migrants and green herons. The island would provide some fish habitat by adding rock substrate and physical structure in an area devoid of both. These secondary benefits would be limited because at most, as only a one-acre island would be constructed in the large open water area northwest of Stoddard Bay.

6.3.3 INCREMENTAL ANALYSIS

There are two nesting island alternatives, a 0.5-acre island and a 1-acre island. From an incremental analysis perspective, the first increment is the 0.5-acre island, and the second increment is the 1-acre island. The analysis is summarized in table 6-8.

Table 6-8
Incremental Analysis of Nesting Island Alternatives

Alt.	Total Cost	Ave. An.[1] Cost	Incr. Cost	Ave. An. Cost	An. Ducks Fldgd.	Incr. Ducks Fldgd.	Incr. Cost/ Duck
B	$166,000	$15,056	$166,000	$15,056	32	32	$470
A	$260,000	$23,581	$ 94,000	$ 8,995	63	31	$290

[1] an average annual cost based on 25-year project life was used for the nesting island to make the costs comparable with other waterfowl nesting projects that used a 25-year project life

The incremental analysis indicates that, if the decision were made to construct a nesting island, consideration should be given to constructing the larger island (nesting island A).

6.3.4 PLAN SELECTION AND JUSTIFICATION

The inability to quantify habitat benefits associated with the nesting islands resulted in a different approach to evaluating their cost effectiveness. The analysis of benefits focused on comparing the cost/duck fledged with this project to the estimated cost/duck fledged incurred by other programs which focus on waterfowl production. A limited literature search was conducted by the U.S. Fish and Wildlife Service. They also gathered information from their Detroit Lakes Wetland Management District and from Duck Unlimited in Bismarck, North Dakota. This information was used to develop a range of costs for waterfowl production based on a 25-year project life (attachment 4). This effort indicated that the annual cost/fledgling over a 25-year project life ranges from $32 to $647. No attempt was made to determine if the costs expended by other management agencies would be considered economically justified. Generally, the lower costs were associated with those programs or projects whose primary purpose was waterfowl production, while the higher costs were often associated with projects or programs where substantial secondary benefits, other than just waterfowl production, were provided from the management activities.

Estimates for production on a 1-acre nesting island above Stoddard Bay are 63 ducks fledged/year at an estimated cost of $260,000. Assuming that there would be no maintenance of the island, the average annual cost/duck fledged would be $374. If less optimistic assumptions were considered, and the assumed 30 nests/acre were adjusted by 1/2 (i.e. 15 nests/acre) to reflect the results of long term monitoring (Nelson and Wetzel, 1995), the costs would increase accordingly to $748/duck fledged. These costs appear to be comparable to what other resource agencies have invested to produce waterfowl in some instances, but with limited opportunities to provide secondary fish and wildlife benefits.

A second consideration in evaluating the justification of the proposed nesting island is to consider this feature within the context of the Fish and Wildlife Services's efforts on the Upper Mississippi River Wildlife and Fish Refuge. While the Refuge Master Plan does include an objective to increase production of historically nesting waterfowl, the project area is not identified as a habitat class on the refuge designated for management for waterfowl production (attachment 9, USFWS letter dated February 8, 1996).

Finally, if the construction of small nesting islands on the Mississippi River is considered to be a cost effective technique for improving waterfowl production, is it reasonable to expect that it would be employed by Federal

and State river resource management agencies. While the value of providing nesting habitat on constructed islands is recognized, the Corps is unaware that any agency has initiated any type of program for constructing small nesting islands on the river to improve waterfowl production. This is a strong indication that this strategy is not be considered a cost effective management technique by resource management agencies for the Mississippi River.

The conclusion of the evaluation of the nesting island feature is that the construction of an isolated nesting island in the area northwest of Stoddard Bay can not be justified and is not recommended for construction. The factors salient to this conclusion are:

(1) The cost per duck fledged is appears very high, and is based on what are considered to be very optimistic benefit projections.

(2) The island would be a single purpose feature and would provide limited secondary fish and wildlife benefits.

(3) The construction of small, isolated nesting islands does not appear to be a strategy currently being implemented by other resource management agencies to increase waterfowl production on the river.

6.4 SEED ISLANDS

6.4.1 COST AND BENEFITS

The seed islands will provide island habitat in a portion of lower pool 8 that presently is open water. The islands will initially provide habitat for wildlife that can make use of small low, sandy islands. These types of islands are used by waterfowl for loafing, by shorebirds, and for turtle nesting. Eventually as the islands grow and begin to support vegetation, they would provide habitat for a wider variety of wildlife.

The islands themselves will provide structure and littoral areas that should improve habitat conditions for fish. As the islands grow larger, they will have shadow zones where conditions will be more conducive to the return of aquatic plant growth.

The islands will concentrate flow between the islands which should cause channels to scour. The purpose would be to try to re-establish long abandoned channels to increase bathymetric diversity. The seed islands have been sited to facilitate this process as much as possible.

The most difficult part of predicting the potential benefits of the seed islands is estimating their rate of growth. A naturally occurring seed island in pool 7 (river mile 709.5) grew from .5 acre in 1973 to 4 acres in 1993. Four islands in lower pool 6 have been accreting in recent years. Two of these islands were not present in 1973. In 1993, they were about 3 acres and 5 acres in size. Another island that was about 5 acres in 1973 grew to about 18 acres in 1993. A fourth island that was about 20 acres in 1973 grew to about 23 acres in 1993. Based on these few examples, it appears that island growth of 3 to 5 acres per 20 years may be typical; however, if conditions are optimum for island formation, a faster rate of growth may occur.

Based on the observations of the growth of natural islands, it is estimated that the seed islands in lower pool 8 would grow at least 4 acres per 20 years, or 10 acres in 50 years. The six islands should total about 12 acres in 10 years, 30 acres in 25 years, and 60 acres in 50 years. If a growth rate of greater than 4 acres/20 years occurs, such as with the one island observed in lower pool 6, even more island acreage will accrue.

As indicated earlier in table 5-10, the construction of six seed islands would cost approximately $260,000. The average annual cost would be $20,332.

6.4.2 INCREMENTAL ANALYSIS

An incremental analysis was performed for the seed islands using the following assumptions.

a. Each seed island would provide equal habitat value, as there is no information available to indicate otherwise.

b. The habitat benefits of the seed islands can not be quantified in habitat units. Therefore, a surrogate indicator of benefits is required, e.g., acres of island created.

c. All islands will grow at the same rate, as there is no information available to indicate otherwise. Because of this, there is no need to use annualized costs in the incremental analysis. Implementation costs will suffice to show the relative cost/benefits for the six seed islands.

Table 6-9 shows the incremental analysis. Because the assumption has to be made that all of the islands will grow at approximately the same rate, the incremental cost/benefit is directly related to the construction costs.

Table 6-9
Incremental Analysis for Seed Islands

Island	Implementation Cost	Acres[1] Created	Cost/ Acre
7	$36,000	10	$3,600
5	$43,000	10	$4,300
10	$43,000	10	$4,300
9	$44,000	10	$4,400
6	$46,000	10	$4,600
11	$48,000	10	$4,800

[1] acres created in 50 years

Incremental analyses for low cost features benefiting small areas can be very deceiving, as small errors in benefit projections can produce dramatically different results in the analysis. Therefore, a sensitivity analysis was conducted (table 6-10). As noted earlier, an average island growth rate of 4 acres/20 years is projected, based on an observed rate of 3-

5 acres/20 years for other naturally accreting Mississippi River islands. Therefore, this range of island growth was used to determine the impact of minor changes in benefit projections on the incremental analysis.

The sensitivity analysis indicates that the incremental analysis for the seed islands provides little useful information for the decision making process because small errors in projecting the rate of island growth can significantly effect the cost/acre of island created. For example, island 11 may cost more than twice as much as island 7 on a cost/acre basis, or conversely, island 7 may cost 30 percent more than island 11 if the growth rates are reversed.

Table 6-10
Sensitivity Analysis of the Seed Islands
Incremental Analysis

Island	Implementation Cost	Acres[1] Created	Cost/ Acre
7	$36,000	7.5-12.5	$2,880-$4,800
5	$43,000	7.5-12.5	$3,440-$5,733
10	$43,000	7.5-12.5	$3,440-$5,733
9	$44,000	7.5-12.5	$3,520-$5,867
6	$46,000	7.5-12.5	$3,680-$6,133
11	$48,000	7.5-12.5	$3,840-$6,400

[1] acres created in 50 years

6.4.3 PLAN SELECTION AND JUSTIFICATION

Plan selection for the seed islands comes down to the basic decision whether to construct them or not. The benefits from the islands would be in the habitat provided by the islands and their local zone of influence. The seed islands would not provide benefits to a much larger area in the manner that the Stoddard Bay islands would. However, they are not designed to do so either.

Because the habitat benefits are unquantifiable, it is not possible to evaluate the cost of the seed islands on a cost/AAHU basis. If the seed islands grow at a rate of 4 acres/20 years as expected, the average size of an island over a 50-year project life would be 5 acres. At a cost of about $43,300 per island, the cost of these islands would be about $8,670/acre. As

a comparison, the cost of the Stoddard Bay islands ranges from $65,000 to $125,000 per acre. While a direct comparison is not possible because the man-made islands at Stoddard Bay have a different purpose and will provide immediate benefits over a much larger area, this does indicate that the cost of the seed islands on a per acre of island created is probably reasonable.

The seed islands would allow natural riverine forces to create islands that will be more diverse in structure and character than any island could be constructed. Thus, the island habitat provided by the seed islands is likely to be more diverse than what can be provided by man-made islands.

The cost/acre benefited for previously constructed UMRS-EMP habitat projects within the St. Paul District has been highly variable, ranging from about $1,000/acre benefited up to $12,000/acre. As noted above, a direct project by project comparison is not possible because of different purposes and different types of benefits. However, it can provide an indication of whether or not a project may be unreasonably costly. If a conservative approach is used and it is assumed that the area of benefit for a seed island is only the island and an equal area surrounding it (e.g., a 5-acre seed island would benefit an additional 5 acres of surrounding open water habitat), the cost per acre benefited would be about $4,335/acre. A cost of $4,335/acre falls within the range of costs considered appropriate for other projects, indicating the cost of the seed islands is not excessive on a cost/acre benefited basis.

The seed islands, if as successful as expected, will provide a substantial amount of knowledge concerning man's ability to work with natural river processes when restoring riverine habitat.

If the rate of seed island growth could be precisely predicted at 4 acres/20 years, there is no question that they would be justified because they offer a habitat restoration opportunity that uses natural river processes at a very low cost. Based on the site conditions where the seed islands would be constructed, there is a high level of confidence that these results will be achieved or exceeded. Therefore, the selected plan is to construct the six seed islands.

SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

7.1 STODDARD BAY

The selected plan for Stoddard Bay is alternative G, which includes the construction of two rock sills and seven islands (plate 19).

7.1.1 ROCK SILLS

Rock sill A will extend from the Wisconsin shoreline to the head of island A. Rock sill B would extend from island A to island B. A typical cross section for the rock sills is shown on plate 15. The rock sills would have a 1V:4H upstream slope to minimize ice dislodgement of the stone.

The 12 foot top width of the rock sills is considered adequate from a stability standpoint. Constructibility considerations also entered into the selection of the sill top width. The preferred method of construction would be to have the contractor construct the rock sills from one or both ends, transporting rock along and working off of the completed portions of the sills. This avoids the costs and environmental problems associated with dredging an access channel 6 to 7 feet deep, and 40 feet wide along the entire length of the rock sills. Working off the top of the rock sills with construction equipment requires a minimum top width of 12 feet. The contractor would have to choke the rock with sand to operate equipment on top of the rock. This sand would be left in place, to filter down between the rocks and/or wash away during high water events.

Both rock sills would be constructed with a top elevation of 632.0 (normal pool elevation in this area is about 630.5). The primary purpose of the rock sills is to reduce flow into Stoddard Bay during the fall-winter period to meet the winter fishery objectives discussed earlier. An elevation of 632.0 was selected following an analysis of fall-winter high water events during the period 1971-93 (see attachment 5, Hydraulics Appendix, for more information).

A sill elevation higher than 632.0 was not selected because it is desirable to allow high water events to continue to flow through Stoddard Bay. The purpose is to take advantage of the scouring action of high flows to remove accumulated fine sediments. This would reduce the long term rate of sediment accumulation in Stoddard Bay and help maintain bathymetric diversity.

The notch in the sill is designed to limit flows into Stoddard Bay during the winter to 50 cfs. Based on the Finger Lakes investigations (Barko, et al., 1993) and investigations conducted for the Peterson Lake habitat project in lower pool 4, a flow of 50 cfs is considered more than adequate to meet winter dissolved oxygen requirements in Stoddard Bay, while at the same time providing sufficient flow to minimize the potential for adverse water quality effects during the summer months.

Geotextile will be placed in the rock sills to serve as a barrier to water seeping through the sills and to accelerate the natural plugging of the rock voids. One of the primary purposes of the sills are to limit flows into Stoddard Bay during the winter months. Analysis indicates that there could be considerable flow passing through the voids in the rock.

The rock for the rock sills (and the rock for the island groins) could come from quarries in either Wisconsin or Minnesota. If taken from a Wisconsin quarry, it would likely be loaded on barges for transport to the site either in the Stoddard area or at lock and dam 8. If taken from a Minnesota quarry, the barge loading site would likely be located in the Brownsville area.

As noted above, the preferred method of construction would be to construct the rock sills from island A and island B. However, most of the rock (by volume) for rock sill A will be required on the Wisconsin shoreline end of the sill. Therefore, it is expected that the contractor would construct the eastern portion of rock sill A from barges. This would require some access dredging. The material from this access dredging could be used in the construction of island A. An access dredging volume of approximately 3,600 cubic yards (access channel 11 on plate 19) has been estimated and accounted for in the material requirements of island A.

7.1.2 ISLANDS

The selected plan involves the construction of seven islands. For ease of reference, table 7-1 summarizes the more salient design information.

Table 7-1
Summary of Island Design Information

Island	length (ft)	top elev.	top width (ft)	sand (cy)	fines (cy)	primary sand source	primary fines source
A	2,900	635.0	50	42,000	30,000	Crosby Sl.	acc. dredg.
B	1,600	634.0	30	19,000	8,000	Crosby Sl.	acc. dredg.
C	2,150	633.5/ 633.0	30	26,000	8,000	Crosby Sl.	acc. dredg.
D1	1,600	634.0	30	23,000	8,000	Crosby Sl.	Stod. Bay
D2	1,000	635.0	30	18,000	7,000	Stod. Land.	acc. dredg.
E1	650	635.0	30	11,000	5,000	Crosby Sl.	Stod. Bay
E2	725	635.0	30	13,000	5,000	Crosby Sl.	Stod. Bay

Island A is considered the cornerstone of the island complex. Failure of island A would result in the loss of most of the projected project benefits. Therefore, a top elevation of 635.0 and a top width of 50 feet was considered the minimum necessary to insure the long term stability of this island.

The top widths of the other islands were reduced to 30 feet to reduce costs. This top width is considered the minimum acceptable for these islands to insure structural stability.

The top elevations of islands B and C were lowered to reduce costs and add topographic diversity. It is believed that a slightly higher risk of failure can be accepted with these islands. Island D1 has a top elevation of 634.0 to be compatable with the top elevation of island B. If island D1 was constructed to elevation 635.0, flows around the west end of this island could result in erosion problems at the junction with island B.

Islands D2, E1, and E2 are being constructed to elevation 635.0 to maximize their effectiveness in concentrating high flows. The purpose of concentrating high flows is to encourage scouring to maintain the existing channels within Stoddard Bay and the bathymetric diversity they provide.

The outer toe of islands B and C would be located about 30 feet east of the 3-foot depth contour on the left descending side of Crosby Slough. This maximizes the amount of shallow water protected while avoiding the need to construct the external groins in water deeper than 3 feet (minimizes rock requirements).

It is expected that all of the sand for the island bases would be dredged and placed hydraulically, and shaped by bulldozers. This has been the typical method of construction used in other island construction projects. The specifics of the individual sand borrow areas are discussed later.

As can be seen from table 7-1, access dredged material would account for about two-thirds of the fine material used in the islands. The access channels shown on plate 19 are those used in the calculation of quantities and for cost estimating purposes. Use of these access channels would not be mandatory; however, certain constraints would be used to control access dredging.

It is expected that the fine material for islands would be mechanically dredged and placed. The contractor would not be precluded from dredging and placing the fine material hydraulically, provided the necessary water quality controls were in place to minimize secondary adverse environmental effects from the effluent discharge.

It was recognized during project planning that constructibility and construction sequencing could be improved if the contractor had a site to place hydraulically dredged access material. The contractor would be allowed to place hydraulically dredged access material in the northeast corner of the intersection of islands B and D1. This is an area where natural accretion of sediments is expected to occur anyway. The contractor would be allowed (but not mandated) to fill up to 5 acres of this corner. Constraints would be placed on how this area could be filled, i.e., containment required, elevation of fill, etc. If this area is filled, the objective would be to create a shallow mudflat for use by shorebirds. A natural mudflat has formed behind the Pool 8 Phase I islands, and observations have been that this mudflat receives considerable use by shorebirds.

7.1.3 CROSBY SLOUGH SAND BORROW

Sand for islands A, B, C, D1, E1 and E2 would come from Crosby Slough, an estimated 134,000 cubic yards. This material would be taken from an area immediately upstream of where material was borrowed in 1992 for the Phase I islands (plate 19). The cut would be 30 feet deep, with 1V:3H side slopes, and a 150-foot bottom width, all dimensions the same as used in 1992. It is estimated that about 1,070 linear feet of dredging would be required to provide the 134,000 cubic yards.

Observations by the Wisconsin DNR of the 1992 dredge cuts indicate that fish appear to prefer the upper ends of the cuts where they can be sheltered from the current (Janvrin, 1995). Thus, the same design will be employed as in 1992, but with the plugs slightly shortened to reduce upstream extent of the dredge cuts. The purpose of minizing the upstream extent of the dredge cuts is to minimize the potential impact on mussel beds which are known to be denser and more diverse proceeding up Crosby Slough.

7.1.4 STODDARD LANDING SAND BORROW

Borings have been taken throughout Stoddard Bay in an effort to find sand suitable for island construction. The Wisconsin DNR believes that sand borrow in Stoddard Bay would provide more fish habitat benefits than sand borrow from Crosby Slough. The only locations where readily accessible (i.e., little or no fine material overburden) sand was found was at two sites along the Wisconsin shoreline near the Stoddard boat landing (plate 19). Borings taken between these two sites show the sand is covered by 2-7 feet of fine material or sand with a high fine material content. Removing this overburden to access sand of suitable quality would be prohibitively expensive and present a significant disposal problem.

The sand material for island D2 (an estimated 18,000 cubic yards) would come from the two sites noted on plate 19. The dredge cut would have an estimated depth of 15 feet, 1V:3H side slopes, and a 100-foot bottom width. If, during preparation of plans and specifications, additional information reveals the presence of accessible sand above and beyond the 18,000 cubic yards required for island D2, portions of other islands such as D1 or E2 may also be constructed using sand from this source. Any additional use of sand from Stoddard Bay would reduce the amount of sand taken from Crosby Slough.

7.1.5 STODDARD BAY FINE MATERIAL BORROW

As indicated earlier, it is estimated that approximately two-thirds of the island fine material requirements will be met by access dredging material. The remainder of the fine material will be taken from Stoddard Bay. Areas have been identified in Stoddard Bay for fine material borrow (plate 19). Given material requirements and access constraints, it appears that the material would come from borrow areas "Q" and/or "R." The final design and layout of the fine material borrow areas would be developed during plans and specifications.

7.1.6 ISLAND VEGETATION AND OTHER MISCELLANEOUS FEATURES

7.1.6.1 Vegetation

As noted earlier, all of the islands would have willows planted along the sand berms for stabilization purposes. In addition, the willows will provide habitat for wildlife.

The long term goal for island A is to have a wooded island. The island will initially be seeded with a herbaceous seed mix to provide a cover for stabilization purposes. Species included in this mix will be smooth bromegrass, alfalfa, and side oats grama, with oats or rye as a nurse crop. The species were selected so as not to complete with the trees that would be planted on the island.

Trees planted on the island would be hardwoods (primarily oaks and other mast producing species). Certain portions of the island would be elevated (see section 7.1.6.2). A different species mix may be used on these elevated sections.

The rock sills provide an attractive nuisance. To control public access to the sills, the areas where the island joins the rock sills would be planted with shrubs and vines to discourage public use of these areas. Species that could be planted in these areas include red-osier dogwood (Cornus stolonifera), nannyberry (Viburnum lentago), Virginia creeper (Parthenocissus quinquefolia), buttonbush (Cephalanthus occidentalis), riverbank grape (Vitis riparia), winterberry (Ilex verticillata), and/or indigobush (Amorpha truticosa).

Islands B, D1, D2, E1, and E2 would be vegetated in a manner similar to that described for island A (with an exception for the elevated areas on

islands D1, D2, E1, and E2 (see section 7.1.6.2)).

Because island C would be constructed to a lower elevation, it would be managed differently from the other islands. The island would be seeded to reed canarygrass, birdsfoot trefoil, and crown vetch, with oats or rye as a nurse crop. It is expected that over time, this island would become colonized nataurally by willows and cottonwoods.

7.1.6.2 Topographic Diversity/Turtle Nesting Habitat

In an effort to create some topographic diversity on the islands without compromising their structural intergrity, certain portions of islands A, D1, D2, E1, and E2 would be elevated in the form of low "humps." On island A, three 100-foot stretches would be elevated 1-, 2-, and 3-feet above the design elevation, respectively. On either end of the humps would be 50-foot transition area where the elevated areas would grade back into the design elevation. The humps would be evenly spaced on island A, centered approximately 675 feet, 1,450 feet, and 2,225 feet from the upper end of the island. The humps on island A would be constructed of fine material and planted in a manner similar to the rest of the island.

Humps would also be added to islands D1, D2, E1, and E2. Two humps would be added to islands D1 and D2, while one hump would be added to each of the other islands. The humps on these islands would be approximately 50 feet long and approximately 2 feet above the island design elevation. The humps would be located in a manner that would not threaten the structural integrity of the islands.

To provide turtle nesting habitat, the humps on islands D1, D1, E1, and E2 would be constructed of sand and planted with "beach grass" species such as common beach grass (Ammophila brevigulata), sand reed grass (Calamovilfa longifolia), and/or thickspike wheatgrass (Agropyron dasystachyum). For constructibility purposes, the entire island cross section in these particular locations would likely be sand, rather than having a fine material layer sandwiched between two layers of sand.

7.2 SEED ISLANDS

The selected plan is to construct six seed islands at sites #5, 6, 7, 9, 10, and 11 (plate 18). The plan, profile, and cross sections of the islands are shown on plate 15.

The final location of the seed islands will be determined by pre-construction surveys, supplemented by the knowledge gained from monitoring of the islands constructed by the USFWS in 1995.

It is expected that the rock for these structures would come from the same location and be loaded at the same site as the rock for the Stoddard Bay features.

The seed islands are located where they should be accessible by marine equipment. Any access dredging required should be minor. If access dredging is required, the material would be used in the Stoddard Bay islands. An option that will be evaluated during the plans and specifications phase would be to use the access dredging to nourish the seed islands and perhaps assist the island formation process.

ENVIRONMENTAL ASSESSMENT

An environmental assessment has been conducted for the proposed action and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in the impact assessment matrix (table 8-1) were reviewed and considered in arriving at the final determination. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation was prepared (attachment 3). Application will be made to the State of Wisconsin regarding water quality certification under Section 401 of the Clean Water Act prior to construction. The State of Wisconsin has indicated that they support the project and will provide water quality certification under Section 401 of the Clean Water Act during the preparation of plans and specifications. The Finding of No Significant Impact can be found at the end of this report.

8.1 RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

The proposed action would comply with all applicable Federal environmental laws, executive orders, and policies, and State and local laws and policies including the Clean Air Act, as amended; the Clean Water Act of 1977, as amended; the Endangered Species Act of 1973, as amended; the Land and Water Conservation Fund Act of 1965, as amended; the National Environmental Policy Act of 1969, as amended; the Fish and Wildlife Coordination Act of 1958, as amended; the National Wildlife Refuge System Administration Act; Executive Order 11988 - Floodplain Management; and Executive Order 11990 - Protection of Wetlands. The proposed action would not result in the conversion of farmland to non-agricultural uses. Therefore, the Farmland Protection Policy Act of 1981 does not apply to this project.

8.2 NATURAL RESOURCE EFFECTS

8.2.1 FISH AND WILDLIFE RESOURCES

The proposed islands/rock sills would improve aquatic habitat on approximately 500 acres in the Stoddard area. Fishery habitat would be improved by providing winter habitat for fish. In addition, the expected vegetation response would improve the area as migration habitat for waterfowl.

TABLE 8-1

IMPACT ASSESSMENT MATRIX

NAME OF PARAMETER	MAGNITUDE OF PROBABLE IMPACT						
	← INCREASING BENEFICIAL IMPACT			NO APPRECIABLE	INCREASING ADVERSE IMPACT →		
A. SOCIAL EFFECTS	SIGNIFICANT	SUBSTANTIAL	MINOR	EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
1. Noise Levels					X		
2. Aesthetic Values				X			
3. Recreational Opportunities					X		
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth & Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality				X			
2. Terrestrial Habitat			X				
3. Wetlands					X		
4. Aquatic Habitat		X					
5. Habitat Diversity and Interspersion		X					
6. Biological Productivity		X					
7. Surface Water Quality					X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Hist & Historic Archeological Values				X			

The seed islands would improve conditions in the area below Heron and Trapping Islands by eventually creating 60 acres of island habitat. The physical effect of these islands would be to improve conditions for aquatic vegetation reestablishment within the zone of the islands' influence.

In order to quantify habitat benefits of the proposed actions, the U.S. Fish and Wildlife Service's Habitat Evaluation Procedure (HEP) was used. The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing existing HU's to HU's expected to be gained with the proposed action, the benefits can be quantified. A detailed discussion of the habitat evaluation procedures conducted for this project is presented in attachment 4.

8.2.1.1 Fish

The restoration of the islands at Stoddard would substantially improve the quality of the fish habitat in this area. The area currently provides fair summer habitat for centrarchids, but overall the area is considered to be very poor habitat. The primary limiting factor is the poor winter habitat conditions in the project area due to the very high flows and cold temperatures. The construction of the islands and the rock sills would substantially change the flow conditions in the area. The flow in the area bounded by the islands would be dramatically reduced. Flow conditions in the winter would be changed from an average of 15 cm/sec to an average of 0.4 cm/sec. It is anticipated the reduced flows would result in somewhat warmer water temperatures. The design flow would result in adequate dissolved oxygen conditions. All of the above conditions result in the development of an area that would provide near optimum winter habitat.

Dredging in Crosby Slough may also provide additional winter habitat. Deep holes located in areas with considerable flow have been identified as important winter habitat for some species, especially catfish. While no detailed studies have been conducted, anecdotal information has indicated that the areas previously dredged in Crosby Slough have been utilized by fish.

Studies have indicated that winter habitat on the river may be a critical habitat component to maintaining fish populations on the river. Some species have been tracked traveling several miles to winter habitat. The establishment of winter fish habitat in this part of Pool 8 may contribute to maintaining healthy fish populations in the pool.

8.2.1.2 Waterfowl

It is anticipated that the construction of the islands in Stoddard Bay will result in conditions conducive to the reestablishment of extensive aquatic vegetation in the project area. This would result in an increase in the value of the project area as waterfowl migration habitat, especially for diving ducks. The model used for this evaluation indicates that the migration habitat value would increase by about 50 percent. Similar effects are expected to occur within the zone of influence of the islands that would develop with the seed islands.

8.2.1.3 Other Wildlife

Numerous other wildlife benefits, not quantified by the habitat models, would accrue with project construction. The island and associated vegetation, both in the Stoddard area and in Raft Channel East, would provide habitat for a wide variety of species, including roosting habitat for raptors, migration and nesting habitat for neotropical migrants and nesting habitat for turtles. The island and associated shallow water zones would provide marsh habitat for marsh and water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and shorebirds. Aquatic and semi-aquatic mammals, such as muskrats, and many species of reptiles and amphibians would have improved habitat conditions with the increased aquatic vegetation and associated marsh habitat that would develop around the islands.

Mussel surveys have been conducted in Crosby Slough, and in Stoddard Bay. Extensive mussel beds are located in portions of Crosby Slough and the proposed dredge cuts have been located so as to avoid affecting established mussel beds in this area. There are no other identified mussel beds in the Stoddard Bay area. Scattered mussel beds are located in the location of the proposed seed islands. Established beds may be affected by the placement of the riprap. Overall, conditions that develop between the islands may improve habitat conditions for mussels in portions of the area.

8.2.2 WETLANDS

The construction of the islands in Stoddard Bay and the construction of the seed islands would result in the placement of fill material in about 30 acres of riverine habitat. About 15 to 25 acres of mudflats are expected to develop with the accumulation of sediment in a portion of the Stoddard Bay area. In addition, the seed island area is projected to eventually result in about 60 acres of islands. The cumulative effect of the proposed action would be the conversion/restoration of between 90 and 100 acres of riverine habitat

to terrestrial habitat. The quality of the aquatic habitat in these areas currently is relatively low due to high flows and lack of aquatic vegetation. The expected increase in habitat quality in the affected areas would more than offset aquatic habitat losses associated with construction.

Fill material for the islands in the Stoddard area would be obtained by dredging in Crosby Slough and in Stoddard Bay. Rock fill and riprap for the various project features would come from established quarries in the area.

8.2.3 WATER QUALITY

The proposed action would result in short-term decreases in water quality because of localized increases in turbidity during construction or dredging. No releases of contaminants or increases in their levels are expected as a result of the placement of the dredged material. The Section 404(b)(1) evaluation (attachment 3) contains a more detailed discussion of construction related effects on water quality.

Over the long term, the project is expected to have some water quality effects in Stoddard Bay. One of the project objectives is to increase winter water temperatures by a few degrees Centigrade. Achieving this objective requires reducing flow into Stoddard Bay during the winter, which in turn will reduce winter dissolved oxygen levels from current conditions. When establishing project objectives, Federal and State resource managers indicated that maintaining dissolved oxygen levels greater than 3 mg/l would be sufficient for supporting fish during the winter. Approximately 50 cfs of flow will be allowed into Stoddard Bay during the winter through the notch in rock sill A. This flow, coupled with some expected seepage through the sill itself, should be more than sufficient to maintain dissolved oxygen levels above 3 mg/l.

The project will substantially reduce flows through Stoddard Bay during the open water season, creating more of a quiet backwater setting. Water quality in the bay will change as a result of this. The effect is expected to be most evident during the late summer. Water temperatures would be expected to increase by a few degrees. Suspended sediment levels should decrease and water clarity is expected to increase, though the change may not be readily noticeable to the casual observer. If the project is successful in restoring aquatic plant growth to a substantial portion of Stoddard Bay, diurnal dissolved oxygen fluctuations typical of quiet vegetated waters may become more common.

The potential changes in the water quality of Stoddard Bay are those that would be expected from a project designed to create a more protected and well vegetated aquatic habitat versus the more open flowing condition that currently exists.

8.2.4 ENDANGERED SPECIES

No State listed or federally listed threatened or endangered species would be adversely affected by the project. No threatened or endangered mussel species were identified in Crosby Slough or the Stoddard Bay area. A mussel survey of the proposed seed island locations was conducted by the Corps in 1995. One Higgins' eye pearly mussel was found in a seed island location that was being considered below Heron and Trapping Islands. This location has been eliminated from further consideration. No threatened or endangered mussel species were identified in the proposed seed island locations.

8.3 CULTURAL RESOURCES EFFECTS

The pre-lock and dam configuration of the Stoddard Bay area was a low floodplain bordered on the northwest by Crosby Slough and the southwest by Coon Slough. This floodplain is now almost entirely under water; the extremely rapid erosion of the last decade has left only a small percentage of the islands (formerly high ground on the floodplain) above water. The current plan for the building of the islands and the two rock sills will not impact any of the remaining island ground. The only effect on any possible archaeological sites on the remaining islands will be to stop erosion and stabilize the sites. The planned dredge cuts will also have no effect on submerged cultural resources such as shipwrecks, since the area was formerly floodplain and was never navigable. The project has been coordinated with the Wisconsin State Historic Preservation Office who have concurred that the proposed project will have no effect on significant cultural resources (see attachment 9 - Coordination/Correspondence).

8.4 SOCIOECONOMIC EFFECTS

The proposed action would have minimal or no impacts on the following socioeconomic categories: transportation, public health and safety, aesthetics, community cohesion, community growth and development, business or home locations, land use, property values, tax revenues, regional growth, employment, business activity, food supply, navigation, flooding effects or energy resources.

8.4.1 NOISE

The immediate vicinity around the project area, and at the public boat landing, may be temporarily disrupted by construction activities. Some disturbance may occur from noise and human activity. These effects would be temporary and adverse effects to the general public would be short-term and insignificant.

8.4.2 RECREATION

The proposed action would most likely alter the general recreational boating routes in the Stoddard area. Direct access to the Stoddard Bay area immediately above the project from the boat landing at Stoddard would be slightly limited due to the construction of the island/rock sill. It is likely that most traffic will have to go out to Crosby Slough to gain access to areas above the project area. Access to the Waters Edge Motel would not be affected. Overall, the effect on recreational navigation would be minor.

SUMMARY OF PLAN ACCOMPLISHMENTS

The habitat benefits of the selected plan are discussed in detail in earlier sections of this report and in attachment 4. The selected plan for the Stoddard Bay area will improve habitat conditions over approximately 500 acres. The islands and rock sills will reduce flows through Stoddard Bay, significantly improving winter habitat conditions for the backwater fish community. The project will reduce flows and reduce the effects of wind and wave action in Stoddard Bay which is expected to substantially improve conditions for the growth of aquatic plants. The islands themselves (26 acres) will provide habitat for wildlife and improve overall habitat diversity in the Stoddard Bay area. The borrow dredging for island construction will provide additional fish habitat benefits in Crosby Slough and Stoddard Bay.

Quantifiable habitat benefits from the selected plan are 325 average annual habitat units for Centrarchids and 64 average annual habitat units for diving ducks. Centrarchids are the indicators of habitat benefits to the backwater fish community while diving ducks are the indicators of habitat benefits to migratory waterfowl. In addition to these major species groups, a substantial amount of unquantifiable habitat benefit is expected to accrue to other wildlife such as shorebirds, wading birds, Neotropical migrant songbirds, aquatic mammals, and turtles.

The seed islands are expected to provide benefits to fish and wildlife similar to those provided by the Stoddard Bay islands, though on a much smaller scale, commensurate with the size and cost of these structures. If the seed islands grow as expected, eventually an area of a few hundred acres in lower pool 8 may be benefited by these islands.

OPERATION, MAINTENANCE, AND REHABILITATION

10.1 GENERAL

Upon completion of construction, the U.S. Fish and Wildlife Service would accept responsibility for operation and maintenance of the Pool 8 Islands Phase II project in accordance with Section 107(b) of the Water Resources Development Act of 1992. Specific operation and maintenance would be defined in a project operation and maintenance (O&M) manual which would be prepared by the Corps of Engineers and coordinated with the U.S. Fish and Wildlife Service. The Wisconsin DNR would be given an opportunity to review the O&M manual.

10.2 OPERATION

The recommended plan would have no specific operational requirements. The U.S. Fish and Wildlife Service would be required to conduct periodic inspections of the project and submit annual reports of inspection activities and maintenance performed.

10.3 MAINTENANCE AND REHABILITATION

An operation and maintenance manual detailing maintenance and repair requirements would be prepared by the Corps of Engineers. Development of the manual would be coordinated with the U.S. Fish and Wildlife Service. Over the 50-year project life, the average annual operation and maintenance costs of the project are estimated to be about $3,000 (rounded). A breakdown of projected annual costs is contained in table 10-1.

Table 10-1
Average Annual Operation and Maintenance Costs

Item	Amount
a. Rock replacement	$ 997
b. Clear debris from notch	422
c. Inspection and reporting	1,400
Total annual amount	$2,819

PROJECT PERFORMANCE EVALUATION

A monitoring plan for project evaluation was designed to directly measure the degree of attainment of the selected project objectives. The plan is described in attachment 8 and summarized in tables 11-1, 11-2, and 11-3. Monitoring activities would be coordinated with similar efforts by the Long-Term Resource Monitoring program. The estimated cost of the recommended project performance evaluation monitoring is $208,000 over the 50-year life of the project. Of this total, approximately $22,000 would be funded by the habitat project component of the UMRS-EMP through its authorized life (2002). The remaining monitoring, if it is to be accomplished, would have to be funded by resource management agencies such as the U.S. Fish and Wildlife Service and/or the Wisconsin Department of Natural Resources.

TABLE 11–1
PROJECT OBJECTIVES AND ENHANCEMENT FEATURES

Objective	Project Accomplishment	Potential Enhancement Feature	Units	Enhancement Potential		
				Existing	Future Without	Future With
Create 200 acres of overwintering habitat	maintain diss. oxy. reduce current velocity increase water temp. maintain depths	rock sills, islands, dredging	mg/l cm/sec degrees C feet	> 10 mg/l > 3 cm/sec < 1 140 ac. > 4 ft.	> 10 mg/l > 3 cm/sec < 1 1xx ac. > 4 ft.	> 3 mg/l < 0.5 cm/sec > 2 140 ac. > 4 ft.
Enhance/create summer fish habitat	maintain diss. oxy. increase aquatic veg.	rock sills, islands, dredging	mg/l % coverage	> 5 mg/l < 10 %	> 5 mg/l < 10 %	> 5 mg/l 25 – 50%
Enhance/create spawning, rearing, and juvenile fish habitat	maintain diss. oxy. reduce current velocity increase aquatic veg. provide sand substrate	rock sills, islands	mg/l cm/sec % coverage acres	> 5 mg/l > 3 cm/sec < 10 % 0	> 5 mg/l > 3 cm/sec < 10 % 0	> 5 mg/l < 0.5 cm/sec 25 – 50% 10
Increase high quality waterfowl habitat to 600 acres	increase aquatic veg. provide resting sites	rock sills, islands	% coverage acres	< 10 % 2	< 10 % 2	25 – 50% 15
Create habitat for other wildlife	provide island habitat increase aquatic veg. provide beaches	rock sills, islands	acres % coverage linear feet	4 < 10 % 0	0 < 10 % 0	30 25 – 50% 22,000

TABLE 11–2
UMRS–EMP Monitoring and Performance Evaluation Matrix

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Problem Analysis	System–wide problem definition. Evaluate planning assumptions.	NBS	NBS (EMTC)	LTRM	Lead into pre–project monitoring; define desired conditions for plan formulation.
Pre–project Monitoring	Identify and define problems at specific sites.	Sponsor	Sponsor	Sponsor	Should attempt to begin defining baseline.
Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field stations or sponsors thru Cooperative Agreements, or Corps.*	HREP	Should be over several years to reconcile perturbations.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	After fact sheet. Data may aid in defining baseline.
Construction Monitoring	Assure permit conditions met.	Corps	Corps	HREP	
Performance Evaluation Monitoring	Determine success of projects.	Corps	Field stations or sponsors thru Cooperative Agreements, sponsor thru O&M**, or Corps.*	HREP	After construction.
Analysis of Biological Responses to Projects	1. Determine critical impact levels, cause–effect relationships, and long–term losses of significant habitat.	NBS	NBS (EMTC)	LTRM	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.
	2. Demonstrate success or response of biota.	Corps	Corps/NBS (EMTC)/Others	HREP	

*Choice depends on logistics. When done by the States under a Cooperative Agreement, the role of the EMTC will be to: (1) advise and assist in assuring QA/QC consistency, (2) review and comment on reasonableness of cost estimates, and (3) be the financial manager. If a private firm or State is funded by contract, coordination with the EMTC is required to assure QA/QC consistency.

**Some limited reporting of information for some projects (e.g., waterfowl management areas) could be furnished by on–site personnel as part of O&M.

TABLE 11–3
POST–CONSTRUCTION MEASUREMENTS

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
Improve habitat conditions for backwater fish community	Create 200 acres of overwintering habitat	rock sills, islands, dredging	diss. oxy. (mg/l) velocity (cm/sec) water temp (deg. C)	Monitor water quality and current velocity during winter.	1, 2, 4, 10, 20, 30, 40, and 50 years post–construction.	$4,000
			water depth (ft)	Bathymetric surveys	10, 30, and 50 years post–construction	$10,000
	Enhance and/or create summer habitat	rock sills, islands, dredging	diss. oxy. (mg/l)	Monitor water quality during summer.	1, 2, 4, 10, 20, 30, 40, and 50 years post–construction.	$4,000
			aquatic veg. (% cover)	Aquatic plant surveys	1, 5, 10, 20, 30, 40, and 50 years post–construction	$6,000
	Enhance and/or create spawning, rearing, and juvenile habitat	rock sills, islands,	diss. oxy. (mg/l) velocity (cm/sec)	Monitor water quality and current velocity during summer.	1, 2, 4, 10, 20, 30, 40, and 50 years post–construction.	*
			aquatic veg. (% cover)	Aquatic plant surveys	1, 5, 10, 20, 30, 40, and 50 years post–construction	*
			substrate (acres)	Substrate survey	every 10 years post–construction	$5,000
Increase water–fowl habitat	Increase waterfowl migratory and resting habitat	rock sills, islands,	aquatic veg. (% cover)	Aquatic plant surveys	1, 5, 10, 20, 30, 40, and 50 years post–construction	*
			beaches (linear ft)	Visual survey and aerial photos	every 10 years post–construction	$3,000
Increase wildlife habitat for a variety of species	Provide grassy and wooded islands, increase aquatic plant growth, and provide beaches.	rock sills, islands,	islands (acres) and beaches (linear ft).	Visual survey and aerial photos	10, 30, and 50 years post–construction	*
			aquatic veg. (% cover)	Aquatic plant surveys	1, 5, 10, 20, 30, 40, and 50 years post–construction	*

* costs covered in estimate for similar monitoring noted above

COST ESTIMATE

The total project cost for the selected plan is estimated to be $4,057,000. This cost does not include prior allocations of $460,000 for general design (planning). A detailed cost estimate is contained in attachment 2. A summary of costs is shown in table 12-1.

Table 12-1
Summary of Total Project Costs

Feature	Cost
Construction	
Mobilization	$ 331,000
Rock Sill A	368,000
Island A	793,000
Rock Sill B	131,000
Island B	278,000
Island C	353,000
Island D1	335,000
Island D2	278,000
Island E1	207,000
Island E2	193,000
Seed Islands	213,000
Planning, Engineering, and Design	299,000[1]
Construction Management	278,000
Total	$4,057,000

[1] This does not include prior allocations of $460,000 for general design (planning).

It should be noted that the above cost estimate is based on the current projection that funds would not be available to begin construction of this project until FY 1999. The St. Paul District has the capability to begin construction in FY 1997. If funds became available to initiate construction in FY 1997, the estimated implementation cost of the project would be approximately $3,600,000.

REAL ESTATE REQUIREMENTS

This habitat rehabilitation and enhancement project is located in the lower portion of pool 8 of the Upper Mississippi River in Vernon County, Wisconsin. The project will be constructed entirely upon lands owned and operated by the United States of America. Most of the lands in the project area are administered by the Corps of Engineers. A small portion is administered by the U.S. Fish and Wildlife Service. All of the lands are managed by the U.S. Department of the Interior's Fish and Wildlife Service as the Upper Mississippi River National Wildlife and Fish Refuge.

SCHEDULE FOR DESIGN AND CONSTRUCTION

A schedule for review and approval, major work tasks, and project construction is shown below. This schedule assumes the availability of funds to prepare plans and specifications and undertake construction will not be limiting.

Requirement	Scheduled Date
Submit final Definite Project Report to North Central Division, U.S. Army Corps of Engineers	May 1996
Submit final Definite Project Report to Headquarters, U.S. Army Corps of Engineers	Jul 1996
Obtain construction approval by Headquarters, U.S. Army Corps of Engineers	Oct 1996
Complete Plans and Specifications	Jan 1999
Advertise for Bids	Jan 1999
Award Contract	Mar 1999
Complete Construction	Sep 2001

This schedule is based on current projections of the availability of funds within the UMRS-EMP habitat projects program. If funds were available, construction could be initiated in FY 97 and completed in FY 99.

IMPLEMENTATION RESPONSIBILITIES

The responsibilities of plan implementation and construction fall to the Corps of Engineers as the lead Federal agency. After construction of the project, project operation and maintenance would be required for features of the project as outlined in the OPERATION, MAINTENANCE, AND REHABILITATION section of this report. These actions would be the responsibility of the U.S. Fish and Wildlife Service.

Should rehabilitation of the Pool 8 Islands Phase II project which exceeds the annual maintenance requirements be needed (as a result of a specific storm or flood), a mutual decision between the participating agencies will be made whether or not to rehabilitate the project. If rehabilitated, the Federal share of rehabilitation would be the responsibility of the Corps of Engineers.

Performance evaluation, which includes monitoring of physical/chemical conditions and some limited biological parameters, would be a Corps responsibility, at least up through the authorized life of the UMRS-EMP. As noted earlier under "Project Performance Evaluation," monitoring performed after the authorized life of the UMRS-EMP would have to conducted by other agencies if it is to be accomplished.

Attachment 7 contains a draft copy of the formal agreement that would be entered into by the Corps of Engineers and the U.S. Fish and Wildlife Service. The Memorandum of Agreement formally establishes the relationships between the Department of the Army, represented by the Corps of Engineers, and the U.S. Fish and Wildlife Service in constructing, operating, and maintaining the proposed Pool 8 Islands Phase II project.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

The planning for the Pool 8 Islands Phase II project has been an interagency effort involving staff from the St. Paul District, the U.S. Fish and Wildlife Service, the National Biological Service, and the Wisconsin and Minnesota Departments of Natural Resources. Interagency coordination meetings were held on a periodic basis throughout the two-year study phase (table 16-1). In addition to the meetings noted in table 16-1, numerous informal meetings took place on a technical level to address specific problems, issues, and ideas.

Table 16-1
Coordination Meetings and Participants

Meeting Date	COE	FWS	NBS	WDNR	MDNR
December 16, 1993	x	x	x	x	x
February 23, 1994	x	x	x	x	x
April 19, 1994	x	x	x	x	x
May 23, 1994	x	x	x	x	x
August 15, 1994	x	x	x	x	x
October 31, 1994	x	x		x	x
December 8, 1994	x	x		x	x
February 15, 1995	x	x	x	x	x
May 11, 1995	x	x	x	x	x
August 16, 1995	x	x	x	x	
October 24, 1995	x	x	x	x	

A public meeting was held on December 8, 1994, in Stoddard, Wisconsin. The meeting was attended by 16 private citizens, including a Vernon County representative to the Wisconsin Conservation Congress and a representative of Ducks Unlimited (see attachment 9 for attendance list). At that time, the study process had evolved to the point where habitat problems had been documented and habitat goals and objectives for the project area had been developed. The salient point put forth by the private citizens in attendance was that habitat quality in the Stoddard Bay area was in decline and they would like to see a solution implemented as soon as possible.

A second public meeting was held on September 28, 1995 in Stoddard, Wisconsin. The meeting was attended by 21 private citizens, including individuals representing the Vernon County Board, the Village of Stoddard, the Town of Genoa, the Wisconsin Conservation Congress, the Vernon County

Conservation Alliance, and Ducks Unlimited (see attachment 9 for attendance list). At this meeting, information was presented on habitat changes, habitat problems, and habitat goals and objectives. The majority of the meeting was spent discussing the alternative plans for the Stoddard Bay area. The large majority of the private citizens attending this meeting preferred alternative G for Stoddard Bay. The private citizens indicated support for the seed islands, but expressed no strong views one way or another concerning the nesting island.

A third public meeting was held on April 10, 1996, in Stoddard, Wisconsin. The meeting was attended by 20 private citizens (see attachment 9 for attendance list). The public in attendance supported the recommended plan for Stoddard Bay (alternative G) and the seed islands. Some of those in attendance did not concur with the recommendation not to construct the nesting island.

The draft Definite Project Report/Environmental Assessment was sent to Congressional interests; Federal, State, and local agencies; special interest groups; interested citizens; and others as listed in attachment 9.

CONCLUSIONS

The Pool 8 Islands Phase II habitat rehabilitation and enhancement project provides the opportunity to restore habitat for fish, migratory birds, and other forms of fish and wildlife indigenous to the Upper Mississippi River. The loss of islands, decline in aquatic vegetation, and changes in bathymetry have significantly reduced the value of the Stoddard Bay area to fish and wildlife. Similar changes occurred throughout the lower reaches of pool 8.

A number of measures are aimed at correcting existing habitat problems and improving habitat conditions. Construction of the proposed islands and rock sills will reduce flows through Stoddard Bay, significantly improving winter habitat conditions for the backwater fish community. The project will reduce flows and reduce the effects of wind and wave action in Stoddard Bay which is expected to substantially improve conditions for the growth of aquatic plants. The islands themselves will provide habitat for wildlife and improve overall habitat diversity in the Stoddard Bay area. The borrow dredging for island construction will provide additional fish habitat benefits in Crosby Slough and Stoddard Bay.

The seed islands are expected to provide benefits to fish and wildlife similar to those provided by the Stoddard Bay islands, though on a much smaller scale, commensurate with the size and cost of these structures. Construction of these structures will also provide a unique opportunity to learn how to use natural riverine forces to restore and improve habitat conditions.

The habitat benefits that would be gained by the Upper Mississippi River System from implementation of the recommended project justify expenditure of public funds for preparation of plans and specifications and for construction.

RECOMMENDATION

I have weighed the accomplishments to be obtained from the Pool 8 Islands Phase II habitat project against its cost and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the cost of the project is a justified expenditure of Federal funds. I recommend that construction of the habitat rehabilitation and enhancement features of the Pool 8 Islands Phase II project be approved at a total estimated cost of $4,057,000, which would be a 100-percent Federal cost according to Section 906(e)(3) of the 1986 Water Resource Development Act, as amended.

J.M. Wansik
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

Management and Evaluation Branch
Engineering and Planning Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act, the St. Paul District, Corps of Engineers has assessed the impacts of the following project.

POOL 8 ISLANDS - PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN

The intent of the proposed project is to improve fish habitat and breeding, resting and feeding habitat for migratory birds, especially waterfowl, on the Upper Mississippi River near Stoddard, Wisconsin The proposed project involves the construction of a combination of islands and rock sills to reduce flows into the Stoddard Bay area and to reduce wind fetch. The project would improve fish habitat on approximately 500 acres in Stoddard Bay by improving winter habitat conditions and would improve waterfowl migration habitat by creating conditions favorable for aquatic vegetation growth. A series of small rock islands would also be constructed adjacent to the right descending bank of the main channel immediately across and slightly downstream of Stoddard, Wisconsin. These islands would create areas of accretion resulting in the gradual development of up to 60 acres of islands. These islands would provide habitat for a wide variety of wildlife and would improve aquatic habitat by creating conditions favorable for aquatic vegetation growth. This Finding of No Significant Impact is based on the following factors: the proposed project would have beneficial impacts on wildlife and fishery resources; the project would have no impacts on the cultural environment; the project would have no impacts on the social environment; the project would have no impacts on the aesthetic/recreation environment; and continued coordination will be maintained with appropriate State and Federal agencies.

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the environment. Therefore, an environmental impact statement will not be prepared.

3 JUNE 96
Date

J. M. Wonsik
Colonel, Corps of Engineers
District Engineer

Printed on Recycled Paper

BIBLIOGRAPHY

Barko, J.W., R.F. Gaugush, W.F. James, B.J. Johnson, T.J. Naimo, J.T. Rogala, S.J. Rogers, and D.M. Soballe. 1993. Hydrologic modification for habitat improvement in the Finger Lakes: Pre-project Report Number 2, 1993. U.S. Fish and Wildlife Service Environmental Management Technical Center, Onalaska, Wisconsin; U.S. Fish and Wildlife Service National Fisheries Research Center, La Crosse, Wisconsin; and U.S. Army Corps of Engineers, Waterways Experiment Station, Eau Galle Limnological Laboratory, Spring Valley, Wisconsin. EMTC 93-T002. 57 pp.

Devendorf, Randall D. 1995. A Migratory Habitat Model for Diving Ducks using the Upper Mississippi River. St. Paul District, Corps of Engineers. 9 pp.

Edwards, E.A., D.A. Krieger, M. Bacteller, and O.E. Maughan. 1982. Habitat suitability index models: Black Crappie. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.6. 25 pp.

James, William F. and John W. Barko. 1990. Macrophyte influences on the zonation of sediment accretion and composition in a north-temperate reservoir. Arch. Hydrobiol. 120:2. pages 129-142. Stuttgart, December 1990.

Janvrin, Jeffrey A. 1995. Wisconsin Department of Natural Resources Mississippi River habitat specialist. Personal communication.

Nelson, J.S. and J.F. Wetzel. 1995. Summary report. Long-term monitoring of nesting mallards on Mississippi River islands. Wisconsin Department of Natural Resouces (unpublished). 12 pp.

Palesh, Gary D. and Dennis D. Anderson. 1990. Modification of the Habitat Suitability Index Model for the Bluegill (Lepomis macrochirus) for Winter Conditions for Upper Mississippi River Backwater Habitats. St. Paul District, Corps of Engineers. 8 pp.

Pitlo, John. 1994. Wintering areas: limiting habitat for Largemouth bass?, in Proceedings of the Fiftieth Annual Meeting of the Upper Mississippi River Conservation Committee, pp. 59-62. Upper Mississippi River Conservation Committee.

Richardson, L.A.H., and T.L. Clemment. 1993. A summary of water quality characteristics at selected habitat sites in Navigation Pool 8 of the Mississippi River from July 17, 1988, to December 31, 1990. Report by the Wisconsin Department of Natural Resources, Onalaska, Wisconsin, for the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-S009. 21 pp.

Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982a. Habitat suitability index models: Largemouth Bass. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.16. 32 pp.

Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982b. Habitat suitability index models: Bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8. 26 pp.

Welke, Kurt I. 1993. Winter Centrarchid Habitat Use (draft). Wisconsin Department of Natural Resources. 18 pp.

Wetzel, John. 1994. Wisconsin Department of Natural Resources wildlife manager. Personal communication.

Wetzel, J., J.S. Nelson, and R. Dahlgren. 1989. Survey of waterfowl nesting success on UMR islands and implications for habitat projects, in Proceedings of the Forty-Fifth Annual Meeting of the Upper Mississippi River Conservation Committee, pp. 97-103. Upper Mississippi River Conservation Committee.

Wilcox, Daniel B. 1993. An aquatic habitat classification system for the upper Mississippi River system. U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-T003.

ATTACHMENT 1

PLATES

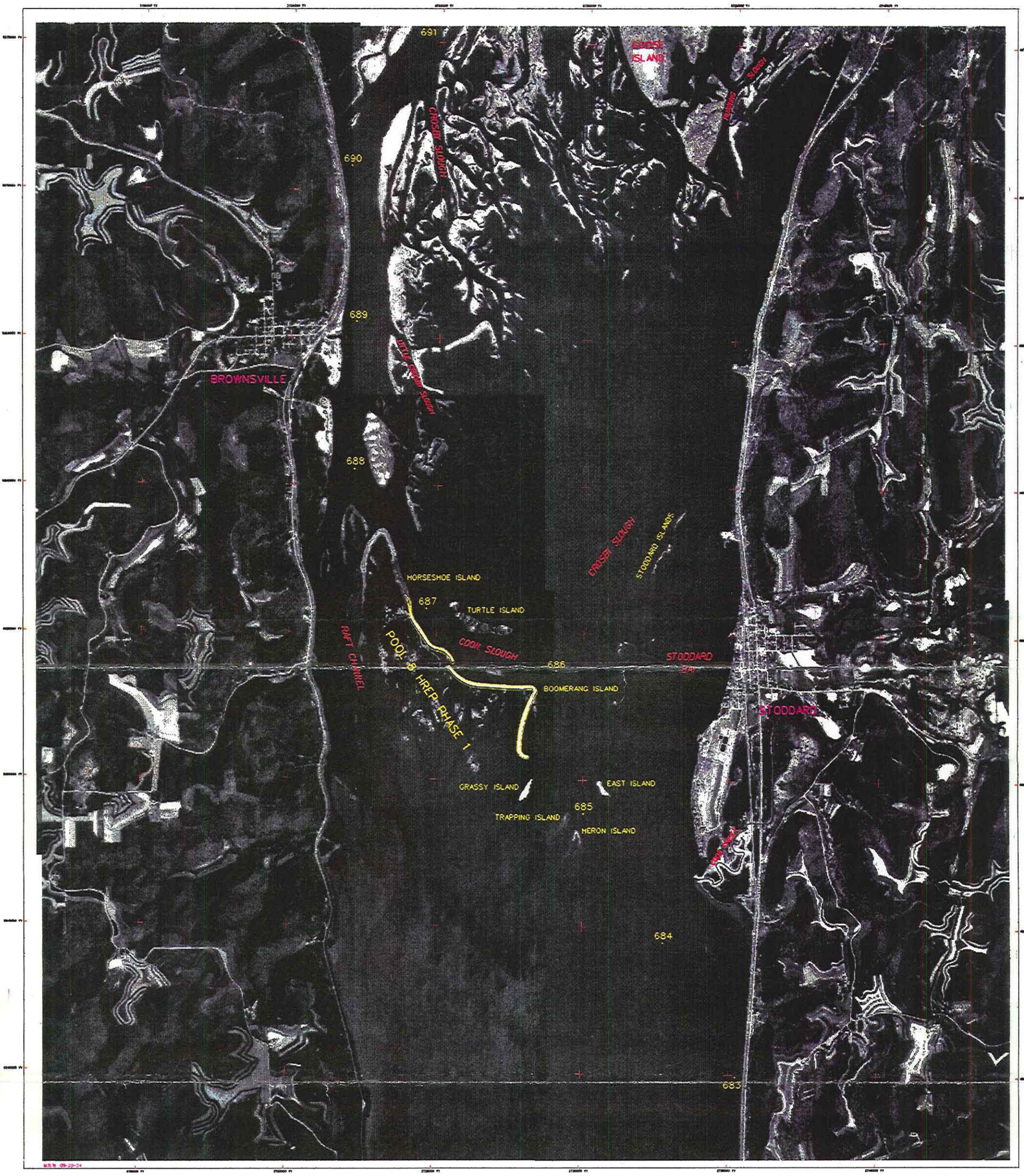
UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

US Army Corps of Engineers
St Paul District

LOCATION MAP

PLATE 1



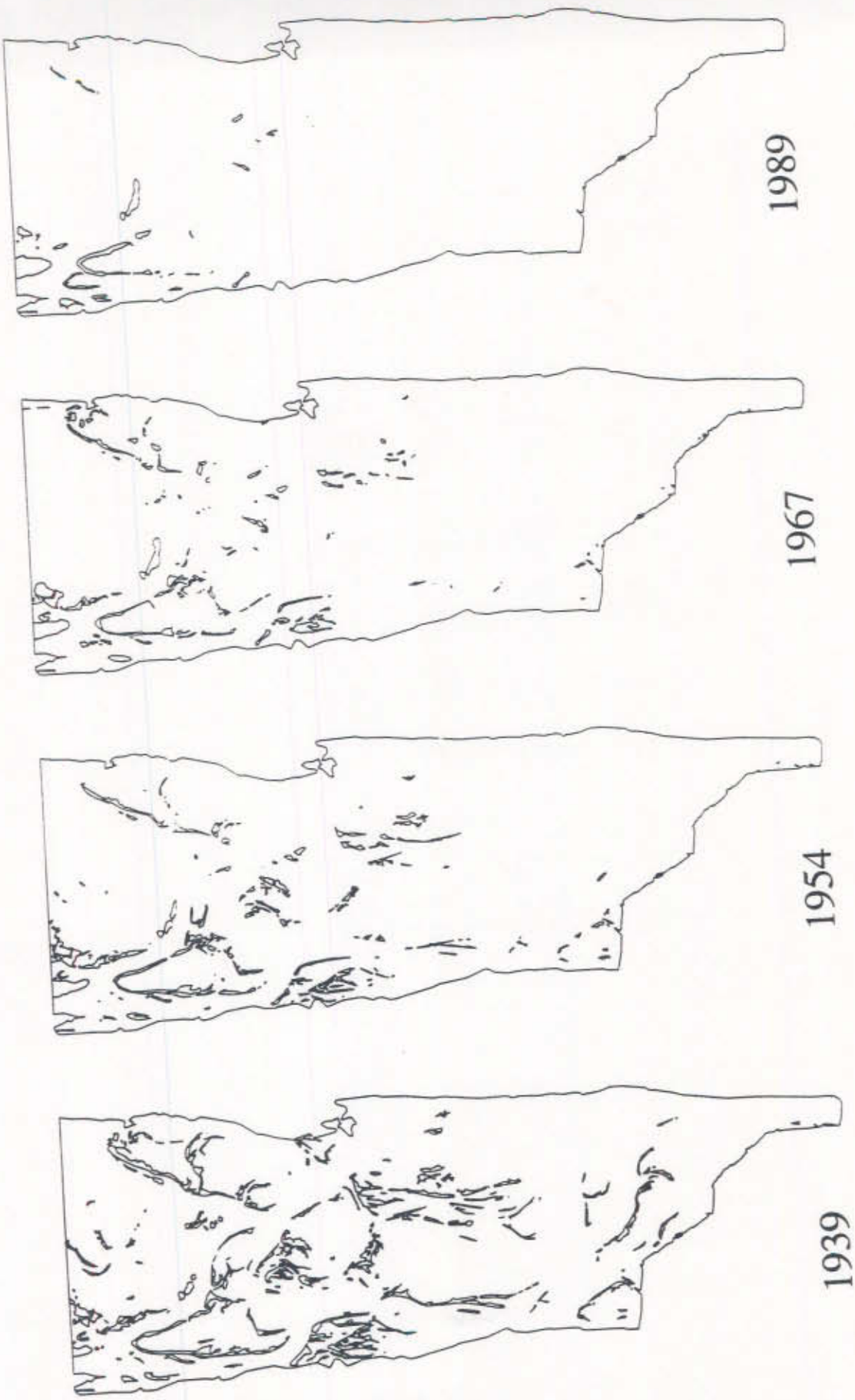
COORDINATE SYSTEM ..... STATE PLANE MINNESOTA SOUTH
GEODETIC DATUM ..... NORTH AMERICAN 1927
ELLIPSOID ..... CLARKE 1866

5000 0 5000 10000 FEET

RECTIFIED PHOTO BASE
POOL 8 NAPP IMAGERY
(5485-216,217 MAY 5, 1992)
(5467-29,30 MAY 6, 1992)
POOL 8 EMTC IMAGERY
(0195 AUGUST 4, 1993)

PRODUCED BY ST.PAUL DISTRICT, GIS CENTER, U.S. ARMY CORPS OF ENGINEERS, JULY 1994.

Plate 2. Lower Pool 8



Source: EMTC

Plate 3. Lower Pool 8 Island Loss

Plate 4a. Stoddard Bay (May 1939)

Plate 4b. Stoddard Bay (Aug 1973)

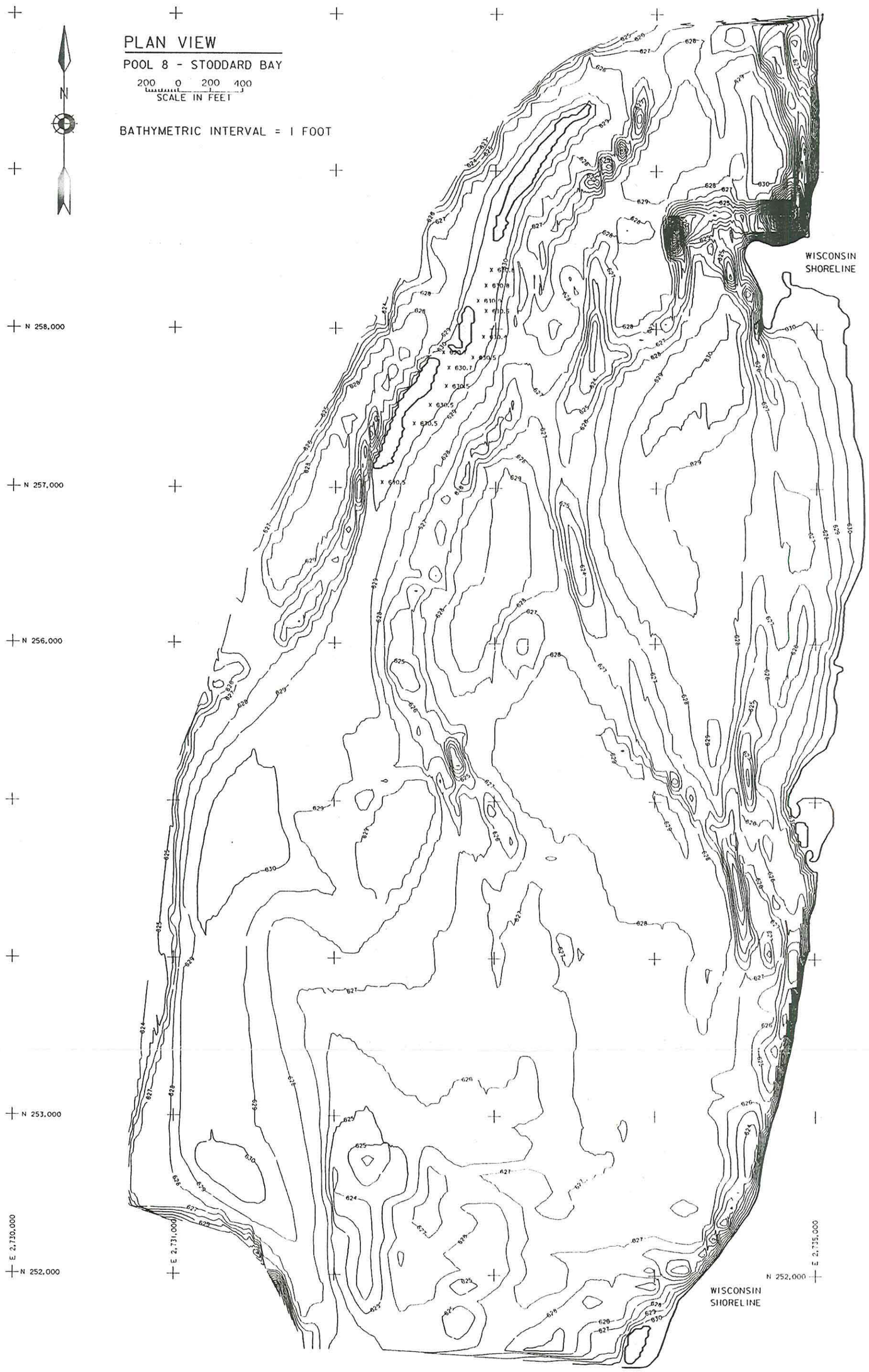
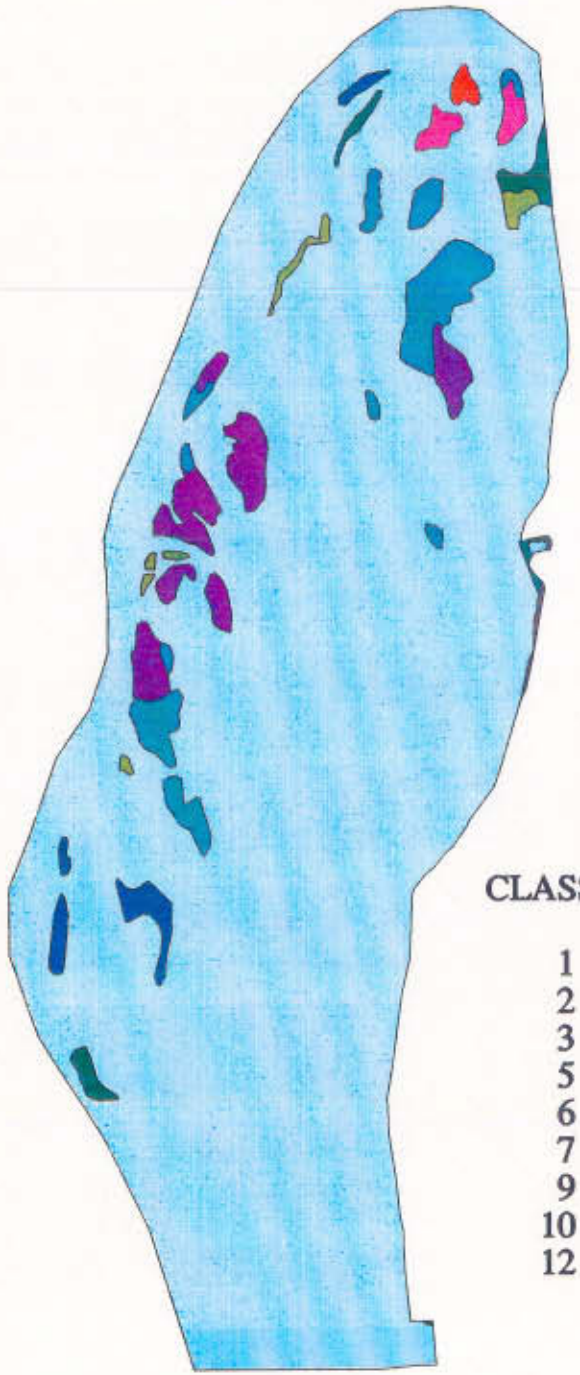


Plate 5. Stoddard Area Bathymetry

Plate 6. Stoddard Area Aquatic Vegetation (1991)



- Class 1 = Open water
- Class 2 = Submergents
- Class 3 = Submergents - rooted floating aquatics
- Class 4 = Submergents - rooted floating aquatics - emergents
- Class 5 = Rooted floating aquatics
- Class 6 = Rooted floating aquatics - emergents
- Class 7 = Emergents
- Class 8 = Emergents - annual/perennial grasses/forbs
- Class 9 = Annual/perennial grasses/forbs
- Class 10 = Woody terrestrial
- Class 11 = Agriculture
- Class 12 = Urban/developed
- Class 13 = Sand/mud/rock

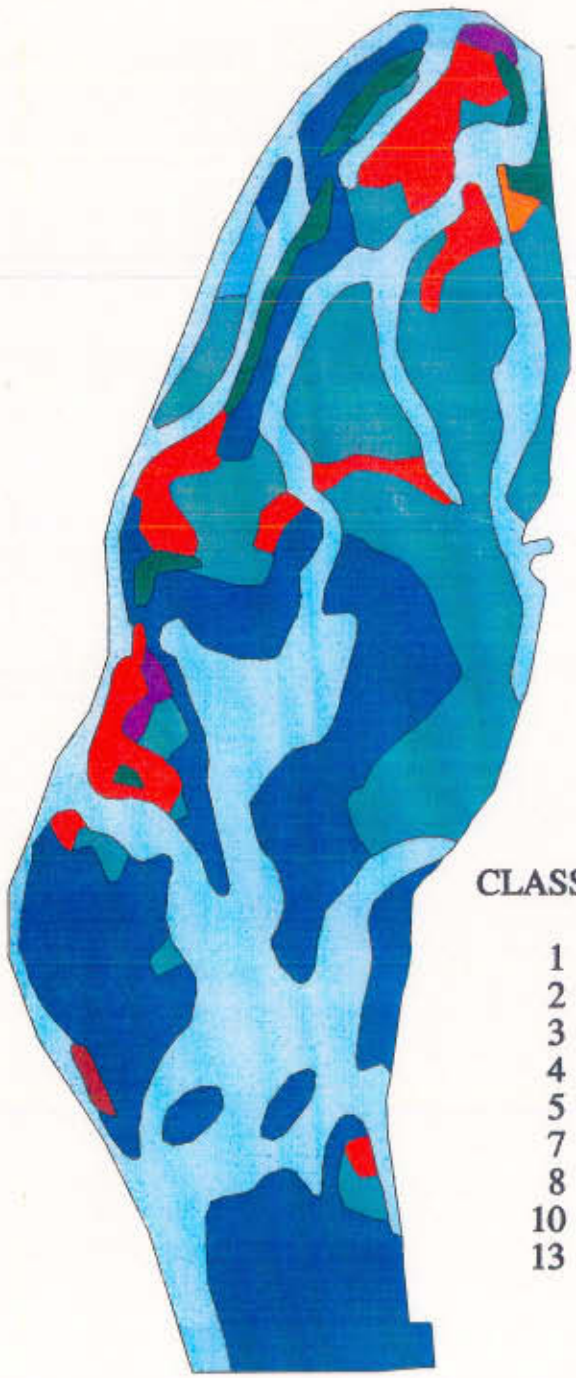
Phase 2

CLASS	FREQ.	ACRES
1	3	953.36
2	4	8.74
3	11	30.74
5	8	27.11
6	2	4.90
7	1	1.72
9	7	5.16
10	5	7.59
12	4	1.20
	45	1,040.57

Data Source:

Base map data were interpreted from 1:15,000 stereo color infrared photographs at the National Ecology Research Center, Fort Collins, Colorado, and the Environmental Management Technical Center, Onalaska, Wisconsin. Interpreted data were then transferred manually to 1:15000 blowups of 7.5-minute USGS quadrangles using a zoom transfer scope. Transferred data were manually digitized and generated into ARC/INFO coverages. The original base map used for this project contained 34 unique vegetation types or vegetation combinations. The order in which plant combinations are listed does not reflect plant dominance. The minimum mapping unit of the computerized data is 1 acre and 10% vegetation cover.

Plate 7. Stoddard Area Aquatic Vegetation (1975)



1 km

- Class 1 = Open water
- Class 2 = Submergents
- Class 3 = Submergents - rooted floating aquatics
- Class 4 = Submergents - rooted floating aquatics - emergents
- Class 5 = Rooted floating aquatics
- Class 6 = Rooted floating aquatics - emergents
- Class 7 = Emergents
- Class 8 = Emergents - annual/perennial grasses/forbs
- Class 9 = Annual/perennial grasses/forbs
- Class 10 = Woody terrestrial
- Class 11 = Agriculture
- Class 12 = Urban/developed
- Class 13 = Sand/mud/rock

Phase 2

CLASS	FREQ.	ACRES
1	1	365.85
2	15	326.27
3	15	233.19
4	1	4.88
5	2	6.93
7	9	72.07
8	1	2.66
10	6	25.84
13	1	2.84
	51	1,040.57

Data Source:

Data used to create this coverage were collected and automated as part of the GREAT I river project of the 1970's. Data were interpreted from 1:9,600 scale color infrared photography taken in Sept. 1975. Interpreted data were transferred to 1:24,000 scale USGS quad maps. As the data were transferred, they were generalized to create a coverage with a minimum mapping unit of 2.5 acres. Some polygons smaller than 2.5 acres and linear features were incorporated into nearby polygons. Others were manually enlarged so data contained within would be preserved. All generalizations were made in accordance with guidelines established for GREAT I project. Data were automated into the PIOS GIS program by GREAT I, and converted to ARC/INFO by the EMTC. For the purpose of the map, the data were generalized from the original 29 classes of land cover/land use to the 13 represented here. The order in which plant combinations are listed does not reflect plant dominance.

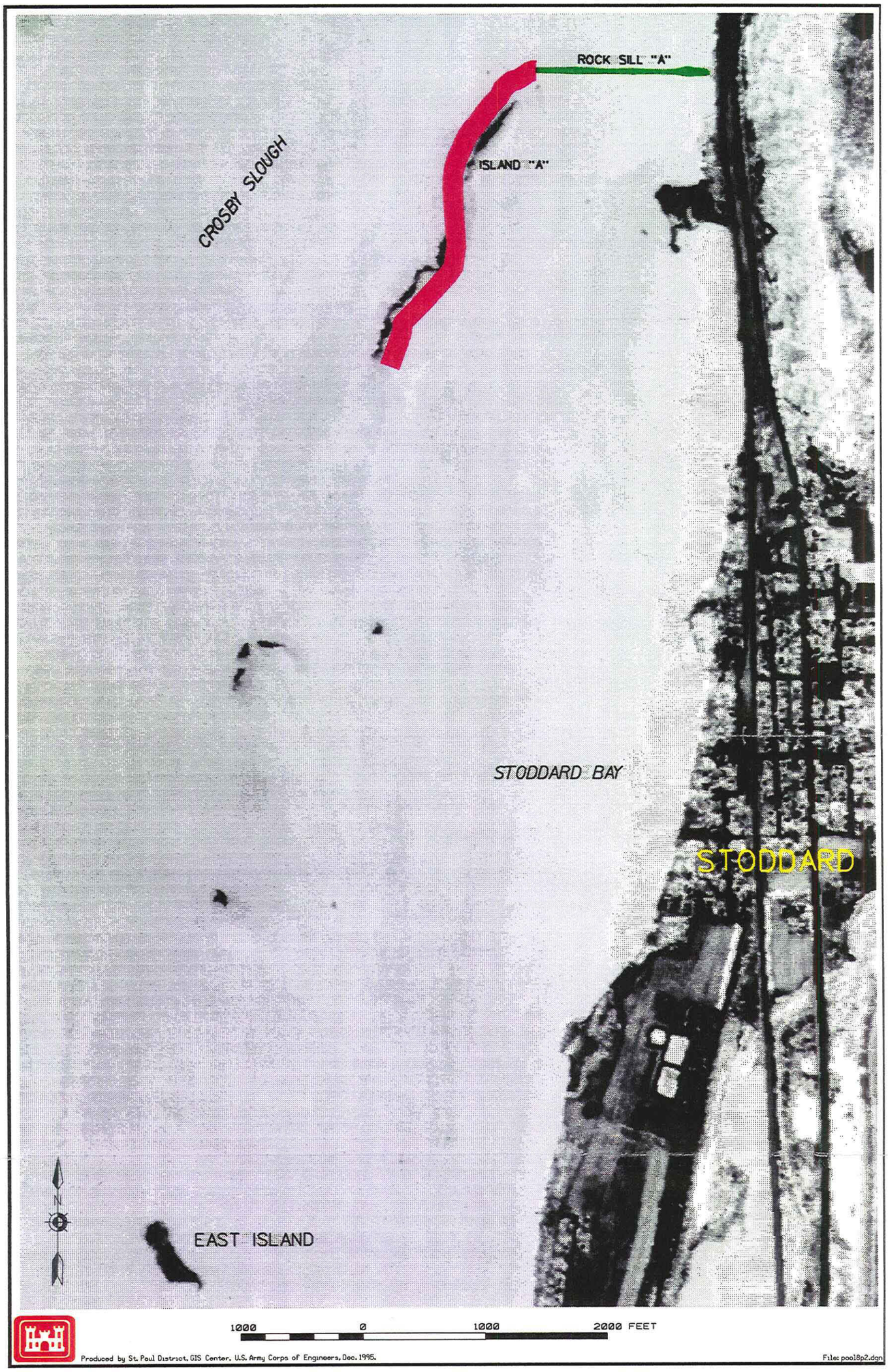


Plate 8. Alternative A

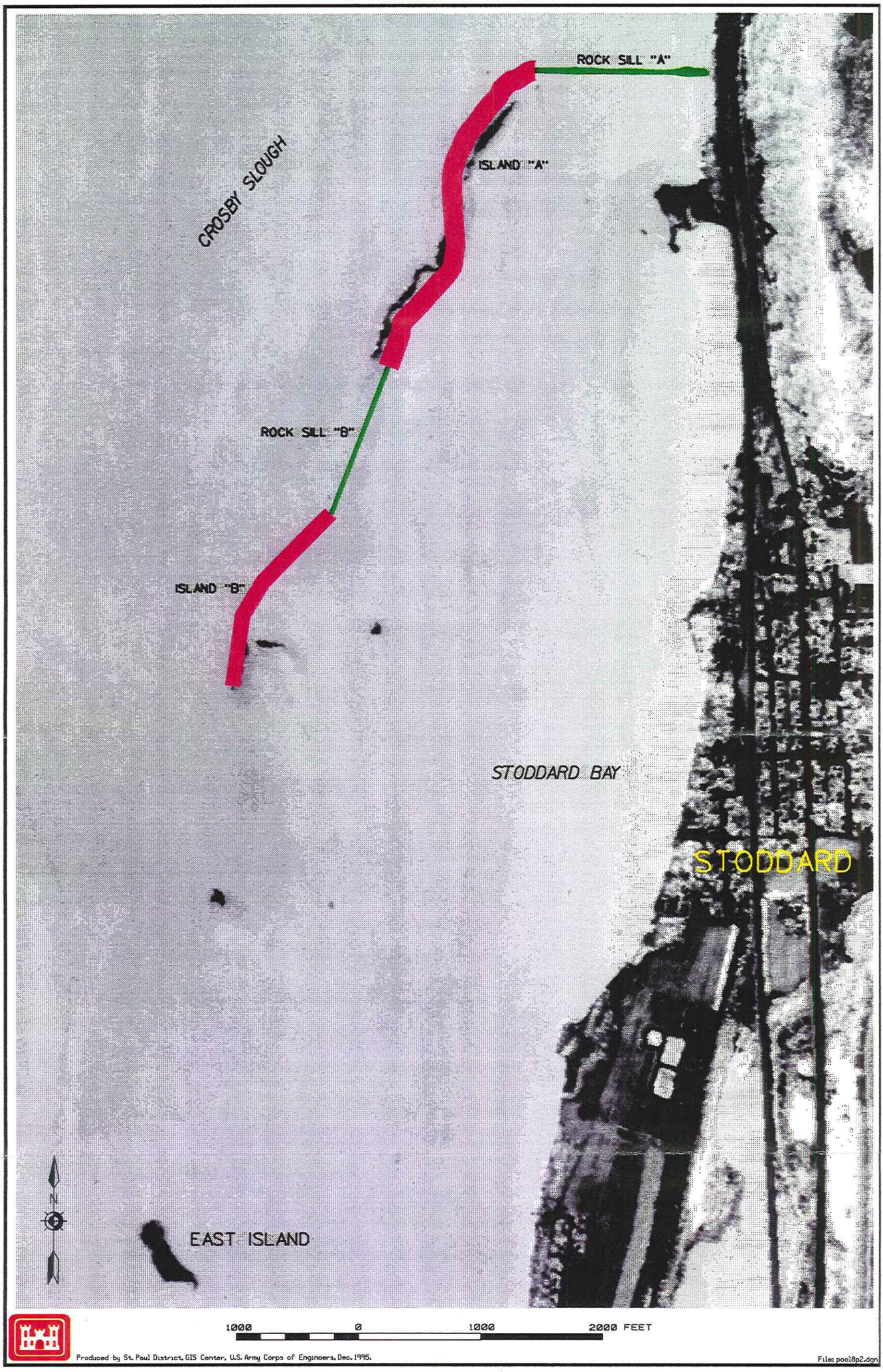


Plate 9. Alternative B

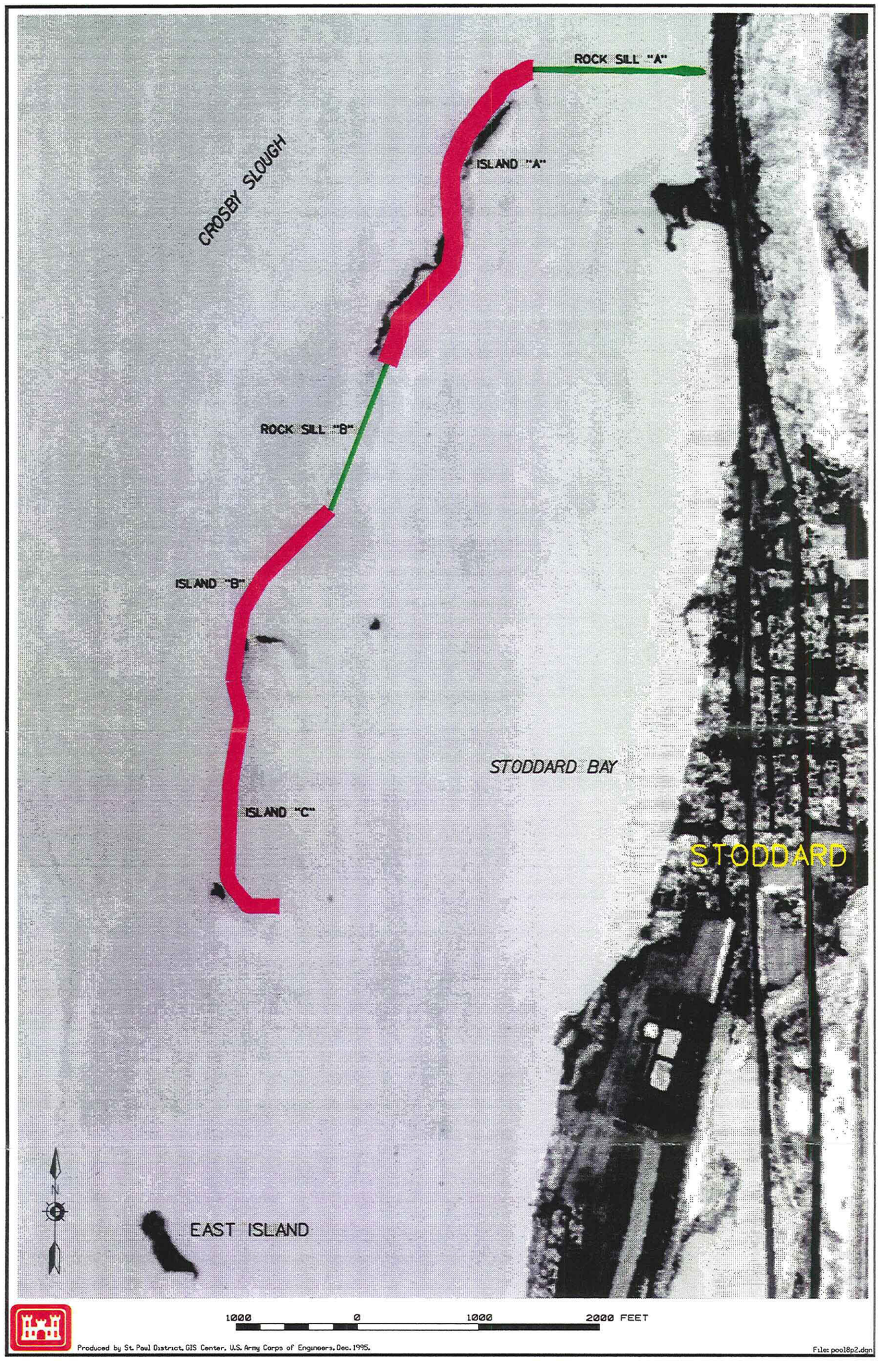


Plate 10. Alternative C

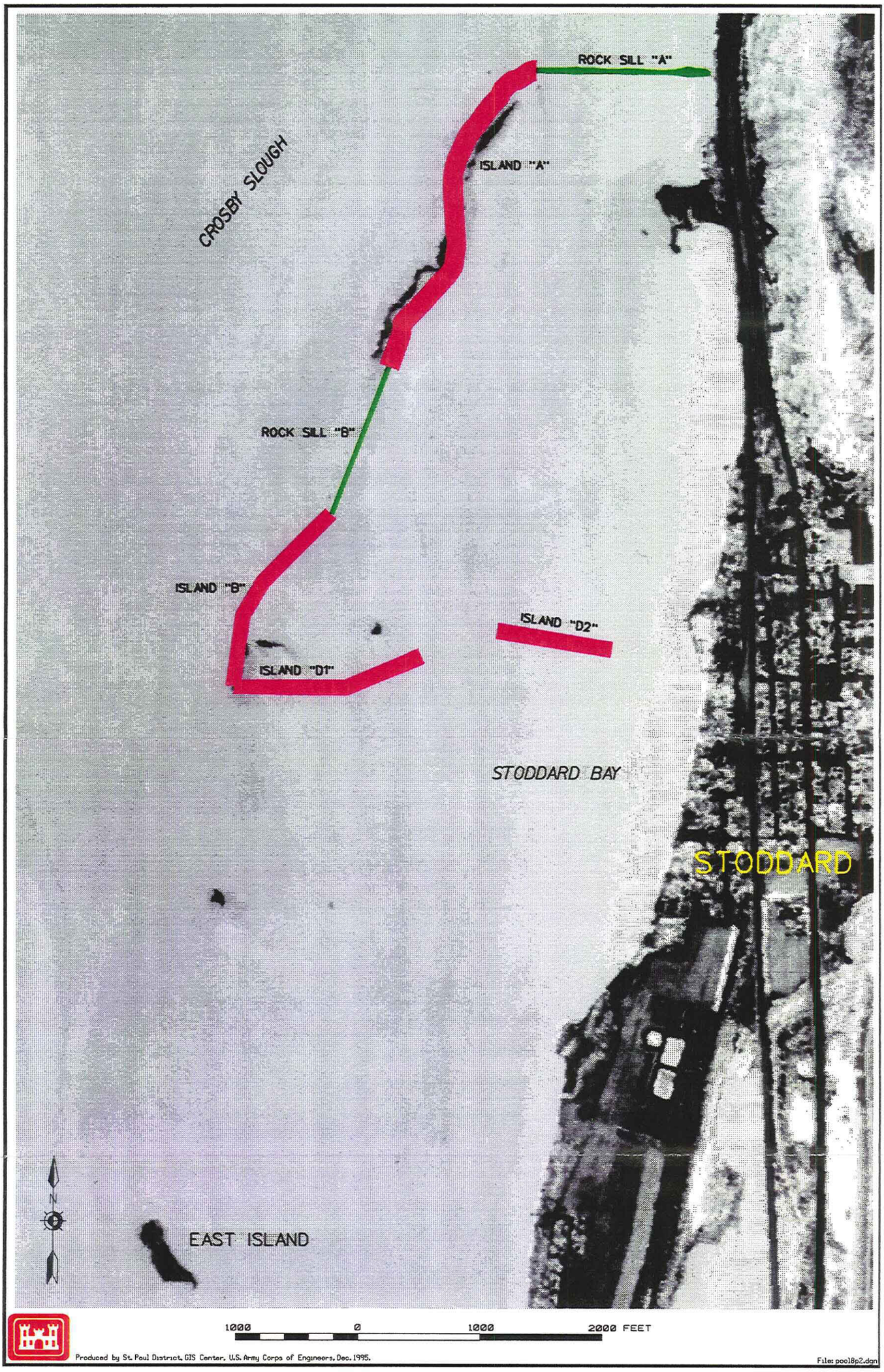


Plate 11. Alternative D

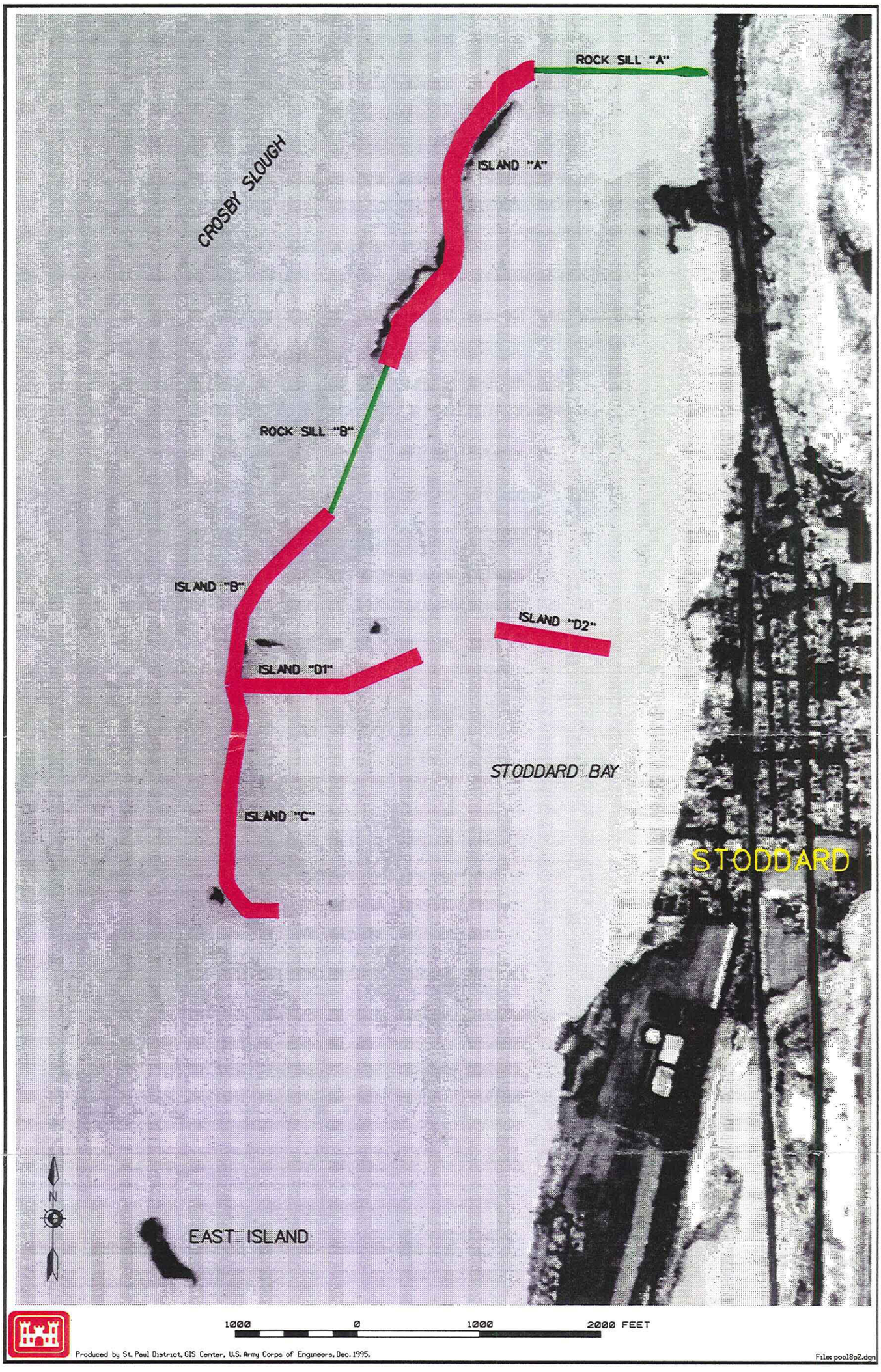


Plate 12. Alternative E

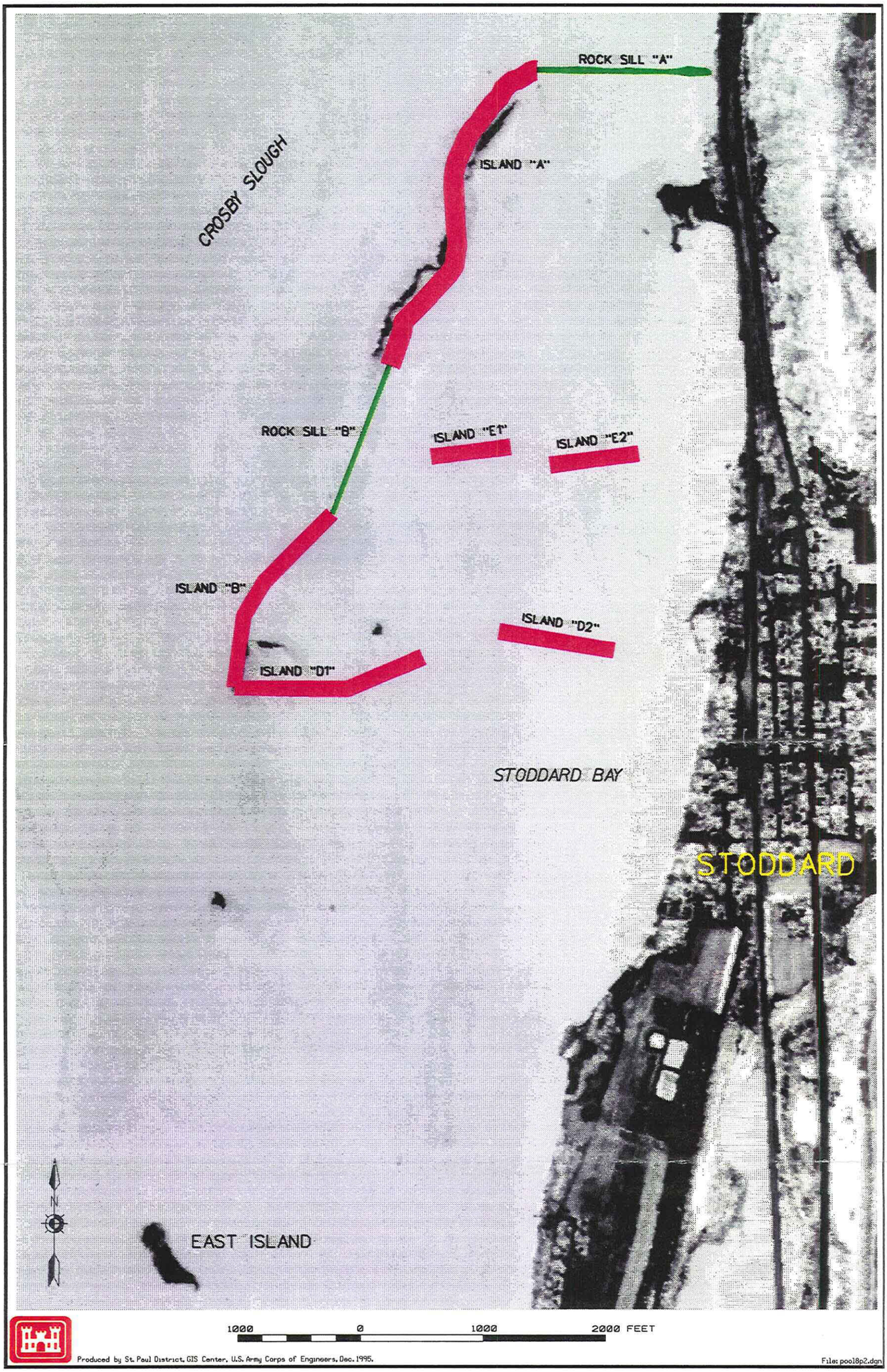


Plate 13. Alternative F

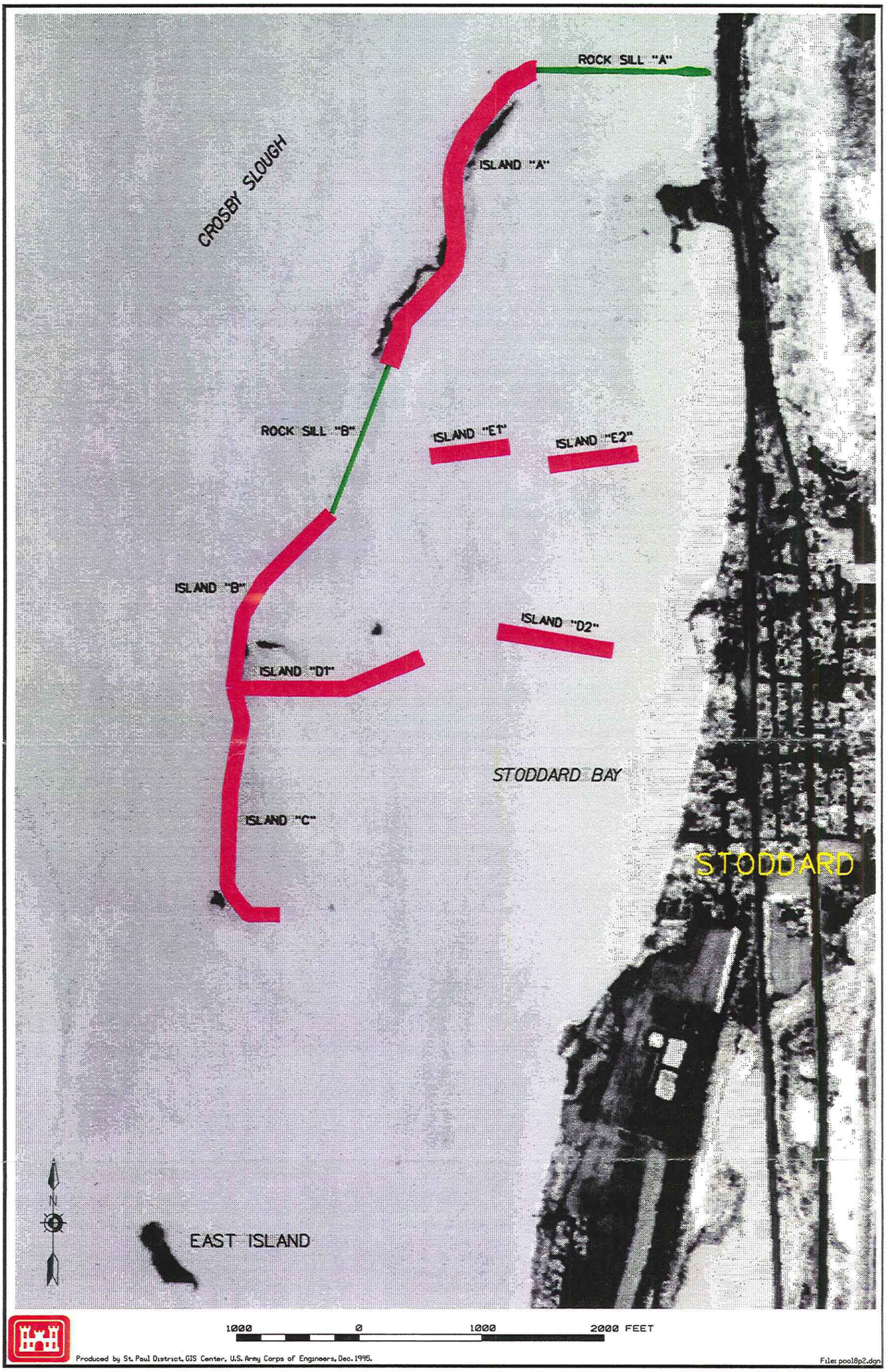
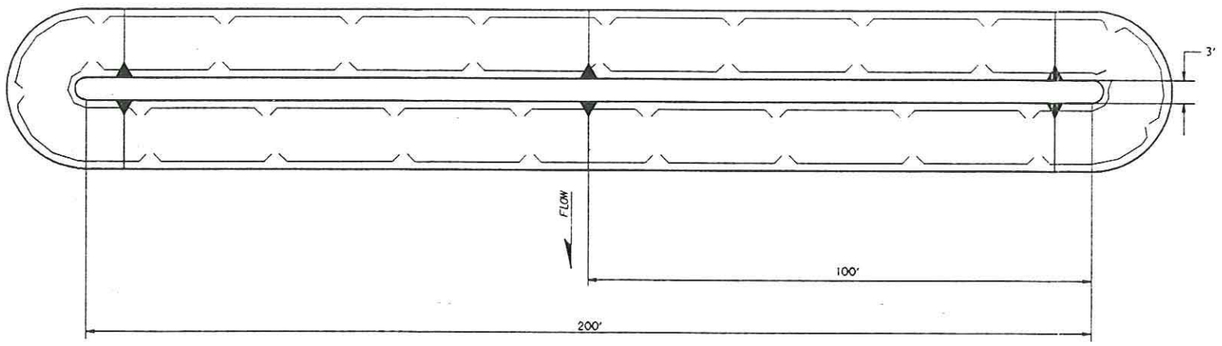
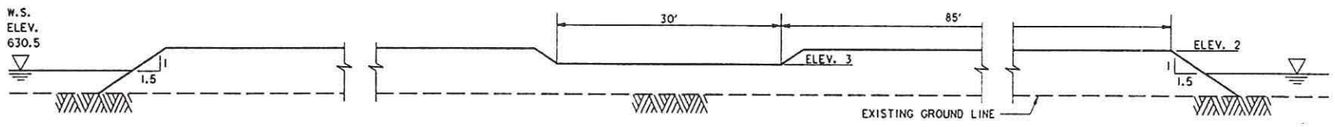


Plate 14. Alternative G

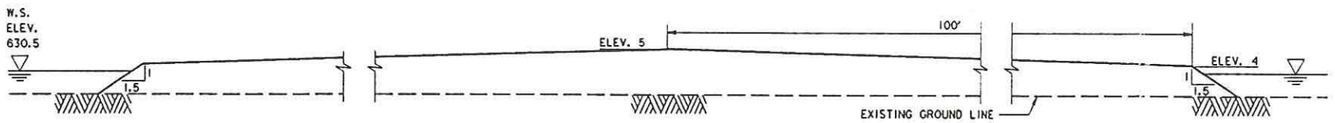


PLAN VIEW
SEED ISLAND
SCALE: NONE

PROFILE - FLAT SEED ISLAND
ISLANDS 5, 7, 10 & 11
SCALE: NONE

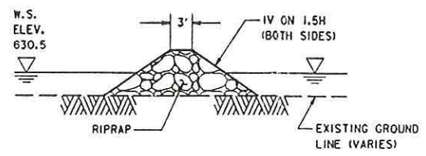


PROFILE - NOTCHED SEED ISLAND
ISLAND 6
SCALE: NONE



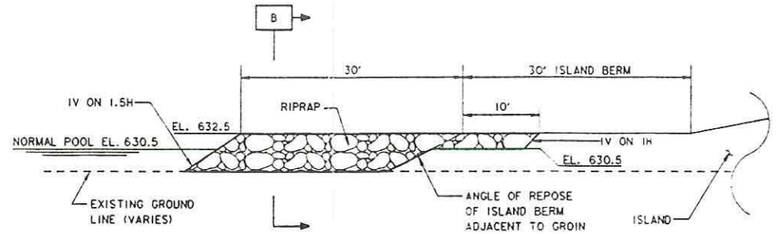
PROFILE - PEAKED SEED ISLAND
ISLAND 9
SCALE: NONE

ISLAND	ISLAND TYPE	ELEV. 1	ELEV. 2	ELEV. 3	ELEV. 4	ELEV. 5
5	FLAT	633.5				
6	NOTCH		633.5	633.5		
7	FLAT	633.5				
9	PEAK				631.5	633.5
10	FLAT	633.5				
11	FLAT	633.5				

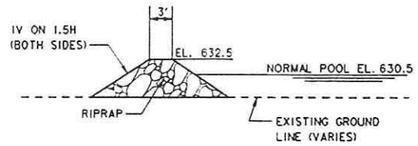


TYPICAL SECTION
SEED ISLAND
SCALE: NONE

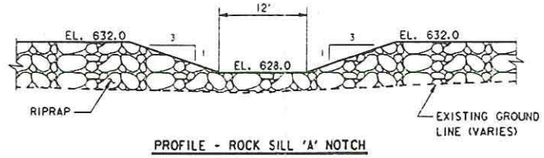
*** ASSUME ONLY 6 SEED ISLANDS FOR PRELIMINARY DRAFT REPORT (11-28-95)



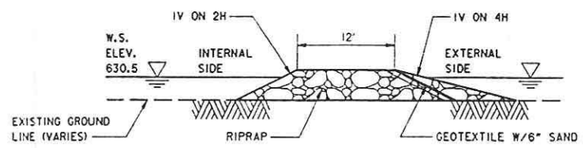
DETAIL
RIPRAP GROIN
SCALE: NONE



SECTION
RIPRAP GROIN
SCALE: NONE



PROFILE - ROCK SILL 'A' NOTCH
SCALE: NONE



TYPICAL SECTION
ROCK SILL
SCALE: NONE

NOTES:
1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).

REFERENCES:
ISLAND PLAN AND CONTROL DATA

DWG. NO.
XX/XX

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

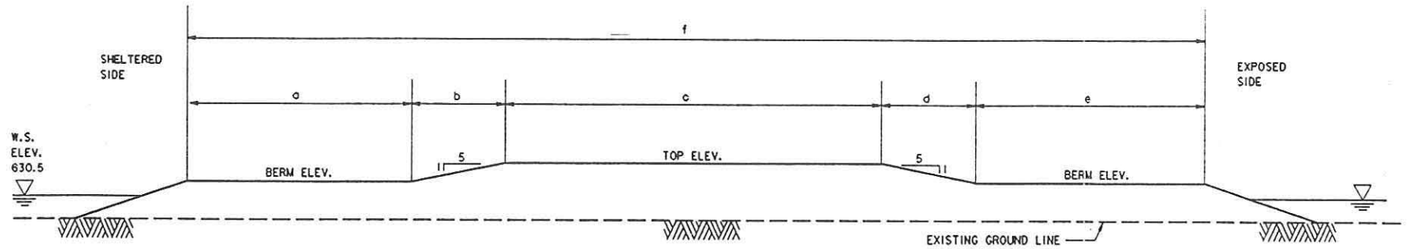
AE APPROVING OFFICIAL:

REPORT DRAWING
POOL 8 ISLANDS - PHASE II
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN
ISLAND CONSTRUCTION
ROCK STRUCTURES

PE-D: DESIGNED: JJG/JJF; CHECKED: JBM/DWR; DRAWN: JJG
PE-H: DESIGNED: JSH; CHECKED: PMF

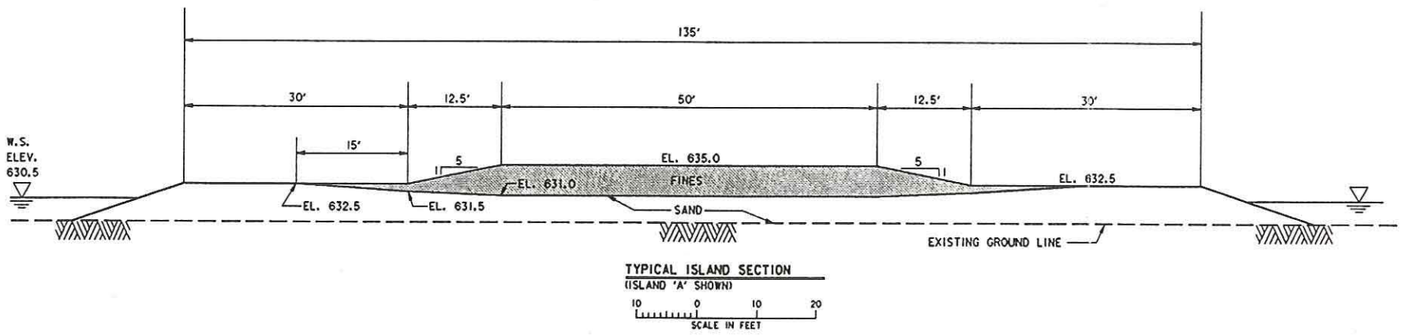
CAD FILE NAME: DPRSECT2.DGN
DRAWING NUMBER: PLATE 15.
SHT 2 OF 2
DATE: 05-02-96
SPEC NO: DACW37-96-B-00XX

GEN ENG
HYD
HYDR
GEOTECH
STR ENG
MEA



TYPICAL ISLAND SECTION
(NOT TO SCALE)

ISLAND DIMENSIONS	a (FT)	b (FT)	c (FT)	d (FT)	e (FT)	TOP ELEV.	BERM ELEV.	f (FT)
ISLAND A	30	12.5	50	12.5	30	635.0	632.5	135
ISLAND B	20	7.5	30	7.5	30	634.0	632.5	95
ISLAND C U.S. 1,185 LF	30	5.0	30	5.0	30	633.5	632.5	100
ISLAND C D.S 1,000 LF	30	2.5	30	2.5	30	633.0	632.5	95
INTERIOR ISLAND D1	20	7.5	30	7.5	30	634.0	632.5	95
INTERIOR ISLANDS D2, E1, & E2	20	12.5	30	12.5	30	635.0	632.5	105
NESTING ISLANDS	20	12.5	30	12.5	30	635.0	632.5	105



TYPICAL ISLAND SECTION
(ISLAND 'A' SHOWN)

10 0 10 20
SCALE IN FEET

NOTES:
1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).

REFERENCES:
ISLAND PLAN AND CONTROL DATA

DWG. NO.
XX/XX

GEN ENG
HYD
HYDR
GEOTECH
STR ENG
MEA

SYMBOL	DESCRIPTION	DATE	APPROVAL

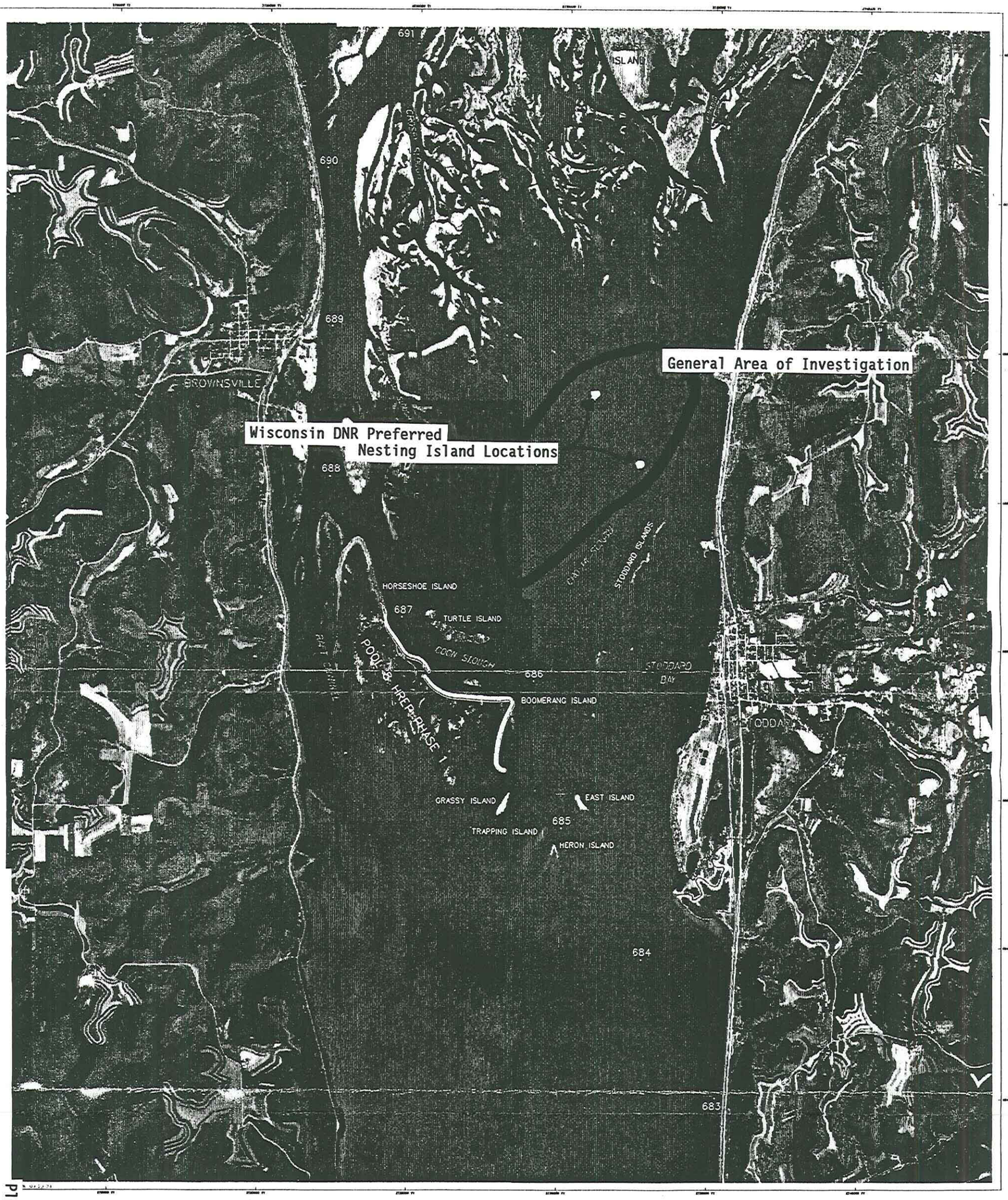
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

REPORT DRAWING
POOL 8 ISLANDS - PHASE II
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN
ISLAND CONSTRUCTION
TYPICAL ISLAND SECTIONS
A, B, C, INTERIOR AND NESTING ISLANDS

PE-D: DESIGNED: JJG/JJF; CHECKED: JBM/DWR; DRAWN: JJG
PE-H: DESIGNED: JSH; CHECKED: PMF
DATE: 11-28-95

Plate 16. Island Cross Sections



ATE SYSTEM ..... STATE PLANE MINNESOTA SOUTH
C DATUM ..... NORTH AMERICAN 1927
ID ..... CLARKE 1866

RECTIFIED PHOTO BASE
POOL 8 NAPP IMAGERY
(5485-216,217 MAY 5, 1992)
(5467-29,30 MAY 6, 1992)
POOL 8 EMTC IMAGERY
(0195 AUGUST 4, 1993)

PRODUCED BY ST.PAUL DISTRICT, GIS CENTER, U.S. ARMY CORPS OF ENGINEERS, JULY 1994.

Plate 17. Nesting Island Study Area

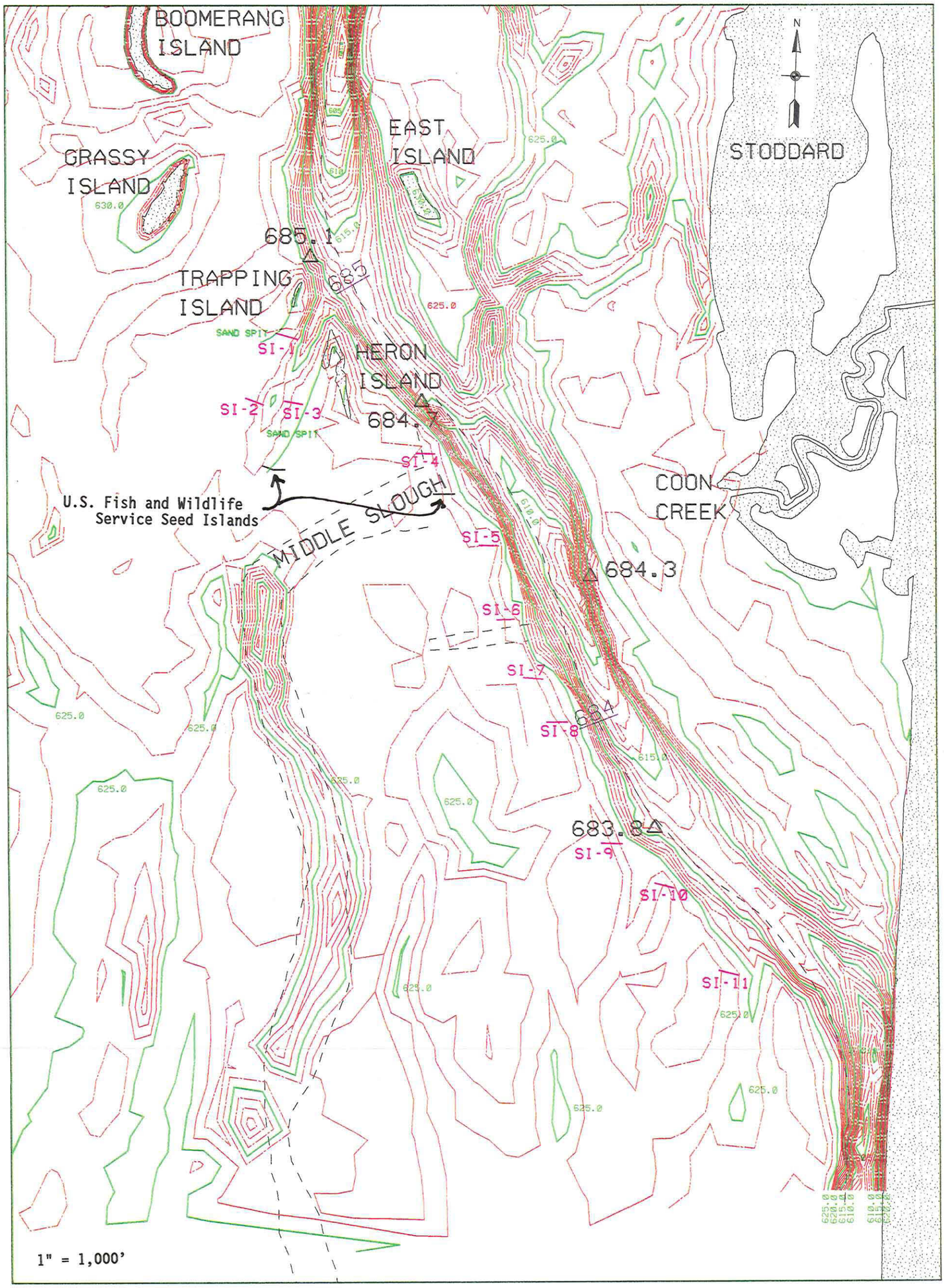


Plate 18. Seed Islands Study Area

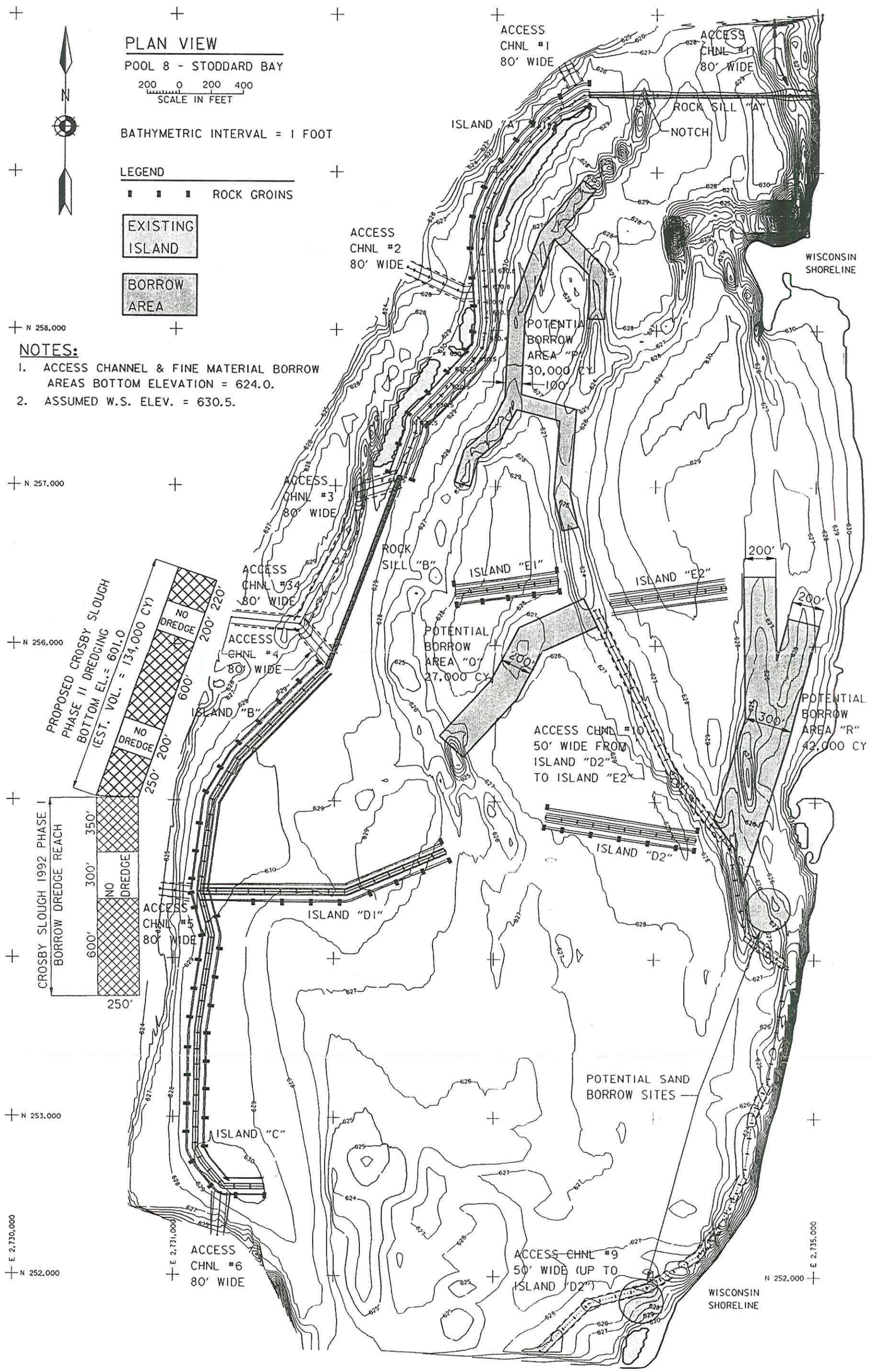


Plate 19. Selected Plan for Stoddard Bay Area

ATTACHMENT 2

COST ESTIMATE

POOL 8 ISLANDS - PHASE II

DEFINITE PROJECT REPORT

DETAILED COST ESTIMATE

ATTACHMENT 2

Table of Contents

Section		Page
2.1	General.	2-1
2.2	Price Level	2-1
2.3	Project Description	2-1
2.4	Cost Relationships	2-2
2.5	Contingency Discussion	2-2
2.6	Construction Methods	2-3
2.7	Attachments.	2-3

ATTACHMENTS

2-1	Total Project Cost Summary	2-4
2-2	Detailed Summary	2-5

ATTACHMENT 2

DETAILED COST ESTIMATE

2.1 GENERAL

2.1.1. This attachment contains a summary of the detailed cost estimates prepared for the Pool 8 Islands Phase II EMP project in Pool 8 of the Upper Mississippi River, near Stoddard Wisconsin. The estimates include construction, planning, engineering and design, and construction management costs. The estimates prepared for this report were developed after review of project plans, discussions with the design team members, and review of costs for similar construction projects. Guidance for the preparation of the estimates and attachment was obtained from ER 1110-2-1150, Engineering and Design for Civil Works Projects and ER 1110-2-1302, Civil Works Cost Engineering. The estimates were prepared using Micro-Computer Aided Cost Estimating System (MCACES) and are presented in accordance with the Civil Works Breakdown Structure as presented in the Models database for MCACES.

2.1.2. Six alternatives were estimated for this Definite Project Report and are included in this attachment. The recommended alternative, Alternative G, includes all of the islands being considered for the project while the remaining alternatives were developed by selecting various combinations of the islands. The estimates for the other alternatives are included to show the incremental cost of adding the islands that make up the entire project. In addition, estimates for two other separable features, the Nesting and Seed Islands, are included. These estimates were included to provide cost information should the project proponents elect to add these features to the project. An operation and maintenance for Alternative G was also prepared. All work is on lands under Federal Government ownership so no Lands and Damages costs are included in any of the alternatives.

2.2 PRICE LEVEL

2.2.1. Project element costs are based on November 1995 prices unless noted otherwise in the project cost summary and incorporate local wage and equipment rates. These costs are considered fair and reasonable to a prudent and capable contractor and include overhead and profit. Estimated costs on the Total Project Cost Summaries are rounded to the nearest $1,000.00.

2.3 PROJECT DESCRIPTION

2.3.1. This project is the second phase of island construction in Pool 8 of the Upper Mississippi River. A series of islands and rock sills will be constructed on the Wisconsin side of the river channel near Stoddard Wisconsin across the main channel from the islands constructed during Phase I.

2.3.2. The purpose of this project is to improve fish and wildlife habitat in Pool 8. This will be accomplished by constructing a series of islands separating a backwater area from the main river channel and dredging within the backwater area. Two rock sills will also be constructed to allow flow into the lake created by the island chain. The work consists mainly of hydraulic dredging and placement of sand for the construction of islands, mechanical dredging and placement of fines for topsoil, placing rock sills and rockfill shore protection.

2.3.3. The main report and other attachments contain more detailed descriptions of the project features and addresses their intended function.

2.4 COST RELATIONSHIPS

2.4.1. Two mobilization and demobilization items were included to represent the costs associated with using both mechanical and hydraulic plant on the project. Mechanical plant will be required for rock placement and for handling fines dredged for use as topsoil. The mechanical plant may also be used for access dredging. The hydraulic plant will be used to dredge sand for the construction of the islands.

2.4.2. The dredging and rock placement costs are based on the crew most suited to the work with unit pricing generated by assigning appropriate productivity to the crew for the feature of work being considered.

2.4.3. Generally, the various islands and rock sills included in each of the alternatives are priced as individual features that can be added or deleted without affecting the rest of the estimate.

2.4.4. The estimates provided for the Nesting and Seed Islands are not intended to stand alone. The costs shown for those items are valid only if they are built in conjunction with one of the alternatives presented.

2.4.5. Planning engineering and design (PED) and construction management costs are based on historical costs for similar projects and modified as follows. For Alternative B, PED costs were taken as 10% of construction cost. This amount was then considered a base PED cost. For the remaining alternatives, PED was computed as the base PED plus a fixed amount depending on the number of island features added for that alternative. Construction management costs are estimated as a fixed percentage of construction costs.

2.5 CONTINGENCY DISCUSSION

2.5.1. After review of project documents and discussion with the design engineers, contingencies were developed which reflect the uncertainties associated with each item. These contingencies are based on uncertainties in quantities, unit pricing and items of work not defined or recognized at the time of design. Quantity and design uncertainties are assigned by the designers while Cost Engineering assigns unit price uncertainties. Generally, the levels of uncertainty used for the estimate are as follows:

a. For unit pricing: 5 to 15 Percent

b. For quantities and unanticipated items of work: 5 to 25 Percent

2.5.2. The following discussion of major project features indicates the assumptions made and the rational for contingencies. For other elements not addressed below, the assignment of contingencies is appropriate to account for the uncertainty in design and quantity calculation.

a. Feature 06, Fish and Wildlife Facilities. This project feature includes all the construction for this project.

1. The contingency assigned to hydraulic dredging of sand and the rock for the sills is based primarily on the lack of current surveys in the project area. The surveys were taken prior to the 1993 flood and other projects have shown that changes in bathymetry are likely. Initial settlement of the structures during construction has been included in the quantity calculations and long term settlement was found to be minimal on the Phase I construction, so no

contingency is included for settlement allowances. The remainder of the contingency is derived from possible island alignment and length changes.

2. The quantity contingency for placement of the fines is relatively low because they are to be placed in a predefined section and are not subject to change based on variations in bathymetry and island alignment. However, the unit price portion of the contingency is high since the workability of the material is variable depending on the percentage of material passing the #200 sieve.

b. Feature 30, Planning, Engineering & Design.

1. Plans and Specifications. Since the district intends to proceed directly from this report to plans and specifications, a relatively high contingency has been applied. The extensive amount of design remaining raises the possibility of unanticipated work being identified during the design process.

2.6 CONSTRUCTION METHODS

2.6.1. General - Since the work site is not accessible from land, marine plant has been used for all features of the work.

2.6.2. Hydraulic Dredging - Hydraulic dredging methods were assumed to be used for the construction of all of the islands. Each alternative includes a sufficient quantity of sand island construction to justify the use of a hydraulic dredge.

2.6.3. Mechanical Equipment - Mechanical equipment was assumed for all rock placement activities. Additionally, the mechanical equipment was assumed to perform all of the access dredging since the material from access dredging will be used as fines on the islands. Mechanical dredging of the fines will result in a more workable material and will eliminate potential difficulty meeting water quality standards if hydraulic methods were used.

2.6.4 The mechanical dredging crew has been modified somewhat since a large portion of the work involves rock placement and the dredged material can be disposed of in the immediate project area. Ten hour work days are assumed for all dredging and rock placement activities.

2.7 ATTACHMENTS

2.7.1. For each alternative, the first attachment is the Total Project Cost Summary. This shows the fully funded project cost estimate and is prepared in accordance with Project Management guidelines to include costs for construction, engineering and design and construction management. It also includes contingencies and appropriate inflation factors to reflect fully funded project costs.

2.7.2. The second attachment for each alternative is the detailed summary sheets to the Total Project Cost Summary. It shows detailed unit costs and contingencies as determined from the MCACES estimate.

2.7.3. For Alternative G, an additional attachment showing estimated annual operation and maintenance costs is included.

POOL 8 ISLANDS - PHASE II, ALTERNATIVE B **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE B
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	1,431,000	274,000	19%	1,705,000	2.80%	1,753,000	JUNE 2000	10.500%	1,626,000	311,000	1,937,000
	TOTAL CONSTRUCTION COSTS =====>	1,431,000	274,000	19%	1,705,000		1,753,000			1,626,000	311,000	1,937,000
30---	PLANNING, ENGINEERING AND DESIGN	143,000	29,000	20%	172,000	4.60%	180,000	DEC 1998	9.800%	164,000	33,000	197,000
31---	CONSTRUCTION MANAGEMENT	107,000	22,000	21%	129,000	4.60%	135,000	JUNE 2000	16.800%	131,000	27,000	158,000
	TOTAL PROJECT COSTS ======>	1,681,000	325,000		2,006,000		2,068,000			1,921,000	371,000	2,292,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,600.00	79,600	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	142,000.00	142,000	35,500	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				221,600			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.23	179,300	35,900	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,873	34.20	64,100	9,600	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				608,000			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.23	81,400	16,300	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	986	34.20	33,700	5,100	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				219,300			
	SUBTOTAL CONSTRUCTION COSTS				$1,431,000			
	SUBTOTAL CONTINGENCIES		19.1%			$274,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$1,705,000		

ACCOUNT CODE	ITEM	UNIT QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT ARE INCLUDED IN THE QUATITY. BORINGS NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	143,100.00	143,100	28,600	20.0%	1
	SUBTOTAL: P.E.D COSTS				$143,100			
	SUBTOTAL CONTINGENCIES		20.0%			$28,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$171,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF CONSTRUCTION COST

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	107,325.00	107,300	21,500	20.0%	1
	SUBTOTAL S&I COSTS				$107,300			
	SUBTOTAL CONTINGENCIES		20.0%			$21,500		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$128,800		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, ALTERNATIVE C **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE C
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	1,677,000	314,000	19%	1,991,000	2.80%	2,047,000	JUNE 2000	10.500%	1,905,000	357,000	2,262,000
	TOTAL CONSTRUCTION COSTS =====>	1,677,000	314,000	19%	1,991,000		2,047,000			1,905,000	357,000	2,262,000
30---	PLANNING, ENGINEERING AND DESIGN	153,000	31,000	20%	184,000	4.60%	192,000	DEC 1998	9.800%	176,000	36,000	212,000
31---	CONSTRUCTION MANAGEMENT	126,000	25,000	20%	151,000	4.60%	158,000	JUNE 2000	16.800%	154,000	31,000	185,000
	TOTAL PROJECT COSTS ======>	1,956,000	370,000		2,326,000		2,397,000			2,235,000	424,000	2,659,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

6-7

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,600.00	79,600	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	142,000.00	142,000	35,500	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				221,600			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.22	178,900	35,800	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,873	34.20	64,100	9,600	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				607,600			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.22	81,200	16,200	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	986	34.20	33,700	5,100	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				219,100			
06.03.73.02.50	ISLAND "C"							
	SAND	CY	25,753	4.22	108,700	16,300	15.0%	1,2,4,7
	FINES	CY	7,741	12.00	92,900	18,600	20.0%	1,7
	RIPRAP	CY	1,114	34.20	38,100	3,800	10.0%	2,3,7
	PLANTINGS	JOB	1	6,730.00	6,700	1,300	20.0%	1,7
	SUBTOTAL: ISLAND "C"				246,400			

ACCOUNT CODE	ITEM	UNIT QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
	SUBTOTAL CONSTRUCTION COSTS			$1,677,000			
	SUBTOTAL CONTINGENCIES	18.7%			$314,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES				$1,991,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS ARE NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	153,100.00	153,100	30,600	20.0%	1
	SUBTOTAL: P.E.D COSTS				$153,100			
	SUBTOTAL CONTINGENCIES		20.0%			$30,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$183,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF ALTERNATIVE B CONSTRUCTION COST PLUS $10,000.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	125,775.00	125,800	25,200	20.0%	1
	SUBTOTAL S&I COSTS				$125,800			
	SUBTOTAL CONTINGENCIES		20.0%			$25,200		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$151,000		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, ALTERNATIVE D **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE D
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	1,867,000	372,000	20%	2,239,000	2.80%	2,302,000	JUNE 2000	10.500%	2,121,000	423,000	2,544,000
	TOTAL CONSTRUCTION COSTS =====>	1,867,000	372,000	20%	2,239,000		2,302,000			2,121,000	423,000	2,544,000
30---	PLANNING, ENGINEERING AND DESIGN	163,000	33,000	20%	196,000	4.60%	205,000	DEC 1998	9.800%	187,000	38,000	225,000
31---	CONSTRUCTION MANAGEMENT	140,000	28,000	20%	168,000	4.60%	176,000	JUNE 2000	16.800%	171,000	34,000	205,000
	TOTAL PROJECT COSTS ======>	2,170,000	433,000		2,603,000		2,683,000			2,479,000	495,000	2,974,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

Z-14

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,400.00	79,400	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	152,000.00	152,000	38,000	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				231,400			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.22	178,900	35,800	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,873	34.20	64,100	9,600	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				607,600			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.22	81,200	16,200	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	558	34.20	19,100	2,900	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				204,500			
06.03.73.02.60	ISLAND "D-1"							
	SAND	CY	22,762	5.07	115,400	23,100	20.0%	1,2,4,7
	FINES	CY	7,803	12.00	93,600	23,400	25.0%	1,7
	RIPRAP	CY	865	34.20	29,600	5,900	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	600	20.0%	1,7
	SUBTOTAL: ISLAND "D-1"				241,500			

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.03.73.02.70	ISLAND "D-2"							
	SAND	CY	18,104	4.22	76,400	15,300	20.0%	1,2,4,7
	FINES	CY	6,862	12.00	82,300	20,600	25.0%	1,7
	RIPRAP	CY	1,137	34.20	38,900	7,800	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	700	25.0%	1,7
	SUBTOTAL: ISLAND "D-2"				200,500			
	SUBTOTAL CONSTRUCTION COSTS				$1,867,000			
	SUBTOTAL CONTINGENCIES		19.9%			$372,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$2,239,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS ARE NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	163,100.00	163,100	32,600	20.0%	1
	SUBTOTAL: P.E.D COSTS				$163,100			
	SUBTOTAL CONTINGENCIES		20.0%			$32,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$195,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF ALTERNATIVE B CONSTRUCTION COST PLUS $20,000.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	140,025.00	140,000	28,000	20.0%	1
	SUBTOTAL S&I COSTS				$140,000			
	SUBTOTAL CONTINGENCIES		20.0%			$28,000		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$168,000		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, ALTERNATIVE E **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE E
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D
REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	2,136,000	415,000	19%	2,551,000	2.80%	2,622,000	JUNE 2000	10.500%	2,426,000	471,000	2,897,000
	TOTAL CONSTRUCTION COSTS =====>	2,136,000	415,000	19%	2,551,000		2,622,000			2,426,000	471,000	2,897,000
30---	PLANNING, ENGINEERING AND DESIGN	173,000	35,000	20%	208,000	4.60%	218,000	DEC 1998	9.800%	199,000	40,000	239,000
31---	CONSTRUCTION MANAGEMENT	160,000	32,000	20%	192,000	4.60%	201,000	JUNE 2000	16.800%	195,000	39,000	234,000
	TOTAL PROJECT COSTS ======>	2,469,000	482,000		2,951,000		3,041,000			2,820,000	550,000	3,370,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,500.00	79,500	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	152,000.00	152,000	38,000	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				231,500			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.22	178,900	35,800	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,873	34.20	64,100	9,600	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				607,600			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.22	81,200	16,200	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	558	34.20	19,100	2,900	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				204,500			
06.03.73.02.50	ISLAND "C"							
	SAND	CY	25,753	5.07	130,600	19,600	15.0%	1,2,4,7
	FINES	CY	7,741	12.00	92,900	18,600	20.0%	1,7
	RIPRAP	CY	1,114	34.20	38,100	3,800	10.0%	2,3,7
	PLANTINGS	JOB	1	6,730.00	6,700	1,300	20.0%	1,7
	SUBTOTAL: ISLAND "C"				268,300			

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.03.73.02.60	ISLAND "D-1"							
	SAND	CY	22,762	5.07	115,400	23,100	20.0%	1,2,4,7
	FINES	CY	7,803	12.00	93,600	23,400	25.0%	1,7
	RIPRAP	CY	865	34.20	29,600	5,900	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	600	20.0%	1,7
	SUBTOTAL: ISLAND "D-1"				241,500			
06.03.73.02.70	ISLAND "D-2"							
	SAND	CY	18,104	4.22	76,400	15,300	20.0%	1,2,4,7
	FINES	CY	6,862	12.00	82,300	20,600	25.0%	1,7
	RIPRAP	CY	1,137	34.20	38,900	7,800	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	700	25.0%	1,7
	SUBTOTAL: ISLAND "D-2"				200,500			
	SUBTOTAL CONSTRUCTION COSTS				$2,136,000			
	SUBTOTAL CONTINGENCIES		19.4%			$415,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$2,551,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS ARE NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	173,100.00	173,100	34,600	20.0%	1
	SUBTOTAL: P.E.D COSTS				$173,100			
	SUBTOTAL CONTINGENCIES		20.0%			$34,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$207,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF ALTERNATIVE B CONSTRUCTION COST PLUS $30,000.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	160,200.00	160,200	32,000	20.0%	1
	SUBTOTAL S&I COSTS				$160,200			
	SUBTOTAL CONTINGENCIES		20.0%			$32,000		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$192,200		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, ALTERNATIVE F **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE F
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	2,122,000	442,000	21%	2,564,000	2.80%	2,636,000	JUNE 2000	10.500%	2,410,000	502,000	2,912,000
	TOTAL CONSTRUCTION COSTS =====>	2,122,000	442,000	21%	2,564,000		2,636,000			2,410,000	502,000	2,912,000
30---	PLANNING, ENGINEERING AND DESIGN	183,000	37,000	20%	220,000	4.60%	230,000	DEC 1998	9.800%	210,000	42,000	252,000
31---	CONSTRUCTION MANAGEMENT	159,000	32,000	20%	191,000	4.60%	200,000	JUNE 2000	16.800%	194,000	39,000	233,000
	TOTAL PROJECT COSTS ======>	2,464,000	511,000		2,975,000		3,066,000			2,814,000	583,000	3,397,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,500.00	79,500	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	152,000.00	152,000	38,000	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				231,500			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.22	178,900	35,800	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,161	34.20	39,700	6,000	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				583,200			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.22	81,200	16,200	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	558	34.20	19,100	2,900	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				204,500			
06.03.73.02.60	ISLAND "D-1"							
	SAND	CY	22,762	5.07	115,400	23,100	20.0%	1,2,4,7
	FINES	CY	7,803	12.00	93,600	23,400	25.0%	1,7
	RIPRAP	CY	865	34.20	29,600	5,900	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	600	20.0%	1,7
	SUBTOTAL: ISLAND "D-1"				241,500			

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.03.73.02.70	ISLAND "D-2"							
	SAND	CY	18,104	4.22	76,400	15,300	20.0%	1,2,4,7
	FINES	CY	6,862	12.00	82,300	20,600	25.0%	1,7
	RIPRAP	CY	1,137	34.20	38,900	7,800	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	700	25.0%	1,7
	SUBTOTAL: ISLAND "D-2"				200,500			
06.03.73.02.80	ISLAND "E-1"							
	SAND	CY	10,962	5.07	55,600	13,900	25.0%	1,2,4,7
	FINES	CY	4,700	12.00	56,400	16,900	30.0%	1,7
	RIPRAP	CY	928	34.20	31,700	6,300	20.0%	2,3,7
	PLANTINGS	JOB	1	1,570.00	1,600	500	30.0%	1,7
	SUBTOTAL: ISLAND "E-1"				145,300			
06.03.73.02.90	ISLAND "E-2"							
	SAND	CY	13,423	5.07	68,100	17,000	25.0%	1,2,4,7
	FINES	CY	5,270	12.00	63,200	19,000	30.0%	1,7
	PLANTINGS	JOB	1	2,150.00	2,200	700	30.0%	1,7
	SUBTOTAL: ISLAND "E-2"				133,500			
	SUBTOTAL CONSTRUCTION COSTS				$2,122,000			
	SUBTOTAL CONTINGENCIES		20.8%			$442,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$2,564,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS ARE NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB 1	183,100.00	183,100	36,600	20.0%	1
	SUBTOTAL: P.E.D COSTS			$183,100			
	SUBTOTAL CONTINGENCIES	20.0%			$36,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN				$219,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF ALTERNATIVE B CONSTRUCTION COST PLUS $40,000.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	159,150.00	159,200	31,800	20.0%	1
	SUBTOTAL S&I COSTS				$159,200			
	SUBTOTAL CONTINGENCIES		20.0%			$31,800		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$191,000		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, ALTERNATIVE G **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, ALTERNATIVE G
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D
REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	2,390,000	486,000	20%	2,876,000	2.80%	2,957,000	JUNE 2000	10.500%	2,715,000	552,000	3,267,000
	TOTAL CONSTRUCTION COSTS =====>	2,390,000	486,000	20%	2,876,000		2,957,000			2,715,000	552,000	3,267,000
30---	PLANNING, ENGINEERING AND DESIGN	193,000	39,000	20%	232,000	4.60%	243,000	DEC 1998	9.800%	222,000	45,000	267,000
31---	CONSTRUCTION MANAGEMENT	179,000	36,000	20%	215,000	4.60%	225,000	JUNE 2000	16.800%	219,000	44,000	263,000
	TOTAL PROJECT COSTS ======>	2,762,000	561,000		3,323,000		3,425,000			3,156,000	641,000	3,797,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

62-29

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.00.--.--	MOB., DEMOB. AND PREP. WORK							
06.03.00.10.--	MOB., DEMOB. MECHANICAL PLANT	JOB	1	79,500.00	79,500	19,900	25.0%	6
06.03.00.20.--	MOB., DEMOB. HYDRAULIC PLANT	JOB	1	152,000.00	152,000	38,000	25.0%	6
	SUBTOTAL: MOB., DEMOB. AND PREP. WORK				231,500			
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.10	ROCK SILL "A"							
	RIPRAP	CY	8,297	33.00	273,800	41,100	15.0%	1,2,4,7
	6" SAND LAYER	CY	260	18.10	4,700	900	20.0%	1,4,7
	GEOTEXTILE	SY	1,600	1.87	3,000	600	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "A"				281,500			
06.03.73.02.20	ISLAND "A"							
	SAND	CY	42,393	4.22	178,900	35,800	20.0%	1,2,4,7
	FINES	CY	29,694	12.00	356,300	71,300	20.0%	1,7
	RIPRAP	CY	1,161	34.20	39,700	6,000	15.0%	2,3,7
	PLANTINGS	JOB	1	8,300.00	8,300	1,700	20.0%	1,7
	SUBTOTAL: ISLAND "A"				583,200			
06.03.73.02.30	ROCK SILL "B"							
	RIPRAP	CY	2,939	33.00	97,000	14,600	15.0%	1,2,4,7
	6" SAND LAYER	CY	115	18.10	2,100	400	20.0%	1,4,7
	GEOTEXTILE	SY	685	1.87	1,300	300	20.0%	1,4,7
	SUBTOTAL: ROCK SILL "B"				100,400			
06.03.73.02.40	ISLAND "B"							
	SAND	CY	19,246	4.22	81,200	16,200	20.0%	1,2,4,7
	FINES	CY	8,300	12.00	99,600	19,900	20.0%	1,7
	RIPRAP	CY	558	34.20	19,100	2,900	15.0%	2,3,7
	PLANTINGS	JOB	1	4,580.00	4,600	900	20.0%	1,7
	SUBTOTAL: ISLAND "B"				204,500			
06.03.73.02.50	ISLAND "C"							
	SAND	CY	25,753	5.07	130,600	19,600	15.0%	1,2,4,7
	FINES	CY	7,741	12.00	92,900	18,600	20.0%	1,7
	RIPRAP	CY	1,114	34.20	38,100	3,800	10.0%	2,3,7
	PLANTINGS	JOB	1	6,730.00	6,700	1,300	20.0%	1,7
	SUBTOTAL: ISLAND "C"				268,300			

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.03.73.02.60	ISLAND "D-1"							
	SAND	CY	22,762	5.07	115,400	23,100	20.0%	1,2,4,7
	FINES	CY	7,803	12.00	93,600	23,400	25.0%	1,7
	RIPRAP	CY	865	34.20	29,600	5,900	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	600	20.0%	1,7
	SUBTOTAL: ISLAND "D-1"				241,500			
06.03.73.02.70	ISLAND "D-2"							
	SAND	CY	18,104	4.22	76,400	15,300	20.0%	1,2,4,7
	FINES	CY	6,862	12.00	82,300	20,600	25.0%	1,7
	RIPRAP	CY	1,137	34.20	38,900	7,800	20.0%	2,3,7
	PLANTINGS	JOB	1	2,860.00	2,900	700	25.0%	1,7
	SUBTOTAL: ISLAND "D-2"				200,500			
06.03.73.02.80	ISLAND "E-1"							
	SAND	CY	10,962	5.07	55,600	13,900	25.0%	1,2,4,7
	FINES	CY	4,700	12.00	56,400	16,900	30.0%	1,7
	RIPRAP	CY	928	34.20	31,700	6,300	20.0%	2,3,7
	PLANTINGS	JOB	1	1,570.00	1,600	500	30.0%	1,7
	SUBTOTAL: ISLAND "E-1"				145,300			
06.03.73.02.90	ISLAND "E-2"							
	SAND	CY	13,423	5.07	68,100	17,000	25.0%	1,2,4,7
	FINES	CY	5,270	12.00	63,200	19,000	30.0%	1,7
	PLANTINGS	JOB	1	2,150.00	2,200	700	30.0%	1,7
	SUBTOTAL: ISLAND "E-2"				133,500			
	SUBTOTAL CONSTRUCTION COSTS				$2,390,000			
	SUBTOTAL CONTINGENCIES		20.3%			$486,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$2,876,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS ARE NOT AVAILABLE.
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	193,100.00	193,100	38,600	20.0%	1
	SUBTOTAL: P.E.D COSTS				$193,100			
	SUBTOTAL CONTINGENCIES		20.0%			$38,600		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$231,700		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 10% OF ALTERNATIVE B CONSTRUCTION COST PLUS $50,000.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	179,250.00	179,300	35,900	20.0%	1
	SUBTOTAL S&I COSTS				$179,300			
	SUBTOTAL CONTINGENCIES		20.0%			$35,900		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$215,200		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

*Life Cycle 50 Yrs
*Rate of Return 7.625%

ITEM	ESTIMATED O&M CYCLE	O&M and MAJOR REPLACEMENT COSTS QUANTITY	UNIT	UNIT PRICE	AMOUNT	EQUIVALENT AVERAGE ANNUAL O&M / MAJOR REPLACEMENT VALUE PRESENT VALUE	ANNUAL COST	COMMENTS
ROCK SILLS								
Replace Rockfill	20 Yrs	575	CY	50.00	28,750	8,372	655	Assume 5% of rock replaced every 20 years. Use high unit price for small quantity.
Clear Debris From Notch	10 Yrs	24	HR	250.00	6,000	5,394	422	Assume 24 hours floating plant crew.
ISLANDS								
Replace Rock Groins	20 Yrs	300	CY	50.00	15,000	4,371	342	Assume 5% of rock replaced every 20 years. Use high unit price for small quantity.
INSPECTION AND REPORTING								
Annual Inspection	1 Yrs	40	HR	35	1,400	17,895	1,400	Annual reporting and other staff requirements.
TOTAL ESTIMATED OPERATION AND MAINTENENCE COSTS:						36,033	2,819	

Z-34

NOTES:

1. Price levels are November 1995 unless noted otherwise.

POOL 8 ISLANDS - PHASE II, NESTING ISLAND A (420 LF) **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, NESTING ISLAND A (420 LF)
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	148,000	41,000	28%	189,000	2.80%	194,000	JUNE 2000	10.500%	168,000	47,000	215,000
	TOTAL CONSTRUCTION COSTS =====>	148,000	41,000	28%	189,000		194,000			168,000	47,000	215,000
30---	PLANNING, ENGINEERING AND DESIGN	22,000	4,000	18%	26,000	4.60%	27,000	DEC 1998	9.800%	25,000	5,000	30,000
31---	CONSTRUCTION MANAGEMENT	11,000	2,000	18%	13,000	4.60%	14,000	JUNE 2000	16.800%	13,000	2,000	15,000
	TOTAL PROJECT COSTS ======>	181,000	47,000		228,000		235,000			206,000	54,000	260,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

2-35

PE-D(MSD) POOL 8 ISLANDS - PHASE II, NESTING ISLAND A (420 LF) 09-May-96

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.95	NESTING ISLAND							
	SETUP	JOB	1	9,800.00	9,800	2,500	25.0%	7
	SAND	CY	14,207	6.35	90,200	31,600	35.0%	5,7
	RIPRAP	CY	1,364	34.30	46,800	7,000	15.0%	2,3,7
	PLANTINGS	JOB	1	1,210.00	1,200	300	25.0%	1,7
	SUBTOTAL: NESTING ISLAND				148,000			
	SUBTOTAL CONSTRUCTION COSTS				$148,000			
	SUBTOTAL CONTINGENCIES		27.7%			$41,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$189,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS NOT AVAILABLE
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

PE-D(MSD) POOL 8 ISLANDS - PHASE II, NESTING ISLAND A (420 LF) 09-May-96

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	22,200.00	22,200	4,400	20.0%	1
	SUBTOTAL: P.E.D COSTS				$22,200			
	SUBTOTAL CONTINGENCIES		19.8%			$4,400		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$26,600		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 15% OF CONSTRUCTION COST

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	11,100.00	11,100	2,200	20.0%	1
	SUBTOTAL S&I COSTS				$11,100			
	SUBTOTAL CONTINGENCIES		19.8%			$2,200		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$13,300		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, NESTING ISLAND B (210 LF) **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, NESTING ISLAND B (210 LF) PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996 REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	96,000	25,000	26%	121,000	2.80%	124,000	JUNE 2000	10.500%	109,000	28,000	137,000
	TOTAL CONSTRUCTION COSTS ======>	96,000	25,000	26%	121,000		124,000			109,000	28,000	137,000
30---	PLANNING, ENGINEERING AND DESIGN	14,000	3,000	21%	17,000	4.60%	18,000	DEC 1998	9.800%	16,000	3,000	19,000
31---	CONSTRUCTION MANAGEMENT	7,000	1,000	14%	8,000	4.60%	8,000	JUNE 2000	16.800%	9,000	1,000	10,000
	TOTAL PROJECT COSTS =======>	117,000	29,000		146,000		150,000			134,000	32,000	166,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

2-39

PE-D(MSD) POOL 8 ISLANDS - PHASE II, NESTING ISLAND B (210 LF) 09-May-96

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.95	NESTING ISLAND							
	SETUP	JOB	1	9,810.00	9,800	2,500	25.0%	7
	SAND	CY	7,103	6.35	45,100	15,800	35.0%	5,7
	RIPRAP	CY	1,173	34.30	40,200	6,000	15.0%	2,3,7
	PLANTINGS	JOB	1	603.00	600	200	25.0%	1,7
	SUBTOTAL: NESTING ISLAND				95,700			
	SUBTOTAL CONSTRUCTION COSTS				$96,000			
	SUBTOTAL CONTINGENCIES		26.0%			$25,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$121,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS NOT AVAILABLE
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT QUANTITY		UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	14,400.00	14,400	2,900	20.0%	1
	SUBTOTAL: P.E.D COSTS				$14,400			
	SUBTOTAL CONTINGENCIES	20.1%				$2,900		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$17,300		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 15% OF CONSTRUCTION COST

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	7,200.00	7,200	1,400	20.0%	1
	SUBTOTAL S&I COSTS				$7,200			
	SUBTOTAL CONTINGENCIES		19.4%			$1,400		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$8,600		

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

POOL 8 ISLANDS - PHASE II, SEED ISLANDS **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: POOL 8 ISLANDS - PHASE II, SEED ISLANDS
LOCATION: MISSISSIPPI RIVER ABOVE LOCK AND DAM NUMBER 8
DATE PREPARED: MAY 1996

PREPARED BY: MICHAEL S. DAHLQUIST, CENCSPE-D

REVIEWED AND APPROVED BY: ALLEN L. GEISEN, CHIEF COST/SPEC

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INFLATION TO 10/96 %	OMB INFLATION TO 10/96 AMOUNT	MID POINT OF FEATURE	OMB (%) INFLATION (+/-)	INFLATED COST AMOUNT ($)	INFLATED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	150,000	38,000	25%	188,000	2.80%	193,000	JUNE 2000	10.500%	170,000	43,000	213,000
	TOTAL CONSTRUCTION COSTS =====>	150,000	38,000	25%	188,000		193,000			170,000	43,000	213,000
30---	PLANNING, ENGINEERING AND DESIGN	23,000	5,000	22%	28,000	4.60%	29,000	DEC 1998	9.800%	26,000	6,000	32,000
31---	CONSTRUCTION MANAGEMENT	11,000	2,000	18%	13,000	4.60%	14,000	JUNE 2000	16.800%	13,000	2,000	15,000
	TOTAL PROJECT COSTS ======>	184,000	45,000		229,000		236,000			209,000	51,000	260,000

NOTES:
1. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS UNLESS NOTED OTHERWISE.

2-43

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
06.--.--.--.--	FISH AND WILDLIFE FACILITIES							
06.03.--.--.--	WILDLIFE FACILITIES/SANCTUARIES							
06.03.73.--.--	HABITAT AND FEEDING FACILITIES							
06.03.73.02.--	SITE WORK							
06.03.73.02.99	SEED ISLANDS							
	RIPRAP	CY	4,382	34.30	150,300	37,600	25.0%	2,5,7
	SUBTOTAL: SEED ISLANDS				150,300			
	SUBTOTAL CONSTRUCTION COSTS				$150,000			
	SUBTOTAL CONTINGENCIES		25.3%			$38,000		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$188,000		

REASONS FOR CONTINGENCIES:

1. FINAL ALIGNMENT WILL BE BASED ON NEW TOPO OBTAINED FOR P&S; ALLOWS FOR ISLAND LENGTH VARIANCE OF APPROX. 100 LF.
2. INITIAL DISPLACEMENT IS INCLUDED IN THE QUANTITY. BORINGS NOT AVAILABLE
3. ALLOWS FOR THE ADDITION OF ONE GROIN; DEPENDENT ON FINAL ISLAND ALIGNMENT & LENGTH.
4. ELEVATION VARIANCE IN BATHYMETRY (BATHYMETRY WAS PRE-1993 FLOOD).
5. BATHYMETRY MAP HAD ONLY ELEVATION RANGES, NO CONTOURS. (THIS IS NOT THE SAME AS THE CONTOUR MAP IN REASON 4).
6. UNKNOWN MOBILIZATION DISTANCE
7. UNKNOWN UNIT PRICES.

NOTES:

A. UNIT PRICES ARE AT NOVEMBER 1995 PRICE LEVELS.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
30.--.--.--.--	PLANNING, ENGINEERING AND DESIGN	JOB	1	22,500.00	22,500	4,500	20.0%	1
	SUBTOTAL: P.E.D COSTS				$22,500			
	SUBTOTAL CONTINGENCIES		20.0%			$4,500		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$27,000		

REASONS FOR CONTINGENCIES

1. UNKNOWNS DUE TO MANHOURS REQUIRED.

NOTES:

A. PLANNING, ENGINEERING AND DESIGN ESTIMATED AS 15% OF CONSTRUCTION COST

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	%	REASON
31.--.--.--.--	CONSTRUCTION MANAGEMENT (S&I)	JOB	1	11,250.00	11,300	2,300	20.0%	1

SUBTOTAL S&I COSTS		$11,300	
SUBTOTAL CONTINGENCIES	20.4%		$2,300
TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)			$13,600

REASONS FOR CONTINGENCIES

1. UNCERTAINTIES DUE TO MANHOURS REQUIRED

NOTES:

A. CONSTRUCTION MANAGEMENT COMPUTED AS 7.5% OF CONSTRUCTION COSTS

ATTACHMENT 3

SECTION 404(b)(1) EVALUATION

SECTION 404(b)(1) EVALUATION
POOL 8 ISLAND CONSTRUCTION - PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8 - UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN

I. PROJECT DESCRIPTION

A. Location - The project area is located in lower pool 8, approximately 10 miles below La Crosse, Wisconsin. Stoddard, Wisconsin is located on the eastern side of the project area. Brownsville, Minnesota is approximately 2 miles west/northwest of the project area. (See plates 1 and 2 of the Main Report).

B. General Description - The Corps of Engineers is proposing to construct Phase II of the Pool 8 Island Construction Habitat Rehabilitation and Enhancement Project as part of the Environmental Management Program. In Stoddard Bay, the proposed action involves the construction of a barrier island system consisting of a series of islands, combined with two rock sills, to alter water flow into the area. The length of the island/rock sill system would be approximately 9,400 feet. Four islands would be constructed in the newly protected area to help maintain channel depths and reduce wind fetch. A total of 26 acres of island would be constructed. A general layout of the island locations are shown in plate 14 of the main report. Fill for the construction of the project would be obtained by dredging in Crosby Slough and in selected areas in Stoddard Bay.

A series of seed islands are proposed along the right descending bank of the navigation channel, just below Heron and Trapping Islands (See plate 18 of the Main Report). This area is referred to as the Raft Channel East area. A seed island would be a small island constructed of rock fill, located in an area with high sediment transport. The constructed seed island would create conditions that would induce accretion and island growth. It is anticipated that this induced island complex could eventually total 60 acres.

C. Authority and Purpose - Phase II of the Pool 8 Island Construction Habitat Rehabilitation and Enhancement Project is being constructed under authority of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The goal of the project is to provide winter habitat for fish, primarily Centrarchids, by reducing water flow velocity through the Stoddard Bay area, and to promote the growth of submergent and emergent aquatic vegetation by reducing sediment resuspension.

Phase II of the Pool 8 project is designed primarily to improve fish habitat in the area. An important secondary goal is to provide migration habitat for waterfowl as pool 8 is an important staging area during migration. Other goals of the project are to provide habitat for other migratory birds (such as neotropical migrants, marsh and water birds) and other types of wildlife in the area through island design and vegetation development on the islands.

D. General Description of Dredged and Fill Material

1. General Characteristics and Source of Material - Sand would be obtained from Crosby Slough and selected areas in Stoddard Bay. This material is a medium/fine sand.

Fine material for the islands would be obtained from Stoddard Bay and areas adjacent to the islands. The material in Stoddard bay is a combination of clay or clayey sand with substantial amounts of silt, sand and organic matter.

Clean rock riprap would be obtained from any of several quarries located within a 15 mile radius of Stoddard. These quarries have provided suitable, clean material for past O&M activities.

2. Chemical Characteristics - Bulk Chemical analysis for materials from the Stoddard Bay was done in 1995. These materials were shown to relatively uncontaminated. These tests, and others that have been done in lower pool 8 indicate that one would expect relatively low levels of contaminants to be present in sediments located in the project area. Sand dredged from areas in Crosby Slough would be expected to be similar to those obtained from maintenance dredging. Due to the nature of the fine material in the backwater areas and along the island alignment, it is likely that they would contain trace amounts of metals or pesticides.

3. Quantity of Fill Material - The quantities of various fill materials to be used in Stoddard area are as follows: sand - 152,000 cubic yards, fine material - 72,000 cubic yards, rock fill - 19,000 cubic yards, Geotextile fabric - 2,300 square yards. In the Raft Channel East area, the quantities of fill material required for the seed islands are as follows: Rock fill - 4,500 cubic yards

E. Description of Proposed Discharge site

1. Location - Dredged sand will be placed primarily in shallow (1-3 feet) water along the east side of Crosby Slough between RM 685.3 and RM 687. Rock sills would be constructed at

two locations to regulate flow into the upper portion of Stoddard Bay. All side channel openings would be filled.

The seed islands constructed in the Raft Channel East area would be located along the right descending bank of the navigation channel below Heron and Trapping Islands.

2. Size - In the Stoddard Bay area, an island/rock sill system approximately 9,400 feet long would be constructed. The rock sills would total about 2,800 feet of the total. Four additional islands would be constructed in the area between the island/sill system and the Wisconsin shoreline. The island top-widths would range from 30 to 50 feet depending on their location. A total of about 26 acres of island would be constructed.

Each seed island would be a low rock berm, 200 feet long with a top width of 3 feet.

3. Types of Habitat - The Stoddard Bay Area is primarily open water in nature. Some remnant islands remain in Upper Stoddard Bay. The islands are sparsely vegetated. A few isolated trees remain on the islands but are rapidly being lost. Herbaceous vegetation that is present is comprised of poison ivy, wood nettle, and reed canary grass. Scattered beds of aquatic vegetation are present and comprise about 10 percent of the total project areas. Submergent and rooted floating aquatic plants area the predominant vegetation types present. The most common species of submergents present are sago pondweed, curly-leafed pondweed and water milfoil.

The seed island locations are open water in nature. Some aquatic vegetation is present in scattered locations along this reach.

4. Timing and Duration - Construction is scheduled for summer of 1997 but may not be initiated as late as 1999. Funding restrictions may require that the construction be delayed and/or conducted over two construction seasons. Therefore, major construction activities could occur between 1997 and 2001 with the following restriction. Because the Seed Island locations are within a closed area of the Upper Mississippi River Fish and Wildlife Refuge, no construction activities would be allowed one week prior to and during the Wisconsin and Minnesota waterfowl hunting seasons in these areas. Construction would also not occur during high spring river discharges, to minimize secondary movement of dredge material. Construction involving rock work (rock sills, groins, seed islands) may be allowed during high flows to reduce or eliminate access dredging. Mechanical access dredging may also be allowed during these periods if the disposal site is above water.

F. Description of Fill and Dredged Material Placement Methods

Sand from Crosby Slough and Stoddard Bay would most likely be obtained and placed by hydraulic dredging. However, mechanical dredging may be utilized if it is determined to be more cost effective. It is possible that maintenance dredging of the 9-foot navigation channel may be required at the time of island construction is scheduled. Direct use of this material would be considered if this occurs. In any case, sand would placed with little confinement.

Fine materials would most likely be excavated by mechanical dredging. However, hydraulic dredging may be used if it is determined to be more feasible or cost effective. If hydraulic dredging were used for the excavation and placement of fine materials, dikes would be constructed on the partially constructed islands to retain the soil and carriage water. Effluent could be released to Crosby Slough. Effluent release on the Stoddard Bay side may be allowed if adequate construction practices are utilized to meet water quality limits. The use of a temporary berm from islands B to D1 to create a containment area, or silt curtains parallel to the islands to increase retention time, are examples of appropriate construction practices that may be utilized to allow effluent release on the Stoddard Bay side.

Rock fill for the sills would most likely be placed with equipment such a large backhoe, working from a barge.

The islands in Stoddard Bay would be constructed with a sand base and a cap of fine materials. The base of the island would be 1 to 2 feet above the normal pool elevation. Sideslopes would be 1V:20H between the elevation of 2 feet to 1 foot above normal pool. From the elevation of 1 foot above normal pool level to the toe of the island the sideslopes would be 1V:6H. Consolidated fine material would be used to build the island to the design elevation with sideslopes of 1V:5H. This design results in a sand layer being present in the wave zone to establish a stable beach and fine material being utilized to establish a good substrate for vegetation establishment. The island top width would range from 50 feet to 30 feet depending on their location. Top elevations would range from elevation 635.0 (about 5 feet above normal pool elevation) to elevation 633.0. Riprap and rock groins would be used in key areas to stabilize the shoreline. Plates 15 and 16 of the main report show the general design and typical cross section for the island.

Two rock sills would be constructed as part of the island chain

in Stoddard Bay. The sills would be trapezoidal in cross section with a 15 foot top width, a 4H:1V upstream slope and a 2H:1V downstream slope (see plate 15). Rock sill A would be a 1500 foot rock sill constructed across the upper end of Stoddard bay. The top of the sill would be at elevation 632.0 and would have 12-foot-wide notch (bottom width)set at elevation 628.0 for low flow purposes. Rock sill be would be a 1,300 foot rock sill constructed from island A to the upper end of island B. The top elevation of this sill would be 631.8, and it would not be notched.

The seed islands would be low rock berms 200 feet long with a top width of 3 feet. The top elevation of the seed islands would be 3 feet over normal pool elevation (See plate 15 of the main report). Rock fill would most likely be placed using heavy equipment (either a large backhoe or a crane with a clamshell bucket) working off a barge.

II. Factual Determinations

A. Physical Substrate Determinations

1. Substrate Elevation and Slope - The few remaining island remnants along the island alignment have an average elevation of 635 feet msl. The top elevation of the proposed islands range from 3 to 5 feet above the normal water surface in the project area. The average water depth throughout the island alignments, and in the seed island locations, is about 3 feet. Slopes of the constructed islands have been discussed in section I.F., above.

2. Substrate Changes - In Stoddard Bay, the substrate currently consists of sand where existing islands are present and alluvial clay or clayey sand with substantial amounts of silt, sand, and organic matter. This material is underlain by fine to coarse alluvial sand. Approximately 30 acres of this substrate would be converted to sand or rock with the construction of the islands, the rock sills and the attendant shoreline protection.

In the Raft Channel East area, the substrate in the seed island locations is primarily sand or clayey sand with substantial amounts of silt, sand and organic matter. Initially, about 1.5 to 2 acres would covered with rock fill. It is anticipated over the life of the project, that up to 60 acres of islands could become established.

3. Dredged/Fill Movement - Riprap would be provided at critical locations where potential for erosion is great. It is expected that wave action would reshape part of the berm and a typical beach profile with off shore slopes of 1:10 to 1:20 will

result. This berm would provide a buffer zone between the main part of the island and erosive forces and should revegetate rapidly to provide additional erosion protection. The fine materials are also expected to revegetate rapidly and thereby provide stability to the islands. By not constructing islands during spring high water, the potential for secondary movement of dredge material would be minimized. However, secondary movement during an unexpected flood, prior to island stabilization, could occur. If this happened, an attempt would be made to retrieve the material for replacement on islands as originally designed.

4. Actions Taken to Minimize Impacts - Islands would not be constructed during high spring water to minimize potential for secondary movement of dredged material. Impacts will also be minimized by requiring that Wisconsin water quality limitations and monitoring requirements for carriage water discharge be followed during construction.

B. Water Circulation and Fluctuations

1. General Water Chemistry - Water quality parameters in Pool 8, as in other pools, vary with discharge, by season, and within habitat type. However, total hardness rarely exceeds 175 mg/l, alkalinity varies slightly around 175 mg/l, pH remains slightly alkaline most of the year, and the water has a characteristic brown color from dissolved organic substances, leached from forest floor areas. No long term changes in these parameters is expected from the project.

2. Current Patterns and Circulation - The Stoddard Bay area currently conveys about 11 % of the total channel flow. Due to the loss of island mass and vegetation beds, flow through the area is unimpeded and has an average residence time of .3 to .4 days.

The purpose of the proposed action is to reduce flows in upper Stoddard Bay, especially during winter. The proposed barrier island/rock sill system would dramatically change the flow conditions in the protected area. With the project, flows less than the 10 percent frequency event would only enter the upper portion of Stoddard Bay via the rock sills. This would dramatically change the current velocity and residence times in the affected area. It is estimated that with the project, the average residence time in the 500 acre protected area would vary from 7.4 days during the early to middle summer to 16 days in late summer and winter. For the more frequent flow conditions (less than 10 year event), flow that would have traveled through upper Stoddard Bay, would travel through other portions of the channel, such as Crosby slough or the navigation channel. During

the winter, current velocity in the protected area would be reduced to less than 1 cm/sec over 90 percent of the area.

Overall current patterns in the Raft Channel East area would not be appreciably altered with the seed islands. Any current pattern changes would be limited to the relatively small zone of influence of the constructed island. Some channel scour may occur in areas between adjacent seed islands (similar to what has occurred between Heron and Trapping Islands). The zone of influence would become larger as islands developed. However, when compared to the larger Raft Channel East area, the overall effect on current patterns and water circulation in the area would be small.

3. Sedimentation Patterns - At present the major sediment deposition in lower pool 8 is caused by bed load and wash load sediments carried by the Mississippi River. Estimates of sediment deposition range from 0.25 to 1.2 inches per year. Recent analysis of sediment load for lower pool 8 indicates that smaller floods (10 percent frequency events or less) are a significant contributor to sediment deposition. Construction of the barrier island/rock sill system would reduce the amount of sediment entering the upper portion of Stoddard Bay. However, the reduced flows in this area would result in creating an area of sediment deposition in the protected area. The rock sills are designed to overtop with the more frequent flow events in order to induce scour in the area. In addition, the interior islands would be located to concentrate flows though the existing channels, thereby maintaining to some degree current water depths. It is also anticipated that a 15 acre mudflat would develop at the juncture of the barrier islands and the lower interior islands. Overall, there would be a slight decrease in water depths in the protected area over the life of the project. Generally, the shallow areas would tend to get shallower and the established channels would maintain their depths or get slightly deeper.

The seed islands would result in creating a zone of deposition on the backside of the islands. The net result would be the eventual development of up to 60 acres of island over the life of the project. Sedimentation patterns would be altered within the zone of influence of these islands as they developed. Overall, the changes in sedimentation patterns would be localized and would not be appreciably changed in the larger Raft Channel East area.

C. Suspended Particulate/Turbidity Determinations

1. Suspended Particulates and Turbidity - Typical suspended solids concentrations in the area during the summer months range between 20 and 60 mg/l. Turbidity values range from

5 to 25 NTU's. The barrier island/rock sill system would reduce sediment input into the area. The interior islands would tend to break up wind fetch in the area bounded by the barrier islands and would reduce the resuspension of bottom sediments. The long term effects of the project should result in a decrease in turbidity in the protected area. The proposed discharge would increase the existing suspended solid/turbidity values during the open water disposal of the coarse dredged material. Past monitoring indicates that the discharged effluent would contain suspended solids greater than 60 milligrams per liter (mg/l). A return to ambient conditions should occur shortly after specific dredging events. Only minor increases in suspended particulates would be expected if the fine material is placed on or behind the islands mechanically. If hydraulic transfer of fine material is used for island construction in some reaches, the effluent would produce short-term, local increases in suspended solid and turbidity levels. Holding this material in retention areas on top of the islands for as long as practicable would minimize increases in these levels.

The seed islands would have no appreciable effect on suspended particulate or turbidity levels in the Raft Channel East Area. The placement of the rock fill during island construction would result in short-term, localized increases in turbidity levels. A return to ambient conditions would occur shortly after rock fill placement. A localized short-term increase in suspended particulate or turbidity levels may also occur due to any access dredging needed to construct the seed islands.

2. Effects on Physical and Chemical Properties of the Water Column

a. Light Penetration - The project will have short term adverse impacts during construction due to turbidity plumes but long term beneficial affects would occur from the reduction in sediment entering upper Stoddard bay and reduced wind fetch. Increased light penetration would be one of the major improvements expected with the project. The seed islands would have no appreciable effect on light penetration in the Raft Channel East area.

b. Dissolved Oxygen - Water quality monitoring data in the Stoddard Bay area indicates dissolved oxygen concentrations range from 8 ppm to 19 ppm depending on the time of year. The decreased flow conditions and increased vegetation extent expected with the project could result in lower dissolved oxygen levels in area bounded by the barrier islands. However, dissolved oxygen levels should remain above 5 ppm.

c. Toxic Metals and Organics - No increase in

contaminants in the aquatic environment would result from the open water disposal of sand or rock fill. The dredging and placement of fine material is expected to be done mechanically, however, even if a hydraulic dredge is used, effluents from the containment areas are not expected to cause toxic effects to fish, wildlife, or other aquatic organisms.

d. Aesthetics - Temporary increases in suspended sediment levels would have temporary negative impacts on aesthetics in the project area, but this will likely be observed by few people. Overall the project would lead to improvements in water quality and thus improved aesthetic values.

3. Actions Taken To Minimize Impacts - Impacts will be minimized by requiring that Wisconsin water quality limitations and monitoring requirements for carriage water discharge be followed during construction.

D. Contaminant Distribution Determinations

Chemical analysis of sediments in Stoddard Bay plus periodic testing of sediments in other areas of lower Pool 8 have indicated that sediments in this reach of the river are relatively uncontaminated. The proposed actions would have no appreciable affects on the location or levels of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organisms Determinations

1. Effects on Plankton - The proposed action would have no appreciable effect on plankton.

2. Effects on Benthos - Project construction would affect about 30 acres of shallow aquatic habitat, and the resulting plumes from the placement of dredged material may have temporary adverse impacts on benthos downstream. However, due to improved water clarity, increased vegetation extent altered flow conditions, habitat quality in upper Stoddard Bay for benthos would improve.

3. Effects on Fish - The proposed fill activities would result in the conversion of about 30 acres of shallow riverine habitat to islands. The proposed action would substantially improve the habitat conditions for fish in Stoddard Bay. The area currently provides fair summer habitat for centrarchids, but overall the area is considered to be very poor fish habitat. The primary limiting factor is the poor winter habitat conditions due to high current velocities and cold water temperatures. The construction of the barrier island/rock sill would result in reduced current velocities and somewhat warmer water

temperatures. The design flow would result in adequate dissolved oxygen conditions. All of the above conditions would result in the development of an area that would provide near optimum conditions. Dredging in Crosby Slough would also provide areas of deep water that may be utilized as winter habitat and for velocity refuge. Studies have indicated that winter habitat on the Mississippi River may be a critical component for maintaining fish populations on the river. Some species have been tracked traveling several miles to winter habitat. The establishment of winter fish habitat in this part of Pool 8 may contribute to maintaining healthy fish populations in the pool.

The seed islands may provide localized areas of improved fish habitat by creating areas of velocity refuge from the main channel.

4. Effects on Wildlife - The construction of the islands in Stoddard Bay would result in conditions conducive to the re-establishment of aquatic vegetation in the project area. This would result in the increase in the value of the area as waterfowl migration habitat. Similar effects are expected to occur within the Zone of influence that would develop with the seed islands. The islands and associated vegetation, both in Stoddard Bay and in Raft Channel East, would provide habitat for a wide variety of wildlife including; roosting habitat for raptors, migration and nesting habitat for neotropical migrants, and nesting habitat for turtles. The islands and associated shallow water zones would provide habitat for marsh and water birds.

5. Effects on Aquatic Food Web - The proposed action would have no appreciable effect on the aquatic food web.

6. Effects on Special Aquatic Sites

a. Sanctuaries and Refuges - The project area is located within the Upper Mississippi River Wildlife and Fish Refuge. The seed islands location is designated as a closed area during the hunting season, by the Fish and Wildlife Service (USFWS). The proposed action would improve habitat conditions on the refuge.

b. Wetlands, Mud Flats, and Vegetated Shallows - Approximately 30 acres of aquatic habitat (mostly unsheltered shallow and slough habitats) would be lost by the placement of island fill material along the alignment. The seed islands could result in the development of an additional 60 acres of island habitat over the next 50 years. This tradeoff is considered essential and acceptable for improving the aquatic productivity in the project area.

7. Threatened and Endangered Species - No State listed or federally listed threatened or endangered species would be adversely affected by the proposed action.

8. Actions Taken To Minimize Impacts - Construction activities in Raft Channel East would be restricted during the fall migration periods to minimize disturbance to waterfowl in the Closed Area.

F. Proposed Disposal Site Determinations

1. Mixing Zone - Coarse dredged material should settle out in the disposal area. Finer material will produce a plume that will become diluted with main channel flow, and near ambient conditions are expected within approximately 2,000 feet of the discharge point.

2. Compliance with Applicable Water Quality Standards - The proposed discharge may, on a short-term localized basis, increase suspended solid levels above the general Wisconsin State water quality standard of 80 mg/l. Ambient conditions for suspended solids during spring flooding in the Mississippi River probably also exceed State of Wisconsin standards. Best management practices will be used to minimize the amount of suspended sediment in the effluent.

3. Potential Effects on Human Use Characteristics - The proposed changes in island design and alignment would have no adverse effects on municipal or private water supplies; recreational or commercial fisheries; or aesthetics, parks, national historic monuments or similar preserves. The proposed action would most likely alter general recreational boating routes in the Stoddard Bay area. Direct access to the Stoddard Bay area immediately above the project would be slightly limited due to the construction of the barrier island/rock sill system. It is likely that most traffic would have to go out to Crosby Slough to gain access to the area above the project area. Overall, the effect on recreational navigation would be minor. The proposed changes are compatible with the goals of the Upper Mississippi river Wildlife and Fish Refuge.

G. Cumulative Effects on the Aquatic Ecosystem

The proposed action would not cause any significant adverse cumulative impact on the aquatic system. The proposed action is the second phase of a five phase plan to improve habitat conditions in lower Pool 8. Phase 1, located on the west side of the navigation channel and extending slightly upstream, was completed in 1993. Complete implementation of the 5 phase plan is

dependent on the extension of the Environmental Management Program, which is funded through 2002. While each phase is designed to function as a complete stand alone project, the synergistic effects of the phases combined would enhance the habitat benefits that are derived from each project individually. Combined with Phase 1, the completion of Phase 2 would result in approximately 1600 acres of fish and wildlife habitat being improved in this reach of pool 8. If all of the phases were constructed, the cumulative effect of all of the phases combined would be to restore and improve habitat conditions over a 5,000 acre portion of lower Pool 8.

H. Secondary Effects on the Aquatic Ecosystems

No significant negative affects should result from the project or the proposed changes. Long-term benefits to aquatic vegetation would result from the project and related secondary benefits to fish and wildlife are expected.

III. FINDINGS OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

The proposed fill activity would comply with Section 404(b)(1) guidelines of the Clean Water Act. No significant adaptations to the Section 404(b)(1) guidelines were made for this evaluation. Other alternatives considered to improve habitat conditions in Stoddard Bay and in Raft Channel East included variations in island design, island alignment and the number of islands constructed. The proposed action represents the best combination of engineering, economic and environmental consideration to achieve the desired habitat improvement goals.

The proposed fill activity would be in compliance with Section 307 of the Clean Water Act and the Endangered Species Act of 1973, as amended. The proposed discharge may, on a short-term localized basis, increase suspended solid levels above the Wisconsin State water quality standard of 80 mg/l. Wisconsin has granted a variance from these standards. The proposed discharge would meet the conditions of the variance. The proposed fill activities would not have a significant adverse impact on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, wildlife, and special aquatic sites. The activities would have no significant adverse effect on the life stages of aquatic organisms or other wildlife. No significant adverse effects on aquatic ecosystem diversity, productivity and stability, or on recreational, aesthetic, and economic values would occur.

Steps taken to minimize potential adverse effects on the aquatic ecosystem include timing dredging activities to avoid high flow

periods, avoiding construction during the hunting season when the Raft Channel East area serves as a sanctuary for waterfowl during fall migration, and requiring that Wisconsin water quality limitations and monitoring requirements for discharge of carriage water be met during construction.

On the basis of this evaluation, I specify that the proposed action complies with the requirements of the guidelines for discharge or placement of fill material.

3 Jun 96
Date

J. M. Wonsik
Colonel, Corps of Engineers
District Engineer

ATTACHMENT 4

HABITAT EVALUATION APPENDIX

HABITAT EVALUATION PROCEDURE USED FOR THE POOL 8 - PHASE II HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Habitat evaluation procedures (HEP) were used to evaluate the potential benefits of the alternative habitat improvement features for the Pool 8 project area at Stoddard, Wisconsin. Active participants included biologists from the St. Paul District, the Upper Mississippi River Wildlife and Fish Refuge and the Wisconsin Department of Natural Resources.

METHODS

METHODOLOGY

The U.S. Fish and Wildlife Services's 1980 version of Habitat Evaluation Procedures (HEP-80) was used to quantify and evaluate the potential project effects and benefits. One of the considerations in the selection of this methodology was the readily available fish species models associated with this methodology.

The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing existing HU's to HU's expected to be gained with a proposed action, the benefits can be quantified.

EVALUATION SPECIES SELECTION

Winter habitat for fish has been identified as a critical habitat component on the river. Studies have indicated that fish will travel several miles to areas that provide wintering habitat (Pitlo 1994). The fish community that is expected to use Stoddard Bay is a backwater community characterized by a predominance of Centrarchids (i.e. largemouth bass, black crappie, and bluegill). A primary project objective is to improve winter habitat conditions for Centrarchids and associated species.

After a review of the available species models, the bluegill model (Stuber, et. al., 1982) was selected to quantify the fish habitat benefits. This model was selected because is has been modified by the St. Paul District (Palesh and Anderson, 1990) to include winter habitat variables.

One of the components of the management plan for the Upper Mississippi River Wildlife and Fish Refuge is to maintain and improve migratory habitat for waterfowl. The highest projected waterfowl use in the project area is as migration habitat,

especially for diving ducks. Improving migration habitat conditions for waterfowl was subsequently identified as one of the major project objectives and diving ducks were selected as the indicator species.

There were no available models for evaluating migratory habitat for waterfowl on the Upper Mississippi River. Therefore, a model to evaluate diving duck migratory habitat on the Upper Mississippi River was developed for this evaluation (enclosure 1). The model is a revised version of model developed in 1991 for a habitat project on the Trempealeau National Wildlife Refuge. Revisions to the model were based on literature review, and inputs from the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

DATA REQUIREMENTS

Pool 8 is a key pool for long term monitoring efforts being conducted on the Upper Mississippi River by Environmental Management Technical Center (EMTC) through the Long Term Resource Monitoring Program. As a result, considerable information was available concerning past and existing conditions in this reach of the river. Land use, bathymetric, vegetation and water quality data for the project area was readily available and was used for providing model inputs for existing conditions. Trend analysis provided an indication of probable future conditions and provided a basis for identifying potential responses.

Extensive hydraulic modeling was done to identify existing flow conditions in the project area and to develop design criteria for meeting the project goals. A discussion of this modeling effort is presented in the hydraulics appendix. This information was used in determining input values for several of the habitat model variables.

EVALUATION AREAS AND PLAN COMPONENTS

The core study area is approximately 960 acres in size lying between Crosby Slough and the Wisconsin shoreline. Preliminary evaluations considered the conditions in this entire area. As the study progressed, design considerations narrowed the primary project area to the upper 500 acres of the study area. This was based primarily on location of the bathymetric conditions conducive to economic island construction. Generally, the shallower areas are located along the alignment where islands had once existed, which are located in the upper half of the core study area. Later design efforts and detailed HEP evaluations focused on this smaller primary study area.

The primary study area was broken down into 2 distinct evaluation areas, based on the primary area of influence of the proposed

barrier islands (figure 1). Area 1 was generally defined as the upper 300 acres of the study area and Area 2 was generally defined as the lower 200 acres.

Several island configurations were developed for detailed evaluation. Separate island/rock sill components were developed and identified as islands A through E (figure 2). Varying combinations of these components were used to develop the various alternatives.

HABITAT SUITABILITY INDEX CALCULATIONS

Model matrixes and Habitat Suitability Index (HSI) calculations are presented in enclosure 2. HSI's were calculated for each species for the existing conditions and for the various combinations of island construction (scenarios). The assumptions and data sources used for the variable values are listed on the evaluation sheets under the comments column. Other assumptions used for each scenario are listed at the bottom of the evaluation sheets under NOTES. Other general assumptions used in completing the evaluation were:

1. At a minimum, islands AB must be constructed first. Construction of the closure is essential to meet any of the fishery goals in Stoddard Bay. Segment A in and by itself would not provide any appreciable benefits as the area affected by the closure would be very limited. None of the other components would be constructed unless the AB islands were constructed.

2. The D islands are essential to realize any appreciable vegetation response. Construction of the closure would dramatically reduce flows to the protected area. Without the D islands, wind fetch combined with decreased flows would likely result in increased turbidity, resulting in no vegetation response.

3. Construction of the closure would result in some sedimentation in the area. Without additional measures, the percentage of the area greater than 4 feet in depth would decline by about 33% over the life of the project.

4. Construction of the interior islands (D islands and E islands) would help to maintain depths in the area by concentrating flows to the existing channels.

5. The period of analysis for this project is 50 years.

EXISTING CONDITIONS

Aquatic: Stoddard Bay currently provides very poor year round habitat for centrarchids, with an HSI of .2 due to the lack of

POOL 8 BATHYMETRIC DATA

STODDARD (S1)

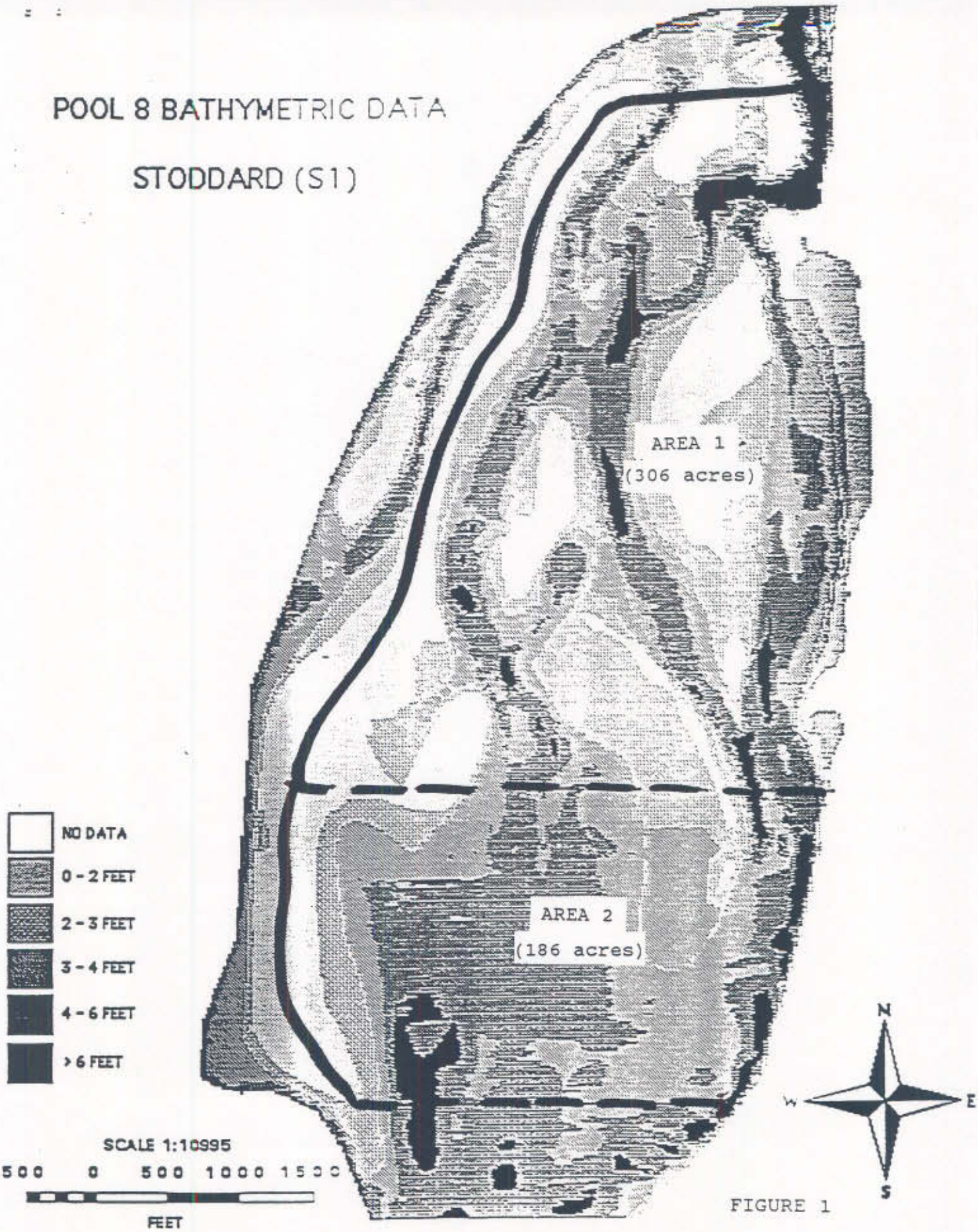


FIGURE 1

POOL 8 BATHYMETRIC DATA

STODDARD (S1)

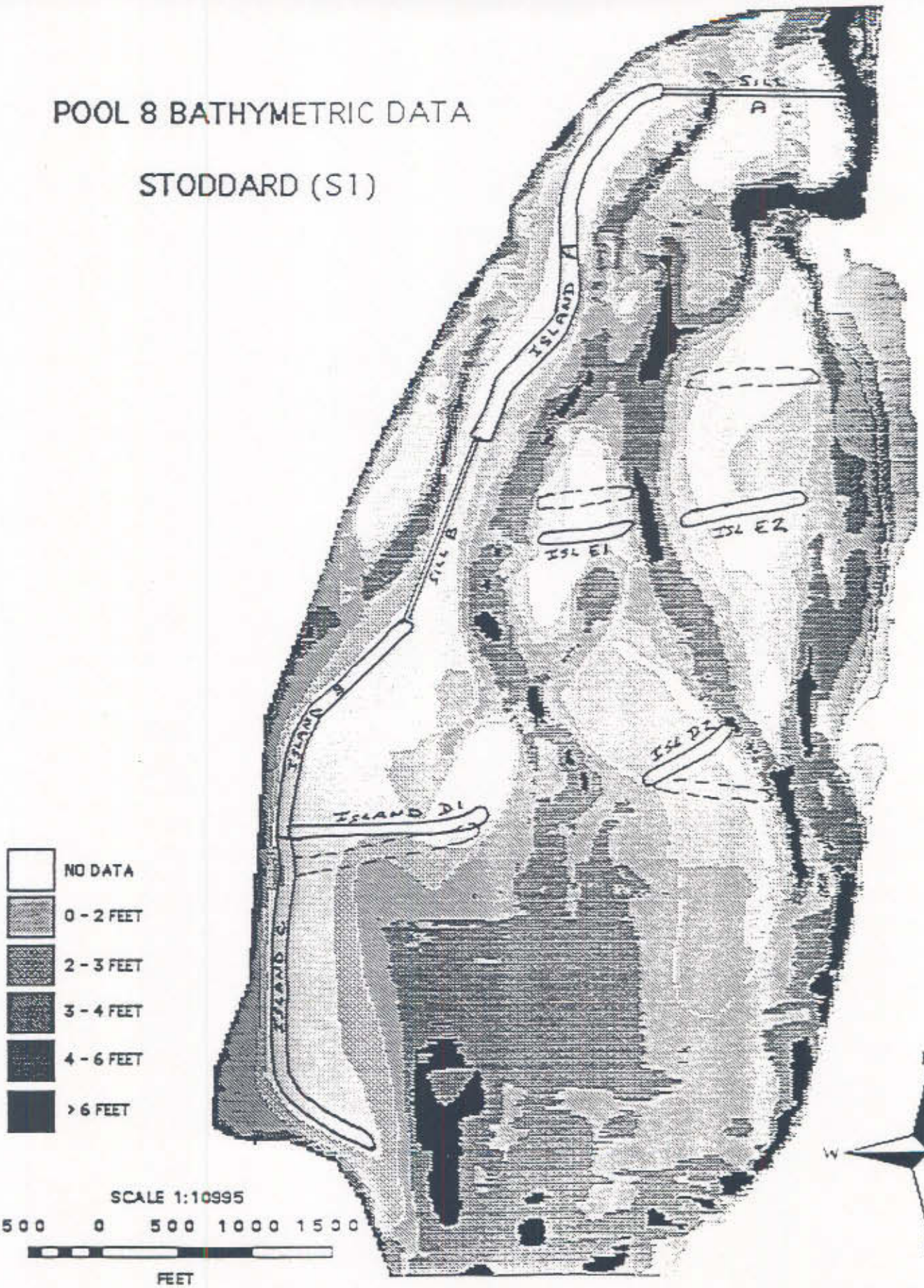


FIGURE 2

suitable habitat conditions during the winter. The primary limiting factors are the high current velocities and low water temperatures that prevail during the winter. The percentage of the area with water depths greater that 4 feet is not optimum, and is also a contributing factor to the poor habitat conditions. When considered separately, Area 1 has a slightly smaller amount of the area with depths greater than 4 feet than does Area 2.

Waterfowl: Overall, Stoddard Bay provides below average migration habitat for waterfowl with an HSI of .35. The primary limiting factors are: the relative lack of aquatic vegetation in the area, limited invertebrate populations and a potential for relatively high disturbance levels during migration from human activity.

FUTURE WITHOUT PROJECT CONDITIONS

If no action is taken, it is expected that the remaining islands in the Stoddard area will eventually erode away. Based on the historic rate of island loss, it is expected that the remaining islands will be lost within 10 years.

It is uncertain as to whether or not the decline of aquatic vegetation levels that were present in the mid 1980's is permanent, or if the vegetation will recover. It is likely, however, that the aerial extent of the aquatic vegetation in Stoddard Bay has been dependent to a great degree on the influence of the islands on current and wind fetch. As the protection that is afforded by the remaining islands is lost, it appears unlikely that aquatic vegetation would ever recover to the extent that was present prior to the mid 1980's. For this analysis, it was assumed that aquatic vegetation in the study area would decline slightly as the remaining islands disappeared.

Aquatic: As the few remaining islands disappear, additional flow would likely enter the Stoddard Bay area. Centrarchid summer habitat conditions would decline slightly due to the assumed increase in velocity with increased flows. The increased flows would further aggravate already poor winter habitat conditions for fish. The model indicates that the HSI would decline slightly from .2 to .18 over the period of analysis.

Waterfowl: The continued limited extent of aquatic vegetation in Stoddard Bay would limit the value of the area as migration habitat for waterfowl. Overall, the migration habitat HSI would not change appreciably.

FUTURE WITH PROJECT CONDITIONS

The following discussion is a presentation of the potential effects the various island components and scenarios may have on habitat quality.

A/B Island

Aquatic: The construction of the A/B Island would essentially create a closure for the upper portion of Stoddard Bay. The reduction of current velocities and the associated increase in water temperatures would dramatically increase the winter habitat conditions in Area 1 of the study area, with the winter HSI increasing from .05 to .79. The overall HSI would increase from .2 to .76.

Waterfowl: It is assumed that without further features, no appreciable change to the value to the area as migration habitat would occur. Reduced flows, coupled with wind fetch, may increase the turbidity in Area 1, thereby preventing any appreciable increase in the extent of aquatic vegetation. The habitat quality of the area as migration habitat would remain at an HSI of .35.

C Island

Aquatic: The construction of the C Island would increase the area of influence of the barrier islands from 306 acres (with the A/B Island) to a total of 492 acres. The percentage of Area 2 with depths greater than 4 feet is slightly greater than Area 1, which is reflected in the slightly greater increase in the winter HSI when the flows are reduced in Area 2. In Area 2 winter habitat quality would be raised from an HSI of .05 to an HSI of.85 with an overall HSI change from .2 to .79. When considered as a whole, the entire study area (Area 1 + Area 2) would increase in overall habitat quality from an HSI of .2 to an HSI of .78

Waterfowl: As with the A/B Island, if no other interior features were included to address wind fetch, it is unlikely that there would be any appreciable change in the amount of aquatic vegetation in upper Stoddard Bay. Any vegetation response would be minimal and limited to the vicinity of the islands. The majority of the area would still be susceptable to wind fetch, resulting in the resuspension of sediments. The effects of wind fetch may not be as pronounced in area 2, as it has a greater proportion of deeper water. However, without any interior island, it is assumed that area 2 would also experience increased turbidity as a result of sediment resuspension that would occur in area 1. Overall, aquatic vegetation in the evaluation area would decline slightly. Therefore, there would be no measurable change in migration habitat quality and the HSI would remain at .35.

A/B Islands + D Islands

Aquatic: The construction of the interior islands would result in an additional 14% increase in the centrarchid habitat quality in Area 1. The D islands would help to maintain depths in the area

and would also help to break up wind fetch which creating conditions conducive to the re-establishment of aquatic vegetation in Area 1. It is estimated that aquatic vegetation could recover to approximately 50% of the 1975 conditions. Given these conditions, the habitat quality for centrarchids would improve from an .2 to an HSI of .88.

Waterfowl: The increase in submergent aquatic vegetation to about 50% of 1975 conditions would increase the quality of waterfowl migration habitat in Area 1. The establishment of fairly extensive aquatic vegetation beds, coupled with the reduced current velocities, would also be conducive to increasing benthic invertebrate populations. With these effects, the diving duck migration habitat HSI would increase from .35 to an HSI of .52.

A/B/C Islands + D Islands

Aquatic: As a result of the reduced flows associated with the C island, the D islands would have effects in both Area 1 and Area 2. The D islands would reduce wind fetch in Area 1, which would reduce sediment resuspension, affecting turbidity levels in both areas. The D island would also provide some measure of protection in Area 2 from wind fetch generated from the north. Due to the exposure to southern wind fetch, the vegetation response in Area 2 may be somewhat lower than in Area 1. It is anticipated that the overall vegetation response would be about 50% of 1975 conditions. Due to the synergistic effects of the increased area of influence the overall HSI would increase from .2 to an HSI of .9.

Waterfowl: The re-establishment of aquatic vegetation beds in Area 2 would result in an increase in the quality of diving duck migration habitat in Area 2. The improvement in habitat quality would be slightly less than would be expected in Area 1 alone with an HSI increase from .35 to an HSI of .49. This is due to the assumption that the continued exposure of Area 2 to southern generated wind fetch may limit vegetation response.

A/B/D Islands + E Islands

Aquatic: The effect of the construction of the E islands would be a greater efficiency in maintaining the existing channel depths in Area 1. In addition, there would probably be an increased vegetation response in Area 1 due to the localized influence of the islands on water current and sedimentation patterns, and a limited zone of protection from winds. With respect to centrarchid habitat quality, the model indicates that the habitat quality gains that would be associated with the maintenance of water depths would be offset by the increased vegetation response, which would be beyond optimum conditions for summer habitat. Overall, there would be no increase in centrarchid habitat quality with the HSI remaining at .88.

Waterfowl: The increase in the extent of aquatic vegetation beds would increase the migration habitat quality in Area 1 by an additional 10%, with an increase in the HSI from .35 to an HSI of .57.

A/B/C/D Islands + E Islands

Aquatic: The E Islands would have no appreciable effects on centrarchid habitat quality in Area 2. The overall habitat quality in Area 1 and Area 2 combined would not increase with the E islands and would remain at an HSI of .9.

Waterfowl: With the E Islands in place, there would be no direct change in habitat quality in Area 2. However, when considered as a single evaluation unit, the habitat quality in Area 1 and Area 2 combined would improve by about 6% with an increase in the HSI from .35 to an HSI of .52.

Synergistic Effects and Their Effect on HSI Calculations

There are synergistic effects of increasing the overall evaluation area when evaluating the various island components. The AB islands primarily affect evaluation Area 1, and the C Island primarily influences Area 2. The habitat models are sensitive to the aerial extent of some habitat components (such as depth for the bluegill model and aquatic vegetation in the diving duck model). The effect of this sensitivity, in some cases, is a slight increase or decrease in the habitat suitability index value when Areas 1 and 2 are evaluated as a single unit, as compared to the calculated HSI when each area is considered separately. In other words, the value of the whole may be slighty lower or higher than the sum of the parts.

Mudflat Construction

Shallow water and mudflat areas for shorebird are limited in lower Pool 8. In areas where they do develop they are used extensively. One objective of the project was to improve habitat conditions for wading and shorebirds. If constructed, it is expected that the area on the north side of Island D where it ties in with Island A/B, will become an accretion area. Over time, a mudflat will form in this area. It was proposed that in order to accelerate the potential habitat benefits for shorebirds in this area, dredged material could be used to construct the mudflat. The size of the mudflat could vary from 5 to 25 acres. A suitable HEP model was not available for evaluating this feature. Based on professional input from agency biologists, it was determined that a mudflat, either naturally accreted or constructed, would most likely have an HSI for shorebirds of .6. This value was based on the consideration that vegetation density, water depth and substrate conditions would provide

habitat of slightly above average quality. However, optimum habitat conditions would most likely not develop due to the minimum management potential, and because the area may not be available to shorebirds during key times due to high water.

HABITAT UNIT CALCULATION

The values used to determine habitat unit gains for the various components and scenarios are presented in enclosure 3 and summarized in table 4-1. For the future with project conditions, it was assumed that habitat benefits associated with features that would reduce flow would be realized immediately after construction. These features are the A/B Islands and the C Island. Habitat benefits associated with vegetation response would not be fully realized until 10 years after project construction because it is estimated that it would take approximately 10 years for these responses to fully develop.

The HEP analysis takes into account the potential development of mudflats in the area where the D island ties into the A/B island. It was estimated that the mudflat would accrete at a rate of 5 acres per decade over the life of the project. A corresponding decrease was factored into the amount of available aquatic habitat over the period of analysis.

The HEP analysis indicates that project benefits can be somewhat categorized by project features (Fig 3). The A/B islands provide substantial centrarchid habitat benefits but no appreciable diving duck migration habitat benefits. Likewise with the C island. The construction of these features would address the primary limiting factors for centrarchid habitat in Stoddard Bay, high flows and low water temperatures during the winter, but would likely do little towards aquatic vegetation recovery.

The D islands would contribute to increasing habitat quality for both centrarchids and waterfowl by maintaining channel depths in the area and creating conditions conducive to aquatic vegetation recovery. The effectiveness of the D islands in promoting aquatic vegetation response would increase with the construction of the C island.

The E islands provide some improvement for waterfowl habitat but negligible centrarchid benefits. The E islands would help to maintain channel depths and would contribute to a stronger aquatic vegetation response.

INCREMENTAL ANALYSIS

An incremental analysis of the proposed features in Stoddard Bay was tiered. The primary goals of the actions in Stoddard Bay are to improve winter habitat for fish, primarily centrarchids. Therefore an incremental analysis of fishery benefits was done

TABLE 4-1. SUMMARY OF HABITAT UNIT CALCULATIONS - POOL 8 EMP AT STODDARD

FEATURE	EVALUATION SPECIES	ACRES	FUTURE WITHOUT					FUTURE WITH					AAHU GAIN	INCREMENTAL AAHU GAIN
			TY0	TY1	TY10	TY50	AAHU	TYO	TY1	TY10	TY50	AAHU		
A/B ISLAND	Centrarchids	306	0.20	0.20	0.18	0.18	56	0.20	0.76	0.76	0.76	231	175	175
	Diving Ducks	306	0.35	0.35	0.35	0.35	107	0.35	0.35	0.35	0.35	107	0	0
C ISLAND	Centrarchids	186	0.20	0.20	0.18	0.18	34	0.20	0.79	0.79	0.79	146	112	112
	Diving Ducks	186	0.35	0.35	0.35	0.35	65	0.35	0.35	0.35	0.35	65	0	0
A/B ISLAND	Centrarchids	306	0.20	0.20	0.18	0.18	56	0.20	0.76	0.88	0.88	248	192	(a) 17
WITH D ISLAND	Diving Ducks	306	0.35	0.35	0.35	0.35	107	0.35	0.35	0.52	0.52	144	37	37
A/B/C ISLAND	Centrarchids	492	0.20	0.20	0.18	0.18	90	0.20	0.78	0.90	0.90	417	327	(b) 40
WITH D ISLAND	Diving Ducks	492	0.35	0.35	0.35	0.35	172	0.35	0.35	0.49	0.49	225	53	53
A/B/D ISLAND	Centrarchids	306	0.20	0.20	0.18	0.18	56	0.20	0.76	0.88	0.88	245	189	(c) 0
WITH E ISLAND	Diving Ducks	306	0.35	0.35	0.35	0.35	107	0.35	0.35	0.57	0.57	165	48	11
A/B/C /D ISLAND	Centrarchids	492	0.20	0.20	0.18	0.18	90	0.20	0.78	0.90	0.90	415	325	(d) 0
WITH E ISLAND	Diving Ducks	492	0.35	0.35	0.35	0.35	172	0.35	0.35	0.52	0.52	236	64	11
MUDFLAT	Shorebirds	25 (e)	0.00	0.00	0.60	0.60	7	0.00	0.20	0.60	0.60	14	7	7

(a) Incremental AAHU Gain = (AAHU A/B+D) - (AAHU A/B)

(b) Incremental AAHU Gain = (AAHU A/B/C+D) - (AAHU A/B + AAHU C)

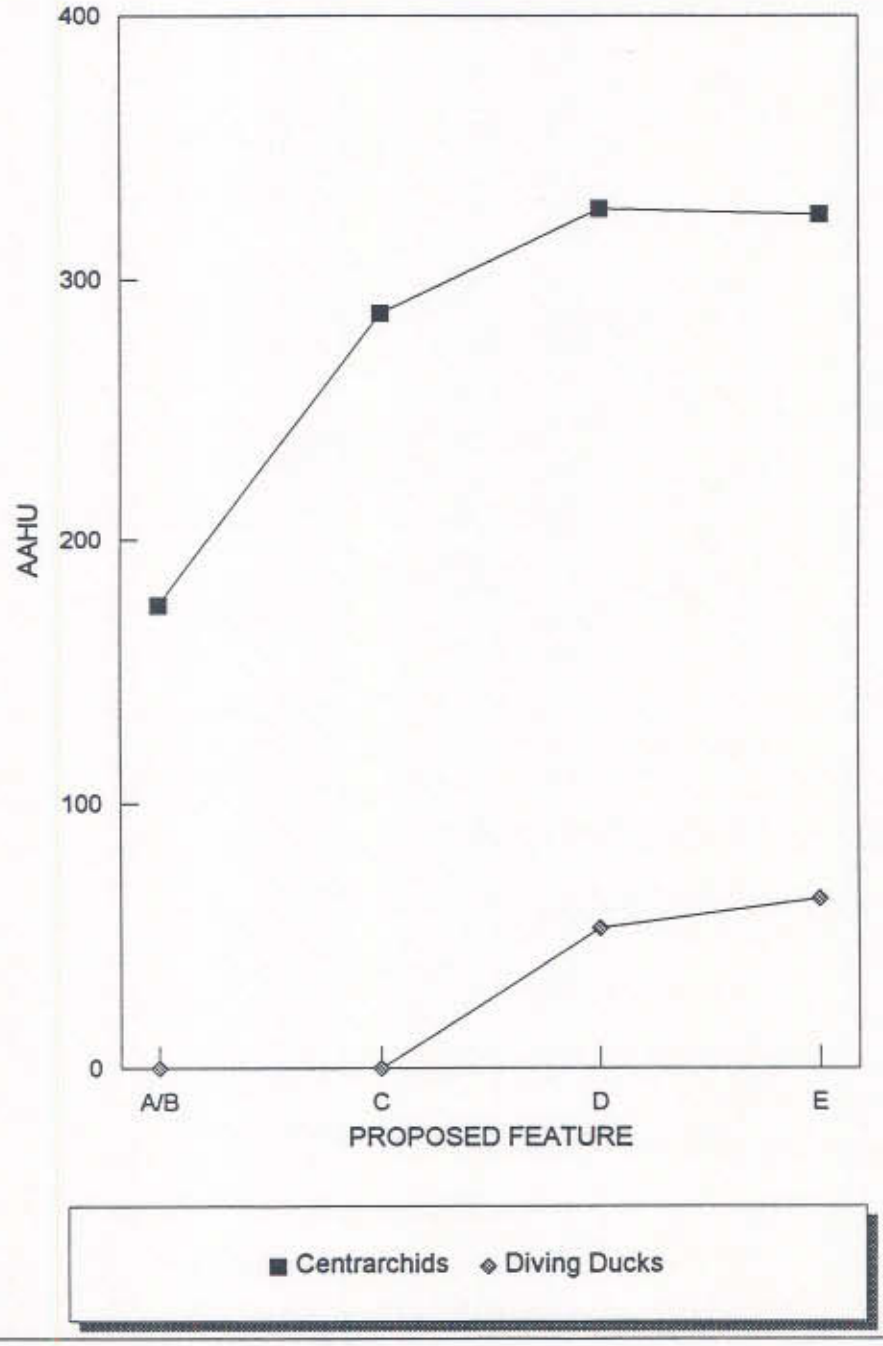
(c) Incremental AAHU Gain = (AAHU A/B/D+E) - (AAHU A/B+D)

(d) Incremental AAHU Gain = (AAHU A/B/C/D+E) - (AAHU A/B/C+D)

(e) Assumes that the mudflat accretion rate in area ABD would be 5 acres/10 years over the life of the project.

Figure 3: AAHU Gain of Proposed Features

Centrarchids vs Diving Ducks



for all the proposed features. The HEP analysis indicates that once the A/B islands are constructed there are opportunities to improve waterfowl migration habitat in the protected area by the construction of interior islands. The incremental analysis for the waterfowl benefits assumed that either the A/B islands or A/B/C islands are already in place and addressed only the cost of the interior islands.

The incremental gains and cost of the proposed features in are summarized in table 4-2 and shown in figure 4.

Centrarchid Benefits: The minimum project that would need to be constructed to provide measurable benefits is the A/B islands/rock sills at a cost of $1024/HU. The next most cost effective increment to construct would be the the C island at a cost of $256/HU. This is because the primary limiting factors for habitat quality in Stoddard Bay are flow and temperature, and the C island feature addresses these habitat components by increasing the area of influence of the barrier islands at a relatively low cost. The incremental cost of the D islands range from $1,390/HU to $3,137/HU depending on whether or not the C island is constructed. The E island has negligible habitat benefits.

Diving Duck Benefits: The D islands would result in an increase in habitat benefits at a cost ranging from $1049/HU to $1,441/HU depending on whether or not the C islands were constructed. The range in cost effectiveness is due to the greater area of influence of the D islands with the C island constructed. The E island would provide an additional 20% increase in habitat benefits at a cost of $3,036/HU.

Shorebird Benefits: The construction of the mudflat to provide shorebird habitat would cost $3,571/HU. The relatively high cost per Habitat Unit is due to the assumption that similar habitat would develop in the target area in absence of this feature.

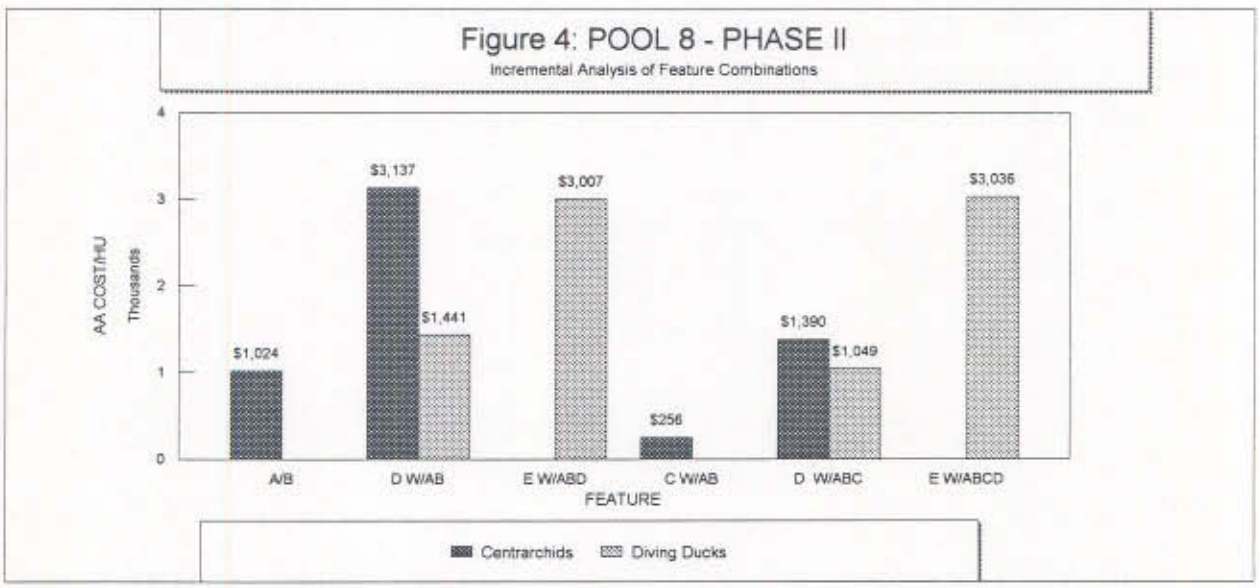
PROJECT FEATURES COMPARISON

A comparison of the cost effectiveness of the proposed features shows that once the A/B islands are constructed (at a cost of $1,024/HU), the C island is the most cost effective increment to implement at $256/HU. The C island also increases cost effectiveness of the D islands by increasing the area of influence of the D island feature. The E islands are dependent on the construction of the other island features. Given their limited area of influence, they are also the least cost effective of the island features.

The cost per habitat unit for the A/B islands/rock sills are justified based on the reasonableness of the costs, the types of benefits being generated, and the importance of the resource

TABLE 4-2: SUMMARY OF INCREMENTAL GAINS AND COSTS OF THE PROPOSED FEATURES

PLAN	COST	AA COST	INCREMENTAL FEATURE	EVALUATION SPECIES	AAHU GAIN	INCREMENTAL GAIN	INCREMENTAL AA COST	AA COST/HU
A/B ISLANDS	$2,292,000	$179,234	A/B ISLANDS	Centrarchids Diving Ducks	175 0	175 0	$179,234	$1,024
A/B/D ISLANDS	$2,974,000	$232,567	D ISLANDS	Centrarchids Diving Ducks	192 37	17 37	$53,333 $53,333	$3,137 $1,441
A/B/D/E ISLANDS	$3,397,000	$265,645	E ISLANDS	Centrarchids Diving Ducks	189 48	0 11	$33,078	$3,007
A/B/C ISLANDS	$2,659,000	$207,934	C ISLAND	Centrarchids Diving Ducks	287 0	112 0	$28,700	$256
A/B/C/D ISLANDS	$3,370,000	$263,534	D ISLANDS	Centrarchids Diving Ducks	327 53	40 53	$55,600 $55,600	$1,390 $1,049
A/B/C/D/E ISLANDS	$3,797,000	$296,925	E ISLANDS	Centrarchids Diving Ducks	325 64	0 11	$33,391	$3,036
MUDFLAT	$315,000	$25,000	MUDFLAT	Shorebirds	7	7	$25,000	$3,571



being benefitted. As noted earlier, studies have indicated that winter habitat on the river may be a key component in maintaining fish populations on the river, which these features do at a relatively low cost per habitat unit. From the fisheries perspective, the D islands, while less cost effective, would maintain the quality of the overall habitat by maintaining depths and increasing aquatic vegetation in the area. The E islands do not appear justified as a fisheries component.

When considered solely as components to improving waterfowl migration habitat, the interior islands are justified based on the reasonableness of the cost and the importance of the resource. Diving duck use, especially for canvasbacks and scaup, has traditionally been very high in pool 8 and these features would contribute to improving and maintaining important migration habitat. The construction of the interior islands would contribute to the goals of the North American Waterfowl Management Plan. The enhancement and restoration of waterfowl habitat, especially along migration corridors such as the Mississippi River, is of key importance in maintaining viable waterfowl populations. The cost of the D islands at $1,049/HU are comparable in cost to other EMP projects that had improvement of waterfowl migration habitat has a component. The E islands at $3,036/HU are on the high end of justifiable costs, when compared to other projects, but the cost is still considered acceptable.

The islands would provide a wide array of unquantifiable benefits. The islands and associated vegetation would provide habitat for wide variety of species including; roosting habitat for raptors, migration and nesting habitat for neotropical migrants and nesting habitat for turtles. The islands and the associated shallow water zones would provide marsh habitat for water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and shorebirds. While this list may seem extensive, Fish and Wildlife Service refuge personnel have indicated that similar outputs have been observed in conjunction with the completion of Phase I of the Pool 8 Island Project.

The mudflat feature at $3,571/HU does not appear to be a justified increment, based on the relatively high cost and the determination that similar habitat would most likely develop over time once the A/B/D islands are constructed.

Based on the multi-purpose nature of the benefits and the cost effectiveness of the features, it is recommended that islands A/B, C, D, and E be considered for implementation and that the construction of the mudflats be dropped from further consideration.

FEATURES CONSIDERED OUTSIDE STODDARD BAY

NESTING ISLANDS

At the onset of project planning it was suggested that the construction of features in Stoddard Bay provides the opportunity to cost effectively construct a nesting island in an area above the constructed islands. Studies by Wetzel et. al. (1989), have indicated that small, predator free nesting island can be very productive with nest densities reaching as high as 100 nests per acre. Criteria developed by the Wisconsin DNR required that the proposed island be a least .5 mile from shore, relatively close to brood cover and between .5 and 1 acre in size.

The evaluation of this project feature was not based on a habitat model. No available model was identified that was sensitive enough to evaluate the increase in habitat quality that would be attributed to an increase of .5 to 1 acre of nesting habitat. Therefore, the effectiveness of the nesting island feature was based on comparing the estimated cost/duck fledged with this project to the estimated cost/duck fledged incurred by other programs which focus on waterfowl production. Input for this evaluation was provided by the Wisconsin DNR and the Fish and Wildlife Service (enclosure 4). A limited literature search and information provided by the U.S. Fish and Wildlife Service's Detroit Lakes Wetland Management District and Ducks Unlimited in Bismarck, North Dakota indicated that the average annual cost/duck fledged for a 25 year project life ranges from $32 to $647.

Estimates for production on a proposed 1 acre nesting island above Stoddard Bay are 63 ducks fledged/year at an estimated cost of $260,000 (Average Annual Cost = $23,581). Assuming that there would be no maintenance on the island, the average annual cost/duck fledged for the proposed nesting island would range from $173 to $374, depending on the assumptions used for production. The higher cost of $374/duck fledged was used in evaluating this feature, based on recent nest densities on other islands in Pool 8.

Based on the above information, it appears that the cost per duck fledged that could be expected with the proposed nesting island would be comparable to what other resource management agencies have invested to produce waterfowl. Based on cost alone, it appears that this feature may be justified.

While the cost effectiveness is an important consideration in evaluating this feature, the following should be considered in developing a final recommendation:

a. The evaluation of the proposed nesting island may be based on somewhat optimistic assumptions with respect to

production. Habitat availability during high water, initial susceptibility to avian predators immediately following construction, changes in island size or changes in vegetation composition, and lack of maintenance over the life of the project could all have adverse effects on the projected nest density or production.

Long term monitoring studies of nesting mallards in pools 7 and 8 on the UMR (Nelson and Wetzel, 1995) have indicated that nesting intensity and success can be highly variable from year to year. Water conditions on the UMR and in surrounding habitat at critical periods, brood habitat condition, nesting vegetation condition and weather conditions at critical periods, can all play a factor in any yearly observed nesting intensity or nesting success. It appears that long-term nesting densities on UMR islands average between 10 to 20 nests per acre with a nest success rate of 60%.

b. The proposed nesting island would be a single purpose feature with limited secondary benefits. Programs by other resource management agencies may have higher costs, but they often involve larger tracts of land, which in turn provide many secondary benefits.

c. The construction of small, isolated nesting islands does not appear to be a strategy currently being implemented on the river by other resource agencies to increase waterfowl production on the river.

SEED ISLANDS

Six seed islands were proposed along the right descending bank of the main channel immediately across and slightly downstream of Stoddard Bay (see Plate 18 of the DPR). Each seed island would be low rock berms approximately 200 feet long with a 3 foot top width. These structures would create conditions that foster accretion, resulting in the development of sand islands.

Due to the uncertainty in predicting the characteristics of the islands that will develop and the area that would benefitted, HEP was not used to quantify benefits associated with this feature. However, it is anticipated that as the islands develop many of the secondary benefits that were discussed for the islands in Stoddard Bay will accrue on the developed islands and within the their area of influence. Initially, the small sandy islands that would develop would provide loafing habitat for waterfowl, nesting habitat for turtles and habitat for shorebirds. As the islands mature, they would provide habitat for a wider variety of wildlife and it is probable that aquatic vegetation beds will become re-established within the shadow zones that develop behind the islands.

Within the island clusters, it is also anticipated that the hydraulic conditions that develop between the islands would create scour areas as the main channel flow is concentrated between the islands. Similar conditions are evident between Heron and Trapping Islands immediately upstream. Past mussel surveys, and anecdotal observations have noted that the scour area between Heron and Trapping Islands supports healthy and diverse mussel beds. Therefore, it is anticipated that scour areas that would develop between the proposed islands would provide improved habitat conditions for mussels.

REFERENCES

Palesh, Gary and Dennis Anderson. 1990. Modification of the habitat suitability index model for the bluegill (Lepomis macrochirus) for winter conditions for the Upper Mississippi river backwater habitats. St. Paul district, Corps of Engineers. 8 pp.

Pitlo, John. 1994. Wintering areas: limiting habitat for Largemouth bass?, in Proceedings of the Fiftieth Annual Meeting of the Upper Mississippi River Conservation Committee, pp 59 - 62. Upper Mississippi River Conservation Committee.

Stuber, R.J., G Gebhart, and O.E. Maughan. 1982a. Habitat suitability index models: Bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8. 26 pp.

Nelson, J.S. and J.F. Wetzel. 1995. Summary report. Long-term monitoring of nesting mallards on Mississippi River islands, 12pp. (Unpublished, obtained from Wetzel, Wis DNR.)

Wetzel,J., J.S. Nelson and R. Dahlgren. 1989. Survey of waterfowl nesting success on UMR islands and implications for habitat projects, in Proceedings of the Forty-Fifth Annual Meeting of the Upper Mississippi River Conservation Committee, pp 97 - 103. Upper Mississippi River Conservation Committee.

ENCLOSURE 1

DIVING DUCK MIGRATION HABITAT MODEL

October 1995

A MIGRATORY HABITAT MODEL FOR DIVING DUCKS USING THE UPPER MISSISSIPPI RIVER

by

Randy Devendorf
U.S. Army, Corps of Engineers
St. Paul District

General

Large lakes and riverine impoundments are major habitat types used by diving ducks during spring and fall migration through the midwestern region of the United States. The Upper Mississippi River (UMR) is a major staging area for diving ducks in the Mississippi and Atlantic Flyways. The most numerous diving ducks using these areas are lesser scaup (Aythya affinis), redhead (Aythya americana), canvasback (Aythya valisineria) and ring-necked duck (Aythya collaris). The UMR's navigation pools 5,7,8,9 and 19 are considered to be the most important areas as far as providing migratory habitat on the river (Korschgen 1989).

The major component of migration habitat differs from breeding habitat in that the requirement for cover is of minor importance. It is assumed the following habitat components need to be considered in developing a model to evaluate the quality of migratory habitat for diving ducks; size of water body, water depth, types and abundance of aquatic vegetation, and susceptibility of the area to human disturbance.

Size of Waterbody

Korschgen (1989) indicated that wetlands greater than 100 acres in size was important to diving ducks, because they provided protection from predators and minimized human disturbance. Stoudt (1970) conducted a survey to delineate canvasback migration and wintering habitat. In 1968 all known concentration areas of canvasbacks were surveyed for use. During that study 35% of the concentration areas surveyed were between 1,000 and 4,000 acres in size, 10% of the areas were less than 200 acres in size and 7% were greater than 50,000 acres in size. The remaining 48% of the areas surveyed were between 200 to 1000 acres in size or between 4,000 and 50,000 acres in size.

Water Depth

Water depth is a parameter affecting the type and amount of aquatic vegetation present. Emergent vegetation is not critically important to diving duck migratory habitat. In addition, feeding habits of diving ducks are adapted more to deeper water depths. Redheads and ring-necked ducks will feed as dabblers in shallower water (1-2 feet in depth) while scaup and canvasback generally feed more by

diving (Bellrose 1978). An area that would be suitable for all species of diving duck would have a range of water depths from 18 inches to 6 feet. Lake Christina, in west-central Minnesota, was at one time a key resting and feeding area for canvasbacks until water quality degradation resulted in the loss of extensive aquatic vegetation beds. The average depth of in Lake Christina is about 5 feet. A diving duck model (unpublished) developed in the Rock Island District for the Lake Chautauqua Habitat Rehabilitation and Enhancement Project suggests a depth of 18 inches to 3 feet as optimum.

Aquatic Vegetation

With the exception of the scaup, the species addressed in this model are primarily herbivorous during migration. Generally, diving ducks feed on the subterranean parts of the plants such as tubers, rootstalks, winter buds and green vegetative parts rather than the seeds. Korschgen (1989) provided a summary of important fall foods for migrating diving ducks in the Mississippi Flyway. The most important submergent vegetation species are sago pondweed (Potamogeton pectinatus), pondweeds (Potamogeton spp.), wildcelery (Vallisneria americana) and coontail (Ceratophyllum demersum). Sedges (Scirpus spp.), arrowhead (Sagittaria spp.), wild rice (Zizania aquatica), yellow water lily (Nuphar spp.), and smartweeds (Polygonum spp.) are some emergent vegetation species of importance. In a study of food habitats of canvasbacks at Lake Onalaska in pool 7 from 1978-1979, (Korschgen et. al 1988) this species fed primarily on winter buds of wildcelery and the tubers of stiff arrowhead. Korschgen (1989) noted that studies of food habits and movements of diving ducks in the Keokuk pool indicate that ducks using Keokuk pool incorporate a greater proportion of invertebrates in their diet than in the Lake Onalaska area. Korschgen (1989) also presented a composite list of fall foods making up the bulk of the diet of migrating diving ducks in the Mississippi Flyway. Benthic invertebrates of that were listed as utilized by three or more of the target species (canvasback, redhead, lesser scaup and ring-necked duck) were: fingernail clams (Sphaeriidae), snails (Gastropoda), mayflies (Hexagenia spp.) and midges (Chironomidae). Krapu and Reinecke (1992) noted that Brazen and Korschgen (cited as personal communication) also found that canvasbacks feed on pondweed and wildcelery during spring stopovers on pools of the Upper Mississippi River, while macro-invertebrates made up about a quarter of their diet.

Disturbance

Staging areas for migratory waterfowl on the UMR are important in that they allow the migrating birds to put on necessary fat reserves to complete their migration. Korschgen (1989) noted that diving ducks feed predominantly on large bodies of water, obtaining their food beneath the surface of the water and away from shore. Korschgens' summary of data indicates that canvasbacks spend about 20 to 25 percent of the time feeding with the remainder of the time spent in energy-conserving behaviors such resting or sleeping. Having areas free of disturbance is important to ensuring the maximum weight gain can be achieved during the staging period. Stoudt (1970) reported that 65% of the canvasback concentration areas were used mainly for feeding and 26 % were used mainly for

refuge. Many areas of refuge, however, also had good food resources. Only 6% of the areas surveyed appeared to be used for refuge purposes only. Thornburg(1973) reported that diving duck movements within the Keokuk Pool were related to hunting activity and food distribution. During the day, flocks tended to congregate in the less disturbed lower portions of the pool to rest, and fed in the upper portions of the pool at night. Korschgen pointed out that other types of human disturbance such as boating, fishing and sightseeing may be just as significant as disturbance factors as hunting.

HABITAT SUITABILITY INDEX MODEL

The format adopted for the development of this model follows the procedures developed for the Wildlife Habitat Appraisal Guide (WHAG) (Missouri Department of Conservation 1990). The WHAG approach is somewhat similar to the approach of habitat model development outlined by the U. S. Fish and Wildlife Service (1981) in that a suitability index relationship for each of the parameters must first be developed. It differs from the FWS approach in that the relationships for each parameter are presented on a discrete scale and the SI ranges from 0 to 10. Some parameters may be identified as having greater importance by identifying them as critical factors or by weighting. The final HSI is calculated by dividing the sum of the suitability indices by the possible maximum score that could be obtained. The Rock Island District used this approach to develop a diving duck model for the Lake Chautauqua Habitat Rehabilitation and Enhancement Project.

Model Applicability

Geographic area. This model was developed address migratory habitat for diving ducks on the Upper Mississippi River.

Season. This model was developed to primarily evaluate fall migratory season habitat for diving ducks. It may be applicable to spring migration habitat with variations in some variables. Most studies with respect to migration habitat characteristics have focused on fall migration requirements. Spring nutritional and energetic requirements for waterfowl may affect food preferences and behavior. As a result the importance and relationship of the variables with respect to spring migration habitat quality may differ. For example, waterbody size and disturbance may not be as critical of migration component variables as they appear to be for fall migration habitat. Consideration should be given to modifying the model if it is to be used for evaluating spring migration habitat.

Cover types. This model was developed to evaluate habitat in Lacustrine, Riverine and Herbaceous Wetland habitats.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat required before a species will use the area during migration. Specific information on the minimum area required before it will be used by diving ducks as migration habitat was not found in the literature.

Verification level. This HSI model provides habitat information useful for

impact assessment. The model is a hypothesis of species-habitat relationships and does not reflect proven cause and effect relationships. Previous drafts of this model were reviewed by Kathy Cheap, Rick Frietsche, Carl Korschgen and Eric Nelson of the U. S. Fish and Wildlife Service, Jeff Janvrin and John Wetzel of the Wisconsin Department of Natural Resources, and Pete Fasbender of the Corps of Engineers. Comments from these reviewers have been incorporated into this version of the model.

Model Description

Overview. The primary concern in providing suitable migratory habitat is food and a minimum of disturbance. Studies of energetics of canvasbacks on the UMR have shown that during the stopover period individuals accumulate an average of 10-15% gain in body weight before departing for the wintering areas (Takekawa 1987). Krapu and Reinecke (1992) noted that mallards, ring-necked ducks, canvasbacks and lesser scaup breeding in the midcontinent region of North America imported most of the fat required for the production of their initial clutches. Large fat reserves were developed on the wintering grounds or on spring staging areas. The key components considered in evaluating migration habitat for diving ducks for this model are: the size and characteristics of the waterbody, its susceptibility to human disturbance, and type and amount of aquatic vegetation that is present.

The following sections provide the logic and assumptions used to interpret the migratory habitat information for diving ducks. The overall model is presented at the end of this discussion.

Size of Water Body. Larger wetland areas appear to be preferred as they minimize the possibility of disturbance. Wetlands smaller than 100 acres were cited as being less valuable than larger areas and is therefore assigned a suitability index of 1. Areas greater than 100 acres in size are assumed to provide average migration habitat and are assigned a suitability index of 5. Stoudt's (1970) survey indicated a high percentage of the known migration concentration areas ranged in size from 200 - 1000 acres and that over 42% of the concentration areas were over 1,000 acres in size. . Based on this information it is assumed that areas greater than 200 acres but less than 1,000 acres have the potential to provide fairly high quality migration habitat and are assigned a suitability index of 7. Wetlands greater than 1,000 acres in size appear to provide optimum feeding or resting areas and are assigned an optimum value of 10.

Water Depth. Water depth is a factor in determining the type and extent of aquatic vegetation present. Suitable water depths for all species of diving ducks would range from 18 inches to 6 feet. Some reviewers felt that the optimum range for water depths should have an upper limit of 4 feet while others felt that an upper limit of 6 feet was appropriate. Prior to its decline in water quality and vegetation composition, Lake Christina, in Minnesota, was one of the Mississippi Flyways most heavily used resting and feeding areas. This 4,000 acre lake had an average depth of about 5 feet. Based on the above information, this model assumes that the optimum depth range for diving duck is between 18 inches and 5 feet. Suitability of the area is based on the amount of the habitat that would meet the depth criteria. It is assumed that an area with less than

10 % meeting the depth criteria would have minimal migration habitat value because the depths would not be suitable for feeding and would most likely not be conducive to the development of the preferred types or amount of aquatic vegetation. Therefore, areas with less than 10% meeting the depth criteria are assigned a suitability index of 1. The areas suitability increases fairly proportionately as the percent area meeting the depth criteria increases. An area with at least 70% meeting the depth criteria is assumed to be optimal with a corresponding suitability index of 10.

Percent submergent vegetation cover. Limited specific information on aquatic vegetation densities for migration habitat was found in the literature. Areas identified as important migration habitat, are described as having dense stands of aquatic vegetation. Korschgen (1988) noted that when Weaver Bottoms, in pool 5, provided good habitat when marsh vegetation was present in about 75% of the 1,100 acre area. The diving duck model developed for the Lake Chautauqua project suggests that greater than 70% coverage in the area should be considered optimal. Reviewers indicated that percent submergent vegetation coverage of 50% should be considered optimal. For this model 50% percent submergent vegetation coverage is considered optimal and is assigned a suitability index of 10. If less than 10% of the area has submergent aquatic vegetation the area is assigned a suitability index of 1.

Percent emergent vegetation cover. Korschgen (1988) indicated that wildcelery was more important than arrowhead to canvasbacks staging in pool 7. Arrowhead was not extensively exploited until later in the migration season when the plants had withered and areas were more characteristic of open water. It appears that emergent vegetation can be an important component of diving duck migration habitat but not if it is too extensive in coverage. As with submergent vegetation, an area with less than 10 percent emergent vegetation coverage is assumed to provide minimal value and is assigned a suitability index 1. In addition if an area is predominately emergent vegetation (50% or greater), the area is assumed to have minimal value for diving duck migration habitat and is assigned a suitability index of 1. An area with 25% coverage of emergent vegetation is considered to be optimal and is assigned a suitability index of 10.

Species composition of aquatic vegetation present. The value of an area as migration habitat is directly related to the presence of key species in the submergent/emergent aquatic beds. The suitability criteria of the aquatic beds are the same for both submergent and emergent species. If none of the key species are present, or less than 10% of the aquatic bed is comprised of identified key species, the area is assumed to have minimal value and is assigned a suitability index of 1. The value of the aquatic beds is assumed to increase proportionately with an increase in % composition by at least one key species. If more than 1 key species is present in the aquatic beds, the corresponding suitability index is increased by 1. An area with greater than 60% of the aquatic bed comprised of key food species is considered to be optimum.

Invertebrate populations present. Benthic invertebrates can be a key food source during migration. While studies indicate that aquatic vegetation appears to be the preferred foods for diving ducks during migration, there are some key migration concentration areas where the primary food source being utilized are

invertebrates. In areas where there is good aquatic vegetation and conditions promote the development of good invertebrate populations, animal foods can comprise a substantial proportion of the diet. Taxonomic groups that appear to be the most important are fingernail clams (Sphaeriidae), snails (gastropoda), mayflies (Hexagenia spp.) and midges (Chironomidae). The suitability index is based on the presence and abundance of these key taxonomic groups. If none of the key groups are present or if they are present but not at levels that are considered to be abundant, the area is assigned a minimal value of 1. Areas where at least 1 key taxonomic group is present at levels that are considered very abundant are considered optimum and assigned a suitability index of 10. Assigning values to this variable is subjective and relies heavily on professional judgement as to abundance. Conditions that may indicate abundance may include vegetation presence, current, water quality, substrates or survey data.

Disturbance. Susceptibility of an area to human disturbance will lower that value of an area as migration habitat. Disturbance in migration areas limit feeding opportunities and force the birds to expend energy in avoidance activity. It is assumed that an area with uncontrolled access will provide minimal value or provide only short term migration habitat and is assigned a suitability index of 1. Areas closed to all human activity or entry is considered optimum and is assigned a value of 5. Areas closed to hunting but subject to other forms of human disturbance are assigned intermediate values.

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

1) Size of Water Body

a.	Less than 100 acres	1
b.	100 to 200 acres	5
c.	200 to 1,000 acres	7
d.	Greater than 1000 acres	10

2) Water Depth - Percent of Area 18" to 5'

a.	Less than 10 percent	1
b.	10 to 40 percent	3
c.	40 to 70 percent	5
d.	Greater than 70 percent	10

3) Percent Submergent Vegetation Cover

a.	Less than 10 percent	1
b.	10 to 30 percent	3
c.	30 to 50 percent	6
d.	Greater than 50 percent	10

4) Species of Submergent Vegetation Present
(Key species: wild celery, sago pondweed, and other pondweeds)

a.	None of key species present or less than 10 percent of aquatic bed	1
b.	At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	3
c.	At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d.	Greater than 60 percent of aquatic bed is comprised of key food species	10

5) Percent Emergent Vegetation Cover

a.	Less than 10 percent or greater than 50 percent	1
b.	10 to 20 percent or 30 to 50 percent	5
c.	20 to 30 percent	10

6) Species of Emergent Vegetation Present
(Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)

a. None of key species present or less than 10 percent of aquatic bed	1
b. At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	3
c. At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d. Greater than 60 percent of aquatic bed is comprised of key food species	10

7) Invertebrate populations present
(Key taxonomic groups: Sphaeriidae, Gastropoda, Hexagenia spp., Chironomidae)

a. None of the key taxonomic groups present or present but not abundant	1
b. At least 1 key taxonomic group present and is moderately abundant	5
c. At least 1 key taxonomic group present and is very abundant	10

8) Disturbance

a. Access uncontrolled - Considerable human activity during migration	1
b. No hunting activity occurs or closed to hunting only but considerable human activity occurs during migration (such as fishing/boating)	3
c. No hunting activity occurs or closed to hunting only and human activity during migration is minimal	4
d. No human activity occurs or closed to human entry	5

TOTAL	____
MAXIMUM POSSIBLE TOTAL	75
HSI	____

LITERATURE CITED

Bellrose, F.C. 1978. Ducks, geese and swans of North America.Stackpole Books, Harrisburg Pa. 540pp.

Korschgen, C.E. 1989. Riverine and deepwater habitats for diving ducks. Pages 157-180. in L.M. Smith, R.L. Pederson and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Tex. Tech Univ. Press.

Korschgen, C.E., George, L.S. and W.L.Green. 1988. Feeding ecology of canvasbacks staging on pool 7 of the Upper Mississippi River. Pages 237-249. in M.W. Weller ed. Waterfowl in winter. Univ. of Minn. Press.

Krapu, G.L. and K.J. Reinecke. 1992. Foraging ecology and nutrition. Pages 1-29. in B.D.J. Batt, M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu, eds. Ecology and management of breeding waterfowl. Univ. of Minn. Press.

Stoudt, J.H. 1970. Delineation of primary canvasback migration and wintering habitat, 1968-1969. NPWRC Pub. #56. Bureau of Sport Fisheries and Wildlife. Jamestown, North Dakota.

Takekawa, J.Y. 1987. Energetics of canvasbacks staging on an Upper Mississippi River pool during fall migration. Ph.D. Thesis, Iowa State Univ., Anes. 189 pp.

Thornburg, D.D. 1973. Diving duck movements on Keokuk Pool, Mississippi River. J. Wild. Manage. 37(3):382-389.

US Fish and Wildlife Service. 1981. Standards for the development of habitat suitablity index models. Ecological Services Manual 103, Division of Ecological services, Washington DC.

Missouri Department of Conservation and U.S.D.A. Soil Conservation Service. 1990. Wildlife habitat appraisal guide (WHAG), users guide. Missouri Department of Conservation, Jefferson City, Missouri.

ENCLOSURE 2

HABITAT SUITABILITY INDEX MATRIXES

POOL 8 - AREA 1 - EXISTING CONDITIONS — BLUEGILL HABITAT MODEL

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	8%	0.50	From GIS Data (91 Vegetation)
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)	7-10cm/sec	0.90	Values for V13-V16 are From LTRM Data, Years 90,91,92
V15 - current (embryo)		0.80	Station M686.1v, Mid May - Mid Sept
V16 - current (fry)		0.40	Value Shown is Median Range, Range for entire period was
V17 - current (juven)		0.70	3-25 cm/sec, Velocity >9cm/sec 45% of the time
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.71	
C-C - cover component		0.50	
C-WQ - water quality		1.00	
C-R - reproduction		0.90	
C-OT - other		0.83	
S-HSI - summer HSI		0.80	
VA - depths	24%	0.70	Based on 89 Data
VB - dissolved oxygen	>5ppm	1.00	LTRM Data,Station M686.1v, Dec-Mar (88,89,90,91,92)
VC - temperature	.15deg C	0.05	LTRM Data, Station M686.1v
VD - current	5 cm/sec	0.10	LTRM Data, Station M686.1v
W-C - winter cover		0.70	
W-WQ - water quality		0.05	VC<.4, therefore W-WQ=VC
W-OT - winter other		0.10	
W-HSI - winter HSI		0.05	W-WQ < .4, Therefore W HSI=W-WQ
HSI - overall HSI		0.20	

BLUEGILL HABITAT MODEL

POOL 8 - AREA 2 - EXISTING CONDITIONS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	8%	0.50	From GIS Data (91 Vegetation)
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)	7-10cm/sec	0.90	Values for V13-V16 are From LTRM Data, Years 90,91,92
V15 - current (embryo)		0.80	Station M686.1v, Mid May - Mid Sept
V16 - current (fry)		0.40	Value Shown is Median Range, Range for entire period was
V17 - current (juven)		0.70	3-25 cm/sec, Velocity >9cm/sec 45% of the time
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.71	
C-C - cover component		0.50	
C-WQ - water quality		1.00	
C-R - reproduction		0.90	
C-OT - other		0.83	
S-HSI - summer HSI		0.80	
VA - depths	43%	0.90	Based on 89 Data
VB - dissolved oxygen	>5ppm	1.00	LTRM Data,Station M686.1v, Dec-Mar (88,89,90,91,92)
VC - temperature	.15deg C	0.05	LTRM Data, Station M686.1v
VD - current	5 cm/sec	0.10	LTRM Data, Station M686.1v
W-C - winter cover		0.90	
W-WQ - water quality		0.05	VC<.4, therefore W-WQ=VC
W-OT - winter other		0.10	
W-HSI - winter HSI		0.05	W-WQ < .4, Therefore W HSI=W-WQ
HSI - overall HSI		0.20	

BLUEGILL HABITAT MODEL

POOL 8 - AREA 1 & 2 COMBINED - EXISTING CONDITIONS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	8%	0.50	From GIS Data (91 Vegetation)
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)	7-10cm/sec	0.90	Values for V13-V16 are From LTRM Data, Years 90,91,92
V15 - current (embryo)		0.80	Station M686.1v, Mid May - Mid Sept
V16 - current (fry)		0.40	Value Shown is Median Range, Range for entire period was
V17 - current (juven)		0.70	3-25 cm/sec, Velocity >9cm/sec 45% of the time
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.71	
C-C - cover component		0.50	
C-WQ - water quality		1.00	
C-R - reproduction		0.90	
C-OT - other		0.83	
S-HSI - summer HSI		0.80	
VA - depths	31%	0.75	Based on 89 Data
VB - dissolved oxygen	>5ppm	1.00	LTRM Data,Station M686.1v, Dec-Mar (88,89,90,91,92)
VC - temperature	.15deg C	0.05	LTRM Data, Station M686.1v
VD - current	5 cm/sec	0.10	LTRM Data, Station M686.1v
W-C - winter cover		0.75	
W-WQ - water quality		0.05	VC<.4, therefore W-WQ=VC
W-OT - winter other		0.10	
W-HSI - winter HSI		0.05	W-WQ < .4, Therefore W HSI=W-WQ
HSI - overall HSI		0.20	

BLUEGILL HABITAT MODEL
POOL 8 - AREA 1 - FUTURE WITHOUT CONDITIONS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	5%	0.30	Assume Vegetation declines slightly due to loss of islands
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)	12 cm/sec	0.85	Assume velocity increase with the loss of islands
V15 - current (embryo)		0.75	Assume velocity increase with the loss of islands
V16 - current (fry)		0.00	Assume velocity increase with the loss of islands
V17 - current (juven)		0.35	Assume velocity increase with the loss of islands
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.20	Suitable spawning in area limited due to loss of islands
C-F - food component		0.55	
C-C - cover component		0.30	
C-WQ - water quality		1.00	
C-R - reproduction		0.53	
C-OT - other		0.70	
S-HSI - summer HSI		0.63	
VA - depths	24%	0.70	Based on 89 Data
VB - dissolved oxygen	>5ppm	1.00	LTRM Data,Station M686.1v, Dec-Mar (88,89,90,91,92)
VC - temperature	.15deg C	0.05	LTRM Data, Station M686.1v
VD - current	5 cm/sec	0.10	LTRM Data, Station M686.1v
W-C - winter cover		0.70	
W-WQ - water quality		0.05	VC<.4, therefore W-WQ=VC
W-OT - winter other		0.10	
W-HSI - winter HSI		0.05	W-WQ < .4, Therefore W HSI=W-WQ
HSI - overall HSI		0.18	

NOTES:
1. ASSUMES LOSS OF ISLANDS IF NO ACTION

BLUEGILL HABITAT MODEL

POOL 8 - AREA 1 & 2 COMBINED - FUTURE WITHOUT CONDITIONS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	5%	0.30	Assume Vegetation declines slightly due to loss of islands
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)	12 cm/sec	0.85	Assume velocity increase with the loss of the islands
V15 - current (embryo)		0.75	Assume velocity increase with the loss of the islands
V16 - current (fry)		0.00	Assume velocity increase with the loss of the islands
V17 - current (juven)		0.35	Assume velocity increase with the loss of the islands
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.20	Suitable spawning in area limited due to loss of islands
C-F - food component		0.55	
C-C - cover component		0.30	
C-WQ - water quality		1.00	
C-R - reproduction		0.53	
C-OT - other		0.70	
S-HSI - summer HSI		0.63	
VA - depths	31%	0.75	Based on 89 Data
VB - dissolved oxygen	>5ppm	1.00	LTRM Data,Station M686.1v, Dec-Mar (88,89,90,91,92)
VC - temperature	.15deg C	0.05	LTRM Data, Station M686.1v
VD - current	5 cm/sec	0.10	LTRM Data, Station M686.1v
W-C - winter cover		0.75	
W-WQ - water quality		0.05	VC<.4, therefore W-WQ=VC
W-OT - winter other		0.10	
W-HSI - winter HSI		0.05	W-WQ < .4, Therefore W HSI=W-WQ
HSI - overall HSI		0.18	

NOTES:

1. ASSUMES ISLANDS WILL BE LOST IF NO ACTION

BLUEGILL HABITAT MODEL

Pool 8 - AREA 1- Future With Project Conditions - WITH A/B ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	5%	0.30	Assumes DECREASE IN VEGETATION W/O D ISLANDS
V6 - turbidity	40<X<70	0.90	Assumed increase due to < FLOWS & wind fetch
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.55	
C-C - cover component		0.30	
C-WQ - water quality		0.98	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.73	
VA - depths	15%	0.55	Increased sedimentation with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.55	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.79	
HSI - overall HSI		0.76	

NOTES

1. ISLANDS A/B ARE IN PLACE WITH THIS SCENARIO
2. WITHOUT D ISLANDS, INCREASED TURBIDITY DUE TO WIND FETCH
3. WITHOUT ISLANDS, INCREASED SEDIMENTATION DUE TO DECREASED FLOWS
4. INCREASED TURBIDITY WOULD RESULT IN DECREASED EXTENT OF VEGETATION

BLUEGILL HABITAT MODEL

Pool 8 - AREA 2- Future With Project Conditions - WITH C ISLAND

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	5%	0.30	Assumes DECREASE IN VEGETATION W/O D ISLANDS
V6 - turbidity	40<X<70	0.90	Assumed increase due to < FLOWS & wind fetch
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.55	
C-C - cover component		0.30	
C-WQ - water quality		0.98	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.73	
VA - depths	30%	0.75	Increased sedimentation with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.75	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.85	
HSI - overall HSI		0.79	

BLUEGILL HABITAT MODEL

Pool 8 - AREAS 1&2- Future With Project Conditions - WITH A/B/C ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	5%	0.30	Assumes DECREASE IN VEGETATION W/O D ISLANDS
V6 - turbidity	40<X<70	0.90	Assumed increase due to < FLOWS & wind fetch
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.55	
C-C - cover component		0.30	
C-WQ - water quality		0.98	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.73	
VA - depths	24%	0.70	Increased sedimentation with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.70	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.84	
HSI - overall HSI		0.78	

NOTES:

1. THIS CONDITION ASSUMES ISLANDS A/B/C IN PLACE
2. WITHOUT D ISLANDS, INCREASED SEDIMENTATION DUE TO DECREASED FLOWS
3. INCREASED TURBIDITY WOULD RESULT IN DECREASED VEGETATION EXTENT

BLUEGILL HABITAT MODEL

Pool 8 - AREA 1 - With Project Conditions - WITH A/B ISLANDS + D ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	40%	0.85	Assumes Waterfowl Goal is 50% met
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.92	
C-C - cover component		0.85	
C-WQ - water quality		1.00	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.95	
VA - depths	18%	0.60	Assumes decreased depths with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.60	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.80	
HSI - overall HSI		0.88	

NOTES:

1. THIS CONDITION IS WITH ISLANDS A/B AND D1/D2 IN PLACE.
2. ISLANDS D1/D2 HELP TO MINIMIZE SEDIMENTATION IN AREA 1 TO SOME DEGREE.
3. ISLANDS D1/D2 INCREASE VEGETATION RESPONSE BY REDUCING WIND FETCH.

BLUEGILL HABITAT MODEL

Pool 8 - AREAS 1&2- Future With Project Conditions - WITH A/B/C ISLANDS + D ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	40%	0.85	Assumes Waterfowl goal 50% met
V6 - turbidity	<50	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.92	
C-C - cover component		0.85	
C-WQ - water quality		1.00	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.95	
VA - depths	27%	0.73	Increased sedimentation with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.73	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.84	
HSI - overall HSI		0.90	

NOTES:

1. ASSUMES D ISLANDS MAINTAIN CHANNEL DEPTHS AND REDUCE SEDIMENTATION TO SOME DEGREE.

BLUEGILL HABITAT MODEL

Pool 8 - AREA 1 - With Project Conditions - WITH A/B/D ISLANDS + E ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	45%	0.83	Assumes Waterfowl Goal is 75% met
V6 - turbidity	<50 ppm	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.91	
C-C - cover component		0.83	
C-WQ - water quality		1.00	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.95	
VA - depths	20%	0.65	D&E Islands maintain channel depths in Area 1
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.65	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.82	
HSI - overall HSI		0.88	

NOTES:

1. ASSUMES D & E MAINTAIN CHANNEL DEPTHS AND REDUCE SEDIMENT DEPOSITION
2. ASSUMES E ISLAND WILL RESULT IN SOME INCREASE IN VEGETATION RESPONSE

BLUEGILL HABITAT MODEL

Pool 8 - AREAS 1&2- Future With Project Conditions - WITH A/B/C/D ISLANDS + E ISLANDS

VARIABLE	VALUE	SI	COMMENTS
V1 - % pool area	>60	1.00	Assumed to be Optimum
V3 - vegetative cover	41%	0.85	Assumes Waterfowl Goal is 75% met in Area 1, 50% met in Area 2
V6 - turbidity	<50	1.00	Assumed to be Optimum
V7 - pH		1.00	Assumed to be Optimum
V8 - dissolved oxygen	>5 ppm	1.00	Assumed to be Optimum
V10 - temperature (adult)		1.00	Assumed to be Optimum
V11 - temperature (spawn)		1.00	Assumed to be Optimum
V12 - temperature (fry)		1.00	Assumed to be Optimum
V13 - temperature (juven)		1.00	Assumed to be Optimum
V14 - current (adult)		1.00	Assume Velocities will be optimum (<8 cm/sec) for all life
V15 - current (embryo)		1.00	stages.
V16 - current (fry)		1.00	
V17 - current (juven)		1.00	
V18 - gradient		1.00	Not Limiting
V20 - substrate		0.90	Some Spawning in area - Not Optimum
C-F - food component		0.92	
C-C - cover component		0.85	
C-WQ - water quality		1.00	
C-R - reproduction		0.97	
C-OT - other		1.00	
S-HSI - summer HSI		0.95	
VA - depths	28%	0.73	Increased sedimentation with decreased velocities
VB - dissolved oxygen	3-7ppm	0.90	DO levels will decline slightly, Usually near Optimum
VC - temperature		1.00	Assume temp will be Optimum
VD - current	<.4cm/sec	0.80	Assume 80% of area is < or = to .4 cm/sec
W-C - winter cover		0.73	
W-WQ - water quality		0.93	
W-OT - winter other		0.80	
W-HSI - winter HSI		0.84	
HSI - overall HSI		0.90	

NOTES:

1. ASSUMES D ISLANDS MAINTAIN CHANNEL DEPTHS AND REDUCE SEDIMENTATION TO SOME DEGREE.
2. E ISLANDS WILL HELP TO MAINTAIN CHANNEL DEPTHS IN AREA 1 AND WILL RESULT IN SOME INCREASE IN VEGETATION RESPONSE.

STODDARD - EXISTING CONDITIONS

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE	VALUE	COMMENTS
1) Size of Water Body a. Less than 100 acres 1 b. 100 to 200 acres 5 c. 200 to 1,000 acres 7 d. Greater than 1,000 acres 10	ENTER VALUE= 7	
2) Water Depth - Percent of Area 18" to 5' a. Less than 10 percent 1 b. 10 to 40 percent 3 c. 40 to 70 percent 5 d. Greater than 70 percent 10	ENTER VALUE= 5	48% - From LTRM Data
3) Percent Submergent Vegetation Cover a. Less than 10 percent 1 b. 10 to 30 percent 3 c. 30 to 50 percent 6 d. Greater than 50 percent 10	ENTER VALUE= 1	Submergent rooted aquatics = 7% From LTRM Data
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds) a. None of the key species present or less than 10 percent of aquatic bed 1 b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present) 3 c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present) 6 d. Greater than 60 percent of aquatic bed is comprised of key food species 10	ENTER VALUE= 7	Assume at least 2 key species comprise at least 30% of the bed
5) Percent Emergent Vegetation Cover a. Less than 10 Percent or greater than 50 percent 1 b. 10 to 20 percent or 30 to 50 percent 5 c. 20 to 30 percent 10	ENTER VALUE= 1	Emergent vegetation = approximately 1% of the bed From LTRM Data
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice) a. None of the key species present or less than 10 percent fo aquatic bed 1 b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present) 3 c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present) 6 d. Greater than 60 percent of aquatic bed is comprised of key food species 10	ENTER VALUE= 3	Assume 1 key species comprise 10% of the bed
7) Invertebrate Populations Present (Key Species: Spheeriidae, Gastropoda,Hexegenia spp,Chironomidae) a. None of the key taxonomic groups present or present but not abundant 1 b. At least 1 key taxonomic group present and is moderately abundant 5 c. At least 1 key taxonomic group present and is very abundant 10	ENTER VALUE= 1	Assume invertebrates are not abundant Based on exisitng aquatic conditions
8) Disturbance a. Access uncontrolled - Considerable human activity during migration 1 b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating 3 c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal 4 d. No human activity occurs, or closed to human entry 5	ENTER VALUE= 1	

TOTAL= 26

MAXIMUM POSSIBLE TOTAL = 75

HSI = 0.35

H-2-13

STODDARD - FUTURE WITH PROJECT CONDITIONS - WITH AB ISLANDS OR ABC ISLANDS

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE	VALUE	COMMENTS
1) Size of Water Body a. Less than 100 acres 1 b. 100 to 200 acres 5 c. 200 to 1,000 acres 7 d. Greater than 1,000 acres 10	ENTER VALUE= 7	
2) Water Depth - Percent of Area 18" to 5' a. Less than 10 percent 1 b. 10 to 40 percent 3 c. 40 to 70 percent 5 d. Greater than 70 percent 10	ENTER VALUE= 5	48% - From LTRM Data
3) Percent Submergent Vegetation Cover a. Less than 10 percent 1 b. 10 to 30 percent 3 c. 30 to 50 percent 6 d. Greater than 50 percent 10	ENTER VALUE= 1	No appreciable change or slight decrease in submergent rooted aquatics due to combination of reduced flows and wind fetch.
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds) a. None of the key species present or less than 10 percent of aquatic bed 1 b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present) 3 c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present) 6 d. Greater than 60 percent of aquatic bed is comprised of key food species 10	ENTER VALUE= 7	Assume at least 2 key species comprise at least 30% of the bed
5) Percent Emergent Vegetation Cover a. Less than 10 Percent or greater than 50 percent 1 b. 10 to 20 percent or 30 to 50 percent 5 c. 20 to 30 percent 10	ENTER VALUE= 1	A slight increase in emergent vegetation may occur in the immediate vicinity of the islands due to shelter from northern winds. Decreased flows in the area along with exposure to southern and northern wind fetch through out most of the area would result in minimal vegetation response.
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice) a. None of the key species present or less than 10 percent fo aquatic bed 1 b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present) 3 c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present) 6 d. Greater than 60 percent of aquatic bed is comprised of key food species 10	ENTER VALUE= 3	Assume 1 key species comprise 10% of the bed
7) Invertebrate Populations Present (Key Species: Sphaeridae, Gastropoda,Hexagenia spp,Chironomidae) a. None of the key taxonomic groups present or present but not abundant 1 b. At least 1 key taxonomic group present and is moderately abundant 5 c. At least 1 key taxonomic group present and is very abundant 10	ENTER VALUE= 1	Assume invertebrates are not abundant Based on exisitng aquatic conditions
8) Disturbance a. Access uncontrolled - Considerable human activity during migration 1 b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating) 3 c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal 4 d. No human activity occurs, or closed to human entry 5	ENTER VALUE= 1	

TOTAL= 26

MAXIMUM POSSIBLE TOTAL = 75

HSI = 0.35

4-2-14

STODDARD - FUTURE WITH PROJECT CONDITIONS - AB ISLANDS WITH D ISLANDS - AREA 1

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE		VALUE	COMMENTS
1) Size of Water Body			
a. Less than 100 acres	1		
b. 100 to 200 acres	5	ENTER	
c. 200 to 1,000 acres	7	VALUE= 7	
d. Greater than 1,000 acres	10		
2) Water Depth - Percent of Area 18" to 5'			
a. Less than 10 percent	1		Depths will remain relatively the same
b. 10 to 40 percent	3	ENTER	
c. 40 to 70 percent	5	VALUE= 5	
d. Greater than 70 percent	10		
3) Percent Submergent Vegetation Cover			
a. Less than 10 percent	1		
b. 10 to 30 percent	3	ENTER	>30%
c. 30 to 50 percent	6	VALUE= 6	Assume submergents will recover to 50% of 1975 conditions (which = approximately 60%)
d. Greater than 50 percent	10		
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds)			
a. None of the key species present or less than 10 percent of aquatic bed	1		
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	ENTER VALUE= 8	Assume at least 3 key species will comprise at least 60% of the established bed
c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
5) Percent Emergent Vegetation Cover			
a. Less than 10 Percent or greater than 50 percent	1		Assume Emergent vegetation will = approximately 10%
b. 10 to 20 percent or 30 to 50 percent	5	ENTER	Response will be greater than 1975 conditions (7%) due
c. 20 to 30 percent	10	VALUE= 4	to decreased flows and increased shelter
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)			
a. None of the key species present or less than 10 percent fo aquatic bed	1		
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	ENTER VALUE= 3	Assume 1 key species comprise 10% of the bed
c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
7) Invertebrate Populations Present (Key Species: Sphaeridae, Gastropoda,Hexagenia spp,Chironomidae)			
a. None of the key taxonomic groups present or present but not abundant	1		
b. At least 1 key taxonomic group present and is moderately abundant	5	ENTER VALUE= 5	Assume decreased flows, increased aquatic vegetation, will result in moderately abundant invertebrate population
c. At least 1 key taxonomic group present and is very abundant	10		
8) Disturbance			
a. Access uncontrolled - Considerable human activity during migration	1		
b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating	3	ENTER VALUE= 1	
c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal	4		
d. No human activity occurs, or closed to human entry	5		

TOTAL= 39

MAXIMUM POSSIBLE TOTAL = 75

HSI = 0.52

4-2-15

STODDARD - FUTURE WITH PROJECT CONDITIONS - ABC ISLANDS WITH D ISLANDS - AREAS 1&2

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE		VALUE	COMMENTS
1) Size of Water Body			
a. Less than 100 acres	1	ENTER	
b. 100 to 200 acres	5	VALUE= 7	
c. 200 to 1,000 acres	7		
d. Greater than 1,000 acres	10		
2) Water Depth - Percent of Area 18" to 5'			
a. Less than 10 percent	1	ENTER	Depths will remain relatively the same
b. 10 to 40 percent	3	VALUE= 5	
c. 40 to 70 percent	5		
d. Greater than 70 percent	10		
3) Percent Submergent Vegetation Cover			Area 1 - >30%. Assume submergents will recover to at least 50% of 1975 conditions (which = approximately 60%)
a. Less than 10 percent	1	ENTER	Area 2 - >10% but <30%. Assume submergent recovery in area 2 will be less due to continued exposure to wind fetch from the South.
b. 10 to 30 percent	3	VALUE= 5	**Area 1 & Area 2 combined = average of 30%**
c. 30 to 50 percent	6		
d. Greater than 50 percent	10		
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds)			
a. None of the key species present or less than 10 percent of aquatic bed	1	ENTER	Assume at least 3 key species will comprise at least 60% of the established bed
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	VALUE= 8	
c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
5) Percent Emergent Vegetation Cover			Area 1 - Assume = approximatley 10%. Response will be greater than 1975 conditions (7%) due to decreased flows and indreased shelter.
a. Less than 10 Percent or greater than 50 percent	1	ENTER	Area 2 - Assume = >3% but <10%. Response will less in area 2 due to wind fetch from the south.
b. 10 to 20 percent or 30 to 50 percent	5	VALUE= 3	**Area 1 & Area 2 Average = 7% to 10%.**
c. 20 to 30 percent	10		
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)			
a. None of the key species present or less than 10 percent fo aquatic bed	1	ENTER	Assume 1 key species comprise 10% of the bed
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	VALUE= 3	
c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
7) Invertebrate Populations Present (Key Species: Sphaeridae, Gastropoda, Hexagenia spp, Chironomidae)			
a. None of the key taxonomic groups present or present but not abundant	1	ENTER	Assume decreased flows, increased aquatic vegetation, will result in moderately abundant invertebrate population
b. At least 1 key taxonomic group present and is moderately abundant	5	VALUE= 5	
c. At least 1 key taxonomic group present and is very abundant	10		
8) Disturbance			
a. Access uncontrolled - Considerable human activity during migration	1	ENTER	
b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating	3	VALUE= 1	
c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal	4		
d. No human activity occurs, or closed to human entry	5		

TOTAL= 37

MAXIMUM POSSIBLE TOTAL 75

HSI = 0.49

4-2-16

STODDARD - FUTURE WITH PROJECT CONDITIONS - AB ISLANDS WITH D ISLANDS AND E ISLANDS - AREA 1

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE		VALUE	COMMENTS
1) Size of Water Body			
a. Less than 100 acres	1		
b. 100 to 200 acres	5	ENTER	
c. 200 to 1,000 acres	7	VALUE= 7	
d. Greater than 1,000 acres	10		
2) Water Depth - Percent of Area 18" to 5'			
a. Less than 10 percent	1		Depths will remain relatively the same
b. 10 to 40 percent	3	ENTER	
c. 40 to 70 percent	5	VALUE= 5	
d. Greater than 70 percent	10		
3) Percent Submergent Vegetation Cover			
a. Less than 10 percent	1		
b. 10 to 30 percent	3	ENTER	>35% in Area 1
c. 30 to 50 percent	6	VALUE= 7	Assume submergents will recover to >50% of 1975 conditions in Area 1(which = approximately 60%) due to the localized effects of the E islands.
d. Greater than 50 percent	10		
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds)			
a. None of the key species present or less than 10 percent of aquatic bed	1		
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	ENTER VALUE= 8	Assume at least 3 key species will comprise at least 60% of the established bed (Same as with the D islands alone)
c. At least one key species covers 30 to 60 percent of the aqutaic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
5) Percent Emergent Vegetation Cover			
a. Less than 10 Percent or greater than 50 percent	1		Assume Emergent vegetation will = > 10%
b. 10 to 20 percent or 30 to 50 percent	5	ENTER	Assume slightly greater response of emergents in Area 1
c. 20 to 30 percent	10	VALUE= 6	due to increased shelter and localized flow conditions created by the E islands.
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)			
a. None of the key species present or less than 10 percent fo aquatic bed	1		
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3	ENTER VALUE= 3	Assume 1 key species comprise 10% of the bed
c. At least one key species covers 30 to 60 percent of the aquatic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
7) Invertebrate Populations Present (Key Species: Sphaeriidae, Gastropoda,Hexagenia spp,Chironomidae)			
a. None of the key taxonomic groups present or present but not abundant	1		
b. At least 1 key taxonomic group present and is moderately abundant	5	ENTER VALUE= 6	Assume decreased flows, increased aquatic vegetation, will result in moderately abundant invertebrate population wtih at least 2 key taxonomic groups present
c. At least 1 key taxonomic group present and is very abundant	10		
8) Disturbance			
a. Access uncontrolled - Considerable human activity during migration	1		
b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating	3	ENTER VALUE= 1	
c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal	4		
d. No human activity occurs, or closed to human entry	5		

TOTAL= 43

MAXIMUM POSSIBLE TOTAL = 75

HSI = 0.57

4-2-17

STODDARD - FUTURE WITH PROJECT CONDITIONS - ABC ISLANDS WITH D ISLANDS AND E ISLANDS - AREAS 1&2

DIVING DUCK MIGRATION HABITAT MODEL
UPPER MISSISSIPPI RIVER

VARIABLE		VALUE	COMMENTS
1) Size of Water Body			
a. Less than 100 acres	1	ENTER VALUE= 7	
b. 100 to 200 acres	5		
c. 200 to 1,000 acres	7		
d. Greater than 1,000 acres	10		
2) Water Depth - Percent of Area 18" to 5'			
a. Less than 10 percent	1	ENTER VALUE= 5	Depths will remain relatively the same
b. 10 to 40 percent	3		
c. 40 to 70 percent	5		
d. Greater than 70 percent	10		
3) Percent Submergent Vegetation Cover			
a. Less than 10 percent	1	ENTER VALUE= 5	Area 1 - >35%. Assume recovery would be slightly > 50% of 1975 conditions due to limited influence of E islands Area 2 - >10% but <30%. Assume recovery in area 2 would be less due to exposure to southern wind fetch. **Area 1+Area 2 = Average of 30%**
b. 10 to 30 percent	3		
c. 30 to 50 percent	6		
d. Greater than 50 percent	10		
4) Species of Submergent Vegetation Present (Key species: wild celery, sago pondweed, and other pondweeds)			
a. None of the key species present or less than 10 percent of aquatic bed	1	ENTER VALUE= 8	Assume at least 3 key species will comprise at least 60% of the established bed (Same as with the D islands alone)
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3		
c. At least one key species covers 30 to 60 percent of the aquatic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
5) Percent Emergent Vegetation Cover			
a. Less than 10 Percent or greater than 50 percent	1	ENTER VALUE= 4	Area 1 - >10%. Assume a slightly greater response of emergent vegetation due to increased shelter and localized flow conditions created by the E islands. Area 2 - Assume = >3% but <10%. Response in area 2 would be less due to wind fetch from the south. **Area 1+Area 2 = Average of approximately 10%**
b. 10 to 20 percent or 30 to 50 percent	5		
c. 20 to 30 percent	10		
6) Species of Emergent Vegetation Present (Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)			
a. None of the key species present or less than 10 percent fo aquatic bed	1	ENTER VALUE= 3	Assume 1 key species comprise 10% of the bed
b. At least one key species covers 10 to 30 percent of the aqutaic bed (add one point if more than one key species is present)	3		
c. At least one key species covers 30 to 60 percent of the aquatic bed (add one point if more than one key species is present)	6		
d. Greater than 60 percent of aquatic bed is comprised of key food species	10		
7) Invertebrate Populations Present (Key Species: Sphaeriidae, Gastropoda,Hexagenia spp,Chironomidae)			
a. None of the key taxonomic groups present or present but not abundant	1	ENTER VALUE= 6	Assume decreased flows, increased aquatic vegetation, will result in moderately abundant invertebrate population wtih at least 2 key taxonomic groups present
b. At least 1 key taxonomic group present and is moderately abundant	5		
c. At least 1 key taxonomic group present and is very abundant	10		
8) Disturbance			
a. Access uncontrolled - Considerable human activity during migration	1	ENTER VALUE= 1	
b. No hunting activity occurs, or closed to hunting only, but considerable human activity occurs during migration (such as fishing/boating	3		
c. No hunting activity occurs, or closed to hunting only, and human activity during migration is minimal	4		
d. No human activity occurs, or closed to human entry	5		

TOTAL= 39

MAXIMUM POSSIBLE TOTAL = 75

HSI = 0.52

4-2-18

ENCLOSURE 3

HABITAT UNIT CALCULATIONS

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 1 (without project) AREA 1 - FUTURE W/O
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 55.75

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.20	61.20
1	306.00	0.20	61.20
10	306.00	0.18	55.08
25	306.00	0.18	55.08
50	306.00	0.18	55.08

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 1 (without project) AREA 1 - FUTURE W/O
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 107.10

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.35	107.10
1	306.00	0.35	107.10
10	306.00	0.35	107.10
25	306.00	0.35	107.10
50	306.00	0.35	107.10

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 2 (without project) AREA 2 - FUTURE W/O
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 33.89

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	186.00	0.20	37.20
1	186.00	0.20	37.20
10	186.00	0.18	33.48
25	186.00	0.18	33.48
50	186.00	0.18	33.48

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 2 (without project) AREA 2 - FUTURE W/O
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 65.10

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	186.00	0.35	65.10
1	186.00	0.35	65.10
10	186.00	0.35	65.10
25	186.00	0.35	65.10
50	186.00	0.35	65.10

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 8 (without project) AREAS 1/2 FUTURE W/O
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 89.64

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.20	98.40
1	492.00	0.20	98.40
10	492.00	0.18	88.56
25	492.00	0.18	88.56
50	492.00	0.18	88.56

Form C: Average Annual Habitat Units Date: 10/31/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 8 (without project) AREAS 1/2 FUTURE W/O
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 172.20

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.35	172.20
1	492.00	0.35	172.20
10	492.00	0.35	172.20
25	492.00	0.35	172.20
50	492.00	0.35	172.20

Form C: Average Annual Habitat Units Date: 12/07/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 3 (with project) A/B ISLANDS
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 230.85

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.20	61.20
1	306.00	0.76	232.56
10	306.00	0.76	232.56
25	306.00	0.76	232.56
50	306.00	0.76	232.56

Form C: Average Annual Habitat Units Date: 12/07/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 3 (with project) A/B ISLANDS
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 107.10

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.35	107.10
1	306.00	0.35	107.10
10	306.00	0.35	107.10
25	306.00	0.35	107.10
50	306.00	0.35	107.10

Form C: Average Annual Habitat Units Date: 12/07/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 4 (with project) AREA 2 - ISLAND C
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 145.84

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	186.00	0.20	37.20
1	186.00	0.79	146.94
10	186.00	0.79	146.94
25	186.00	0.79	146.94
50	186.00	0.79	146.94

Form C: Average Annual Habitat Units Date: 12/07/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 4 (with project) AREA 2 - ISLAND C
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 65.10

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	186.00	0.35	65.10
1	186.00	0.35	65.10
10	186.00	0.35	65.10
25	186.00	0.35	65.10
50	186.00	0.35	65.10

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 5 (with project) AB WITH D ISLANDS
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 247.62

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.20	61.20
1	300.00	0.76	228.00
10	295.00	0.88	259.60
25	288.00	0.88	253.44
50	275.00	0.88	242.00

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 5 (with project) AB WITH D ISLANDS
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 144.07

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.35	107.10
1	300.00	0.35	105.00
10	295.00	0.52	153.40
25	288.00	0.52	149.76
50	275.00	0.52	143.00

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 6 (with project) ABC WITH ISLAND D
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 417.18

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.20	98.40
1	486.00	0.78	379.08
10	481.00	0.90	432.90
25	474.00	0.90	426.60
50	461.00	0.90	414.90

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 6 (with project) ABC WITH ISLAND D
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 224.70

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.35	172.20
1	486.00	0.35	170.10
10	481.00	0.49	235.69
25	474.00	0.49	232.26
50	461.00	0.49	225.89

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 7 (with project) AB WITH ISLANDS D/E
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 245.05

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.20	61.20
1	297.00	0.76	225.72
10	292.00	0.88	256.96
25	285.00	0.88	250.80
50	272.00	0.88	239.36

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 7 (with project) AB WITH ISLANDS D/E
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 155.18

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	306.00	0.35	107.10
1	297.00	0.35	103.95
10	292.00	0.57	166.44
25	285.00	0.57	162.45
50	272.00	0.57	155.04

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 11 (with project) ABC WITH ISLANDS D/E
Period of Analysis: 50
Evaluation Species: 1 CENTRARCHID AAHU's: 414.55

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.20	98.40
1	483.00	0.78	376.74
10	478.00	0.90	430.20
25	471.00	0.90	423.90
50	458.00	0.90	412.20

Form C: Average Annual Habitat Units Date: 02/06/1996

Study Name: POOL 8 EMP - STODDARD
Action: PA 11 (with project) ABC WITH ISLANDS D/E
Period of Analysis: 50
Evaluation Species: 2 DIVING DUCK AAHU's: 235.81

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	492.00	0.35	172.20
1	483.00	0.35	169.05
10	478.00	0.52	248.56
25	471.00	0.52	244.92
50	458.00	0.52	238.16

Form C: Average Annual Habitat Units Date: 11/01/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 9 (without project) MUDFLAT ACCRETION
Period of Analysis: 50
Evaluation Species: 3 SHOREBIRDS AAHU's: 7.26

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	0.00	0.00	0.00
1	0.00	0.00	0.00
10	5.00	0.60	3.00
25	12.00	0.60	7.20
50	25.00	0.60	15.00

Form C: Average Annual Habitat Units Date: 11/01/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 10 (with project) MUDFLAT CONSTRUCTED
Period of Analysis: 50
Evaluation Species: 3 SHOREBIRDS AAHU's: 13.83

Target Year	Area of Habitat	Habitat Suitability Index	Habitat Units
0	0.00	0.00	0.00
1	25.00	0.20	5.00
10	25.00	0.60	15.00
25	25.00	0.60	15.00
50	25.00	0.60	15.00

4-3-11

Form D: Net Change in AAHU's Date: 12/06/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 3 (with project) A/B ISLANDS
Compared To: PA 1 (without project) AREA 1 - FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	230.85	55.75	175.09
2	DIVING DUCK	107.10	107.10	0.00

Form D: Net Change in AAHU's Date: 12/07/1995

Study Name: POOL 8 EMP - STODDARD
Action: PA 4 (with project) AREA 2 - ISLAND C
Compared To: PA 2 (without project) AREA 2 - FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	145.84	33.89	111.95
2	DIVING DUCK	65.10	65.10	0.00

Study Name: POOL 8 EMP - STODDARD
Action: PA 5 (with project) AB WITH D ISLANDS
Compared To: PA 1 (without project) AREA 1 - FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	247.62	55.75	191.87
2	DIVING DUCK	144.07	107.10	36.97

Study Name: POOL 8 EMP - STODDARD
Action: PA 7 (with project) AB WITH ISLANDS D/E
Compared To: PA 1 (without project) AREA 1 - FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	245.05	55.75	189.30
2	DIVING DUCK	155.18	107.10	48.08

Study Name: POOL 8 EMP - STODDARD
Action: PA 6 (with project) ABC WITH ISLAND D
Compared To: PA 8 (without project) AREAS 1/2 FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	417.18	89.64	327.54
2	DIVING DUCK	224.70	172.20	52.50

Study Name: POOL 8 EMP - STODDARD
Action: PA 11 (with project) ABC WITH ISLANDS D/E
Compared To: PA 8 (without project) AREAS 1/2 FUTURE W/O
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	CENTRARCHID	414.55	89.64	324.91
2	DIVING DUCK	235.81	172.20	63.61

Study Name: POOL 8 EMP - STODDARD
Action: PA 10 (with project) MUDFLAT CONSTRUCTED
Compared To: PA 9 (without project) MUDFLAT ACCRETION
Period of analysis: 50

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
3	SHOREBIRDS	13.83	7.26	6.57

ENCLOSURE 4

COMPARATIVE COSTS OF WATERFOWL PRODUCTION

Devendorf (MAY96)

POOL 8 - PHASE II

ESTIMATES FOR COST OF WATERFOWL PRODUCTION ON NESTING ISLANDS

As a component in evaluating the cost effectiveness of constructing nesting islands on the Upper Mississippi River, costs incurred by other resource management agencies or organizations for waterfowl production was investigated for comparison. The following comparison was developed based on; a study conducted by Lokeman (1984), information provided by the U.S. Fish and Wildlife Service (which includes information from their Detroit Lakes Wetland Management Office and Ducks Unlimited) and the Wisconsin Department of Natural Resources.

ASSUMPTIONS

In order to compare production costs, some assumptions must be made concerning waterfowl production, interest rates, and project life.

PRODUCTION ASSUMPTIONS

The Fish and Wildlife Service and the Wisconsin Department of Natural Resources concurred that the following figures could be used for estimating the Number of ducks fledged per year.

- NEST SUCCESS = 75%
- EGGS/NEST = 8
- FLEDGLING SUCCESS = 35%

- DUCKS/YEAR = (# NESTS)(NEST SUCCESS)(EGGS/NEST)
- FLEDGED/YEAR = (DUCKS/YEAR)(FLEDGLING SUCCESS)

COST ASSUMPTIONS

The following was used in determining the Average Annual Cost (AAC) for a 1 acre nesting island:

- CONSTRUCTION COST = $ 260,000
- PROJECT LIFE = 25 YEARS - ASSUMES NO MAINTENANCE
- INTEREST RATE = 7.625 % (AMORTIZATION FACTOR = .090696)
- AVERAGE ANNUAL COST = ($260,000)(.090696) = $ 23,581

ESTIMATED COST/FLEDGLING ON THE PROPOSED NESTING ISLAND

WISCONSIN DNR ESTIMATE

Studies by John Wetzel (1989) of the Wisconsin Department of Natural Resources have indicated that waterfowl production on small, isolated islands on the Mississippi River can be very high, with nest densities reaching as high as 100 nests per acre. The Wisconsin DNR suggested that the proposed island would have a

nest density of 65 nests per acre. Based on that assumption the proposed island would result in an AAC/Duck Fledged of $ 173.

- Assume 65 Nests/Acre/year

DUCKS/YEAR = (65)(.75)(8) = 390
FLEDGED/YEAR = (390)(.35) = 136

AVERAGE ANNUAL COST/DUCK = $ 23,581/390 = **$ 60**
AVERAGE ANNUAL COST/FLEDGLING = $ 23,581/136 = **$ 173**

FWS ESTIMATE

The Fish and Wildlife Service has indicated that nest densities on the larger islands in Lake Onalaska in Pool 8 have reached 28 nests/acre when they are predator free. The have suggested that a nest density of 30 nests/acre may be a more reasonable assumption. Based on that assumption the proposed island would result in an AAC/Duck Fledged of $ 374.

- Assume 30 Nests/Acre/Year

DUCKS/YEAR = (30)(.75)(8) = 180
FLEDGED/YEAR = (180)(.35) = 63

AVERAGE ANNUAL COST/DUCK = $ 23,581/180 = **$ 131**
AVERAGE ANNUAL COST/FLEDGLING = $ 23,581/63 = **$ 374**

ESTIMATED PRODUCTION COSTS OF OTHERS

Waterfowl Production Area Costs

The USFWS Detroit Lakes Wetlands Management District in western Minnesota manages 37,000 acres that are in fee title. They estimate that on an annual basis their production rate is .1 birds/acre/year with a total of 3,100 ducks fledged from the fee title acres each year. The USFWS estimates that the average initial cost per acre of fee title lands are $ 500 for acquisition and $ 125 for initial management measures. For this evaluation, it is assumed that 50% of the Districts' annual total operating budget, which averages $ 600,000, represent the O&M cost of the fee title acres. Based on these assumptions, the Detroit Lakes Wetland Management District have an AAC/Duck Fledged of $ 647.

Assumptions

- Fledges 3,100 ducks/year for 37,000 fee title acres
- .1 birds/acre/year = 1 bird/10 acres/year
- Initial cost/acre (acquisition + mgmt) = (500+125)= $ 625
- Therefore initial cost/bird = 10(625) = $ 6,250
- Annual O&M = (.5)(600,000) = $ 300,000.
- Annual O&M/acre = 300,000/37,000 = $ 8

- Therefore Annual O&M to produce 1 duck = 10(8) = $ 80
- Amortize initial cost over 25 years at 7.625%

Average Annual First Cost(AAFC)/Bird = ($6,250)(.090696) = $ 567

AVERAGE ANNUAL COST/BIRD = AAFC + O&M = ($ 567 + $ 80) = **$ 647**

LOKEMAN 1984

Lokeman's study cited an average annual cost/fledgling on man made islands to range from **$223** in the Dakota region to **$ 580** in western Minnesota. All other management measures were fairly inexpensive **but** DID NOT INCLUDE ACQUISITION COST OF LANDS. If acquisition costs were included it appears that other management measures would be comparable to WPA cost cited above.

DUCKS UNLIMITED

The USFWS contacted the Bismarck Office of Ducks Unlimited. They indicated that they estimate a 30 year life for their projects. In their evaluation of projects, they assume that the islands they construct in large shallow alkaline lakes in North Dakota, will have a nest density of 30 nests/acre with 80% nest success. With these assumptions, they feel they can justify a cost of about $ 25,000 for a 1 acre nesting island. Assuming similar values for eggs per nest and fledge rates that are being used for the proposed nesting island, DU's cost per duck fledged on those types of nesting islands is estimated at $ 32

FOR 1 ACRE NESTING ISLANDS CONSTRUCTED BY DUCKS UNLIMITED

- DU uses 30 year life, 30 Nests/acre, 80% nest success
- Cost they feel they can justify = $25,000
- Assuming a 7.625% interest rate - Amortization rate over 30 years = .085704

AVERAGE ANNUAL COST = (25,000)(.085704) = $ 2,143

- Assuming an average of 8 eggs per nest
- Assuming a similar fledge rate of 35%

DUCKS/YEAR = (30)(.8)(8) = 192
DUCK FLEDGED/YEAR = (192)(.35) = 67

DU'S AVERAGE ANNUAL COST/DUCK = $ 2143/192 = **$ 11**
DU'S AVERAGE ANNUAL COST/FLEDGLING = $ 2143/67 = **$ 32**

DISCUSSION

Depending on the assumptions used for production, it appears that the cost/duck fledged on the proposed nesting island would range from $ 173 to $ 374. Based on the above information, it appears that the cost/duck fledged of the proposed nesting island is

comparable to the costs cited for the WPA production in western Minnesota, and with waterfowl production costs for constructed islands cited by Lokeman 1984. The estimated cost/duck fledged for island projects constructed by Ducks Unlimited are substantially lower than any other costs cited. This is a reflection of the different construction conditions in the areas where their islands are constructed.

This evaluation may involve optimistic assumptions with respect to the annual production. It likely that in some years, the nesting island will be flooded and not suitable for nesting starts, or started nests may be lost. The current design elevation indicates that this may occur approximately 10% of the time. The rock protection proposed for the islands may initially serve as roosting attractants for some avian predators such as gulls, thereby reducing the number of successful nests. Other events over the life of the project, such as changes in size or changes in vegetative composition or density, may have adverse affects on projected nest density or production.

Nesting intensity and success on the UMR islands can be highly variable. A recent project progress report (Nelson and Wetzel, 1975) summarizing long-term nest monitoring efforts in Pool 7 and Pool 8 from 1981 to 1993, indicates that out of the 12 years of monitoring, 1981, 1988,1989 and 1990 had relativley high nests/acre starts. The remaining 8 years had relatively lower nests/acre initiated, being 1/3 to 1/2 as as much. This data indicates that while nesting starts/success on islands may be higher than on upland areas, exceptionally high nesting densities may be the occassional exception rather than the rule.

If the assumed 30 nests/acre for this evaluation were adjusted by 1/2 (i.e 15 nests per acre), the AAC/duck would increase accordingly to $ 748 per duck fledged.

REFERENCES

Lokeman, J.T., 1984. Examining economic efficiency of management practices that enhance waterfowl production. in Transactions of the North American Wildlife and Natural Resources Conference 49, pp 584 - 607.

Nelson, J.S. and J.F. Wetzel. 1995. Summary Report. Long-term Monitoring of Nesting Mallards on Mississippi River Islands, 12pp. (Unpublished, obtained from Wetzel, Wis DNR.)

Wetzel, J., Nelson, J.S and R. Dahlgren. 1989. Survey of waterfowl nesting success on UMR islands and implications for habitat projects, in Proceedings of the Forty-Fifth Annual Meeting of the Upper Mississippi River Conservation Committee, pp 97 -103. Upper Mississippi River Conservation Committee.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River Refuge Complex
51 East 4th Street
Winona, Minnesota 55987

IN REPLY REFER TO:

June 16, 1995

John Wetzel
Wisconsin Department of Natural
Resources
3550 Mormon Coulee Road
State Office Building
La Crosse, Wisconsin 54601

Dear John:

Thanks for the opportunity to comment on your write-up entitled, "Cost::Benefit Ratio: Proposed Mississippi River Nesting Island Versus a WPA." Jim Nissen, Eric Nelson, and I have reviewed it and offer the following comments:

The first comment deals with the figures used to determine costs associated with production from the nesting island. For the average number of nests expected on an island with good nesting cover and a 1-acre top, you use the figure of 65 per year. A review of the recent data regarding the number of "nest starts" for constructed islands in the La Crosse area shows Cormorant Island has done the best with 85 "starts" in 1994. With about a 3-acre top, that equates to almost 28 nests per acre per year; the best Arrowhead and Broken Gun Islands have done is about 10 nests per acre in 1994. Therefore, a more realistic figure to plug-in for the expected number of "nest starts" per season would be 30.

We agree with your figures of 75% for the average hatching success and 35% for duckling survival.

In your cost projections for an island with a 1-acre top, the figure of $275,000 was used. According to Gary Palesh (6/12/95 telephone conversation with Jim Nissen), after revising the quantities, etc. needed for this smaller island, he estimated the cost of the island at $325,000.

With these revised figures, the average costs per nest, duckling, and fledgling over a 50-year period for a 1-acre island constructed in the Mississippi River for $325,000 would be as follows:

- Nests: 30 nests/year x 50 years = 1,500 nests
- Ducklings: 1,500 nests x .75 (ave. hatch rate) x 8 (ave. no. eggs hatched/nest) = 9,000 ducklings hatched
- Fledglings: 9,000 ducklings x .35 (ave. duckling survival to flight) = 3,150 ducks to flight

4-4-5

With this in mind, the Average Costs Per:

- Nest: $325.0/1,500 = $215
- Duckling: $325.0/9,000 = $35
- Fledgling: $325.0/3,150 = $105

None of the above figures include O&M costs.

WPA Cost Figures

We checked with Tom Atkins and Larry Hanson from the Detroit Lakes Wetland Management District (WMD) in western Minnesota for an update on production numbers and costs. The Detroit Lakes WMD contains approximately 37,000 acres, * and the area fledges approximately 18,000 - 19,000 ducks per year. The production figures are obtained through the 4 square mile method. Tom estimates that in addition to the $500/acre acquisition costs for the land, we should figure in $125 per acre for a one time cost for improvements, bringing the total initial cost per acre to $625. The total annual budget for the Detroit Lakes WMD is $600,000. Using these figures, we calculate the cost per fledged bird as follows:

Initial Costs

* .5 bird/acre/year = 1 bird/2 acres/year
2 acres cost $1,250
Therefore the cost of producing one bird/year = $1,250.
Over 50 years, the cost per bird = $25

O&M Costs

$600,000/18,500 birds = $32/bird

Adding the initial costs to the O&M costs gives a figure of $57 per fledged bird.

We believe that these figures are reasonable, and if anything are on the high side. For one thing, the $600,000 O&M figure is the Detroit Lakes WMD total station budget, not just the portion that is specifically geared towards waterfowl production on fee title lands. For another, although we included the initial costs in the calculations, after 50 years, those islands will still exist and will still produce birds.

* Jim Nissen of The USFWS contacted me in Nov 95 to correct the WPA production Figures cited in this letter - He indicated that the Figures cited were production goals & not actual production Figures - Current production Figures are around 3,100 ducks/year on 37,000 Fee title Acres - WMD personal estimate they produce ~ .1 birds/acre/year ≈ 10 Acres/bird - These corrected Figures were used in calculating waterfowl production costs for the Detroit Lakes WMD 4-4-6

Randall [signature] 4-4-6

Having said that, I think that it is only fair to point out that comparing WPA acres to islands in the river may be an "apples and oranges" comparison because these two geographic areas have different primary ecological functions for waterfowl, the former for production, the latter for migration. Both areas provide secondary benefits that include migrating and nesting birds.

Alternative Approaches

Ducks Unlimited

In looking for more information on the economics and cost benefits of island construction for waterfowl production, we turned to Ducks Unlimited. Rick Warhurst from the Bismarck, ND office (701/258-5599) supplied the following information:

- DU recommends construction of 1-acre islands in large shallow alkaline lakes in North Dakota. They do not recommend constructing 1-acre islands in freshwater wetlands because of predation problems, but will build a series of .1-acre islands in these areas instead. These islands are dedicated to waterfowl nesting.
- The numbers they use for cost justification are: 30-year life, 30 nests per acre, 80% nest success.
- Islands are constructed about 4' above normal pool, in water depths of 1-2', and a minimum of 100 yards from land. Islands are normally constructed in the winter using imported material. No riprap is added, and as a general rule, no post-construction maintenance is done. An exception to that rule would be those islands that have a history of duck nesting success, some maintenance may be considered.
- With this in mind, DU can justify spending $20,000-25,000 per nesting island on construction costs. The Bureau of Reclamation in North Dakota will go as high as $30,000 per nesting island in the same type of habitat.
- DU and others would like to monitor/study the islands built to-date to get a better handle on why some are better producers than others.

John Lokemoen Paper

In 1984, John T. Lokemoen wrote a paper entitled, "Examining Economic Efficiency of Management Practices That Enhance Waterfowl Production," dealing with management practices in the pothole region of North and South Dakota, and western Minnesota (copy enclosed). Following are quotes from the paper:

- "Although a relatively large number of ducks were fledged from man-made islands, construction costs were high, and fledged duck costs were estimated to exceed $200 per bird." (page 591)

- "Of the management methods examined, man-made islands, as an example, showed the highest rate of duck production. Yet, islands were expensive to construct, the cost of each individual produced on islands was quite high, the dollars spent on islands were not efficiently used." (page 596)

Conclusion

We would all agree that producing ducks is expensive, regardless of the geographic location. If we disagree on anything, it is on whether we should construct islands whose sole purpose would be waterfowl production. Because of the costs involved with island construction, the Refuge prefers to see EMP islands constructed with multiple benefits in mind. The Stage 2 process of the Pool 8 Islands EMP project in which Boomerang Island was constructed and Grassy Island rehabilitated is an example of what we would like to see done. Although Grassy Island is referred to as a nesting island, other benefits are realized in the Phase I area because of it. We do not feel that we will realize the same array of benefits by building a nesting island away from an island complex.

Insofar as waterfowl use on the river is concerned, our management and restoration efforts generally have been oriented toward sustaining optimal migration habitat consisting of a wide distribution of emergent and submergent aquatic vegetation. Such habitat will benefit a wide range of migrating and breeding waterbirds as well as fish and other aquatic life. In the context of getting the "most bang for the buck" with the Pool 8 Islands project, we prefer taking the $325,000 estimated as the cost of constructing a nesting island as part of Phase 2, and use that money in the Phase 3 project area to build islands that will result in better migrational habitat, sites for nesting waterfowl, etc.

This letter was written to explain our point of view and in no way is intended to refute or diminish yours. You know us well enough to realize that we are not turning our backs on nesting waterfowl. n this situation, we feel that limited resources would be better utilized in a project that encompasses a range of benefits. I believe that we can find a way to increase waterfowl production using the EMP, and I believe that we should sit down as a group and discuss mutually acceptable alternatives.

Sincerely,

Jim Fisher

James R. Fisher
Complex Manager

Enclosure

cc: Jim Nissen, USFWS-LaCrosse

Summary Report
John S. Nelson and John F. Wetzel

Project: Long-Term Monitoring of Nesting Mallards on Mississippi River Islands

Period: 1993 Nesting Season

Objectives:

1. Continue 20-year long-term mallard nesting study on predator-free islands in lower Pool 8.
2. Maintain high mallard production islands in order to assist such possible collateral investigations as duckling survival/habitat use, mallard hen homing rates, hen nesting success, second nesting attempt rates/success, etc.
3. Expand study to Pool 7 to help meet objective 2 and study colonization of newly constructed islands by nesting mallards. This information can improve our understanding of mallard nesting islands for future construction projects.

INTRODUCTION

This study was initiated in 1980 (detailed nesting information is available since 1981) as a basis to help formulate long-term management strategies to enhance waterfowl recruitment on the Mississippi River. Long-term mallard nesting data will help us understand normal variations in mallard nesting densities on predator-free islands and understand how these variations relate to changes in spring nesting populations, local nesting success and fledging rates, drought or flood conditions, brood habitat availability, etc.

Results will expand our knowledge of island nesting mallards which can be used to improve the design and location of constructed islands.

Many variations in weather and water levels have been observed over the course of the study. Nineteen hundred and ninety-three was an extreme high water year during the late hatch and early brood rearing stage of the mallard nesting season.

METHODS

All islands were surveyed at two to three week intervals as described in Appendix 1 "Duck Nesting Survey on Mississippi River Islands, Field Methodology." Nest success was estimated with the apparent estimation technique, the preferred method for island nesting situations encountered in this study (Johnson, 1990). Pool 8 study islands were Trapping, Heron, East,

Grassy and Turtle. Pool 7 study islands were Arrowhead, McIlvane, Broken Gun, Cormorant and Osprey (Old Cormorant). Nest searches were initiated May 5 and continued until all nests were hatched - approximately August 6.

A new, duck brood survey was conducted on July 21 on Pool 7 to provide additional information on brood survival. Eleven observers from Wisconsin Department of Natural Resources and U. S. Fish and Wildlife Service were stationed in brood habitat on Lake Onalaska and recorded the specie and age of each brood sighted for one hour at first light. Chris Kochanny of the Upper Mississippi River Science Center coordinated the survey and tabulated results.

No major predator problems were observed on Pool 8 study islands this year so no predator removal was attempted. Because nest disturbance by campers appears to be a problem, voluntary avoidance signs were again posted on Cormorant Island in Pool 7. Local interest from sportsmen in both Wisconsin and Minnesota prompted voluntary avoidance posting on Pool 8 study islands as well.

RESULTS AND DISCUSSION

Mallard Nesting

Pool 7: The survey on Pool 7 nesting islands recorded 113 nest attempts with 83 successful for a 73% nest success rate. The three constructed islands - Arrowhead, Broken Gun and Cormorant - have shown a dramatic increase in duck use over the three years since construction (Table 1 and Figure 2). Broken Gun Island receives the most public use during the nesting season and is probably less likely to be chosen as a nesting site by hen mallards. Cormorant Island received very little public use during the nesting season in part due to the Voluntary Closed Area Program (April 15 - July 15) and had the highest density of nesting mallards. Seventeen of the 83 successful nests on Pool 7 islands were used in the U. S. Fish and Wildlife Service's duckling survival study using field procedures similar to previous years.

Pool 8: Pool 8 study islands had 37 nest attempts with 13 successful or a success rate of 35%. Seven of the successful nests were used in the duckling survival study. Seventeen nests or 46% were abandoned due to disturbance by campers and flooding. East Island suffered the highest disturbance rate with five nests believed to be disturbed to the point of abandonment as a result of a large camping party on Memorial Day weekend (Table 1). Their reaction to the voluntary avoidance posting was to continue with their camping plans because "the program was only voluntary".

Grassy Island was riprapped and raised in 1992, and no nesting cover was available for the 1993 nesting season.

Unusually heavy rains during spring and summer of 1993 caused a prolonged water level increase in mid-June to mid-August. Fortunately, most ducks on Pool 8 had already hatched. Seven of the 17 abandoned nests on Pool 8 study islands were due to high water. Only three of the 113

nest attempts on Pool 7 were abandoned because of high water (Table 1). However, Pool 7 abandonment would have been much higher if the islands had not been constructed above the peak 1993 high water as many nests were still active during the June - August high water period.

The average hatch date for Pool 8 nests was June 6; however, if the seven nests flooded in mid-June were allowed to hatch, the average hatch date would have been later. Pool 7 average hatch date was June 14. This is probably a more accurate estimate of the 1993 Mississippi River La Crosse area average mallard nest hatch date.

Table 2 shows the nesting summary for Pool 8 study islands from 1981 through 1993. Dramatic changes have taken place over the 13 years of nest surveys (also see Figure 1). Nineteen hundred and eighty-one (1981) was an excellent year for mallard production on Pool 8 study islands with 95 nests initiated and 70 successful. Production dropped dramatically in 1982 and remained at a relatively low level from 1983 through 1987 with 22 to 31 successful nests out of 33 to 47 nest attempts. During that time, Turtle Island went from a major nesting island to a minor contributor to the Pool 8 nest totals because nest predators drastically reduced production from 51 nests with 36 successful in 1981 to eight nests with one successful by 1984. Also, Small Island went from four nests with three successful in 1981 to one successful nest attempt in 1983 because it was gradually washing away. By 1986, none of the surface area of the island remained to support nesting cover. However, it is unclear why the total nest attempts dropped so dramatically between 1981 and 1982.

In 1988, waterfowl production on the study islands increased dramatically with 111 nest attempts and 69 successful. This increase in nesting waterfowl on the river is believed to be a result of low water in other area wetlands (and perhaps the U. S. and Canadian Prairie areas) because of drought conditions in 1988. Summer mallard banding on Pool 8 also yielded a large increase in adult mallards believed to be unsuccessful breeders from surrounding areas that took refuge in Pool 8 to molt as it was one of the only large bodies of water for many miles. The large increase in nesting mallards in 1988 carried into 1989 which was a record year for nest initiation during the study period with 113 nests and 64 successful (57%). Nineteen hundred and ninety through 1993 was a period of decline in nest initiation and also coincided with a decline in aquatic vegetation and brood habitat. Studies on brood survival from 1991 through 1993 conducted by the U. S. Fish and Wildlife Service showed poor brood survival over this interval resulting in a decline in hen recruitment. A large number of mallards were also lost as a result of a botulism outbreak in 1992 near the study islands; however, the direct effect on local nesting mallards is unknown.

Another factor in the decline of nesting mallards is the gradual decline of island surface area. All study islands have eroded resulting in a loss of nesting cover. Small Island has completely eroded away. Heron Island has been reduced from approximately 1.5 acres in 1981 to an island six feet by 50 feet. Trapping Island was approximately three acres in 1981 and is now less than one-half acre, most of which no longer supports adequate nesting cover. Even East Island, which is on the inside of a main channel bend, has lost nearly an acre of surface area. If this trend continues, lower Pool 8's secure nesting islands will be nearly gone by the end of the 20-year study period. Judging from the response of nesting mallards to the constructed islands on Pool 7, constructed nesting islands on Pool 8 is a waterfowl production strategy that deserves consideration.

The 13-year hatch rate (Pool 8) is 60% (481 of 809 nests - Table 2) indicating that predator-free nesting islands in this area have the potential to be high, net producers of waterfowl. Many upland areas have nest hatch rates of ≤15% and are population sinks. This is an extremely important point that Mississippi River managers need to keep in mind when considering habitat management projects on the River.

Riprapping of the present nesting islands is a minimum requirement to maintain some Pool 8 mallard production.

Duck Brood Survey

The new duck brood survey (run in Pool 7 on July 21) located 24 broods on Lake Onalaska. Thirteen were mallards, ten were wood ducks and one was a blue-winged teal. With some refinement in the timing of the survey and in placement of observers, the technique appears to have merit for developing an index to brood production. Brood survey results and techniques are described in correspondence from Chris Kochanny, Biological Technician, Northern Prairie Wildlife Research Center.

We express gratitude to the U. S. Fish and Wildlife Service for their continued cooperation and field assistance with the survey and to our field assistant, Doug Mroch.

c\wm\report08.jn

4-4-12

Table 1. Mallard Nesting Attempts on Pools 7 and 8 Study Islands, 1993

	Approx. Acres	Total Nests	Hatched		Predated		Abandoned		Unknown	
			No.	%	No.	%	No.	%	No.	%
Pool 7										
Arrowhead	3.50	38	25(4)	66	8	21	4	11	1	3
McIlvane	0.10	2	2(1)	100						
Broken Gun	3.50	11	10(2)	91	1	9				
Cormorant	3.50	60	46(10)	77	8	13	6	10		
Osprey	0.20	2					2	100		
Total	10.80	113	83(17)	73	17	15	12	11	1	1
Pool 8										
Trapping	0.37	9	3(3)	33			6	67		
Heron	0.10	6	3	50	1	17	2	33		
East	1.64	15	6(4)	40	3	20	6	40		
Grassy	2.5	0*								
Turtle	12.6	7	1	14	3	43	3	43		
Total	17.21	37	13(7)	35	7	19	17	46		

( ) Indicates number of nests artificially hatched for telemetry study.
* No nesting cover was available on Grassy Island in 1993.

Table 2. Mallard Nesting Summary 1981-1993 for Trapping, Heron, East and Turtle Islands in Pool 8

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Total Nests *	6.2 95	3.1 47	2 33	2 34	2.6 40	2.8 44	3 46	7.1 111	7.4 113	6 93	5 75	2.7 41	2.5 37
Successful Nests	70	28	29	23	31	22	31	69	64	43	(25) 31	(13) 27	(7) 13
% Successful Nests	74%	60%	87%	68%	78%	50%	70%	62%	57%	46%	41%	66%	35%
Successful Nests/Acre	4.57	1.83	1.89	1.50	2.02	1.44	2.02	4.50	4.18	2.81	2.02	1.80	0.88
Average Clutch Size	9.5	9.4	9.8	10.3	10.9	9.2	11.6	10.4	10.9	9.2	7.8	9.4	10.23

Total acres of all islands, 1988 - estimate 15.32 acres.

( ) Indicates number of nests artificially hatched for telemetry study.

* Nests / ACRE = Total Nest / Total Acres

= Total Nest / 15.3 · / my Work

4-4-14

Mallard Nesting Summary 1981-1993
Pool 8 Study Islands

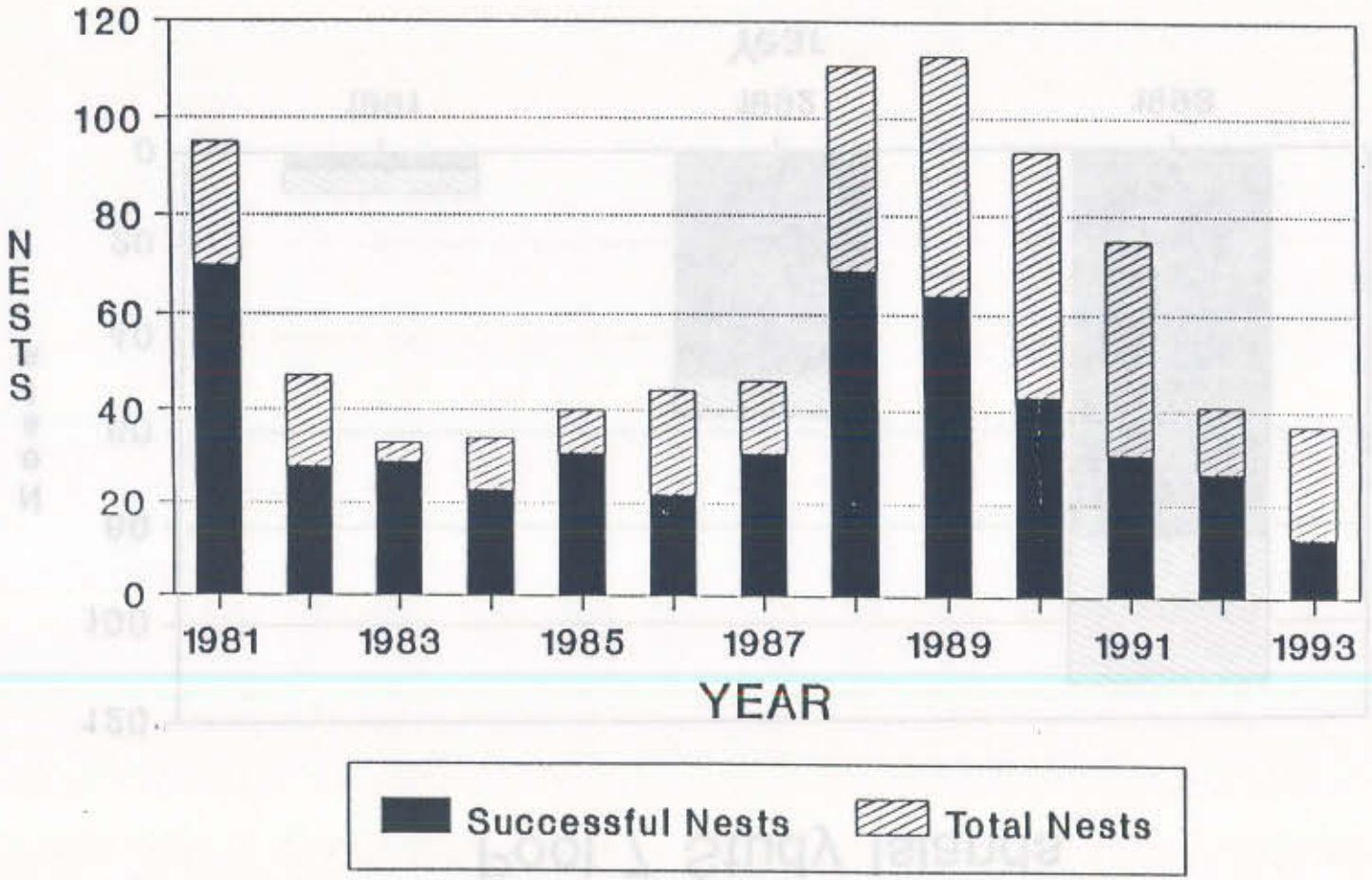


Figure 1

Mallard Nesting Summary 1991-1993
Pool 7 Study Islands

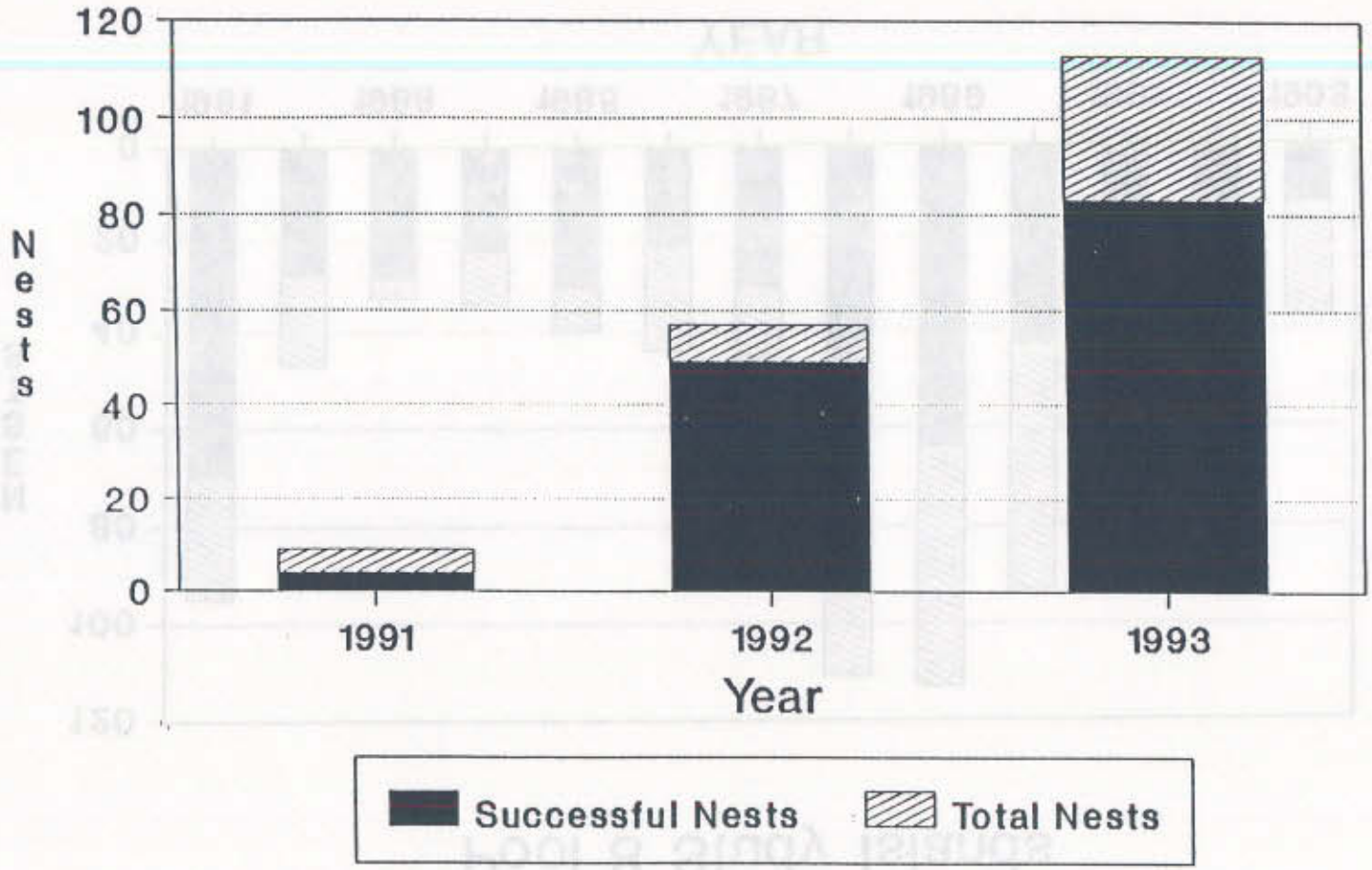


Figure 2

Literature Cited

Johnson, D. H. and J. O. Schaffer. 1990. Estimating Nest Success: When Mayfield wins. Auk. 107: 595-600.

Report Date: July 1995

Appendix 1

Duck Nest Survey on Mississippi River Islands

Field Methodology

Time of Year

Mallards nesting in the La Crosse area peaks about mid-May as measured by the number of birds incubating. In order to maximize efforts for a three-visit schedule, the first visit should be no later than mid-May; however, further south this may be earlier and schedules should be adjusted accordingly (one week or so). Subsequent visits, to note results of nesting, are most effective at three week intervals. This schedule should yield success rates of both initial nesting attempts and most renesting attempts.

Nest Searches

Small islands of two acres or smaller can be effectively searched with two to three people, depending on cover density. Larger islands may be searched in sections with a small crew or simultaneously with a larger crew. Usually nests are located by flushing hens and noting the location of the flushes; however, by carefully searching the ground under dense cover, additional nests can also be found.

Marking the Nest

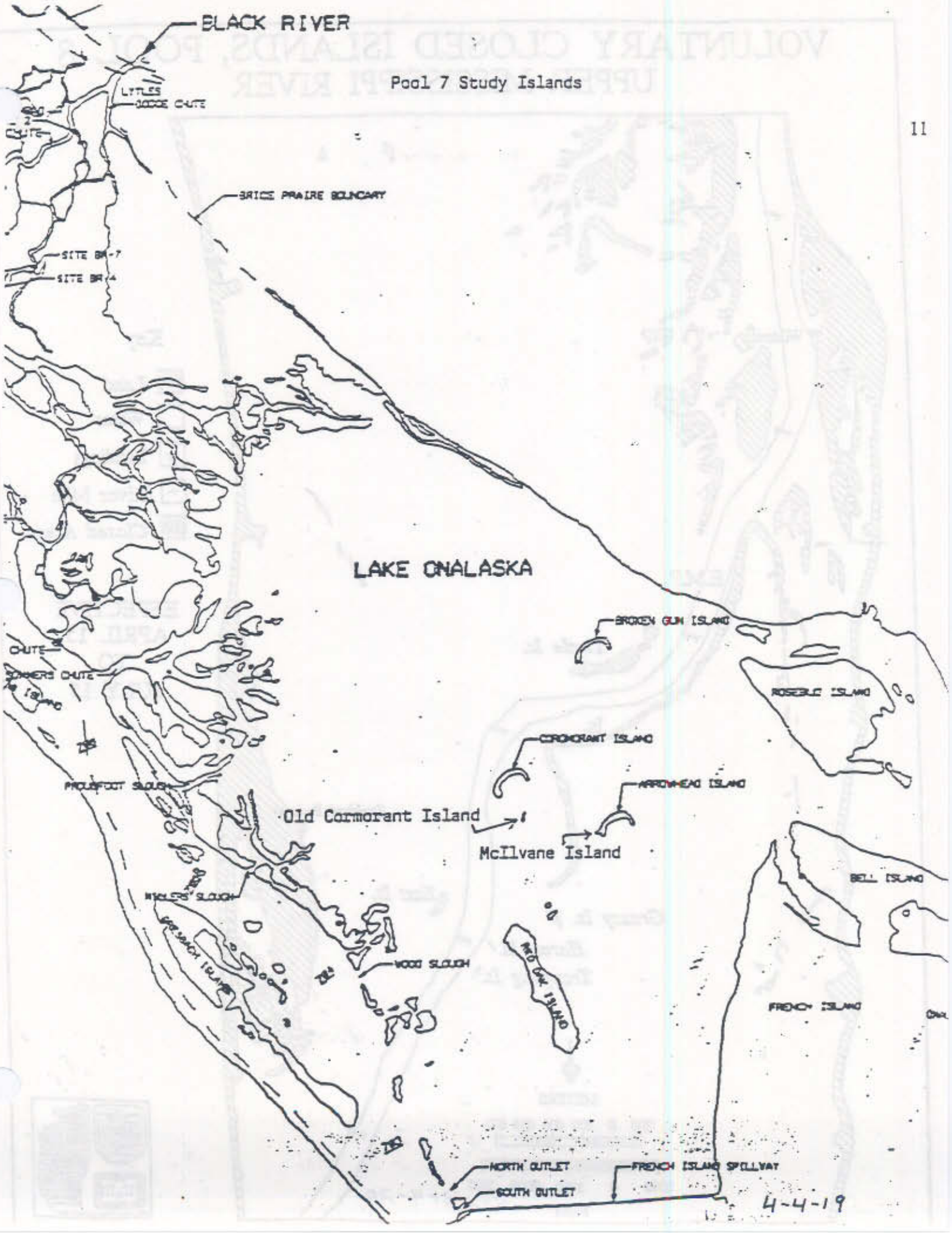
Marking a nest so it can be found on subsequent visits is essential to record disposition. Finding marked nests on subsequent visits can become very difficult as leaf out of vegetation is occurring at this time. On brushy islands, brightly colored flagging has proven to be most effective. The flagging should also be marked with a number corresponding to the nest number and date the nest was originally found. On grassy islands a lath, wire or branch located near the nest can be used to support the flag. Be sure to attach the flag high enough to allow for rapid growth of vegetation. In addition to flagging, concise notes (each nest) and maps (each island) should be prepared to aid in locating nests during later visits.

Nest Data Log

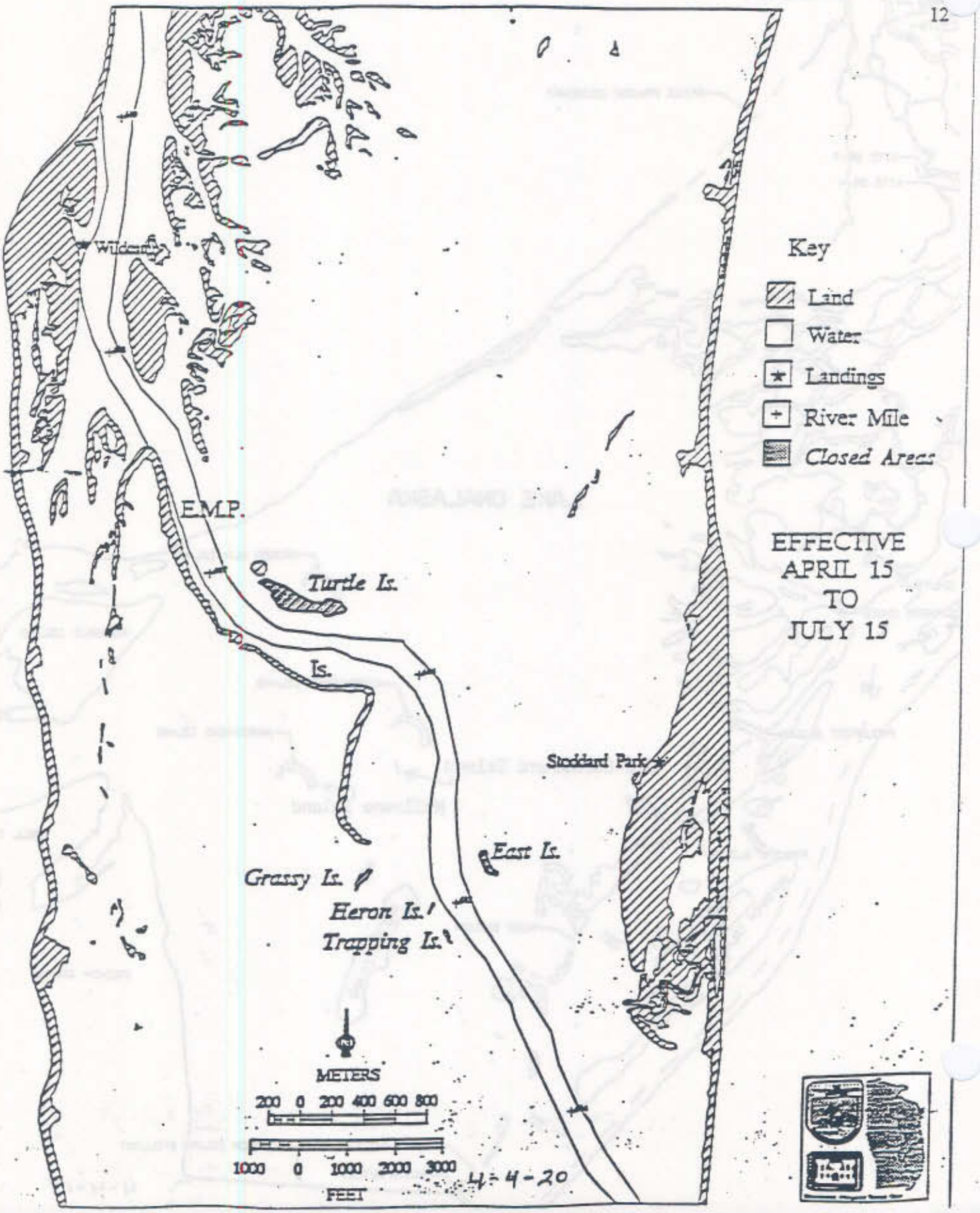
Our nest data log provides for nest disposition (hatch, predated, etc.) and nest site information. Data on nest site information is being collected to further knowledge on cover types important for Mississippi River island nesting. A copy of our nest data log is available upon request.

Prepared by:
John Nelson
April, 1990

4-4-18


BLACK RIVER
Pool 7 Study Islands
LYTLES
DODGE CHUTE
BRICE PRAIRE BOUNDARY
SITE BR-7
SITE BR-4
LAKE ONALASKA
BROKEN GUN ISLAND
CHUTE
ROSEBUD ISLAND
CORMORANT ISLAND
ARROWHEAD ISLAND
Old Cormorant Island
McIlvane Island
BELL ISLAND
WOOD SLOUGH
FRENCH ISLAND
NORTH OUTLET
SOUTH OUTLET
4-4-19

VOLUNTARY CLOSED ISLANDS, POOL 8
UPPER MISSISSIPPI RIVER



ATTACHMENT 5

HYDRAULICS APPENDIX

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-3)

POOL 8 ISLAND CONSTRUCTION
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 8, UPPER MISSISSIPPI RIVER
HOUSTON COUNTY, MINNESOTA

APPENDIX A
HYDRAULIC DESIGN/HYDRODYNAMICS/SEDIMENT TRANSPORT

Jon S. Hendrickson
St. Paul District Corps of Engineers
190 E 5th Street
St. Paul, Minnesota 55101

February 1996

CONTENTS

	Page
Introduction	1
Hydrodynamic Model	1
STODDARD BAY	2
Existing Physical Conditions	2
Hydrology	2
Discharge Duration, Discharge Frequency	2
Stage-Duration	3
Hydrodynamics	3
Discharge Distribution	3
Stage-Discharge	4
Flow Velocities	4
Hydraulic Residence Time	5
Wave Action	5
Sediment Transport	7
Deposition/Erosion	7
Sediment Types	8
Sediment Load	8
Trap Efficiency	9
Sediment Resuspension by Waves	9
Previous Island Design Experience (Pool 8, Phase 1)	10
Island Top Elevations	10
Island Widths	12
Island Side Slopes	13
Shoreline Stabilization	13
Postproject Observations	14
Stoddard Bay Goals, Objectives, Criteria	15
Stoddard Bay Hydraulic Design Factors	17
Stoddard Bay Design	18
Island Layout	18
Island Cross Section	19
Island Top Elevation	20
Island Widths	20
Island Side Slope	21
Shoreline Stabilization	21
Rock Size	22
Rock Sills	22
Layout	22
Top Elevation	23
Top Width	25
Low Flow Channel	26
Proposed Physical Conditions	26
Hydrology	26
Hydrodynamics	26
Discharge Distribution	26
Stage-Discharge	27
Flow Velocities	28
Hydraulic Residence Time	29
Wave Action	29

Impacts on Phase 1 ---------- 30
Sediment Transport ---------- 30
Deposition/Erosion ---------- 30
Sediment Types ---------- 31
Sediment Loads ---------- 32
Trap Efficiency ---------- 32
Sediment Resuspension by Waves ---------- 32

SEED ISLANDS ---------- 34
Existing Physical Conditions ---------- 34
Hydrology ---------- 34
Hydrodynamics ---------- 34
Discharge Distribution ---------- 34
Flow Velocities ---------- 35
Wave Action ---------- 35
Sediment Transport ---------- 35
Deposition/Erosion (1932 to 1991) ---------- 35
Sediment Types ---------- 35
Previous Island Design Experience (USFWS Seed Islands) ----- 35
Island Cross Section ---------- 36
Postproject Observations ---------- 36
Seed Island Goals ---------- 36
Seed Island Hydraulic Design Factors ---------- 37
Seed Island Design ---------- 37
Island Layout ---------- 37
Island Cross Section ---------- 38
Rock Size ---------- 38
Proposed Physical Conditions ---------- 38
Hydrodynamics ---------- 38
Discharge Distribution ---------- 38
Flow Velocities ---------- 38
Wave Action ---------- 39
Impacts on Phase 1 ---------- 39
Sediment Transport ---------- 39
Deposition/Erosion ---------- 39
Sediment Types ---------- 39

References ---------- 40

TABLES

Page

Table 1 Geometric Characteristics of Stoddard Bay Subareas - 2
Table 2 Discharge-Duration at Lock and Dam 8 ---------- 2
Table 3 Discharge-Frequency at Lock and Dam 8 ---------- 3
Table 4 Stage-Duration at Lock and Dam 8 ---------- 3
Table 5 Stage-Duration at Brownsville ---------- 3
Table 6 Hydraulic Residence Time in Stoddard Bay for Existing Conditions ---------- 5
Table 7 Analytical Predictions of Wave Characteristics in Stoddard Bay ---------- 6
Table 8 Stoddard Bay, Pool 8, Deposition and Erosion ------- 7
Table 9 Analytical Prediction of Bottom Shear Stress in Stoddard Bay ---------- 10
Table 10 Island Widths, Phase 1 of the Pool 8 Island Project 12
Table 11 Rock/Biotechnical Stabilization Components -------- 13
Table 12 Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 1 ---------- 15
Table 13 Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 2 ---------- 16
Table 14 Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 3 ---------- 16
Table 15 Island Cross Section Dimensions, Stoddard Bay ----- 20
Table 16 Rock Stabilization Dimensions ---------- 21
Table 17 Rock Sill Dimensions ---------- 22
Table 18 Stage-Discharge Data at Sill A, Sill B, and Brownsville ---------- 24
Table 19 Percent of Time Sill A Overtopped ---------- 24
Table 20 Rock Sill Overtopping Events, 1971 to 1993 -------- 25
Table 21 Discharge Conveyed in Stoddard Bay, Existing and Proposed Conditions ---------- 27
Table 22 Water Surface Elevations in Stoddard Bay, Existing and Proposed Conditions ---------- 28
Table 23 Hydraulic Residence Time in Stoddard Bay for Existing and Proposed Conditions ---------- 29
Table 24 Analytical Predictions of Wave Characteristics in Stoddard Bay, Existing and Proposed Conditions ---- 30
Table 25 Analytical Prediction of Bottom Shear Stress in Stoddard Bay, Existing and Proposed Conditions ---- 33

FIGURES

Figure 1 Plan View of Lower Pool 8
Figure 2 Two-Dimensional Hydrodynamic Model Grid
Figure 3 Two-Dimensional Hydrodynamic Model Bathymetry
Figure 4 Stoddard Bay Project Area
Figure 5 Pool 8 Discharge Measurement Sites, RM 683 - 692
Figure 6 Pool 8 Discharge, Sites 11/12 and 26
Figure 7 Stage-Discharge, Lock 8, Brownsville, Stoddard Bay
Figure 8 Stoddard Bay Existing Conditions Low Flow Velocity
Figure 9 Stoddard Bay Existing Conditions Flood Flow Velocity
Figure 10 Stoddard Bay Bathymetry, 1932 and 1991
Figure 11 Stoddard Bay Erosion and Deposition, 1932 to 1991
Figure 12 Typical Cross Section Used in Phase 1 Construction
Figure 13 Lower Pool 8 Island Loss
Figure 14 Horseshoe Island Cross Sections, May 1995
Figure 15 Boomerang Island Cross Sections, May 1995
Figure 16 Boomerang Island Cross Sections, May 1995
Figure 17 Plan View of Stoddard Bay Islands
Figure 18 Cross Section of Stoddard Bay Islands
Figure 19 Stoddard Bay Proposed Conditions Low Flow Velocity
Figure 20 Stoddard Bay Proposed Conditions Flood Flow Velocity
Figure 21 Seed Island Project Area
Figure 22 Pool 8 Discharge, Sites 24 and 25.
Figure 23 Seed Islands Existing Flow Velocity and Direction
Figure 24 Seed Island Bathymetry, 1932 and 1991
Figure 25 Seed Island Erosion and Deposition, 1932 to 1991
Figure 26 Seed Island Sediment Types
Figure 27 Plan View of Seed Islands

INTRODUCTION

This Appendix summarizes the hydrodynamic and sediment transport analyses completed for the Pool 8 Islands, Phase 2 HREP (Habitat Rehabilitation and Enhancement Project). This project is located in lower pool 8, which is defined as the reach from Lock and Dam 8 (River Mile 679.2) to Brownsville (River Mile 689.0). The reach of primary interest extends from River Mile 684.0 to 688.0 and includes both phase 1 and phase 2 of the Pool 8 Islands HREP (Figure 1). This reach can be divided into five primary hydrodynamic areas. These areas are the Raft Channel, the navigation channel (Coon Slough), the Crosby Slough area, (Phase 1 of the Pool 8 Islands HREP), and Stoddard Bay (Phase 2 of the Pool 8 Islands HREP). Phase 1, Stage 1 of the Pool 8 project was constructed in July 1989 using sand dredged from the adjacent navigation channel. The purpose of this project stage was to reduce backwater inflows and rebuild Horseshoe Island located on the right descending side of the navigation channel between river miles 687 and 687.6. Two tertiary channels (sites 4 and 5) through the island were closed as part of this work. Phase 1, Stage 2 of the Pool 8 project was constructed between April and October, 1992, resulting in a 1.5 mile long island (Boomerang Island) between river miles 685.3 and 687.1. The purpose of this project stage was to partially isolate the downstream backwater area from river flows and wave action. Phase 2 of the Pool 8 project involves rebuilding islands that have eroded. The primary project area, Stoddard Bay, is located on the east side of the river valley at river mile 686.0. The purpose of island construction in Stoddard Bay is to rebuild the Stoddard Islands, or island remnants (Figure 1), and improve conditions for backwater fish, waterfowl, and a variety of birds and animals that depend on island habitat. In addition to the Stoddard Bay portion of the project, seed islands will be constructed along the right descending side of the navigation channel in the reach between river miles 683 and 685. As the name implies, seed islands are small obstructions placed in the river that act as a starting point, or seed, that will lead to formation of a larger island through sediment accretion. The first section of this appendix presents information on the Stoddard Bay analysis. The second section covers the Seed Islands.

HYDRODYNAMIC MODEL

Hydrodynamic conditions in lower pool 8 were modeled using the two-dimensional computer model RMA-2V. Fast Tabs software was used to develop this model. The reach modeled extended from Lock and Dam 8 (River Mile 679.2) to just above Brownsville (River Mile 689.3). The upper half of the model grid is shown on Figure 2. Bathymetric data provided by the Environmental Management Technical Center was used for model geometry (Figure 3). Water surface

elevation data, which was available from the St. Paul District Water Control Center, was used to set downstream boundary conditions at Lock 8 and to calibrate the model to reproduce stages at Brownsville. Flow distribution across the floodplain was available from previous monitoring done by the St. Paul District Hydraulics Section. The model was calibrated so that water surface elevations and flow distributions across the entire floodplain matched dield data.
Because of model instabilities associated with shallow flow, certain conditions couldn't be simulated with the two-dimensional model. Included are shallow flows over the rock sills, and shallow flows over the islands during floods.

STODDARD BAY

EXISTING PHYSICAL CONDITIONS

The Stoddard Bay project area (Figure 4) is 474 acres in size, is 7,200 feet long from the upstream to the downstream end, and has a mean depth of 3.4 feet. The west boundary of the project area is defined by the Stoddard barrier island remnants. Flow enters Stoddard Bay across these remnants and at the upstream end of the bay. Based on aerial photo analysis, it is obvious that the barrier islands have eroded severely since inundation. Aerial photos also show that interior islands existed within Stoddard Bay. For this appendix, the project area will be subdivided into three subareas as shown on Figure 4. The geometric characteristics of each subarea are given in Table 1.

Table 1. Geometric Characteristics of Stoddard Bay Subareas.

Subarea	Average Depth (feet)	Area (acres)	Volume (cubic feet)
A	3.35	123	17,900,000
B	3.01	171	22,900,000
C	3.79	180	29,700,000

HYDROLOGY

DISCHARGE-DURATION, DISCHARGE-FREQUENCY, AVERAGE DISCHARGE

Discharge-duration information at Lock and Dam 8 on an annual basis and monthly basis is shown in Table 2. The discharge that

DAM8

YEARS 1959 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED DISCHARGE

FLOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
210000.				1.11									
207500.				1.20									
205000.				1.20									
202500.				1.39									0.11
200000.				1.57									0.13
197500.				1.67									0.14
195000.				1.67									0.14
192500.				1.85									0.15
190000.				1.85									0.15
187500.				1.85									0.16
185000.				2.04									0.18
182500.				2.13									0.18
180000.				2.13									0.18
177500.				2.13	0.27	0.28							0.22
175000.				2.31	0.45	0.37							0.27
172500.				2.31	0.54	0.37	0.18						0.28
170000.				2.31	0.63	0.46	0.18						0.30
167500.				2.59	0.63	0.46	0.27						0.33
165000.				2.78	0.63	0.46	0.36						0.35
162500.				3.06	0.72	0.56	0.45						0.40
160000.				3.24	0.90	0.56	0.54			0.18			0.46
157500.				3.61	0.90	0.56	0.54		0.19	0.27			0.50
155000.				3.70	0.99	0.65	0.63		0.19	0.36			0.54
152500.				3.80	0.99	0.65	0.63		0.28	0.36			0.56
150000.				4.07	1.08	0.74	0.72		0.28	0.45			0.61
147500.				4.35	1.08	0.74	0.72		0.28	0.45			0.63
145000.				4.35	1.16	0.74	0.81		0.37	0.54			0.66
142500.				4.54	1.25	0.74	0.81		0.37	0.54			0.69
140000.			0.36	4.81	1.25	0.74	0.90		0.37	0.54			0.75
137500.			0.54	5.09	1.25	0.74	0.99		0.37	0.63			0.80
135000.			0.63	5.28	1.34	0.74	1.08		0.37	0.63			0.84
132500.			0.72	5.56	1.43	0.74	1.43		0.46	0.63			0.91
130000.			0.90	5.93	1.52	0.74	1.61		0.46	0.72			0.99
127500.			0.99	6.39	1.52	0.83	1.70		0.46	0.72			1.05
125000.			1.25	6.85	1.52	0.83	1.79		0.46	0.72			1.12
122500.			1.34	7.41	2.15	0.83	1.79		0.46	0.81			1.23
120000.			1.52	7.78	2.42	0.83	1.88		0.46	0.81			1.31
117500.			1.61	8.52	3.05	0.83	1.88		0.46	0.81			1.43
115000.			1.61	9.35	3.76	0.83	1.88		0.46	0.90			1.57

Table 2 - Discharge-Duration at Lock and Dam 8

Table 2 (Continued) - Discharge-Duration at Lock and Dam 8

DAM8

YEARS 1959 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED DISCHARGE

FLOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
112500.			1.97	10.28	4.21	1.20	1.97		0.46	0.90			1.75
110000.			2.15	11.11	4.48	1.39	1.97		0.56	0.99			1.89
107500.			2.24	12.04	4.93	1.48	2.06		0.56	1.16			2.04
105000.			2.42	13.33	5.65	1.76	2.06		0.56	1.25			2.25
102500.			2.78	14.54	6.54	1.85	2.24		0.56	1.34			2.49
100000.			3.23	16.67	7.35	1.85	2.42		0.56	1.52			2.80
97500.			3.49	18.15	8.15	1.85	2.60	0.18	0.56	1.79			3.07
95000.			4.21	20.37	9.05	1.94	2.87	0.36	0.56	2.06			3.46
92500.			4.57	22.31	10.48	2.69	3.14	0.36	0.56	2.06			3.85
90000.			5.38	24.91	12.63	3.80	3.58	0.45	0.56	2.24			4.47
87500.			6.36	27.13	14.34	4.44	3.94	0.54	0.56	2.33			4.98
85000.			7.17	28.61	15.59	5.09	4.12	0.54	0.56	2.78	0.19		5.40
82500.			8.24	30.37	16.58	6.30	4.57	0.63	0.65	2.78	0.46		5.89
80000.			9.23	33.24	20.16	8.52	4.93	0.63	0.93	2.96	0.83		6.80
77500.			10.04	36.85	25.00	10.19	5.73	1.25	1.11	3.67	0.93		7.91
75000.		0.20	11.38	41.30	28.14	12.04	6.99	2.33	1.76	4.30	1.20		9.16
72500.		0.39	12.99	45.28	30.56	13.61	8.69	2.87	2.59	4.84	2.04		10.34
70000.		0.49	13.80	49.81	34.05	15.65	9.86	3.58	2.96	5.91	2.69		11.59
67500.		0.59	14.61	54.44	37.90	17.96	11.38	3.76	3.43	6.45	3.15		12.83
65000.		0.59	16.04	57.22	40.95	20.46	12.90	3.94	3.98	7.17	4.44	0.18	14.02
62500.		0.98	17.56	59.35	44.09	22.59	15.23	4.12	4.81	8.51	5.19	0.45	15.27
60000.		1.47	19.53	62.50	46.86	25.19	17.83	4.12	6.11	9.23	6.48	0.81	16.71
57500.		1.57	21.59	65.09	50.18	26.67	19.98	5.11	7.87	10.22	8.61	0.81	18.18
55000.		1.77	23.21	68.06	53.85	28.24	21.95	6.09	9.17	11.38	10.09	1.08	19.62
52500.		1.87	25.63	70.28	57.26	31.30	23.84	7.62	11.94	13.44	12.22	1.54	21.46
50000.		1.97	27.06	73.52	61.20	35.93	26.08	8.78	14.35	15.41	13.98	2.17	23.42
47500.		2.16	29.57	75.65	64.87	39.26	28.41	10.13	16.39	17.56	16.39	3.07	25.35
45000.		2.65	31.63	77.41	69.27	45.37	31.09	11.65	18.70	19.89	17.96	3.52	27.50
42500.		3.24	34.23	78.61	72.58	52.04	34.41	13.53	21.30	22.76	21.85	5.33	30.07
40000.	0.63	4.03	36.38	79.81	74.64	58.15	36.74	15.59	25.93	25.45	27.04	7.41	32.72
37500.	1.08	4.72	38.62	81.11	76.97	63.61	40.59	18.91	28.89	28.58	31.76	9.49	35.43
35000.	2.15	5.31	41.04	83.80	79.66	68.06	44.71	22.40	31.39	33.06	36.20	14.27	38.59
32500.	4.39	5.90	45.43	86.85	82.53	71.30	49.73	25.63	34.81	37.72	40.74	19.69	42.17
30000.	8.78	7.08	48.30	89.17	85.48	75.00	53.32	30.91	39.44	41.04	45.93	25.65	45.97
27500.	12.72	9.14	52.96	92.50	87.54	77.59	57.26	36.83	45.09	45.07	50.56	31.98	50.08
25000.	19.98	16.13	58.96	94.17	90.14	79.63	61.11	42.83	49.26	50.63	54.54	38.39	54.79
22500.	28.76	23.80	64.87	95.74	91.94	82.69	64.43	48.75	54.72	56.27	60.93	44.44	59.91
20000.	39.34	33.24	72.13	97.59	93.82	85.46	70.52	55.91	60.74	62.46	71.02	50.14	66.15
17500.	50.27	49.46	82.08	98.80	95.25	90.09	76.08	62.90	68.33	68.82	81.76	59.71	73.70

Table 2 (Continued) - Discharge-Duration at Lock and Dam 8

DAM8

YEARS 1959 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED DISCHARGE

FLOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
15000.	58.60	63.32	89.16	99.63	97.22	94.35	82.89	72.85	78.24	78.94	89.72	73.17	81.55
12500.	73.39	76.79	94.27	99.81	99.55	97.59	89.43	81.99	87.59	91.49	94.07	83.29	89.14
10000.	90.23	90.86	99.46	100.00	100.00	98.89	96.15	92.56	94.81	97.49	96.76	89.88	95.61
7500.	100.00	99.90	100.00	100.00	100.00	99.81	99.37	97.13	98.33	99.82	99.44	97.92	99.31
5000.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.91	99.99
2500.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
0.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

correspond to the 2, 5, 10, 50, 100, and 500 year floods is given in Table 3. The average discharge in the project area is approximately 34,900 cfs (cubic feet per second).

Table 3. Discharge - Frequency at Lock and Dam 8.

Time of Return (Years)	Discharge (cfs)
2	94,000
5	134,000
10	161,000
50	224,000
100	254,000
500	321,000

STAGE-DURATION

Stage-duration data at Lock and Dam 8 and at Brownsville on an annual and monthly basis is shown in Tables 4 and 5.

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

Information on discharge measurements collected in Pool 8 are contained in reference 3. Discharge data collected prior to Phase 1, Stage 2 (1987-92) and after (1993) are available. Sites where discharge measurements have been collected are shown on Figure 5. Site discharge is discussed as a percentage of total river discharge (or reference discharge) at the upstream or downstream lock and dam. To facilitate this discussion, the percentages given are for a reference discharge of 50,000 cfs unless stated otherwise. The accuracy of individual discharge measurements is discussed in reference 3. Usually the measured total river flow was within 10-percent of the calculated Lock and Dam flow.

The discharge at site 11/12 at the upstream end of Stoddard Bay, and at site 26 in lower Stoddard Bay is shown on Figures 6. The combined discharge through sites 11 and 12 for existing conditions is 4.8-percent of the total river discharge, with site 11 conveying 2.7-percent of the total and site 12 conveying 2.1-percent. Site 26 conveys 11.2-percent of the total river flow. The difference between the flow percentages at sites 26 and site

DAM8-POOL

YEARS 1970 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION

ELEV	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
635.00													
634.90													
634.80													
634.70						0.27							
634.60					0.13	0.53							
634.50					0.39	0.53	0.13						
634.40					0.39	0.53	0.13						
634.30					0.52	0.67	0.26						0.12
634.20					0.52	0.67	0.26						0.12
634.10					0.65	0.67	0.39						0.14
634.00					0.65	0.67	0.52						0.15
633.90					0.77	0.80	0.52						0.18
633.80				0.13	0.77	0.80	0.65						0.20
633.70				0.40	0.77	0.80	0.65						0.22
633.60				0.67	0.90	0.93	0.77		0.13				0.28
633.50				0.67	0.90	0.93	0.77		0.27	0.13			0.31
633.40				0.67	0.90	0.93	0.90		0.27	0.26			0.33
633.30				0.93	1.03	0.93	0.90		0.40	0.39			0.38
633.20				0.93	1.03	1.07	1.03		0.40	0.39			0.41
633.10				0.93	1.03	1.07	1.03		0.40	0.52			0.42
633.00				1.07	1.03	1.07	1.03		0.53	0.52			0.44
632.90				1.20	1.16	1.07	1.16		0.53	0.52			0.47
632.80			0.26	1.33	1.16	1.07	1.16		0.53	0.65			0.52
632.70			0.52	1.33	1.29	1.07	1.16		0.53	0.65			0.55
632.60			0.77	1.47	1.29	1.07	1.29		0.53	0.65			0.59
632.50			0.77	1.47	1.29	1.07	1.42		0.67	0.77			0.62
632.40			1.03	1.73	1.29	1.07	1.55		0.67	0.77			0.68
632.30			1.29	1.87	1.42	1.07	1.94		0.67	0.77			0.76
632.20			1.29	2.13	1.42	1.20	2.06		0.67	0.77			0.80
632.10			1.55	2.80	1.42	1.20	2.32		0.67	0.90			0.91
632.00			1.81	3.07	1.55	1.20	2.32		0.67	0.90			0.96
631.90			1.81	3.60	1.55	1.20	2.45		0.67	0.90			1.02
631.80			1.81	3.73	1.55	1.20	2.58		0.67	0.90			1.04
631.70			1.94	4.53	1.94	1.20	2.58		0.67	1.03			1.16
631.60			2.32	5.07	2.32	1.20	2.58		0.67	1.03			1.27
631.50			2.58	5.60	2.71	1.20	2.71		0.93	1.03	0.13		1.41
631.40			3.61	6.27	3.35	1.33	2.71	0.39	1.73	1.16	1.07		1.81
631.30			4.13	7.33	4.00	1.73	3.23	1.68	3.47	2.06	1.73	0.13	2.47
631.20			4.52	8.93	4.77	2.27	5.29	4.77	4.67	3.74	3.87	0.52	3.63

Table 4 - Stage-Duration at Lock and Dam 8

Table 4 (Continued) - Stage-Duration at Lock and Dam 8

DAM8-POOL

YEARS 1970 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION

ELEV	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
631.10	1.55		4.90	9.87	5.42	4.67	8.39	9.42	8.27	8.65	6.40	2.21	5.84
631.00	2.58	1.42	6.71	10.40	6.84	7.20	13.42	16.26	15.47	14.06	9.47	4.55	9.07
630.90	4.77	3.97	9.03	11.47	8.65	12.53	19.23	21.16	21.07	21.55	13.60	8.71	13.03
630.80	8.39	6.66	10.97	14.13	10.97	17.33	25.55	28.00	28.27	27.87	18.27	16.38	17.80
630.70	14.19	11.90	16.65	16.80	13.29	20.13	29.55	33.42	36.53	32.13	22.40	23.80	22.63
630.60	18.71	16.71	20.13	18.53	16.77	23.07	32.52	38.06	43.87	37.55	26.67	29.52	26.90
630.50	26.45	22.52	25.29	21.33	21.03	27.47	34.97	42.71	52.27	43.10	32.00	38.36	32.35
630.40	34.97	26.06	31.74	24.00	26.84	31.60	36.52	47.74	56.80	50.06	39.07	44.60	37.58
630.30	43.23	31.59	40.00	29.87	33.29	36.13	40.90	56.13	62.53	56.39	46.93	50.98	44.09
630.20	57.03	43.20	49.42	41.07	43.61	48.27	50.84	66.32	72.53	65.16	58.40	59.82	54.72
630.10	74.32	59.21	63.61	59.33	56.39	63.20	64.26	78.06	81.20	77.55	70.13	71.39	68.28
630.00	85.42	77.62	76.26	74.53	73.03	78.13	80.77	87.23	90.40	89.29	82.40	79.84	81.27
629.90	91.87	85.84	85.94	85.87	85.42	86.00	88.52	94.45	95.73	95.23	91.47	88.82	89.62
629.80	94.58	89.09	91.23	92.93	90.97	90.80	93.55	98.19	99.07	99.10	95.47	92.72	94.01
629.70	96.00	92.49	93.68	95.47	93.55	92.80	95.23	99.74	99.73	99.61	97.60	95.19	95.95
629.60	97.16	93.77	96.13	96.67	94.58	94.13	96.77	100.00	99.87	99.74	98.13	97.01	97.02
629.50	98.19	95.61	98.19	97.60	95.48	95.07	98.19	100.00	100.00	99.87	98.40	98.18	97.92
629.40	99.74	98.16	99.61	99.07	97.68	96.27	98.97	100.00	100.00	100.00	98.93	98.83	98.95
629.30	100.00	99.58	99.87	99.73	99.48	99.60	99.48	100.00	100.00	100.00	99.73	99.09	99.72
629.20	100.00	99.86	99.87	99.87	99.74	100.00	100.00	100.00	100.00	100.00	100.00	99.22	99.88
629.10	100.00	100.00	99.87	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.35	99.93
629.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.48	99.96

BRWM5

YEARS 1970 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION

ELEV	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
636.50													
636.40													
636.30						0.30							
636.20						0.60							
636.10					0.31	0.74	0.14						0.10
636.00					0.46	0.74	0.14						0.11
635.90					0.46	0.74	0.28						0.13
635.80					0.61	0.89	0.55						0.18
635.70				0.63	0.92	0.89	0.69						0.26
635.60				0.95	1.08	1.04	0.69						0.32
635.50				1.11	1.23	1.04	0.83		0.14				0.37
635.40				1.43	1.69	1.19	0.83		0.43	0.13			0.48
635.30				2.06	1.84	1.19	0.96		0.58	0.27			0.58
635.20				2.70	2.15	1.19	0.96		0.58	0.40			0.67
635.10				3.02	2.15	1.19	0.96		0.58	0.40			0.69
635.00				3.17	2.46	1.19	1.10		0.58	0.40			0.74
634.90				3.49	2.76	1.19	1.10		0.72	0.54			0.82
634.80				3.81	3.23	1.19	1.24		0.72	0.54			0.89
634.70				3.97	3.53	1.19	1.24		0.72	0.54			0.93
634.60			0.15	4.60	3.99	1.34	1.38		0.72	0.67			1.07
634.50			0.31	4.92	4.45	1.34	1.38		0.72	0.67			1.15
634.40			0.77	5.08	4.61	1.34	1.51		0.72	0.67			1.22
634.30			1.08	5.40	4.76	1.34	1.79		0.72	0.81			1.32
634.20			1.54	5.56	4.76	1.34	2.34		0.72	0.81			1.42
634.10			1.54	6.19	4.92	1.34	2.48		0.72	0.81			1.50
634.00			1.84	6.51	5.07	1.34	2.48		0.87	0.94			1.59
633.90			2.15	6.83	5.22	1.34	2.61		0.87	0.94			1.66
633.80			2.61	6.98	5.53	1.49	2.75		0.87	0.94			1.76
633.70			3.07	7.78	5.99	1.49	2.75		0.87	1.08			1.92
633.60			3.53	7.94	6.30	1.49	2.75		0.87	1.08			1.99
633.50			3.99	8.73	6.61	1.49	2.89		0.87	1.08			2.13
633.40			4.92	9.37	7.53	1.64	2.89		0.87	1.08			2.34
633.30			5.07	10.48	8.45	1.64	3.03		0.87	1.21			2.55
633.20			5.68	11.43	9.37	1.93	3.03		0.87	1.21			2.77
633.10			6.30	11.90	9.83	2.08	3.16		0.87	1.21			2.92
633.00			6.91	12.54	9.98	2.38	3.16		0.87	1.48			3.09
632.90			7.68	13.49	10.75	2.83	3.16		1.01	1.61	0.29		3.38
632.80			8.14	14.92	11.37	3.12	3.71		1.01	1.75	0.29		3.67
632.70			9.06	15.71	12.14	3.42	3.71	0.28	1.01	1.88	0.29		3.93

Table 5 - Stage-Duration at Brownsville

BRWM5

YEARS 1970 TO 1994

PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION

ELEV	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL YEAR
632.60	0.17		9.22	17.46	14.29	4.02	4.26	0.69	1.01	2.02	0.44		4.44
632.50	0.17		10.14	18.73	15.98	4.61	4.68	0.83	1.01	2.28	0.58		4.89
632.40	0.34		11.06	21.11	17.20	5.51	4.95	1.24	1.45	3.09	0.58	0.67	5.57
632.30	0.85	0.17	12.44	22.38	18.28	6.55	5.50	1.24	1.45	3.36	0.87	1.68	6.19
632.20	1.37	0.17	14.59	25.56	19.66	7.59	6.33	1.52	1.45	3.90	1.45	2.01	7.08
632.10	1.88	1.21	17.51	26.98	22.89	8.33	8.12	1.66	1.88	4.03	1.89	2.35	8.17
632.00	2.56	1.21	20.43	31.11	26.73	9.97	10.87	2.07	2.03	4.57	2.03	2.85	9.64
631.90	3.08	1.73	23.81	36.19	29.19	12.50	12.24	3.04	2.61	5.51	2.33	3.69	11.25
631.80	3.59	2.60	25.96	40.79	31.80	14.43	14.44	4.42	4.06	6.32	2.76	4.36	12.89
631.70	4.96	4.16	28.26	45.87	35.33	17.41	16.64	6.08	4.93	7.66	3.49	5.03	14.91
631.60	5.30	6.07	30.72	51.75	39.02	20.09	18.71	7.32	8.41	10.08	5.38	6.20	17.35
631.50	5.30	8.49	35.33	58.73	44.24	24.11	22.56	9.25	11.01	12.63	8.14	8.38	20.63
631.40	6.15	10.75	40.86	65.87	49.31	30.95	27.51	14.36	16.96	15.19	12.21	12.73	25.23
631.30	11.11	13.69	48.39	69.68	53.76	39.14	32.74	23.48	24.64	22.45	18.31	17.92	31.36
631.20	20.00	18.54	55.15	74.60	59.91	48.21	43.60	32.60	33.33	33.33	28.20	22.95	39.43
631.10	36.41	25.65	60.98	79.21	68.05	58.48	53.23	42.68	46.23	45.16	39.53	33.17	49.32
631.00	43.93	37.61	66.36	83.02	75.12	69.94	64.79	52.35	59.42	58.33	47.38	44.39	58.88
630.90	53.33	48.70	71.12	88.89	80.80	79.02	73.18	65.47	72.32	69.49	60.47	58.79	68.83
630.80	60.00	59.97	77.73	92.38	86.79	85.71	79.09	75.97	80.29	79.17	76.60	70.35	77.38
630.70	77.78	74.18	85.87	95.24	92.32	88.54	83.63	87.57	87.54	86.83	89.97	77.55	85.84
630.60	88.38	82.50	92.17	97.14	95.08	91.82	87.76	94.75	94.78	93.55	95.78	84.92	91.75
630.50	97.44	88.39	96.01	98.10	97.08	94.64	92.30	97.93	97.39	96.77	97.82	90.62	95.48
630.40	98.97	92.89	96.62	98.25	99.39	96.73	94.50	98.90	99.13	99.33	99.27	95.48	97.52
630.30	99.83	96.19	98.00	98.41	99.54	98.81	96.42	99.45	99.86	100.00	100.00	97.65	98.71
630.20	100.00	96.88	98.77	99.05	99.85	99.40	97.66	99.59	100.00	100.00	100.00	98.83	99.19
630.10	100.00	97.92	99.08	99.05	100.00	99.70	98.49	100.00	100.00	100.00	100.00	99.66	99.51
630.00	100.00	100.00	99.69	100.00	100.00	100.00	99.45	100.00	100.00	100.00	100.00	100.00	99.92
629.90	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.80	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.70	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.60	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.50	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.40	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.30	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.20	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.10	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
629.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 5 (Continued) - Stage-Duration at Brownsville

11/12, 6.4-percent, equals the inflow over the Stoddard barrier island remnants.

STAGE-DISCHARGE

The plan of operation of Lock and Dam 8 is discussed in detail in the Lock and Dam 8 operation manual and is briefly described here.

Elevation 631.0 (all elevations given in this appendix are NGVD, 1912 adjustment) is maintained at LaCrosse, Wisconsin, the primary control point for Pool 8 until the total river discharge exceeds 23,000 cfs. At this discharge, the maximum drawdown of the pool at the dam, one foot to elevation 630.0, is reached, and control of the pool is shifted to secondary control at the dam. As total river discharge exceeds 23,000 cfs, the pool level at the dam is held at elevation 630.0, and the stage at all other points in the pool is allowed to rise. At a total river discharge of 95,000 cfs the gates at Lock and Dam 8 are raised out of the water. As discharges increase above 95,000 cfs open river conditions exist and the dam is out of control. On the recession, the gates are returned to the water when the pool at the dam drops to elevation 630.0, which occurs at a discharge of approximately 95,000 cfs. Elevation 630.0 is maintained at the dam until the water level at Genoa drops to project pool, elevation 631.0, which occurs at a discharge of approximately 23,000 cfs. The lock miter gates are never used for regulating the discharge. When the pool level is above Elevation 634.0, the lock gate operating motors must be removed, and the upper miter gates are kept in the closed position while the lock is out of operation.

Figure 7 shows the stage-discharge curves for Lock and Dam 8, Brownsville, and the Phase 2 project area (see curves for upper and lower rock sill) based on model results.

FLOW VELOCITIES

Stoddard Bay depth averaged velocities for a low flow condition of 20,000 cfs and for the 5-year flood condition of 134,000 cfs are shown on figures 8 and 9. These velocities were simulated by the two-dimensional hydrodynamic model. For low flow conditions, the average velocity was 0.2 fps (feet per second) or 6 cm/s (centimeters per second) and the velocity range was 0.06 to 0.26 fps (2 to 8 cm/s). For high flow conditions, the average velocity was 1.2 fps (37 cm/s) and the velocity range was 0.8 to 1.8 fps (24 to 55 cm/s)

HYDRAULIC RESIDENCE TIME

The hydraulic residence time in Stoddard Bay for existing conditions is given in Table 6.

Table 6. Hydraulic Residence Time in Stoddard Bay for Existing Conditions.

Miss. R. Disch. (cfs)	Volume (ft3)	Inflow (cfs)	Hydraulic Residence Time (days)
20,000	55,014,000	2150	0.30
32,500	61,415,000	3300	0.22
70,000	83,301,000	9500	0.10
94,000	98,580,000	17700	0.06
134,000	131,616,000	26100	0.06
161,000	158,045,000	33600	0.05

WAVE ACTION

Conditions on Mississippi River backwaters typically result in transitional wave conditions (ie. wave height is affected by water depth). The wave characteristics of height, length, and period can be determined using methods in the 1984 Shore Protection Manual and the maximum orbital wave velocity (Um) at the bottom due to wave action will be determined using the following equation.

$$Um = \frac{3.14 * H}{T * \sinh (2 * 3.14 * d/L)}$$

Um = maximum orbital wave velocity at bottom (fps, feet per second)
H = wave height in transitional water depths (feet)
T = wave period in transitional water depths (seconds)
L = wave length (feet)
d = local water depth (feet)

As an example, consider subarea B, located at roughly the midpoint of Stoddard Bay. Wave characteristics were determined for a constant wind speed of 25 mph (miles per hour), for water depths of 3, 4, and 5 feet, and for fetches of 11,000 feet (representative of southerly wind fetches) and 4,000 feet (representative of

northerly wind fetches). Table 7 lists wave height and bottom velocity for these conditions. The 25 mph wind speed doesn't represent a maximum wind speed, however based on wind data from meteorological stations at La Crosse, Wisconsin and Rochester, Minnesota, it exceeds 95-percent of the recorded wind speeds. The 3, 4, and 5 foot water depths are typical of this subarea. Some simplifying assumptions, such as no frictional effects from aquatic vegetation, no influence of river flow, and constant water depths for wave growth were made.

Table 7. Analytical Pridictions of Wave Characteristics on the Stoddard Bay.

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Maximum Orbital Velocity at Bottom (fps)
Existing Conditions				
11,000	S	3	0.84	0.88
	S	4	0.96	0.74
	S	5	1.05	0.62
4,000	N	3	0.67	0.46
	N	4	0.70	0.28
	N	5	0.73	0.19

In the 3 to 5 foot water depths that exist in this area, maximum bottom velocity due to wave action from south winds range from 0.88 to 0.62 fps. Modeled depth averaged velocities in the project area (see Figures 8 and 9) averaged 0.2 fps for low flow conditions to 1.2 fps for the 10-year flood. In other words, the orbital wave velocity for a 25 mph wind from the south is greater than the average water velocity due to river currents during low flow conditions and approaches those velocities produced during flood events. If a bottom velocity could be extracted from the depth averaged velocity, this comparison would be even closer. The existing barrier island remnants limit wind fetches from the north and west. The 4,000 foot fetch in subarea B, limits velocities generated by north winds to less than half the magnitude of those generated by south winds.

SEDIMENT TRANSPORT

DEPOSITION/EROSION

Bathymetric data collected in 1990/91 by the EMTC (Environmental Management Technical Center) and topographic information from the 1932 flowage easement surveys (Figure 10) was compared to determine deposition/erosion patterns in Stoddard Bay (Figure 11). Table 8 summarizes this comparison.

Table 8. Stoddard Bay, Pool 8, Deposition and Erosion.

1932-91	yd3	acre-ft	yd3/yr	in/yr	cm/yr	acres
Deposition	1,109,000	688	18,800	0.31	0.79	446
Erosion	616,000	382	10,400	0.42	1.07	185
Net	493,000	306	8,400	0.10	0.25	642
Absolute	1,725,000	1,070	29,200	0.34	0.86	642

The following conclusions can be drawn based on this comparison.

- The aerial distribution of deposition and erosion is 70-percent and 30-percent respectively.

- The maximum deposition and erosion amounts were 3 feet and in excess of 5 feet respectively.

- The net result was deposition of 0.1 inches/yr.

- Deposition can't be categorized by depth.

- Two types of erosion appear to be taking place, river current erosion resulting in channel formation, and wave erosion of most of the interior islands or high spots on the 1932 bathymetry

- The deposition/erosion patterns and good bathymetric diversity in Stoddard Bay suggest that wind isn't as significant a factor as it is in other larger backwaters. The north/south orientation of the bay and existence of islands or island remnants on the north and west sides may decrease the severity of the predominant NW/SE winds in this area.

- Deposition at barrier island remnants is significant, indicating sediment entering here.

SEDIMENT TYPES

The majority of surface sediments found in Stoddard Bay are silts and clays (d < 0.062 mm). The only exceptions to this are sands found in the SE corner of the project area and along parts of the remnant islands. Fine sands were found mixed in with silts and clays at the upstream end of the project. The sand along the barrier islands is probably from the barrier islands themselves and doesn't represent sand transport into Stoddard Bay. In the southeast corner erosion has occured (Figure 11) and the sands found there probably represent historical deposits that have been exposed. Lack of significant sands,especially at site 11/12, is due to lack of a significant external sand source. Sources of data on sediment types in Stoddard Bay are summarized below:

- McHenry (1978) did particle size analysis in Stoddard Bay and found less than 4-percent sand in the upper 20 cm of sediment. Using the average material composition of the samples in the McHenry Study, the specific weight of Stoddard Bay sediments was calculated to be 47 pcf (pounds per cubic foot)

- USCOE surface sediment samples collected along transects done for discharge measurements at sites 11/12 and 26. Field classification of samples indicated primarily fine sediments of various degrees of cohesiveness. USCOE field reconnaissance near the barrier island remnants indicate surficial sand deposits.

- USCOE borings done for the project (see Geotechnical Appendix).

- WDNR surface probes in Stoddard Bay (see Geotech Appendix borings ST01 through ST-15)

- EMTC sediment investigations in Stoddard Bay including penetrometer data, bulk density, and moisture content throughout the project area. Laboratory analysis of sediment samples is still required.

SEDIMENT LOAD

The annual suspended sediment load to Stoddard bay for existing conditions is 184,000 tons. This was determined by integrating the Stoddard Bay discharge relationship at site 26 with the sediment discharge relationship from the USGS gage at Winona (Reference 7). The USGS gage has a 7 year sediment sampling period (1974 to 1981).

TRAP EFFICIENCY

Net deposition in Stoddard Bay based on the GIS analysis is 8,400 yd3/yr. Using the specific weight of sediment of 47 pcf that McHenry found, the weight of sediment deposited annually is 5,300 tons/year. If the assumption is made that throughout time the annual deposition and sediment loads have been constant, then comparing this deposition to the sediment load of 184,000 tons per year gives a trap efficiency of 2.9 percent. If the specific weight of the sediment was 70 lbs/ft3 (corresponding to 100-percent silt), the net deposition would be 7,900 tons/year, resulting in a trap efficiency of 4.6-percent. Either way, the trap efficiency of Stoddard Bay is relatively low.

SEDIMENT RESUSPENSION BY WAVES

Since one of the primary hydrodynamic processes acting on backwaters is wind driven wave action, it is desirable to quantify this effect on the project area, especially on sediment resuspension. A common model method involves determining if ambient shear stresses on the sediment due to orbital wave velocities exceed a calibrated or experimentally determined critical shear stress for erosion. The bottom shear stress is determined using the following equation:

$$Tb = rho * fw * Um^2 / 2$$

Tb = bottom shear stress, psf (pounds per square foot)
Um = maximum orbital wave velocity at bottom,
rho = water density (assume 1.94 slugs per cubic feet)
fw = bottom friction factor (assume fw= 0.032, or n = .02)

The critical shear stress for erosion is defined as the shear stress above which resuspension of sediment particles begins and is a function of physical and chemical sediment properties. Values of critical shear stress for erosion found in the literature, vary significantly. For Mississippi River backwaters a critical shear stress of 0.01 psf is reasonable. Table 9 is a continuation of Table 7 (Hydrodynamics Section), which was developed for subarea B in Stoddard Bay, with a column added for bottom shear stress.

Table 9. Analytical Predictions of Wind Driven Wave Effects on the Project Area.

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Maximum Orbital Velocity at Bottom (fps)	Maximum Bottom Shear Stress (psf)
Existing Conditions					
11,000	S	3	0.84	0.88	0.024
	S	4	0.96	0.74	0.017
	S	5	1.05	0.62	0.012
4,000	N	3	0.67	0.46	0.0066
	N	4	0.70	0.28	0.0023
	N	5	0.73	0.19	0.0011

In the 3 to 5 foot water depths that exist in subarea B, maximum bottom shear stress due to wave action generated by south winds ranges from 0.012 to 0.024 psf respectively. Comparing the bottom shear stresses to critical bottom shear stresses indicates that the potential for resuspension of bottom sediments is great. Winds from the north aren't as big a factor, due to the shorter wind fetches. While one of the conclusions in the erosion/deposition section was that wave action in Stoddard Bay didn't appear to be as significant a factor as in other backwater areas, this analysis indicates that sheltering of the project area from wave action from southerly directions is needed.

PREVIOUS ISLAND DESIGN AND CONSTRUCTION EXPERIENCE (Pool 8, Phase 1)

Phase 1 of the pool 8 island project provided valuable design and construction experience and was the starting point for the phase 2 design. The typical island cross section developed as part of Phase 1 is shown on Figure 12. A summary of this experience follows.

ISLAND TOP ELEVATIONS

As part of the Phase 1 study, the elvation and stability of existing islands was investigated through field reconnaissance, aerial photo analysis, comparison of historic and recent

topographic information, and analysis of dredge material placement site stability. From these investigations it was determined that islands in lower pools 7, 8, and 9 that are relatively stable, typically have elevations 4 feet or more over average water surface elevations. Islands that have been severely eroded had top elevations less than 3 feet over the average water surface elevation. Examples of stable islands in lower pool 8 include:

- Dredge material islands created as part of navigation channel maintenance dredging. Most notable among these is an island created in 1967 on the west side of the navigation channel between RM 687.0 and 687.4 (Figure 1). This island is of particular interest because of the similarities between it and the proposed islands. Material at this site was placed to an elevation of 4 to 5 feet over average water surface elevation and this has remained stable over the last 22 years.

- Turtle Island (Figure 1), which is another dredge material placement site, has top elevations greater than 5 feet over the average water surface. Examination of 1973 and 1984 aerial photos of Turtle island show minimal change in shoreline position during this period.

- The original barrier islands that had top elevations of 4 feet or more over average water surface elevations have lasted longer than lower islands. Examples of this include Horshoe Island and the islands at the upstream end of Stoddard Bay.

Examples of unstable islands include most of the islands in lower pool 8 that have eroded since Lock and Dam construction (Figure 13). Most of these islands were less than three feet over the average water surface elevation.

The final design elevations chosen for phase 1 were 635.0 for Horshoe Island (the upstream island in Phase 1) and 634.8 for Boomerang Island (the downstream island in Phase 1). Both elevations are approximately 4.5 feet over average water surface elevations and correspond to a flood with a 10-percent chance of occurrence (10-year flood). These elevations were chosen because of the island stability analysis described above and because one of the objectives was to reduce 75-percent of the main channel flow into the project area for conditions up to the 10-year flood flow. In addition, Grassy Island (downstream of Boomerang Island) was constructed with a top elevation of 633.0. This elevation corresponds approximately to a flood with a 20-percent chance of occurrence (5-year flood).

The primary constructability constraint was that at least a three foot base of coarse aggregate was needed for heavy equipment operation. This was a concern of the contractor prior

to phase 1, stage 2 construction, however no problems were encountered.

ISLAND WIDTHS

The top width of an island affects hydraulics, sediment transport, and stability as follows:

- a wider island with vegetation on it, will resist flow to a greater extent and reduce the flow rate over the island during a flood.

- the hydraulic slope, flow velocity, and potential for erosion decrease with increased island width. In fact, a well vegetated island may actually trap sediment during a flood.

- a wider island will last longer given a constant erosion rate.

Top and base widths used in Phase 1 of the Pool 8 HREP are listed in Table 10.

Table 10. Island Widths, Phase 1 of the Pool 8 Island Project.

Island	Top Width	Base Width	Reach Length
Horseshoe	50	150 -200	2,125 foot reach from head of island extending down each leg
Horseshoe	75	150 -200	775 foot reach on west leg
Horseshoe	30	120	550 foot reach on west leg
Boomerang	50	100 -150	8,175 foot reach
Boomerang	30	70	570 foot reach constructed on existing island.
Grassy	30 -150	60 - 180	900 feet

Note: 1. Base width is the estimated total width at the bottom.

From a constructability standpoint a 100-foot base width was the lower limit at which the contractor could place material with the 12-inch to 16-inch hydraulic dredges used on Phase 1, Stage 2. Narrower widths may require significant berming to contain the dredge plume. The 75 foot top widths (140 to 180 foot base widths) at Horshoe Island are a result of the wider outfall plume created by the 20-inch dredge used for this job. The section of Boomerang Island with a 30-foot topwidth and all of Grassy Island were constructed using mechanical placement of material.

ISLAND SIDE SLOPES

The side slopes of the islands were set at 1V:5H except in reaches where rock revetment was being used. The main reason for this was to reduce rill erosion due to rainfall runoff. This was a problem at previous island projects where steeper slopes were used. Also, guidance on habitat projects suggests that flatter slopes are beneficial for wildlife. (Reference 9)

SHORELINE STABILIZATION

Shoreline stabilization used on the Phase 1 project fell into 3 general categories; rock revetments, biotechnical, rock/biotechnical combinations. The rock revetments consisted of an 18 inch layer of rock above water and a 27 inch layer of rock below water. Revetment was used on shorelines exposed to significant flow velocities and on convex shorelines such as island tips.

On shoreline reaches where rock revetment wasn't used, biotechnical or rock/biotechnical stabilization was used. These techniques involve construction of a a 20 to 30 foot wide berm. The design elevations of the berm were 0.5 feet over the average water surface elevation at the shoreline/water interface to 2.0 feet over the average water surface elevation at the back of the berm (Figure 12). In all cases, Willows were planted near the back of the berm for stabilization purposes. The berm design was developed based on field reconnaissance of previously constructed projects and of dredge material placement sites. A characteristic frequently observed at these sites was that a stable earth surface near the average water surface resulted in good growth of woody and grassy vegetation.

On reaches exposed to significant wave action, 30 foot long groins were placed at 180 foot intervals to stabilize the berms. The groins had a 3 foot top width and 1V:1.5H side slopes. Table 11 lists the function of each component of the rock/biotechnical design.

Table 11. Rock/Biotechnical Stabilization Components.

COMPONENT	FUNCTION
Groin	Stabilize berm
Berm	Function 1 - Provide sand for beach formation Function 2 - Provide substrate for woody vegetation growth Function 3 - Provide diverse habitats
Willows	Stabilize Island

POSTPROJECT OBSERVATIONS

Postproject cross Sections of Horseshoe and Boomerang Island are shown on Figures 14, 15, 16. The flood of 1993 offered an excellent test of island stability. Horeshoe Island was overtopped in several low reaches, Boomerang Island was overtopped by 0.25 to 1.0 feet, and Grassy Island had 2 to 3 feet of water over it. During this flood, several episodes of strong winds occurred with one event having sustained winds in excess of 40 mph. Boomerang and Grassy Island had been constructed in 1992 and had just been seeded a few weeks prior to the flood. Based on this experience, several conclusions can be drawn.

a. The island design used in Phase 1 results in stable islands and should be used as a starting point for designing Phase 2.

b. Lower top elevations can be considered based on the stability of Grassy Island.

c. Narrower top widths should be considered. None of the islands suffered serious damage from being overtopped.

d. The rock size and revetment design performed well. A few rocks were displaced due to the storm event that produced the 40 mph sustained winds at the peak of the flood, but the damage was minimal.

e. Terminal groins were used at the end of revetments. During the extreme storm event, the movement of waves around these groins caused extreme erosion. The design of these should be modified based on this fact.

In addition to the lessons learned from the 1993 Flood, other lessons learned, include:

f. The berms were designed with variable elevations in an effort to provide more diverse island habitat. Wave action and higher than normal water during construction immediately reshaped these berms. In the future, enough sand should be provided in a horizontal berm so that it will function as stated in Table 11 and the shaping of it will be left to the river.

g. The 1V:5H side slopes appear to have eliminated the rill erosion problem that had occurred on other island projects where steeper side slopes were used.

h. The berm/willow design resulted in a stable shoreline. By 1995, willow growth on the island had spread from the water line

to almost the top of the island, providing a 20 to 30 foot swath of willows. Because of this, it is likely that sediment will be trapped on the island during the next flood, rather than erosion occurring.

i. Groins should be used if prevailing winds will result in littoral drift predominantly in one direction. The groin length/spacing ratio of 1:6 appears to have successfully stabilized the berms. There is some evidence of drift around the ends of the groins, but this should stabilize over time. The groin cross section has held up under the wave and ice forces in this area.

STODDARD BAY GOALS, OBJECTIVES, CRITERIA

The Pool 8 Islands, Phase 1 design provides a starting point for Phase 2. Design changes will be considered based on construction experince and post project monitoring. But first, the three goals for phase 2 will be considered. These goals and the objectives or criteria associated with each goal that affect hydraulic design, are listed in the following tables.

Table 12. Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 1.

Goal 1 : Improve habitat conditions for backwater fish species with an emphasis on habitat for Centrarchids.

Objective/Criteria	Design Feature Affected
Create 200 acre winter fishery	Island length > 7,300 feet
Winter D.O. > 3 mg/L	Low flow channel needed
Winter Current Velocity < 0.3 fps.	Inflows must be decreased. 50 cfs is max flow in winter
Water depths > 4 feet in 40% of area in year 25	To maintain deep water, need sills and interior islands.
Summer D.O. > 5 mg/L	Low flow channel needed
Create 15 ac.spawning, rearing, juvenile Centrarchid habitat.	Shallow, protected, sand shorelines needed.

Table 13. Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 2.

Goal 2: Increase high quality waterfowl habitat to 600 acres and then maintain

Objective/Criteria	Design Feature Affected
Create 600 acres waterfowl habitat	Island length > 9,450 feet
Aquatic plants in 60-percent of area	Amount of shallow habitat protected by barrier and interior islands
Create 2-3 acres of nesting habitat	Build nesting island. Top elev. interior islands.
6 acres of beaches mudflats and logs for loafing	Island cross section. Berms needed.

Table 14. Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 3.

Goal 3: Create habitat for migratory birds other than waterfowl (Neotropical migrants, marsh and water birds, and shorebirds); increase turtle nesting habitat; restore habitat for mammals (primarily beaver, mink, and muskrats), reptiles, and amphibians; and improve conditions for the reestablishment of roosting habitat for species such as bald eagles, peregrine falcons,and other raptors.

Objective/Criteria	Design Feature Affected
Neotropical migrant habitat including woodland/grassland	Island width must be 50 feet to create forest interior Island elev. is function of desired tree species. 2 feet over ave. water is min. Plan for succession.
Marsh and water birds	Shorelines must provide shallow littoral zones
Shorebirds	Gradually sloping beaches
Nesting turtles need isolated island with flat slope, sparse vegetation.	Island elevation, topsoil and seeding not needed.
Trees for Raptors	Island width and height as it affects tree growth

STODDARD BAY HYDRAULIC DESIGN FACTORS

In addition to the goals/objectives/criteria, various opportunities and constraints were considered in the hydraulic design. These will be referred to as hydraulic design factors and are listed below.

1. The project should work with and enhance the sediment transport regime, controlling the location of deposition and erosion zones. Sediment deposition has been the dominant process affecting Stoddard Bay, yet only 3-percent of the average annual sediment load entering Stoddard Bay has been trapped. While the project obviously is going to reduce water inflows and subsequently sediment loads, this will also result in increased trap efficiency. The channels that currently traverse the length of Stoddard Bay, have formed since inundation due to erosion. It is desireable to maintain this erosion process, so that these channels don't fill in over time.

2. Island position and orientation is often a function of local bathymetry and aquatic habitat, however if possible islands should be oriented based on flow directions in the project area and prevailing wind directions. An island oriented with its long axis perpendicular to the dominant flow direction will result in the largest sheltered area downstream of the island. An island oriented with its long axis perpendicular to prevailing wind directions will maximize the area of reduced wave energy. At Stoddard Bay, barrier islands should be positioned as far west as practical to maximize sheltered areas.

3. The project area should be chosen so that the greatest chance of project success is possible. Since one of the goals is to enhance aquatic vegetation growth, islands should target shallower areas where this growth is more likely to occur.

4. The physical geometry of Stoddard bay, and the existing bathymetric diversity suggest that wave action isn't as big a factor as in other backwater areas. Nevertheless, south winds are significant and could cause sediment resuspension in shallow areas due to wave action. This potential sediment resuspension should be minimized.

5. Ice forces near the upstream end of the project are severe based on observations by people familiar with this area.

6. Rock Islands or structures should be placed at a lower elevation than sand islands to act as overflow spillways and

reduce head differentials across sand islands when they are overtopped.

7. Generally islands should decrease in elevation in the downtream direction so that overtopping begins at the downstream end where the hydraulic forces are less.

8. The combination of height and width should be such that the activities of burrowing animals doesn't result in continuous pathways for water conveyance through the islands. A minimum top width of 30 feet should be used.

9. Because of the increased hydraulic residence time, the impacts on water quality is a concern during the summer.

10. Islands should be constructed in shallow water for shoreline stability. The shallow water area sheltered by the island is more likely to be stable also.

11. Island side slopes should be 1V:5H or flatter to minimize rill erosion from local runoff.

STODDARD BAY DESIGN

The Stoddard Bay design is based on:

- Phase 1 design/experience/monitoring
- Goals/Objectives/Criteria
- Hydraulic Design Factors
- Other design factors.

Other design factors include: economics, constructability, and aesthetics. Access to the proposed island sites is one of the most important cost and constructability factors. If possible, islands should be positioned near natural channels or deep areas to provide equipment access.

ISLAND LAYOUT

A plan view of the proposed design Plan G) is shown on Figure 17. Barrier islands A, B, and C follow the existing island remnants to optimize stability (foundation and shoreline) and costs. In reaches where there are existing island remnants, the remnants will be incorporated into the proposed barrier islands, to preserve the integrity of the remnants and to enhance the quality of the new island. The barrier island layout was based on the following goals/objectives/criteria:

- create 200 acres of fish habitat

- create 600 acres of waterfowl habitat
- create 15 acres of shallow spawning habitat

The barrier island locations are based on the following hydraulic design factors:

- Construct on existing island remnants to decrease costs and increase stability.

- Position the islands as far west as possible, while staying on the barrier island remnants. This increases the total area sheltered, will increase the area of shallow littoral habitat on the sheltered side of the islands, and improve access to the islands from the navigation channel.

The interior islands are designed to train flood flows to channels and to reduce wave action. Islands D1 and D2 serve a dual purpose as flow training structures and to reduce wave action. Islands E1 and E2 mainly train flows to channels. Island E1 provides more benefit from a wave protection standpoint than E2 but island E2 provides more benefit from a flow training standpoint. The layout of the interior islands is based on the following goals/objectives/criteria:

- water depths greater than 4 feet in 40-percent of area in year 25.
- create 15 acres of shallow spawning habitat
- aquatic plants in 60-percent of area

Interior island layout is based on the following hydraulic design factors:

- Enhance sediment transport regime. Interior islands act as training structures
- place perpindecular to flows and prevailing winds to shelter maximum area
- place towards d/s end of mud flats to shelter shallow area
- shallow areas for cost and stability
- decrease wave action
- construct in shallow water for shoreline stability

ISLAND CROSS SECTION

The basic island cross section is shown on Figure 18. Dimensions for the island cross sections are given in Table 15.

Table 15. Island Cross Section Dimensions, Stoddard Bay.

Island	a	b	c	d	e	Top Elev.	Berm Elev.	f	
			(feet)			(NGVD, 1912 adj)			
A	30	12.5	50	12.5	30	635.0	632.5	135	
B	20	7.5	30	7.5	30	634.0	632.5	95	
C	30	5.0	30	5.0	30	633.5	632.5	100	**
D1	20	12.5	30	12.5	30	634.0	632.5	105	
D2	20	12.5	30	12.5	30	635.0	632.5	105	
E1	20	12.5	30	12.5	30	635.0	632.5	105	
E2	20	12.5	30	12.5	30	635.0	632.5	105	

a = most sheltered side berm width
b = side slope
c = top width
d = side slope
e = least sheltered side berm width
f = total width
Note: ** The lower 1,000 feet of island C will have a top elevation of 633.0

The major change is in the reduced top width and elevation. These reductions were based on the performance of the Phase 1 islands during the 1993 flood, economics, and creating habitat diversity. The berm design is similar to that used in Phase 1 of the pool 8 project, except that a horizontal berm rather than a gradually sloping berm is being proposed.

ISLAND TOP ELEVATION

Island Top Elevations were based on the following goals/objectives/criteria:

- Create 600 acres of waterfowl habitat
- Neotropical migrant habitat
- Nesting turtle habitat
- Raptor habitat.

Island top elevations were based on the following hydraulic design factors:

- Rock structures must be at a lower elevation than sand islands.
- Island elevation should decrease in the downstream direction.

ISLAND WIDTHS

Island widths were based on the following goals/objectives/criteria:

- Neotropical migrant habitat

Island widths were based on the following hydraulic design factors

- The width should be such that the activities of burrowing animals doesn't result in continuous pathways for water conveyance through the islands.

ISLAND SIDE SLOPES

Island side slopes were based on the following goals/objectives/criteria:

- Nesting turtles

The only hydraulic design factor affecting island side slope was that slopes should be 1V:5H or flatter to minimize rill erosion due to local runoff.

SHORELINE STABILIZATION

Shoreline stabilization used in Stoddard Bay falls into 3 general categories; rock revetments, biotechnical, rock/biotechnical combinations. The rock revetments will consist of 24 inch layer of rock on a 1V:3H slope. Revetment will be used on shorelines exposed to significant flow velocities and on convex shorelines such as island tips. On shoreline reaches where rock revetment isn't used, the stabilization technique will involve construction of a 30 foot wide berm. The design elevations of the berm will be 632.5, 2.0 feet over the average water surface elevation (Figure 18). In all cases, willows will be planted near the back of the berm for stabilization purposes. On reaches exposed to significant erosive forces (waves and river currents), 30 foot long groins will be placed at 180 foot intervals to stabilize the berms. Figure 17 shows the location of groins. Table 16 provides dimensions of groins and revetments

Table 16. Rock Stabilization Dimensions.

Rock Feature	Top Elev. (1912 adj)	Top Width (feet)	Side Slope	Length (feet)
Groins	632.5	3	1:1.5	30
Revetment	Top of Island	-	1:3	-

ROCK SIZE

The rock thickness for revetments was set at 24-inches. The 24-inch layer thickness is greater than the 18-inch thickness used in Phase 1 because of the more significant wind fetches and wave action. River currents weren't as significant as waves. The maximum velocity over the rock sills is approximately 4 fps. Propeller wash from tow boats isn't a factor at any of the sites. The increase in revetment size as compared to the 18-inch thick layer used in Phase 1, doesn't significantly affect cost since, rock revetments account for only a small fraction of the total rock required for this project.

ROCK SILLS

The bathymetry analysis for Stoddard Bay indicated that many of the channels that exist now had formed since inundation, apparently due to scour during flood events. To maintain these natural riverine processes, two rock sills are being designed to allow flood flows into Stoddard Bay. These sills serve the dual function of decreasing the head differential across the sand islands during overtopping events. The dimensions of the rock sills are given in Table 17.

Table 17. Rock Sill Dimensions.

Rock Feature	Top Elev. (1912 adj)	Top Width (feet)	Side Slope	Length (feet)
Rock Sill A	632.00	15	1:4 u/s side 1:2 d/s side	1500
Rock Sill B	631.75	15	1:4 u/s side 1:2 d/s side	1300

LAYOUT

Two rock sills were required to achieve desired flow

patterns and velocity magnitudes in Stoddard Bay in Stoddard Bay during flood events (Figure 14). Rock sill A was located at the upstream end to increase velocities there. Rock sill B is at the midpoint to increase flow in the middle and lower Stoddard Bay. The existing island remnants upstream of Sill B prevents moving sill B upstream any further.

Goals/Objectives/Criteria considered include:

- Water depths greater than 4 feet in 40-percent of area in year 25 is desired.

Hydraulic Design Factors considered include:

- Enhance the sediment transport regime and increase flood scour.

TOP ELEVATIONS

In choosing a sill elevation, the the main goal of the project, fisheries habitat was balanced against the desire to maintain flood flows in Stoddard Bay. One of the criteria in the fisheries goal is that winter flow velocity in Stoddard Bay be reduced to less than 0.3 cm/s.

The following goals/objectives/criteria were considered:

- Create 200 acre fishery
- Winter current velocity less than 0.3 cm/s
- Water depths greater than 4 feet in 40-percent of the area in year 25.

The following hydraulic design criteria were considered:

- enhance sediment transport regime
- rock islands or structures should be at a lower elevation than sand islands to act as overflow spillway

The following procedure was used to determine rock sill elevations.

1. Elevation-discharge rating curves at Brownsville, and Rock Sills A and B, based on numerical model results, were developed (Figure 7). Stage information from the numerical model was available for discharges of 20,000, 32,000, 60,000, 90,000, 134,000, and 161,000 cfs.

2. Given a rock sill elevation, the corresponding Brownsville water surface elevation was determined using these rating curves. Table 18 summarizes this effort.

Table 18. Stage-Discharge Data at Sill A, Sill B, Brownsville.

Sill A Elevation	Sill B Elevation	Brownsville Elevation	Total River Discharge (cfs)
630.50	630.45	630.68	30,000
631.0	630.89	631.28	49,000
631.5	631.28	631.87	66,000
632.0	631.75	632.43	81,500

3. Then exceedance for the Brownsville water surface elevations (based on the 1970 to 1994 stage record) was determined from Table 5. Table 19 gives the percent of time each month and annually that sill A would be overtopped for various elevations.

Table 19. Percent of Time Sill A is Overtopped.

Sill A Elev	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
630.5	78	74	86	95.2	92.3	88.5	83.6	87.6	87.5	86.8	90.	77.5	85.8
630.75	44	38	66	83.0	75.1	69.9	64.8	52.3	59.4	58.3	47.4	44.4	58.9
631.0	11	14	48	69.7	53.8	39.1	32.7	23.5	24.6	22.4	18.3	17.9	31.4
631.5	3	2	24	36.2	29.2	12.5	12.2	3.0	2.6	5.5	2.3	3.7	11.2
632.0	0.2	*	11	19.9	16.6	5.1	4.8	1.0	1.2	2.7	0.6	0.3	5.2

4. Next, the primary goal of the project, fisheries, and the main criteria to achieve that goal, reduce winter flows, was considered. Since winter fisheries is the most critical part of the overall fisheries goals, the months of October through February were focused on. Based on the above table, a sill elevation of 631.5 to 632.0 would be needed to provide a dependable winter fishery.

5. Next, the actual hydrologic record between 1971 and 1993 was analyzed to determine the number of overtopping events. Table 20 below contains data on the number of overtopping events that would have occurred for a sill A elevation of 631.5, the days of overtopping, and the peak elevation at Brownsville of each event. A Brownsville elevation of 631.87, which corresponds to a sill A elevation of 631.5, was used to determine if overtopping would have occurred. There were eight years when the sills would have been overtopped during the 23 year period 1971 to 1993. This is unacceptable from a winter fisheries standpoint. If sill A were

raised to elevation 632.0, the corresponding Brownsville elevation would be 632.43, and the sill would be overtopped only twice (not including the minor overtopping in 1977). If sill A elevation was 631.8, the corresponding Brownsville elevation would be 632.22, and the sill would be overtopped five times, which again is probably unacceptable for winter fisheries. Based on this, a sill A elevation of 632.0 was chosen. The corresponding elevation at sill B is 631.75.

Table 20. Rock Sill Overtopping Events, 1971 to 1993.

Dates	Days of Overtopping	Peak Brownsville Elevation
Dec. 06 to 27, 1977	15	632.45
Oct. 25 and 26, 1982 Nov. 16 and 17, 1982	02 02	631.91 631.97
Dec. 17 and 18, 1983	02	632.00
Feb. 19 to 29, 1984	11	632.32
Oct. 09 to 18, 1985	10	632.58
Oct. 01 to 23, 1986	23	635.40
Oct. 24 to 28, 1990	05	632.37
Nov 03 1991 to Jan 30, 92	40	632.98

TOP WIDTH

Embankment widths were studied as part of the Arkansas River project (Reference 10). One of the main conclusions stated in this report is that, "Test results indicate that the combined effect of embankment height and crown width on riprap stability is small, that all stone failure occurred in the zone of free flow, and that the effective or critical size stone of a particular gradation is that which represents 60 to 65 percent by weight of the total.". Embankment geometry and hydrodynamic conditions looked at in Arkansas River Studies included: a 24.5 foot top width, 1:3 upstream slope and 1:4 downstream slope, and head differentials of 2' to 7'

The maximum head differential that will occurr across sill A or Sill B is about 0.5' so submerged flow can be assumed (as opposed to free flow when failure occurred in the Arkansas River studies). Because of this, top width and stone size are probably

not as big a concern, and the design should be based on

- constructability
- the potential for downstream scour and sluffing of rock
- displacement of rock by ice

To operate equipment, a 12' top width is usually needed. If scour causes displacement of rock, a wider structure can self heal, thus a 15 foot width was chosen. The upstream slope is 1:4 because of ice concerns.

LOW FLOW CHANNEL

A low flow channel is needed at the upstream end of Stoddard Bay to allow flow in for dissolved oxygen purposes. To provide a flow of 50 cfs for low flow conditions a channel with a 12 foot bottom width, 1V:3H side slopes, and an invert elevation of 626.5 is required.

PROPOSED PHYSICAL CONDITIONS

Proposed conditions refers to Plan G.

HYDROLOGY

Hydrology of the project area is discussed in the previous section "EXISTING PHYSICAL CONDITIONS". No significant changes to hydrology will occur due to the project.

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

Discharge in Stoddard Bay for existing and proposed conditions is shown in Table 21. The rock sills are overtopped at a discharge of approximately 82,000 cfs (Rock sills A and B are designed to overtop together). Prior to overtopping the flow into Stoddard Bay occurs through the low flow channel only.

Table 21. Discharge Conveyed in Stoddard Bay, Existing and Postproject Conditions.

Total River Discharge (cfs)	Existing Conditions Discharge (cfs)	Postproject Conditions Discharge (cfs)
20,000	2,150	50
32,500	3,300	110
70,000	9,500	400
94,000 (2-yr)	17,700	4,600
134,000 (5-yr)	26,100	23,300
161,000 (10-yr)	33,600	31,700

STAGE-DISCHARGE

The Stoddard Bay project will increase water surface elevations for the 100-year flood discharge of 254,000 cfs by 0.007 feet in the vicinity of the project. This was determined using the two-dimensional hydrodynamic model that was developed for this project. The reason for the small impact, is because the islands will be submerged by 4 to 6 feet of water during the 100-year flood. With this degree of submergence, the islands will act like weirs, efficiently conveying water over them.

The maximum decrease in water surface elevation within Stoddard Bay simulated with the numerical model was 0.46 feet. This will occur near the upstream end of Stoddard Bay at a discharge of about 70,000 cfs (Table 22).

Table 22. Water surface elevation in Stoddard Bay for Existing and Proposed Conditions.

Total River Discharge (cfs)	Existing Conditions Water Surface	Proposed Water Surface	Decrease (feet)
20,000	630.25	630.15	0.10
32,500	630.56	630.44	0.12
70,000	631.62	631.16	0.46
94,000 (2-yr)	632.36	631.98	0.38
134,000 (5-yr)	633.96	633.78	0.18
161,000(10-yr)	635.24	635.10	0.14

FLOW VELOCITIES

Figure 19 shows proposed conditions depth averaged velocities, with and without ice, for a low flow discharge of 20,000 cfs. The "with ice" velocities were determined by increasing the "without ice" velocities by a factor that accounts for the reduced conveyance area due to ice. Since ice isn't as likely to occur in the low flow notch, it was assumed that the inflow discharge wouldn't be affected. The average velocity for the "without ice" conditions is approximately 0.01 fps (0.3 cm/s). The average velocity for "with ice" conditions is approximately 0.013 fps (0.4 cm/s).

Figure 20 shows depth averaged velocities in Stoddard Bay for the 10-year flood. Existing conditions (Run 1), and several plans (Runs 2-5) that were looked at during the design process are included on this plot. One of the primary hydraulic design criteria is to maintain or enhance existing conditions velocities in the deeper channelized areas of Stoddard Bay during flood conditions. Runs 2 and 3 (Plan C with and without Rock Sill B) indicate higher velocities in the upstream third of the project area, but lower velocities in the lower 2/3 of the project area. Run 4 (Plan G), which includes the interior islands, results in channel velocities that equal and even exceed existing conditions. This is indicated by the red, yellow, and green colors which define channel position. Comparing plan G to existing conditions indicates that velocities have decreased near the islands (both upstream and downstream) and in the lower portion of Stoddard Bay. One of the unknowns, is how much flow there will be over islands B, C, and D1 during floods. This couldn't be modeled with the two-dimensional computer model because of model instabilities. Flow over these islands may slightly increase velocities in lower Stoddard Bay.

HYDRAULIC RESIDENCE TIME

Hydraulic residence times for proposed conditions have increased significantly over existing conditions (Table 23).

Table 23. Hydraulic Residence Time in Stoddard Bay for Existing and Proposed Conditions.

	Existing			Proposed		
Miss. R. Disch. (cfs)	Volume (ft3)	Inflow (cfs)	Hydraulic Residence Time (days)	Volume (ft3)	Inflow (cfs)	Hydraulic Residence Time (days)
STODDARD BAY						
20,000	55,014,000	2150	0.30	52,950,000	50	12.26
32,500	61,415,000	3300	0.22	58,937,000	110	6.2
70,000	83,301,000	9500	0.10	73,804,000	400	2.1
94,000	98,580,000	17700	0.06	90,734,000	4600	0.23
134,000	131,616,000	26100	0.06	127,900,000	23300	0.06
161,000	158,045,000	33600	0.05	155,154,000	31700	0.06

Note 1. The volume of the Stoddard Bay Study area is 70,500,000 cubic feet when the water surface elevation is 631.0. The area of the study area is 474 acres. Volumes for other water surface elevations (wsel) were obtained using the formula:

$$\text{Volume} = 70{,}500{,}000 + (\text{wsel1} - 631) * (474 * 43{,}560)$$

WAVE ACTION

Construction of the Interior Islands will reduce wind fetches throughout the project area. As discussed previously, the existing barrier island remnants act as a wave break limiting wind fetch and wave action due to north and west winds. Wind fetches from the south reach a maximum of about 15,000 feet. The reduction in fetch for proposed conditions varies depending on location in the project area and wind direction. As an example, consider again subarea B (Figure 4), located at the midpoint of Stoddard Bay, and corresponding roughly to the area between the D and E islands. Table 24 is a continuation of Table 7 from the existing physical conditions section. The wave characteristics of wave height and wave velocity in subarea B are provided for proposed conditions along with existing conditions. A wind speed of 25 mph was assumed. The existing conditions wind fetches of 11,000 feet to the south and 4,000 feet to the north will be reduced to 1,000 feet by island construction.

In the 3 to 5 foot water depths that exist in this area, interior island construction will result in significant reductions in wave height, maximum bottom velocity, and bottom shear stress due to wave action in subarea B. In subarea A, similar reductions will occur. In subarea C, south of the D islands, wave action will be reduced for north winds, but will be unaffected for south winds.

Table 24. Analytical Predictions of Wind Driven Wave Effects on Project Area (Subarea B).

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Maximum Orbital Velocity at Bottom (fps)
Existing Conditions				
11,000	S	3	0.84	0.88
	S	4	0.96	0.74
	S	5	1.05	0.62
4,000	N	3	0.67	0.46
	N	4	0.70	0.28
	N	5	0.73	0.19
Proposed Conditions				
1,000	N&S	3	0.40	0.05
	N&S	4	0.41	0.01
	N&S	5	0.41	0.01

IMPACTS ON PHASE 1

The impacts of Phase 2 construction on the existing islands that were constructed as part of Phase 1 was determined using the two-dimensional hydrodynamic model. This analysis indicates minimal impact. The only detectable velocity increase was at the southerly tip and on the bend of Boomerang Island. Both of these areas have been armoured with rock.

SEDIMENT TRANSPORT

DEPOSITION/EROSION

Bathymetric changes will occur due to the combined effects

of changes in sediment deposition which is primarily a function of sediment load and trap efficiency; and sediment erosion which is primarily a function of flow velocity, wave action and advective transport out of the area.

Although sediment loads will be decreased, there will be greater tendancy for the sediment that enters Stoddard Bay to settle out during years of low to average flows. The reasons for this include:

- increased trap efficiency
- deposition will occur in the lower portion of the project area because of an eddy that will form as water flows around the downstream end of island C
- the interior islands reduce wave action throughout Stoddard Bay, decreasing erosion and resuspension of previously deposited sediments

Because of the increased potential for deposition, the rock sills and interior islands are designed to reverse this process during high flow years. The rock sills were designed so that during high water events such as the 5-year flood or larger, flow over the rock sills will approach existing conditions flows. The interior islands act like training structures, increasing velocities in the adjacent channels and decreasing velocities in the zones upstream and dowsntream of the islands during floods.

Future deposition zones include, the areas near the interior islands and possibly in lower Stoddard Bay. The bay that is formed by island B and D1 will be especially prone to deposition. Future erosion zones include the channelized portions of Stoddard Bay, and the areas downstream of the rock sills where a scour hole may form. One of the unknowns, is how much flow there will be over islands B, C, and D1 during floods. This couldn't be modeled with the two-dimensional computer model because of numerical instabilities. Flow over these islands may slightly increase velocities and erosion potential in lower Stoddard Bay.

SEDIMENT TYPES

No significant change in sediment particle size is expected. Sediment that enters Stoddard Bay for existing conditions is conveyed mostly as suspended sediment. This condition, won't change for proposed conditions. The only significant change is that with the interior islands in place, erosion of fine sediments won't occur in some areas and sediment particle sizes could gradually get finer.

SEDIMENT LOADS

The average annual suspended sediment load will be decreased approximately 73-percent from 184,000 to 49,000 tons per year.

TRAP EFFICIENCY

The GIS analysis of bathymetry changes indicated a net sediment deposition of 5,700 tons per year for existing conditions. Comparing this to the existing conditions sediment load gave a trap efficiency of 3.1 percent. Unfortunatley, analytical techniques to calculate trap efficiency don't exist for shallow backwater areas like Stoddard Bay, making it impossible to determine the trap efficiency for proposed conditions. Since the hydraulic residence time in Stoddard bay is being increased so much, it is obvious that the trap efficiency will increase. An increase in trap efficiency to only 11.6-percent would result in the same quantity of sediment deposition (5,700 tons per year) as has occurred historically. The proposed design with rock sills and interior islands is necessary to offset the increased trap efficiency.

SEDIMENT RESUSPENSION BY WAVES

Sediment resuspension by wave action will be reduced throughout the project area. As and example, consider again subarea B, the reach between the D and E interior islands. The maximum bottom shear stress generated by a 25 mph wind in this subarea for existing and proposed conditions is listed in Table 25. For existing conditions, the shear stress generated by south winds exceeds commonly reported critical shear stress for erosion reported by many researchers. For proposed conditions, the shear stress is reduced two orders of magnitude. The positive aspect of this is that water quality will be enhanced. The negative aspect of this is that sediment that deposits in this area will not be resuspended due to wave action and transported out of Stoddard Bay.

Table 25. Analytical Prediction of Bottom Shear Stress in Stoddard Bay, Existing and Proposed Conditions

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Maximum Orbital Velocity at Bottom (fps)	Maximum Bottom Shear Stress (psf)
Existing Conditions					
11,000	S	3	0.84	0.88	0.024
	S	4	0.96	0.74	0.017
	S	5	1.05	0.62	0.012
4,000	N	3	0.67	0.46	0.0066
	N	4	0.70	0.28	0.0023
	N	5	0.73	0.19	0.0011
Proposed Conditions					
1,000	N&S	3	0.40	0.05	0.0001
	N&S	4	0.41	0.01	0.0001
	N&S	5	0.41	0.01	0.0001

SEED ISLANDS

The Seed Island project area is shown on Figure 21. The purpose of seed islands is to place an obstruction in flowing water where coarse sediment accretion is occurring. The obstruction creates upstream and downstream stagnation zones and adjacent zones of higher flow velocity. Sediment entering the stagnation zones accretes at a rate faster than erosive processes can remove it. In the adjacent higher flow areas, a scour zone will occur resulting in a deeper channel. The desired result is an island forming in the stagnation zones, and a channel forming in the adjacent scour zones. It is assumed that this enhanced bathymetric diversity is better than the shallow windswept sand flat that would exist otherwise.

The seed islands weren't analyzed to the same level of detail as the Stoddard Bay portion of this project. One of the reasons for this was the cost of the seed island portion which is only about 6-percent of the total proejct cost. A second reason is that predictive techniques for sediment transport are weak for all but the simplest processes. Island accretion and channel scour are complex processes that simply can't be modeled with any degree of confidence. Given the nature of the project impacts, which is to redistribute water and sediment flow locally (as opposed to valley wide), the lack of quantitative predictive tools isn't a great concern. This is one situation where the old adage "The best model of the river is the river itself" applies. In fact, two existing islands in this area (Heron and Trapping Islands) provide evidence that this process will occur. Sand spits have formed downstream of these islands and a deep channel as formed between them.

EXISTING PHYSICAL CONDITIONS

HYDROLOGY

Hydrology of the project area is the same as described in the hydrology section for "EXISTING PHYSICAL CONDITIONS" in the Stoddard Bay portion of this report.

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

Discharge data was collected at sites 24 and 25 (Figure 22). Site location is shown on Figure 5. After Phase 1 construction, flow through these two sites increased to 10.1-percent and 5.5-

percent of the total river flow (based on a reference discharge of 80,000 cfs).

FLOW VELOCITIES

Flow patterns in the study area are shown on Figure 23. This data was collected on two survey dates. The data north of Middle Slough was collected on 31 May 1994 when the total river flow was 70,000 cfs, and the data south of Middle Slough was collected on 2 May 1995 when the total river flow was 82,000 cfs. Between river miles 685.3 and 683.5 flow is from the navigation channel to the backwater area. The velocity range is 0.5 to 2 fps.

WAVE ACTION

Wave action in the project area is severe with south wind fetches exceeding 20,000 feet . Since, there is evidence that seed islands will form inspite of this wave action, and since the project isn't necessarily going to change wave action, wave characteristics were not quantified.

SEDIMENT TRANSPORT

DEPOSITION/EROSION (1932 TO 1991)

Bathymetric data collected in 1990/91 by EMTC and topographic information from the 1932 flowage easement surveys (Figure 24) was compared to determine deposition/erosion patterns in the Seed Island area (Figure 25). Three feet or more of sediment has accumulated over much of the area. Erosion has occurred in several areas. Although it isn't shown on these surveys, emerged sand spits have formed on the downstream side of Heron and Trapping Islands.

SEDIMENT TYPES

The distribution of surficial sediments in this area is shown on Figure 26. These were classified visually during field reconnaissance. Sand was found over 80-percent of the area.

PREVIOUS ISLAND DESIGN EXPERIENCE
(USFWS Seed Islands)

The United States Fish and Wildlife Service funded a seed island construction and bank stabilization project in this area

in 1995. Two seed islands were constructed near river mile 684.5 (Figure 21) and the shorelines of Heron and Trapping Island were stabilized with off-shore rock mounds. The seed island southwest of Heron Island was 225 feet long, and the seed island closer to the navigation channel was 210 feet long. As part of the Trapping Island work, an 80-foot groin was constructed extending west from the upstream tip of the island. This groin will also act as a seed island. The method of construction involved dredging 90-foot wide by 5-foot deep access channels to the midpoint of each seed island and then placing rock using a crane with a long enough boom to reach the end of each island. The cost of the seed islands was approximately $45,000.

ISLAND CROSS SECTION

The cross section used for the seed islands included a top elevation of 633.5 (3 feet over average water surface elevation), a top width of 3 feet, and a side slope of 1V:1.5H.

POSTPROJECT OBSERVATIONS

Since the two seed islands are less than a year old, the performance of these structures can't be evaluated yet. The following observations were made during construction.

- Sequencing is important. There was a delay of a couple of weeks between access channel dredging and placement of rock. During this time, noticeable sediment deposition occurred in the access channels.

- To construct the seed islands, access channels were dredged to the center of each island. These access channels will act as sediment traps and sand that would have otherwise contributed to island formation will be deposited in the channels delaying the initial rate of seed island formation. To prevent this, more control on access channel location and depth should be considered for future designs

- There was some settlement of rock after placement. The design elevation should account for the possibility of settlement.

SEED ISLAND GOALS

The basic goal is to enhance riverine habitat through island and channel formation using techniques that work with natural riverine processes.

SEED ISLAND HYDRAULIC DESIGN FACTORS

Hydraulic design factors include:

1. The sediment transport regime must be such that sediment deposition exceeds sediment erosion. In most cases, this implies that coarse sediment transport and deposition is needed in an area where wave action or river currents won't degrade the deposits. Theoretically seed island could form from fine sediments, but only if erosive forces are neglible.

2. Shallow water depths will result in quicker formation of emerged islands (all other things being equal).

3. Proximity to existing islands or other seed islands. Sediment accretion at individual islands may eventually result in one larger island being formed.

SEED ISLAND DESIGN

The Seed Island Design is based on:

- Previous design and construction experience
- Seed island goals
- Hydraulic design factors
- Other design factors

Other design factors include: economics and constructability. Access to the proposed island site is one of the most important cost and constructablity factors. If possible, islands should be placed near natural channels or deep areas to provide equipment access. This has to be balanced with other factors. The design below assumes that all seed islands will be constructed of rock. Investigation of other construction techniques such as timber piles, geotubes, and simply anchoring snags in place will be investigated during plans and specs.

ISLAND LAYOUT

A plan view of potential seed island locations is shown on Figure 27. Seed Islands 1, 2, and 3 are adjacent the channel leading into the backwaters that has formed between Heron and Trapping Islands. This channel is deep enough to allow access by construction equipment and rock barges. Seed Islands 4 through 11 are located adjacent the navigation channel. All islands are located in areas of known coarse sediment transport.

Initially only 6 of the 11 islands shown on Figure 27 will be constructed. These islands are SI-5, 6, 7 and SI 9, 10, 11. This selection will result in the formation of 2 new island groups. Seed islands 5, 6, and 7 will be part of the first island group, along with the USFWS seed island that was constructed near the navigation channel in 1995. Seed islands 9, 10, and 11 will form the second group of islands. This layout may be adjusted based on monitoring of the USFWS seed islands constructed in 1995. Also, if cheaper construction techniques are identified, additional seed islands may be constructed.

ISLAND CROSS SECTION

The cross section proposed for the seed islands is the same as that used for the USFWS seed islands. The top elevation is 633.5, the top width is 3 feet, and the side slope is 1V:1.5H. The top elevation of 633.5 accounts for the possibility of post-construction settling. The top width of 3 feet results in a waterline width of about 12 feet, which allows for the possibility of operating equipment on the island base.

Rock Size

The rock gradation used here is the same as that used throughout the rest of the project.

PROPOSED PHYSICAL CONDITIONS

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

The basic premise of seed islands is to create a disturbance in a flow field thus creating stagnation and scour zones. Based on this premise, there is obviously going to be a local change in the discharge distribution. However, due to the fact that scour will occur concurrently with island formation, the effect on a pool wide basis should be minimal. This can't be modeled with the fixed bed two-dimensional model. Rather preproject and postproject monitoring will be done to determine the effects of seed island construction.

FLOW VELOCITIES

Again, preproject and postproject monitoring will be done to determine the impacts of seed island construction. The expected impact will be a decrease in velocity and eddy formation

downstream of the islands and an increase in velocity adjacent the islands.

WAVE ACTION

Wave action in the project area will continue to be severe with south wind fetches exceeding 20,000 feet . As discussed previously there is evidence that seed islands will form inspite of this wave action. As islands form, they will will act as wave breaks reducing wave action locally.

IMPACTS ON PHASE 1

The seed islands will not change flow patterns in the Phase 1 area (or the Stoddard Bay portion of Phase 2). Wave action due to southeast winds in the extreme lower end of Phase 1 (Grassy Island and the lower end of Boomerang) will be reduced due to seed island construction.

SEDIMENT TRANSPORT

DEPOSITION/EROSION

Sediment deposition will continue to dominate the seed island area, however construction of seed islands will alter this locally, by increasing sediment deposition in the area downstream of each seed island and initiating scour in the area adjacent each island. Rather than the broad submerged sand flat that is characteristic of this area, emerged islands will accrete downstream of each seed island, and deeper channels will form between the islands. The bathymetric diversity of the area will be increased.

SEDIMENT TYPES

Sediment types entering the area won't be changed by seed island construction. However, the distribution of surficial sediments will be altered because of changes in hydrodynamics and the sediment transport regime. As the island accretion progresses, fine sediments will deposit in areas sheltered from wave action or in vegetated (aquatic or terrestrial) areas. As scour occurs in coarser sediments (gravels) or cohesive sediments (hard clay) may be exposed.

REFERENCES

1. Copeland, R.H., (1988). Resuspension Study For the Wisconsin River. Memorandum for the Record From Waterways Experiment Station to the St. Paul District Corps of Engineers.

2. GREAT 1, Study of the Upper Mississippi River, (1980). Vol. 4, "Sediment and Erosion."

3. Hendrickson, J.S., F.R. Haase, and M.T. Hoff (1994). Upper Mississippi River Hydrodynamics: Discharge Distribution in Pool 8, 1987-93. Internal Report Compiled by the U.S. Army Corps of Engineers, St. Paul District.

4. McHenry, J. R., J. C. Ritchie, and C.M. Cooper (1978). An Assessment of Sediment Accumulation in Pool 8 of the Upper Mississippi River. Submitted to GREAT Sediment and Erosion Work Group by the Sedimentation Laboratory, Oxford, Mississippi.

5. Sheng, Y.P., and Lick, W. (1979). The Transport and Resuspension of Sediments in a Shallow Lake. Journal of Geophysical Research. Vol. 84, No. C4.

6. Shore Protection Manual (1984). Vol. 1 and 2. Prepared by the Coastal Engineering Research Center.

7. Tornes, L.H. (1986). Suspended Sediment in Minnesota Streams. U.S. Geological Survey, Water-Resources Investigations Report 85-4312.

8. U.S. Army Corps of Engineers, Engineering Manual No. 1110-2-4000. (1989). Sedimentation Investigations of Rivers and Reservoirs.

9. U.S. Army Corps of Engineers, Engineering Manual No. 1110-2-5026. (1987). Beneficial Use of Dredge Material.

10. U.S. Army Corps of Engineers, Waterways Experiment Station, Technical Report No. 2-650 (1964). Stability of Riprap and Discharge Characteristics, Overflow Embankments, Arkansas River, Arkansas.

11. Upper Mississippi River System Environmental Management Program. Definite Project Report/Environmental Documentation (SP-4). Pool 8 Island Construction - Phase 1. Habitat Rehabilitation and Enhancement Project. Pool 8, Upper Mississippi River, Vernon County, Wisconsin. May 1989.

COORDINATE SYSTEM ..... STATE PLANE MINNESOTA SOUTH
GEODETIC DATUM ..... NORTH AMERICAN 1927
ELLIPSOID ..... CLARKE 1866

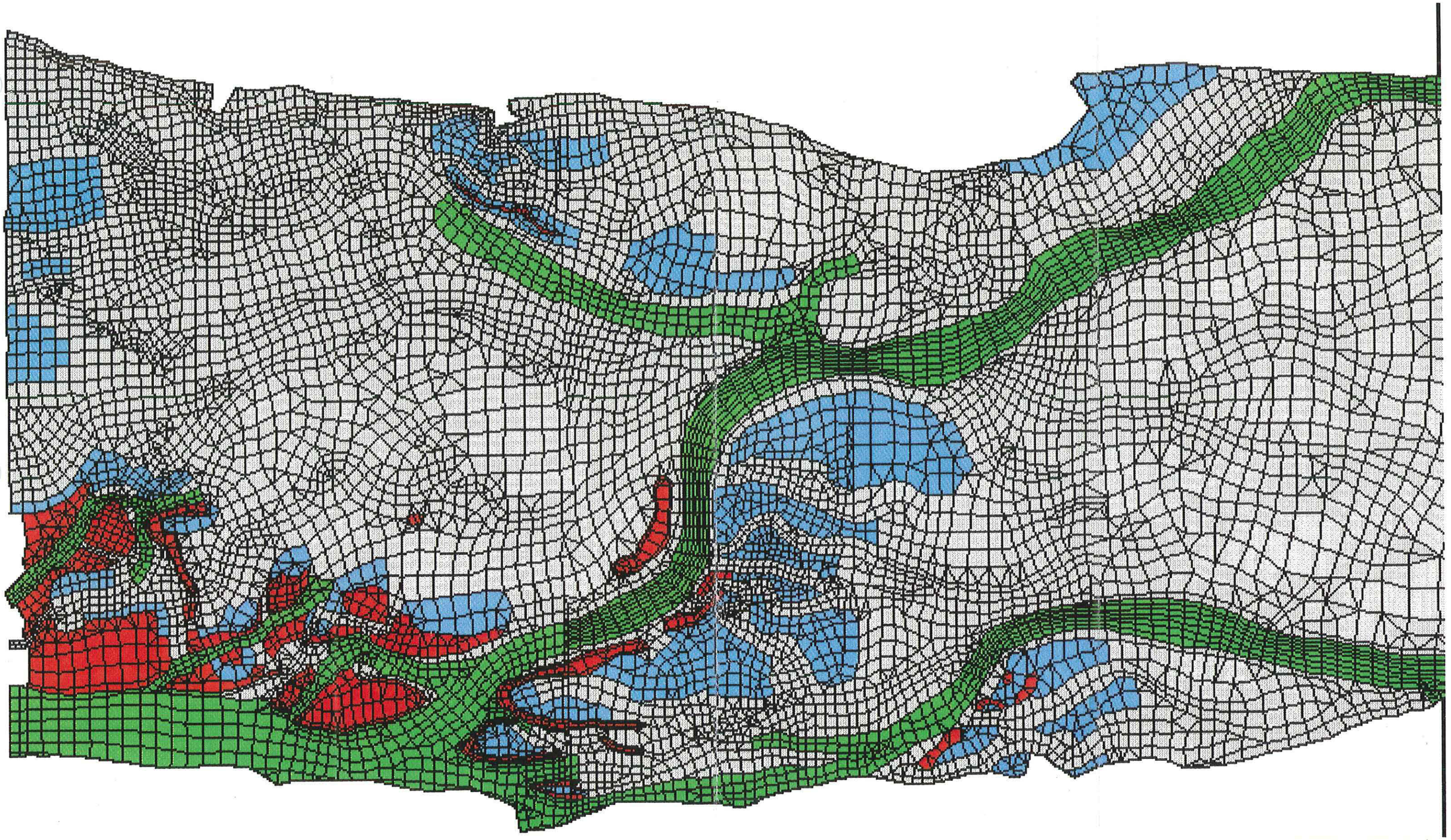
5000 0 5000 10000 FEET

RECTIFIED PHOTO BASE
POOL 8 NAPP IMAGERY
(5485-216,217 MAY 5, 1992)
(5467-29,30 MAY 6, 1992)
POOL 8 EMTC IMAGERY
(0195 AUGUST 4, 1993)

PRODUCED BY ST.PAUL DISTRICT, GIS CENTER, U.S. ARMY CORPS OF ENGINEERS, JULY 1994.

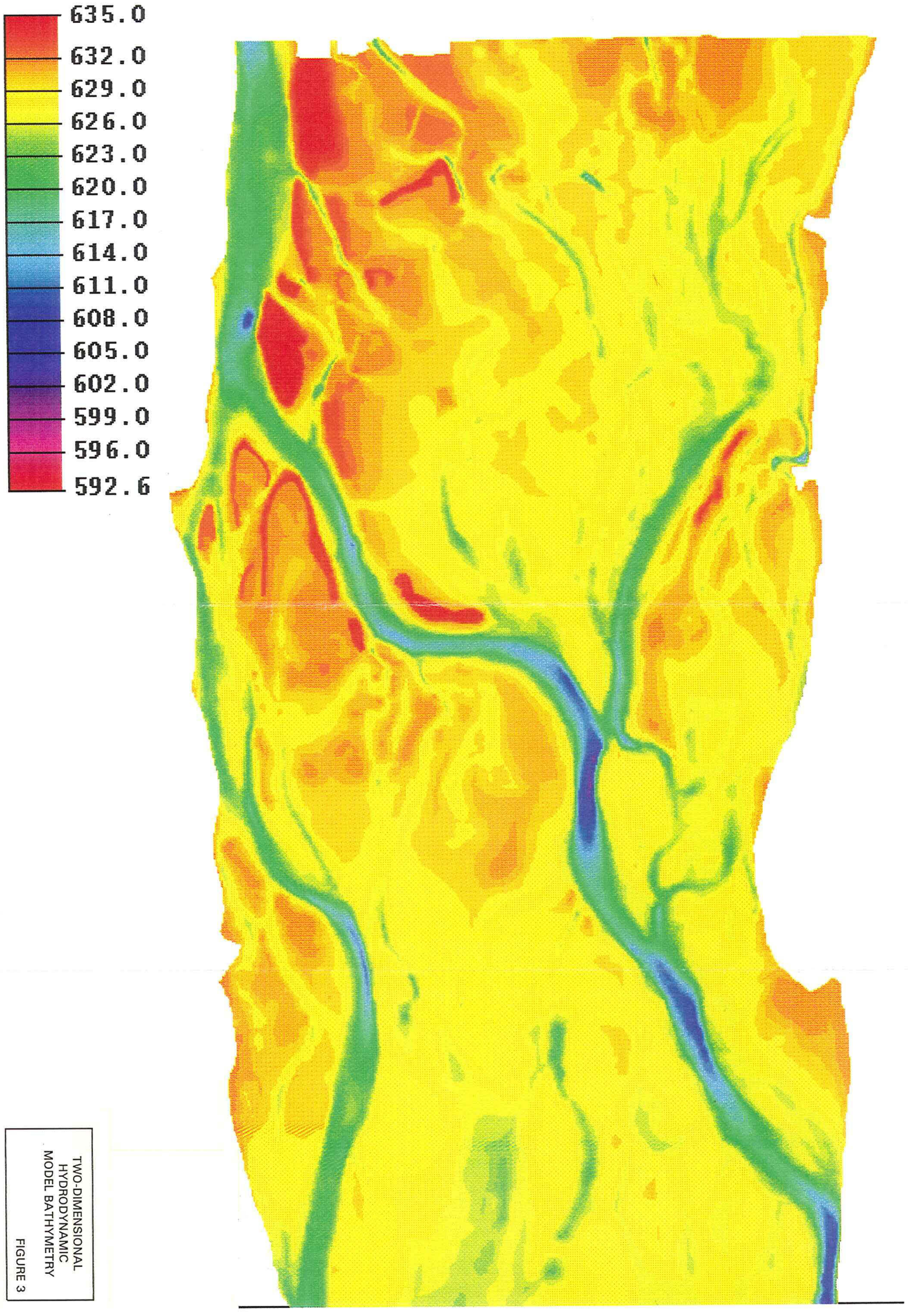
PLAN VIEW
OF
LOWER POOL 8

FIGURE 1



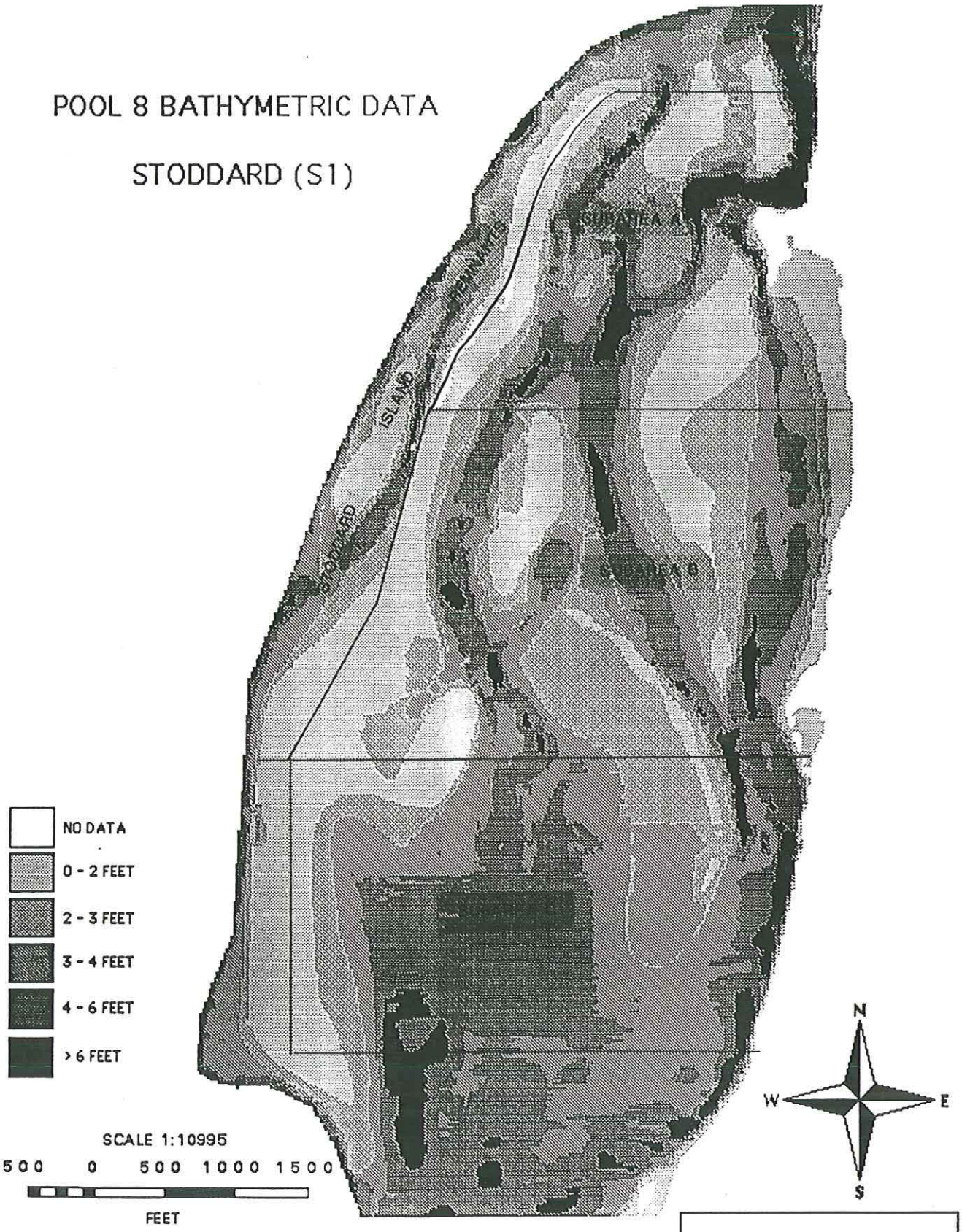
TWO-DIMENSIONAL
HYDRODYNAMIC
MODEL GRID

FIGURE 2



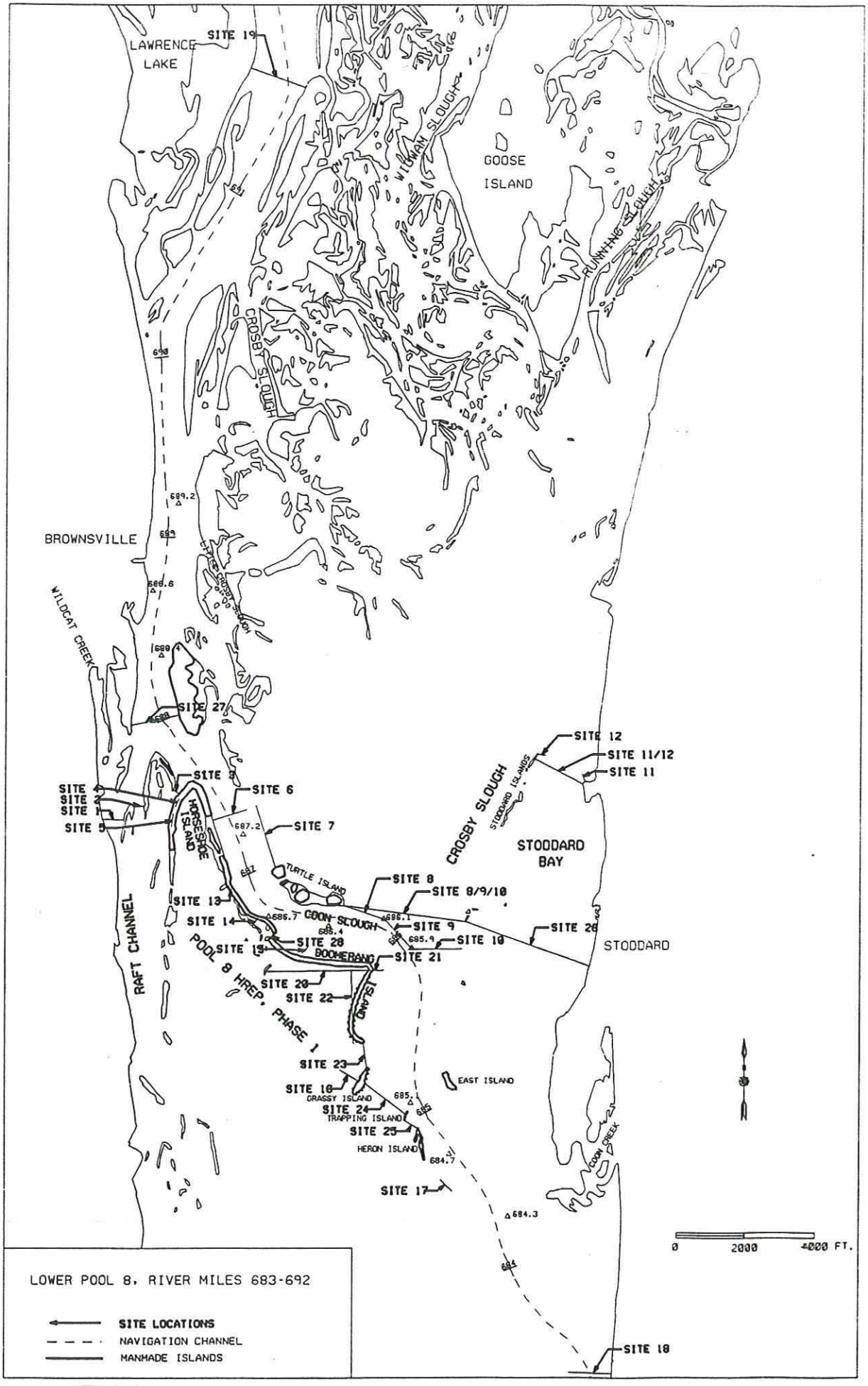
TWO-DIMENSIONAL
HYDRODYNAMIC
MODEL BATHYMETRY

FIGURE 3

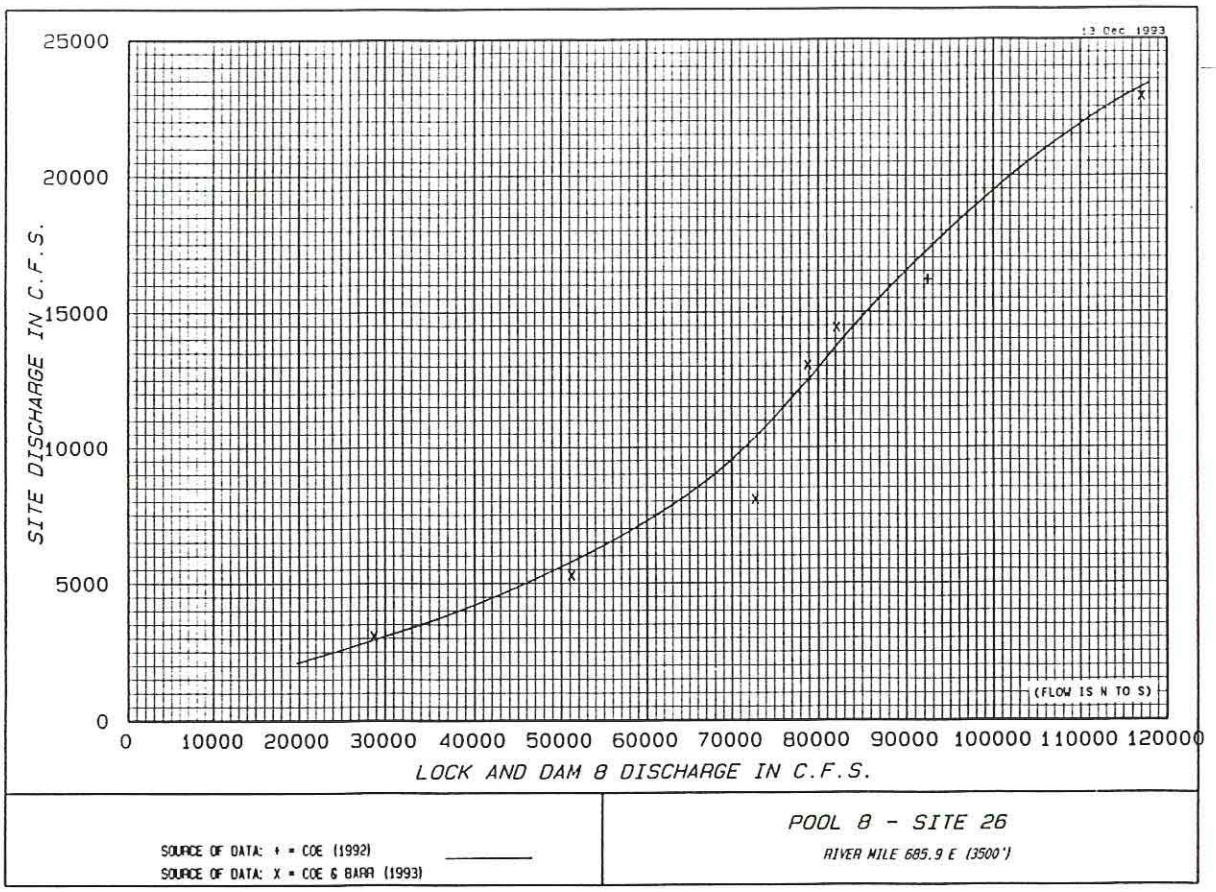


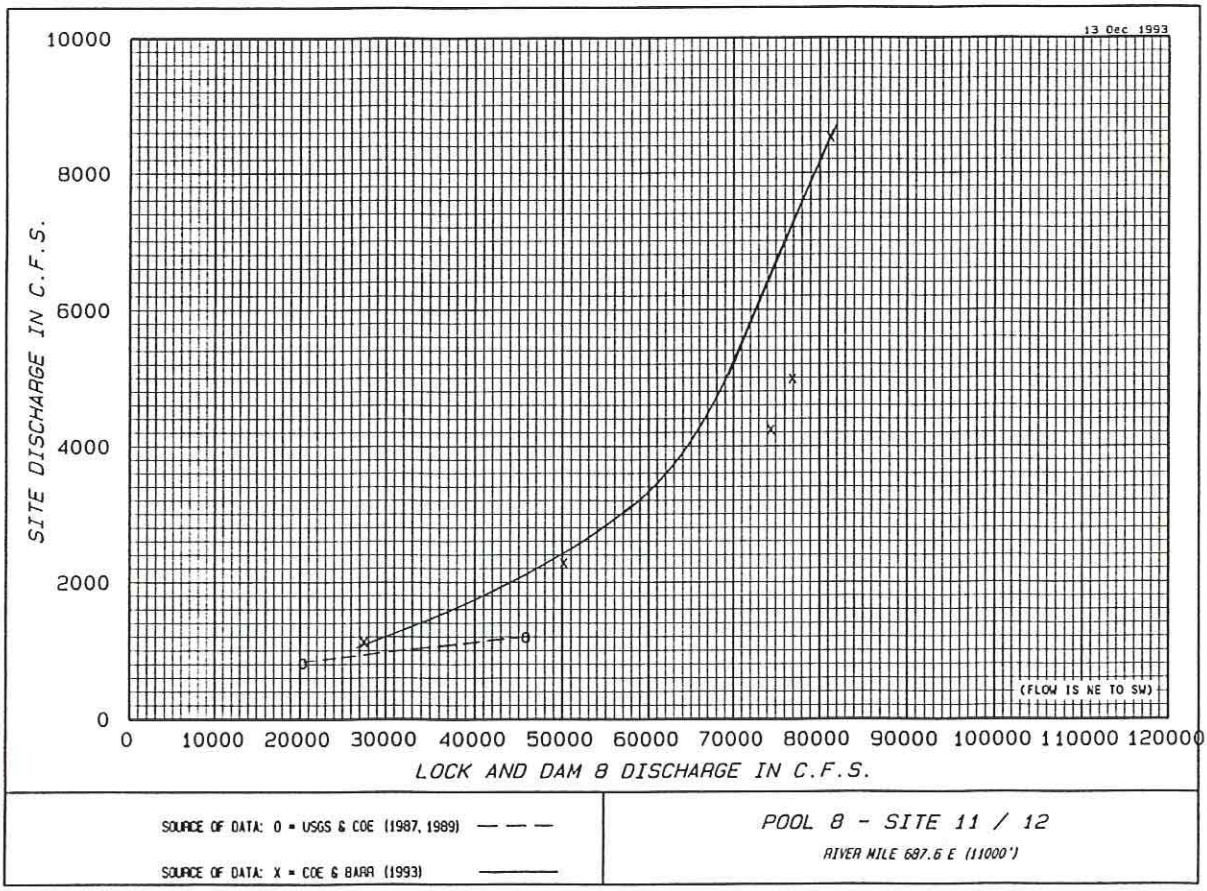
STODDARD BAY
PROJECT AREA

FIGURE 4



POOL 8 DISCHARGE MEASUREMENT SITES, RM 683 - 692 FIGURE 5

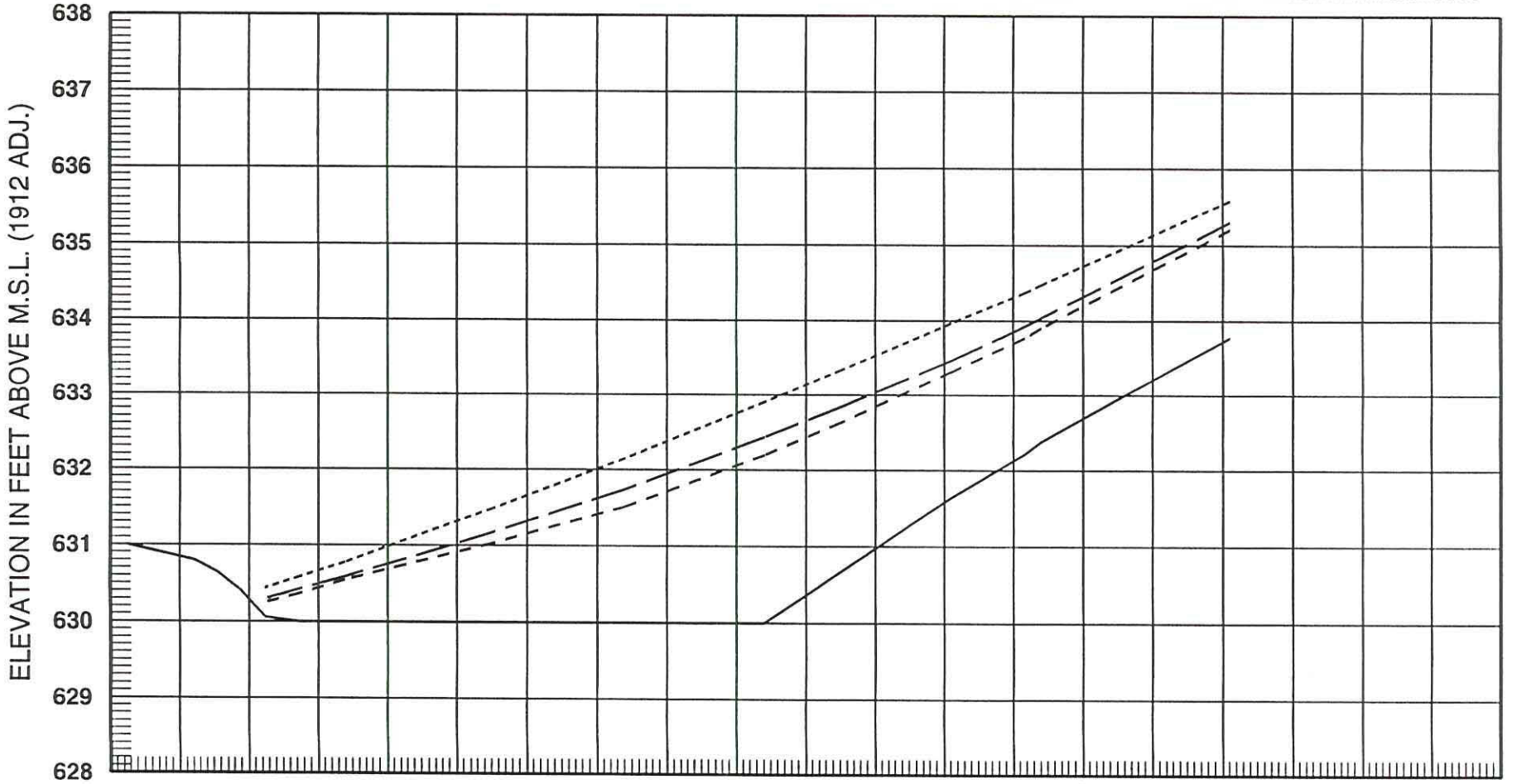




POOL 8 DISCHARGE, SITES 11 / 12 AND 26

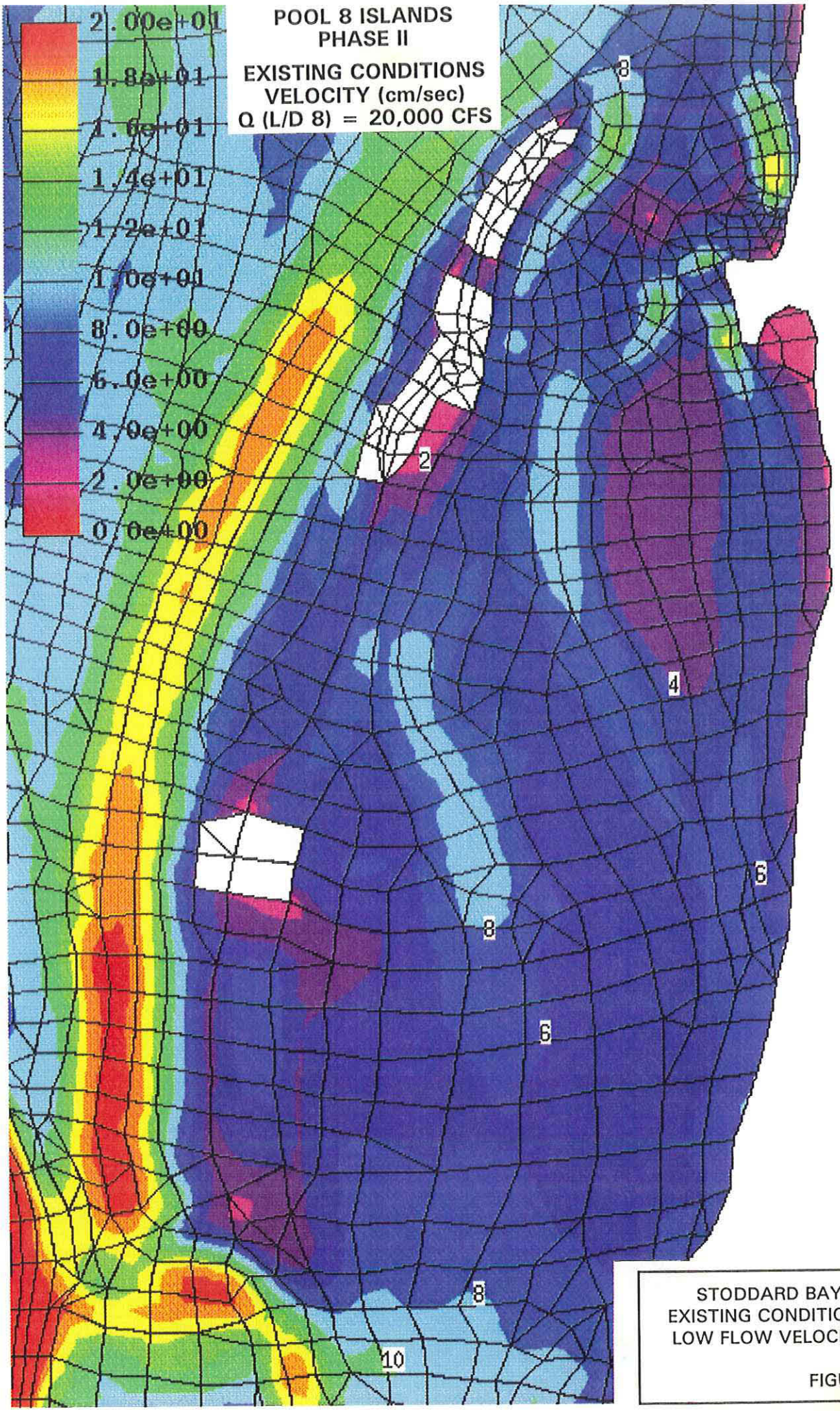
FIGURE 6

STODDARD BARRIER ISLAND



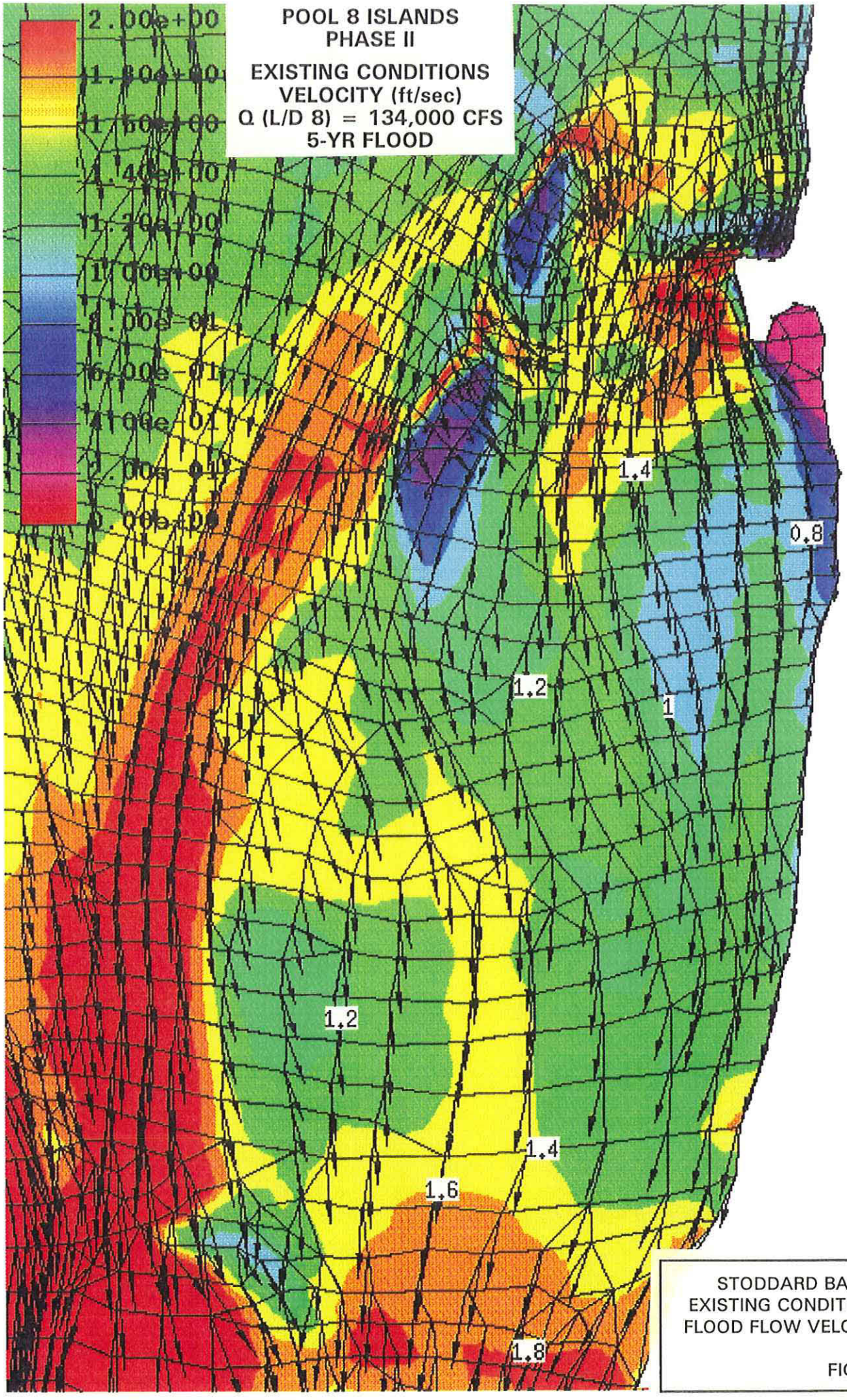
STAGE - DISCHARGE, LOCK 8, BROWNSVILLE, STODDARD BAY

FIGURE 7



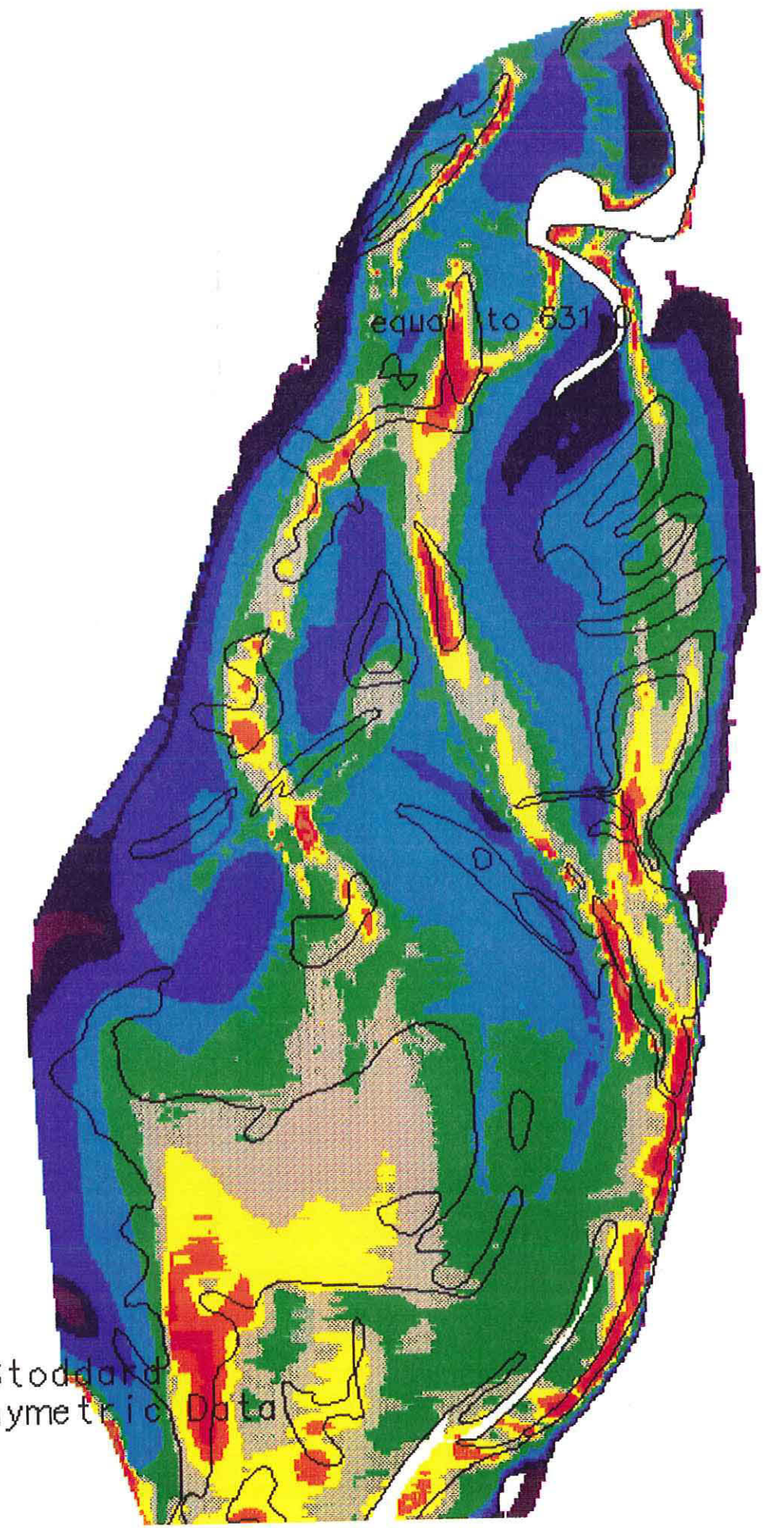
STODDARD BAY
EXISTING CONDITIONS
LOW FLOW VELOCITY

FIGURE 8



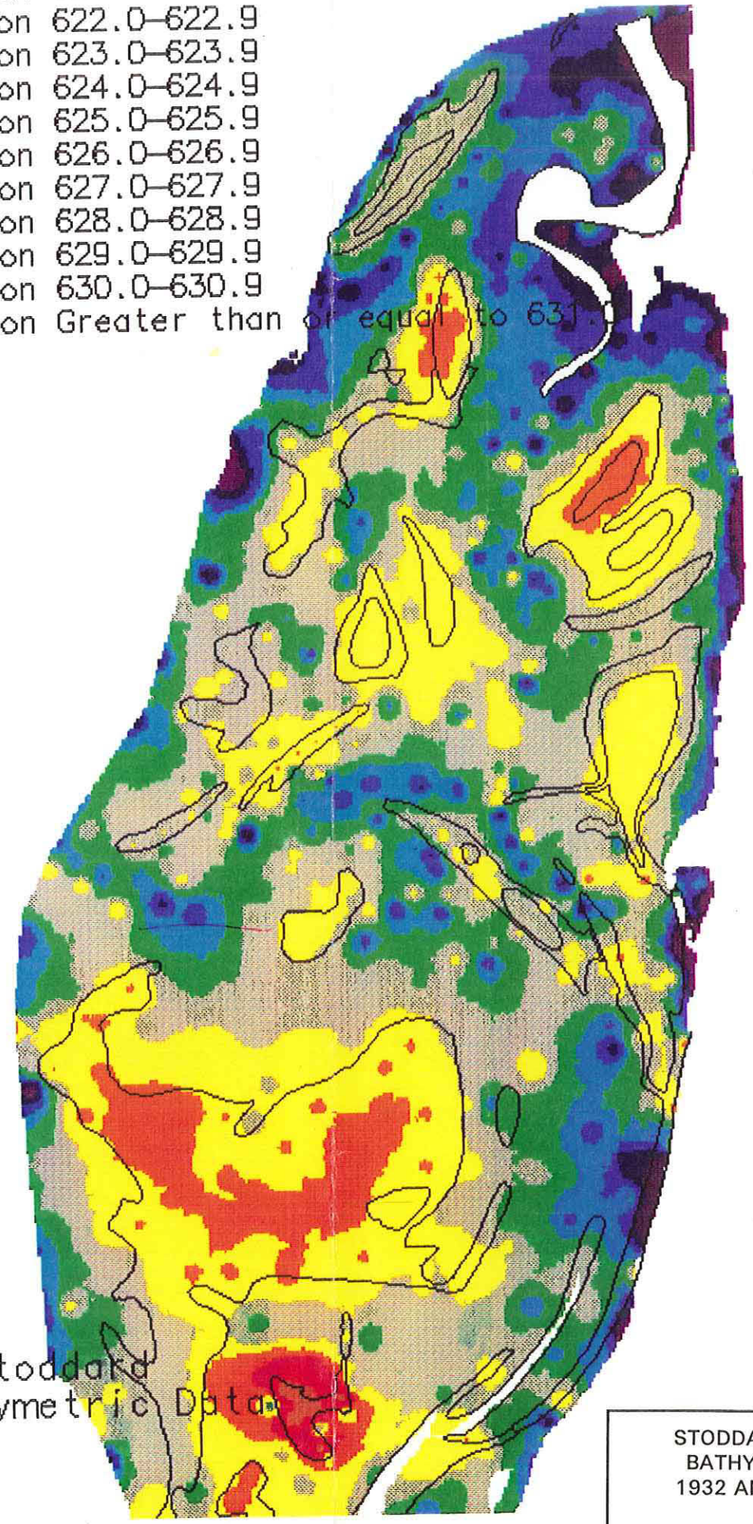
STODDARD BAY
EXISTING CONDITIONS
FLOOD FLOW VELOCITY

FIGURE 9



Pool 8, Stoddard
1991 Bathymetric Data

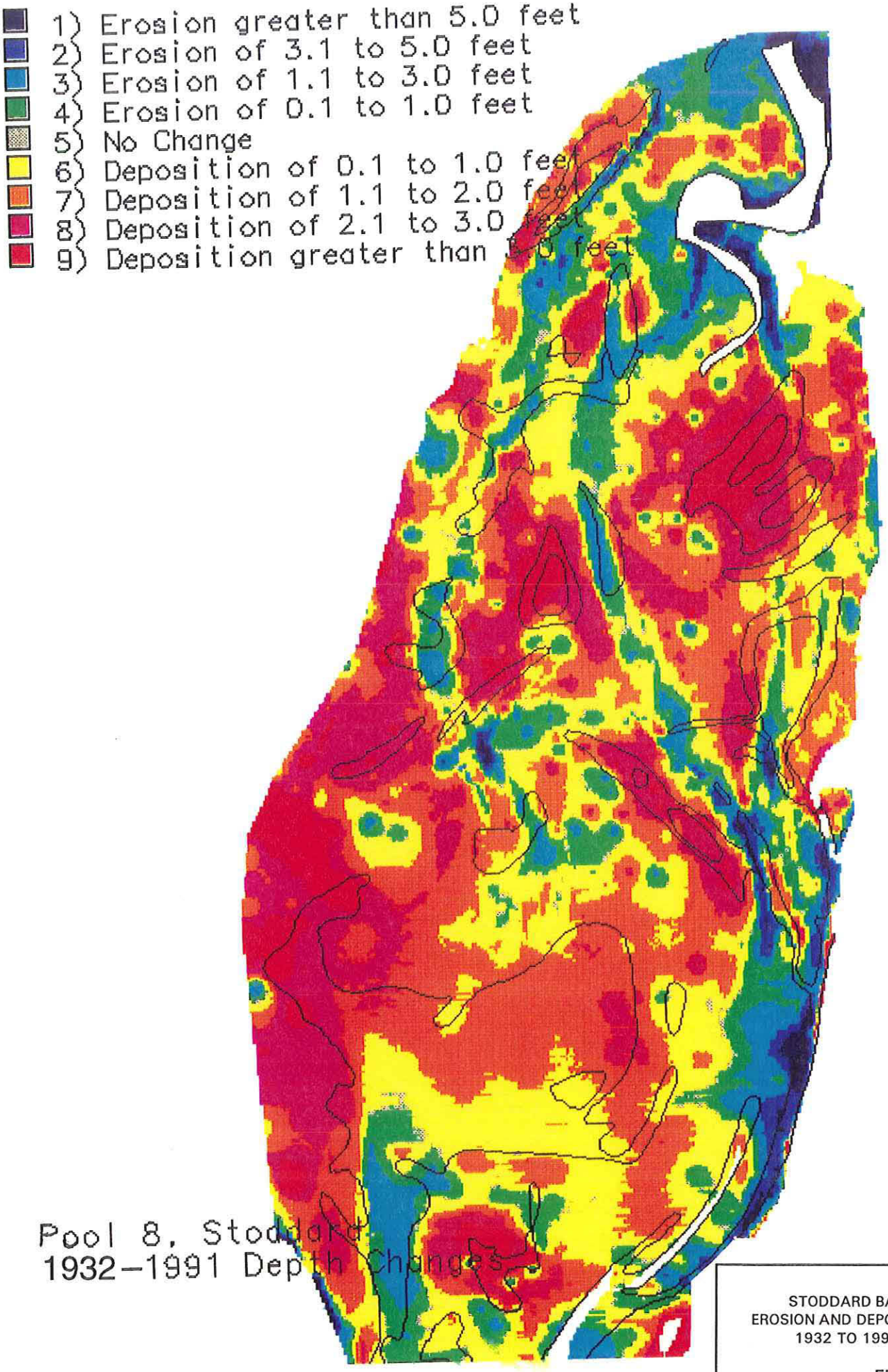
1) Elevation 621.0–621.9
2) Elevation 622.0–622.9
3) Elevation 623.0–623.9
4) Elevation 624.0–624.9
5) Elevation 625.0–625.9
6) Elevation 626.0–626.9
7) Elevation 627.0–627.9
8) Elevation 628.0–628.9
9) Elevation 629.0–629.9
10) Elevation 630.0–630.9
11) Elevation Greater than or equal to 631.0



Pool 8, Stoddard
1932 Bathymetric Data

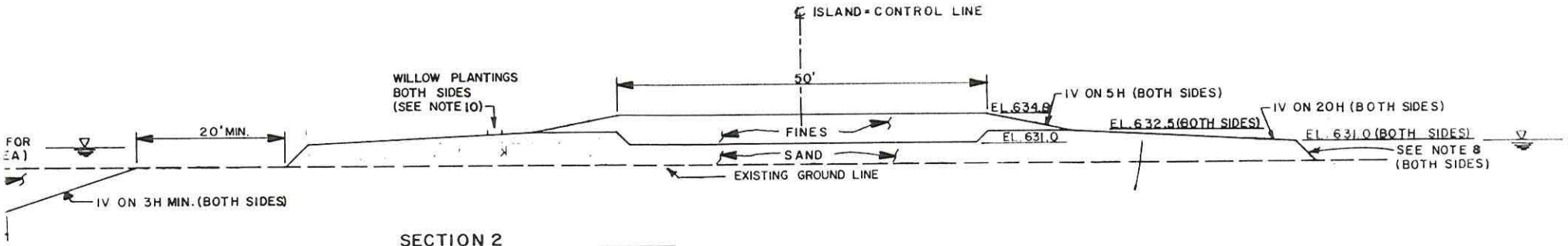
STODDARD BAY
BATHYMETRY
1932 AND 1991

FIGURE 10



STODDARD BAY
EROSION AND DEPOSITION
1932 TO 1991

FIGURE 11

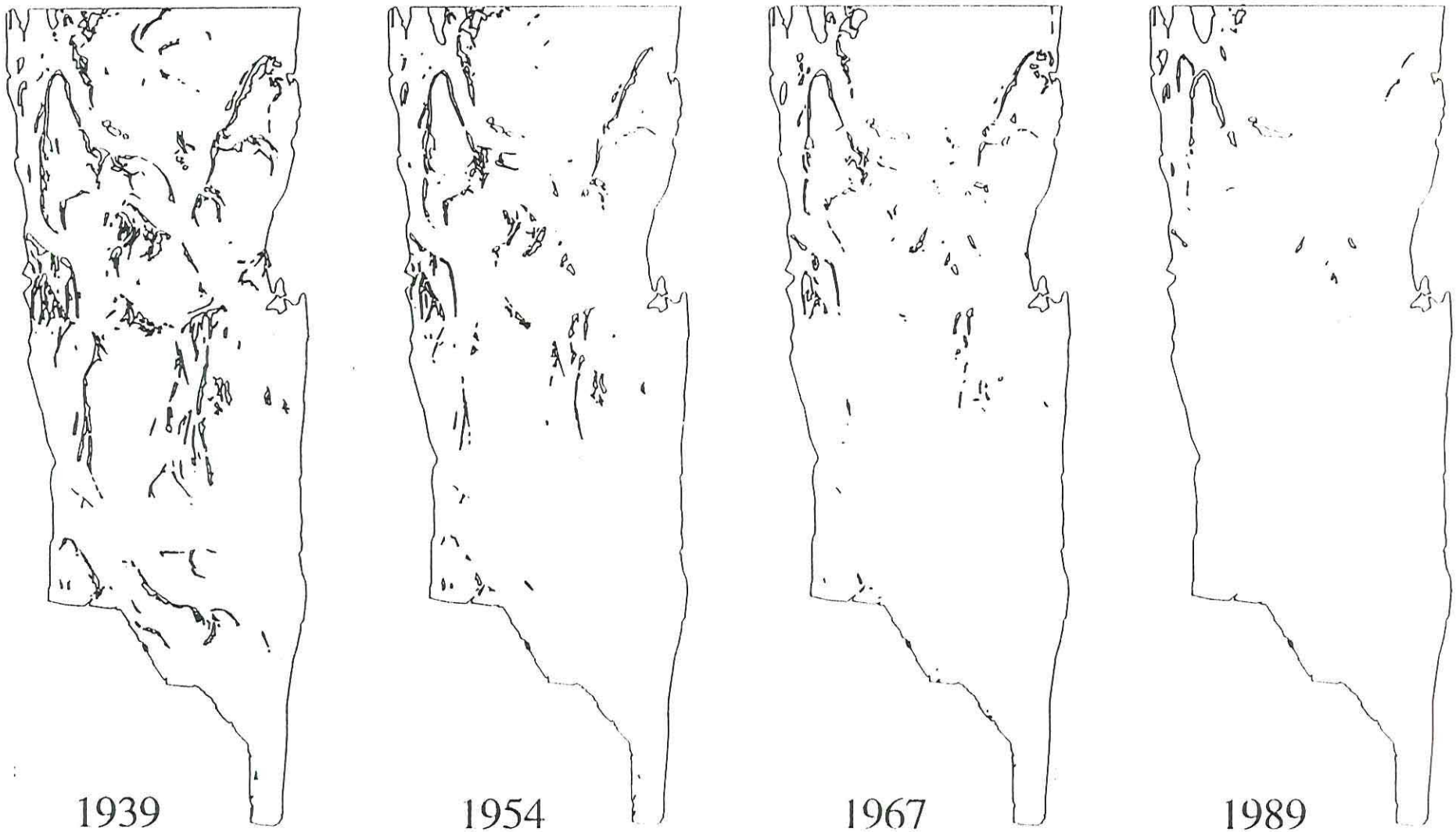


SECTION 2

STA. 0+50 TO STA. 23+00 ✳
STA. 27+60 TO STA. 55+20
NOTE: TRANSITION BERM WIDTH & SIDE SLOPE OF ISLAND ON BACKWATER SIDE, FROM SECTION 2 TO SECTION 3, BETWEEN STA. 55+20 AND STA. 55+40.

TYPICAL CROSS SECTION
USED IN
PHASE 1 CONSTRUCTION

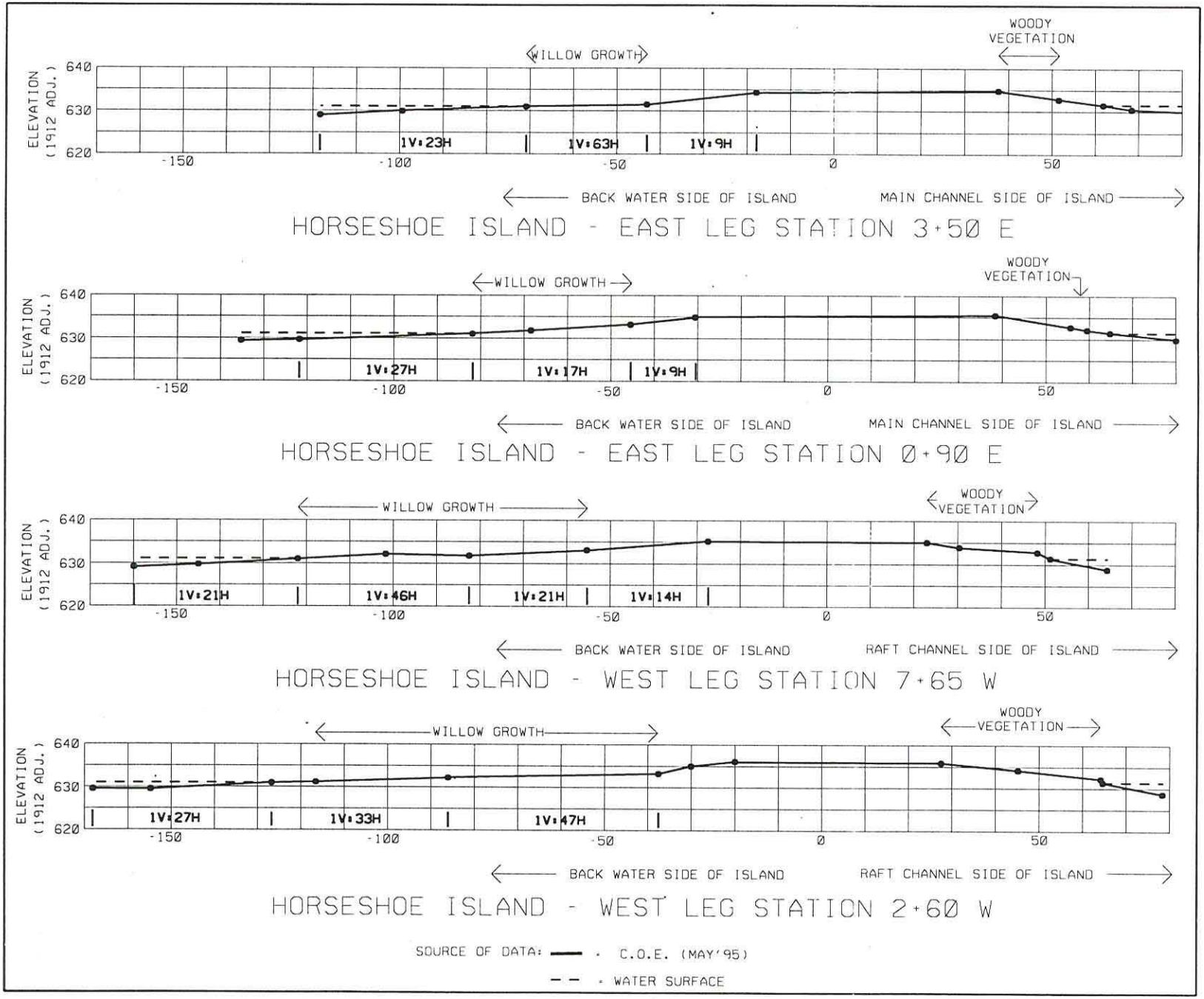
FIGURE 12



NOTE: SOURCE OF DATA - EMTC

LOWER POOL 8 ISLAND LOSS

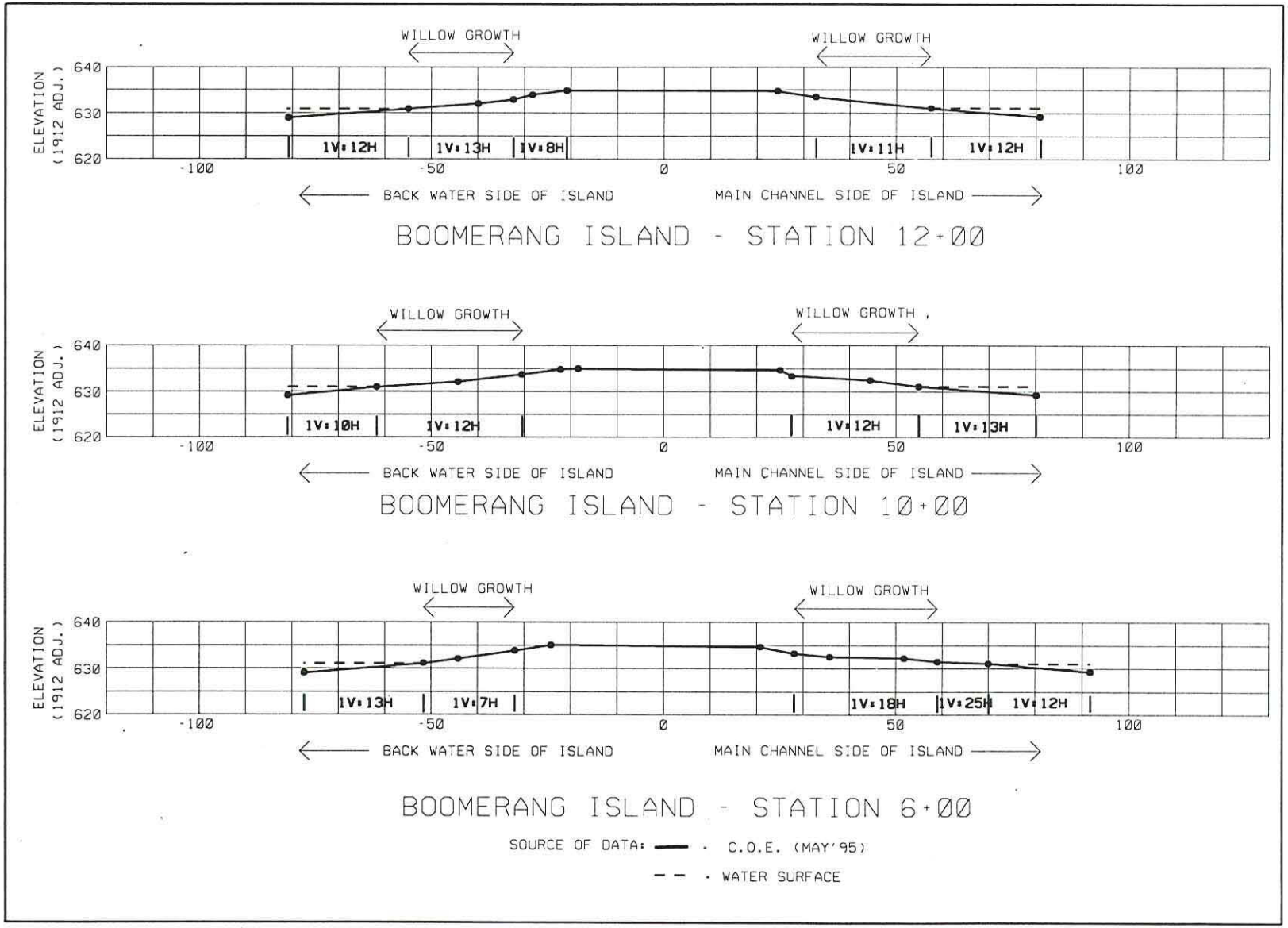
FIGURE 13



./p81sl.dgn May. 10. 1995 15:57:37

HORSESHOE ISLAND CROSS SECTIONS MAY 1995

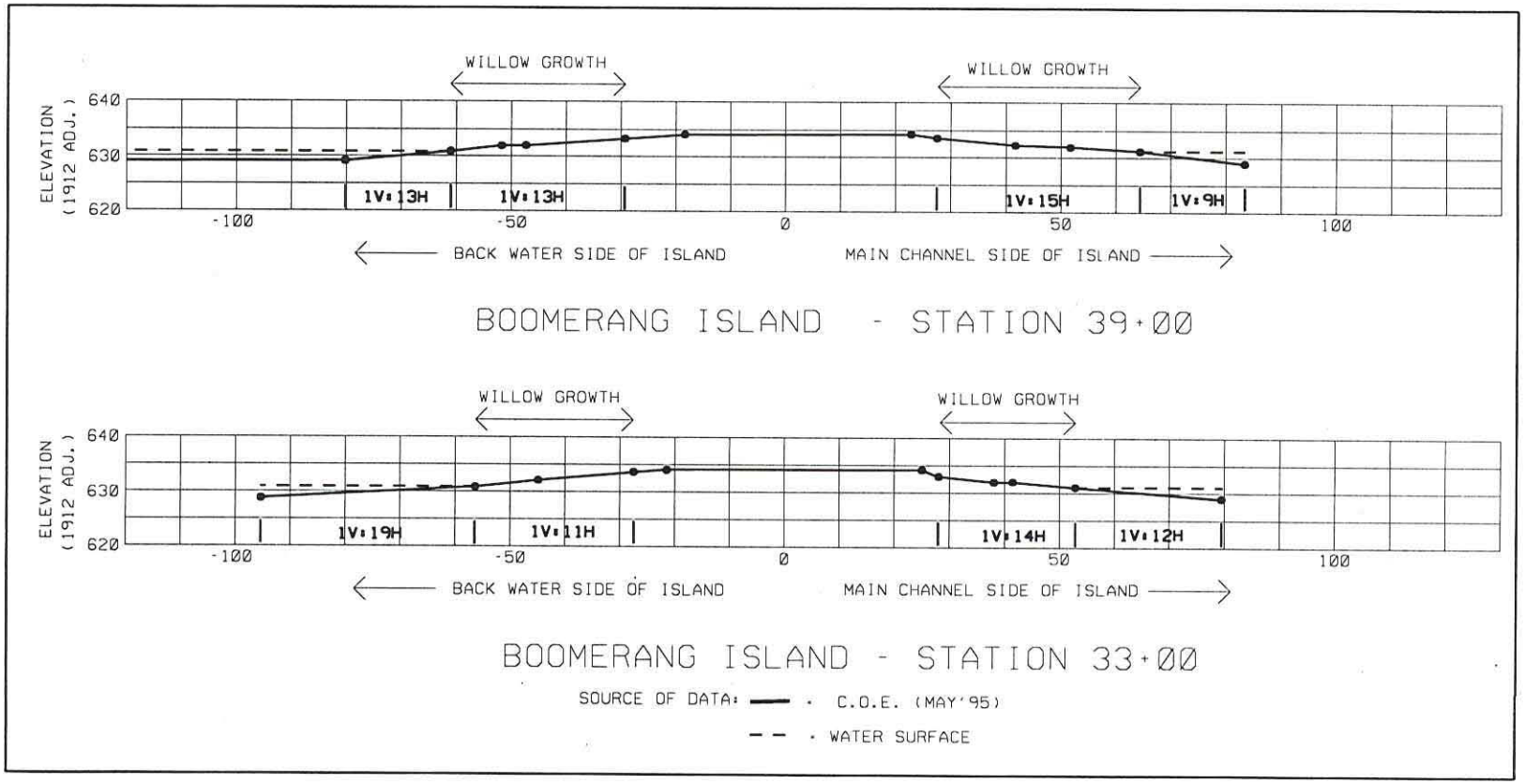
FIGURE 14



./p8isl.dgn May. 10, 1995 16:31:07

BOOMERANG ISLAND
CROSS SECTIONS
MAY 1995

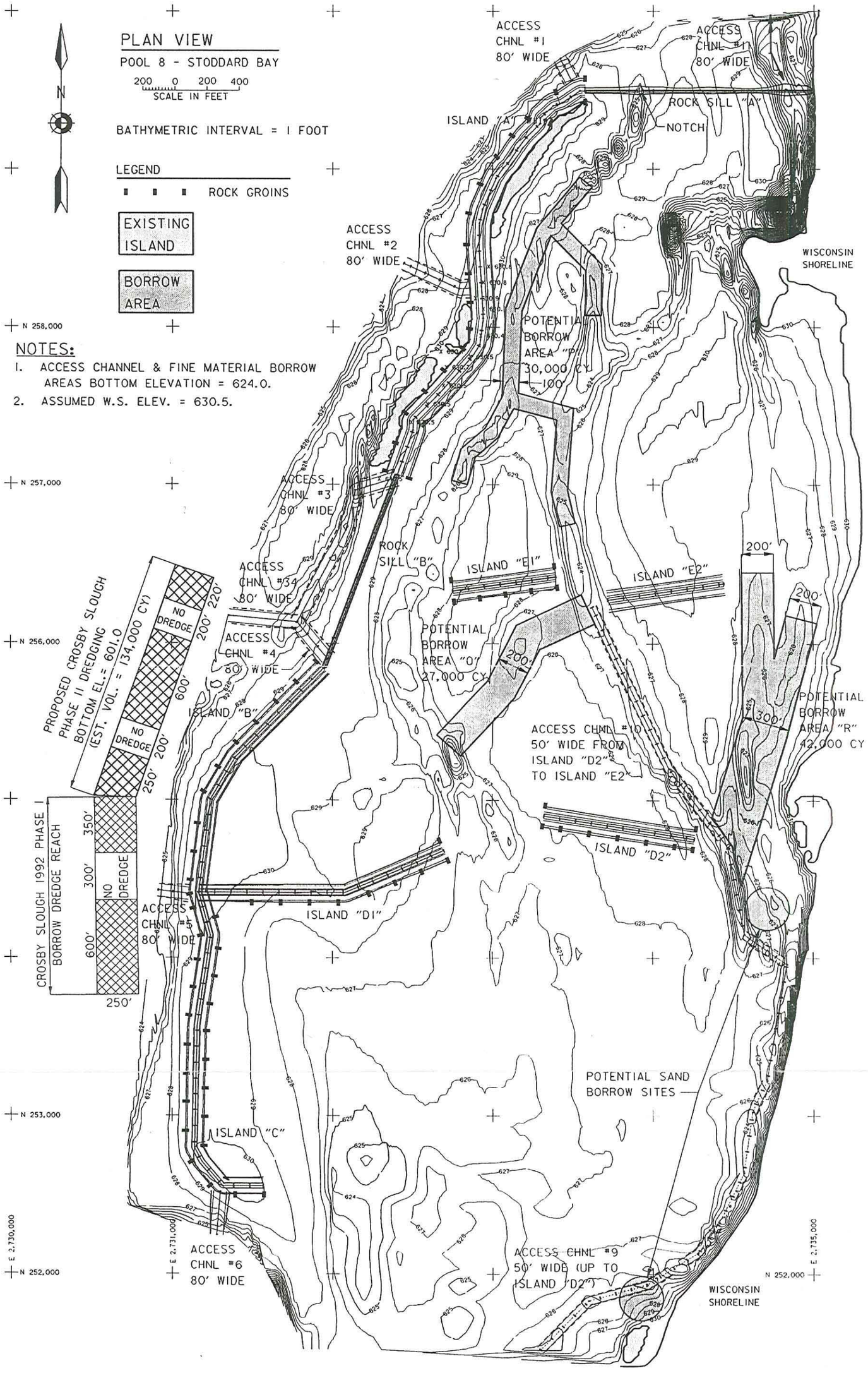
FIGURE 15



./p8isl.dgn May. 10, 1995 16:51:20

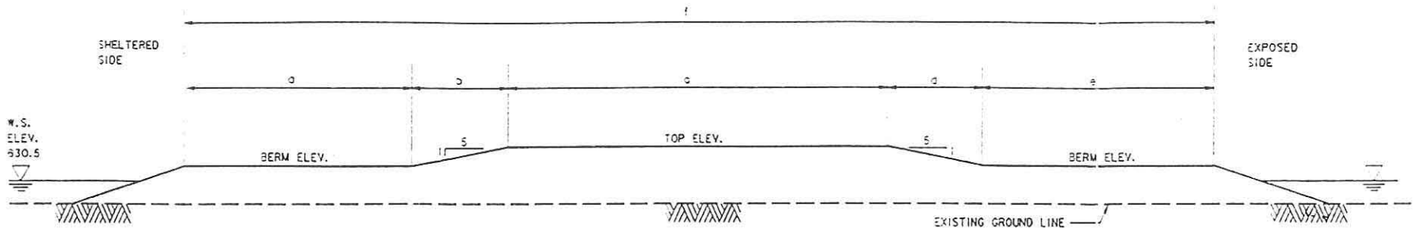
BOOMERANG ISLAND
CROSS SECTIONS
MAY 1995

FIGURE 16



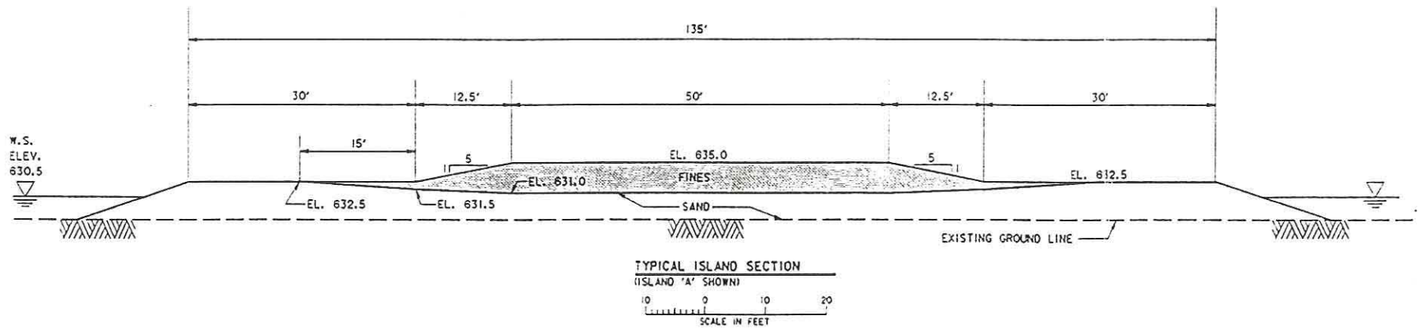
PLAN VIEW OF STODDARD BAY ISLANDS

FIGURE 17



TYPICAL ISLAND SECTION
(NOT TO SCALE)

ISLAND DIMENSIONS	a (FT)	b (FT)	c (FT)	d (FT)	e (FT)	TOP ELEV.	BERM ELEV.	f (FT)
ISLAND A	30	12.5	50	12.5	30	635.0	632.5	135
ISLAND B	20	7.5	30	7.5	30	634.0	632.5	95
ISLAND C U.S. 1,185 LF	30	5.0	30	5.0	30	633.5	632.5	100
ISLAND C D.S 1,000 LF	30	2.5	30	2.5	30	633.0	632.5	95
INTERIOR ISLAND D1	20	7.5	30	7.5	30	634.0	632.5	95
INTERIOR ISLANDS D2, E1, & E2	20	12.5	30	12.5	30	635.0	632.5	105
NESTING ISLANDS	20	12.5	30	12.5	30	635.0	632.5	105



TYPICAL ISLAND SECTION
(ISLAND 'A' SHOWN)

10 0 10 20
SCALE IN FEET

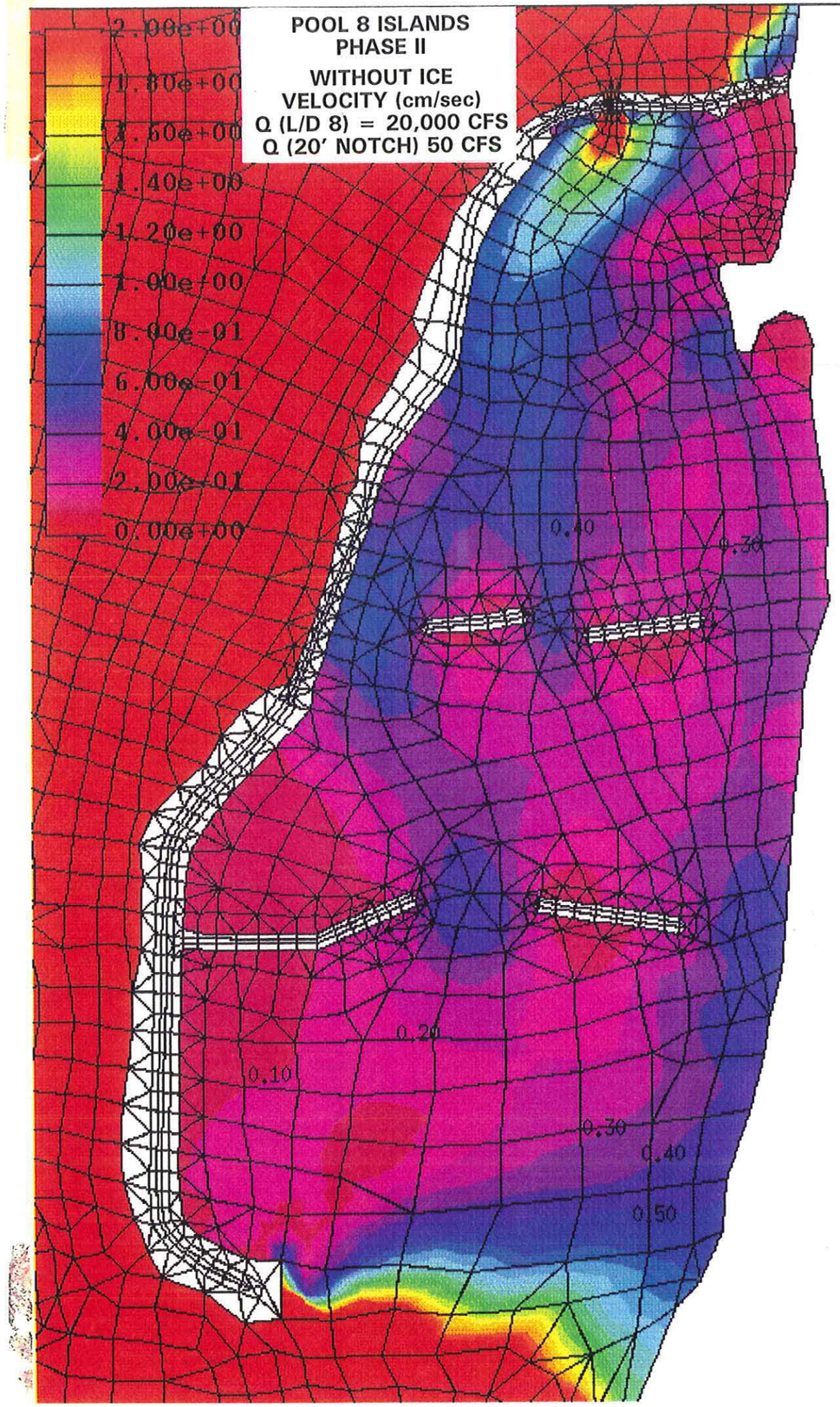
NOTES:
1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).

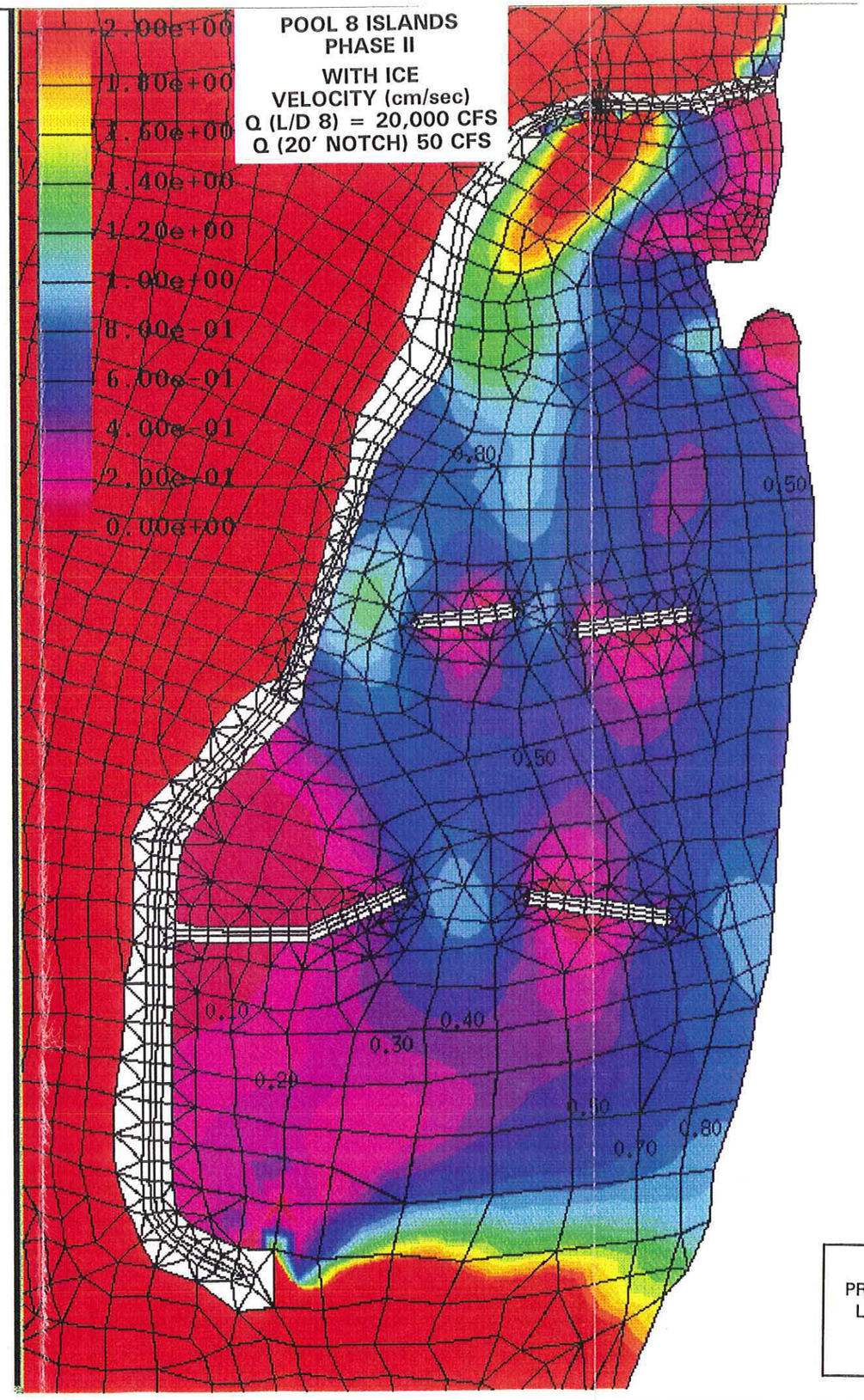
REFERENCES:
ISLAND PLAN AND CONTROL DATA

DWG. NO.
XX/XX

CROSS SECTION
OF
STODDARD BAY ISLANDS

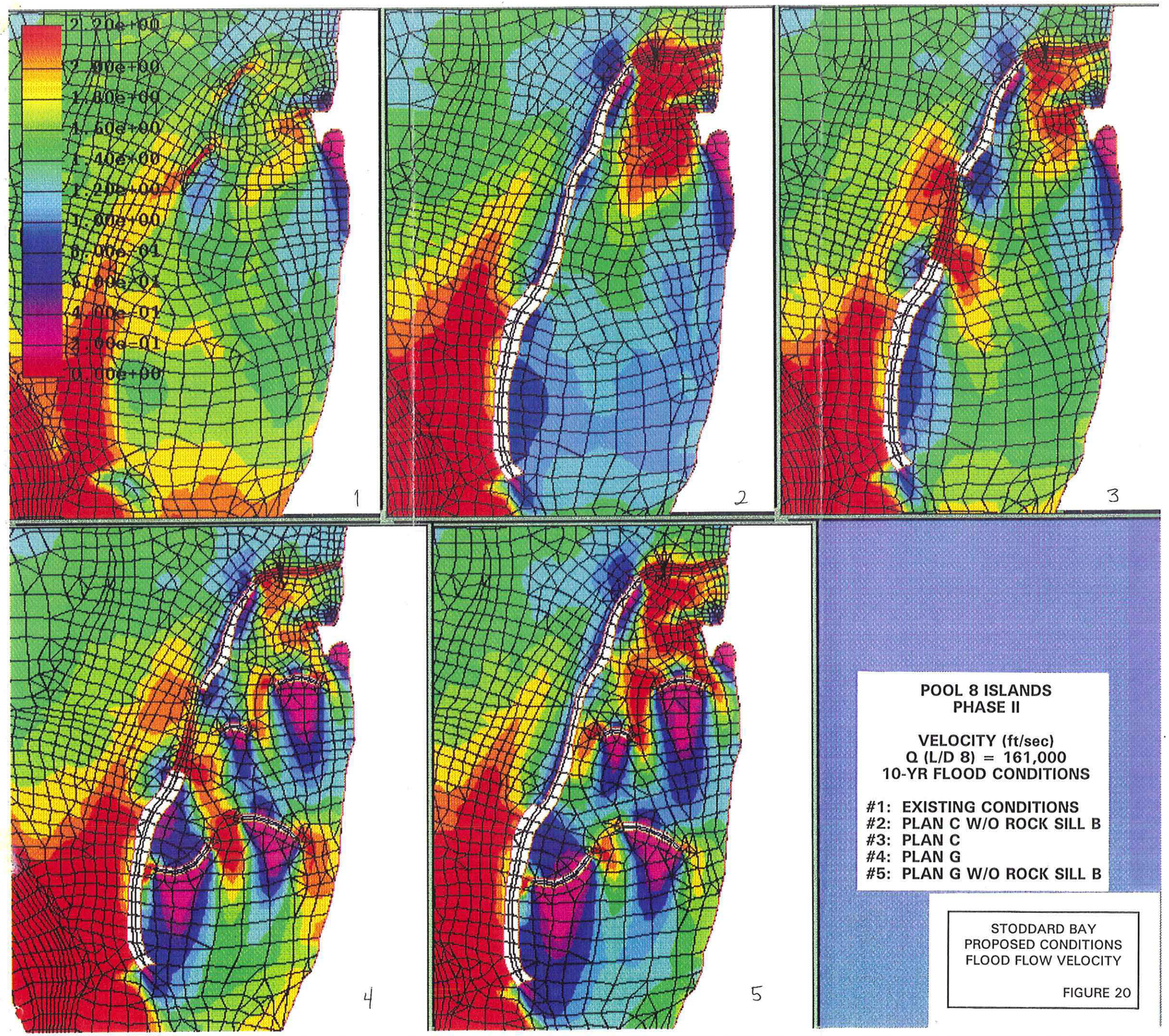
FIGURE 18





STODDARD BAY
PROPOSED CONDITIONS
LOW FLOW VELOCITY

FIGURE 19



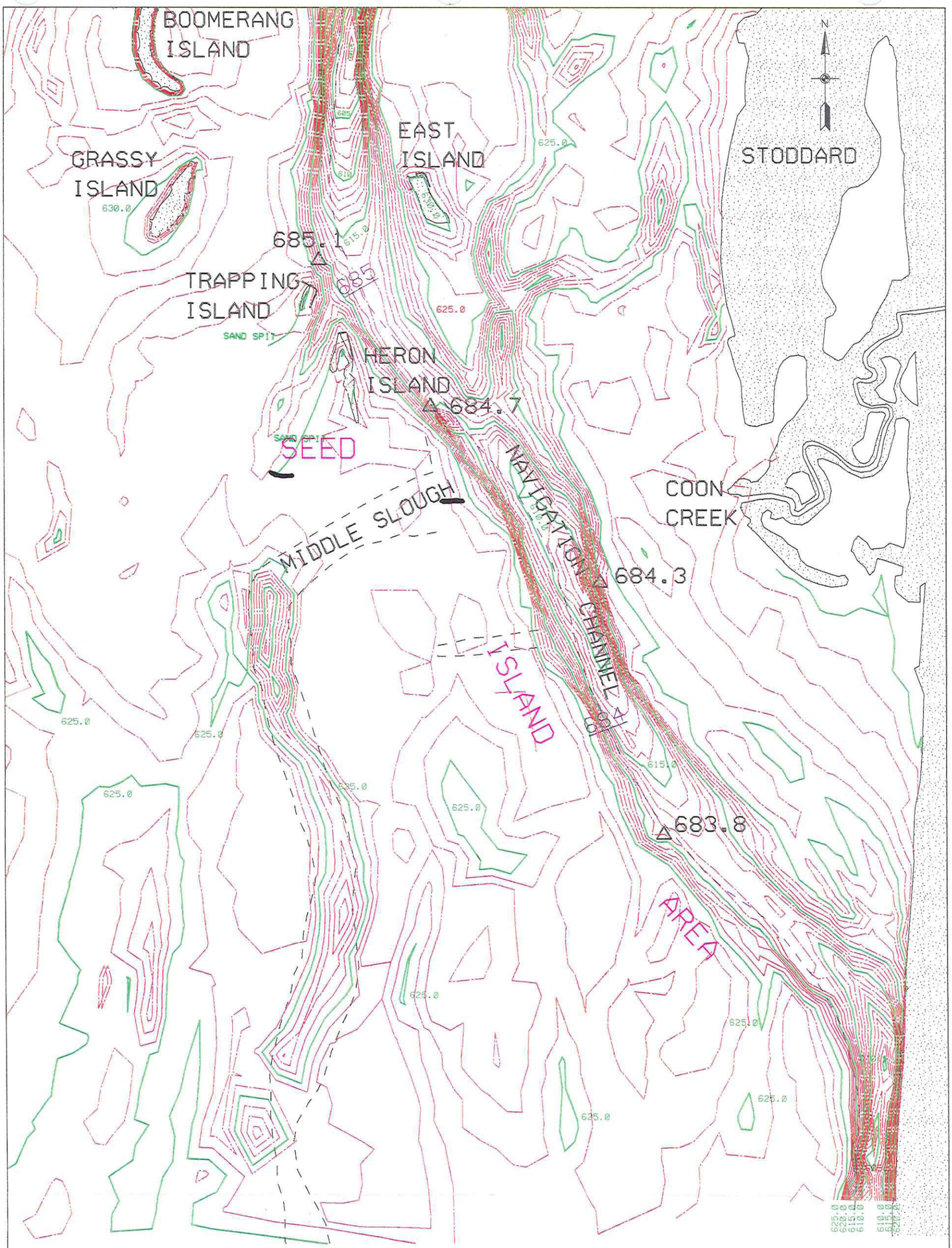
POOL 8 ISLANDS
PHASE II

VELOCITY (ft/sec)
Q (L/D 8) = 161,000
10-YR FLOOD CONDITIONS

#1: EXISTING CONDITIONS
#2: PLAN C W/O ROCK SILL B
#3: PLAN C
#4: PLAN G
#5: PLAN G W/O ROCK SILL B

STODDARD BAY
PROPOSED CONDITIONS
FLOOD FLOW VELOCITY

FIGURE 20



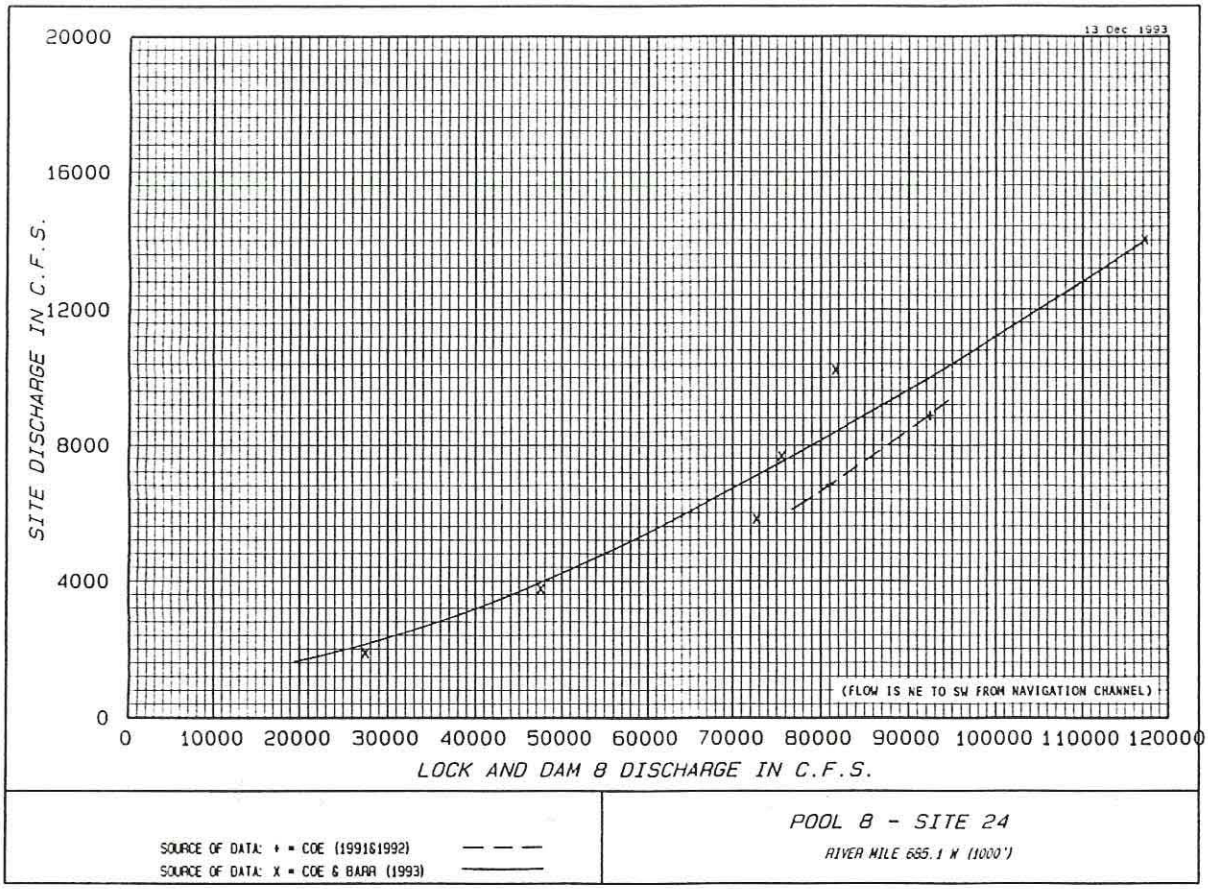
GENERAL LEGEND

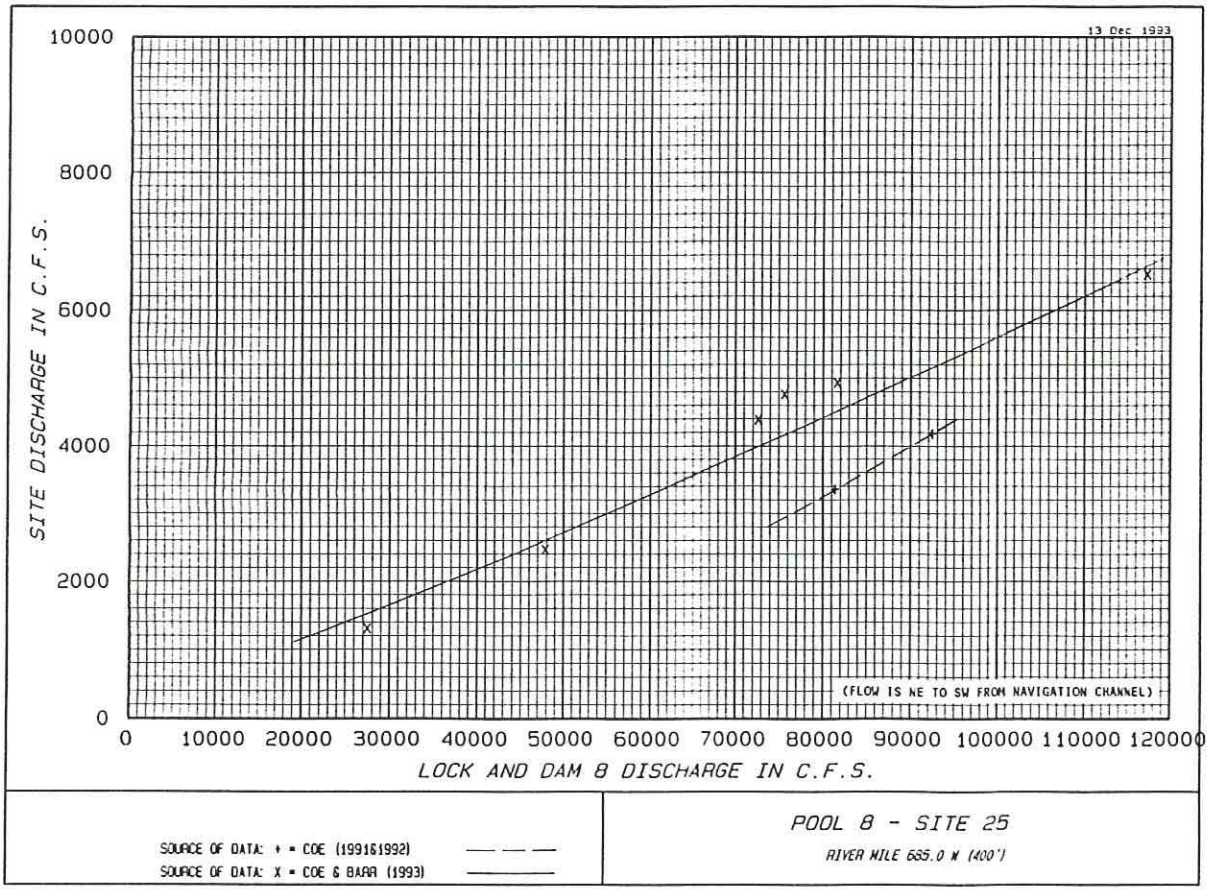
EXISTING SEED ISLANDS	684 RIVER MILE
5′ CONTOURS	△ DAYMARK
1′ CONTOURS	SLOUGH
LAND	WINGDAM

FIGURE 21

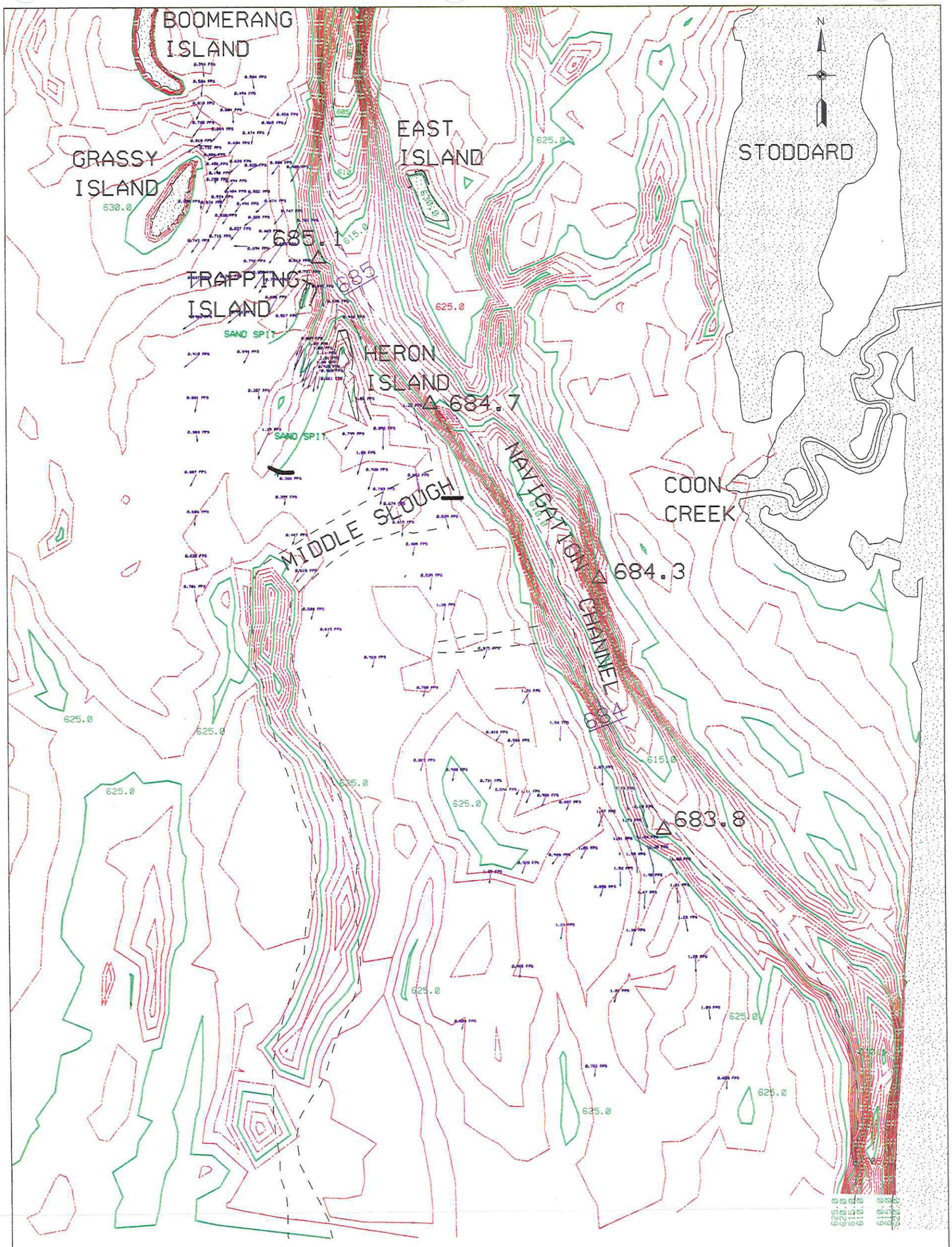
SEED ISLAND PROJECT AREA

FIGURE 21





POOL 8 DISCHARGE, SITES 24 AND 25 FIGURE 22

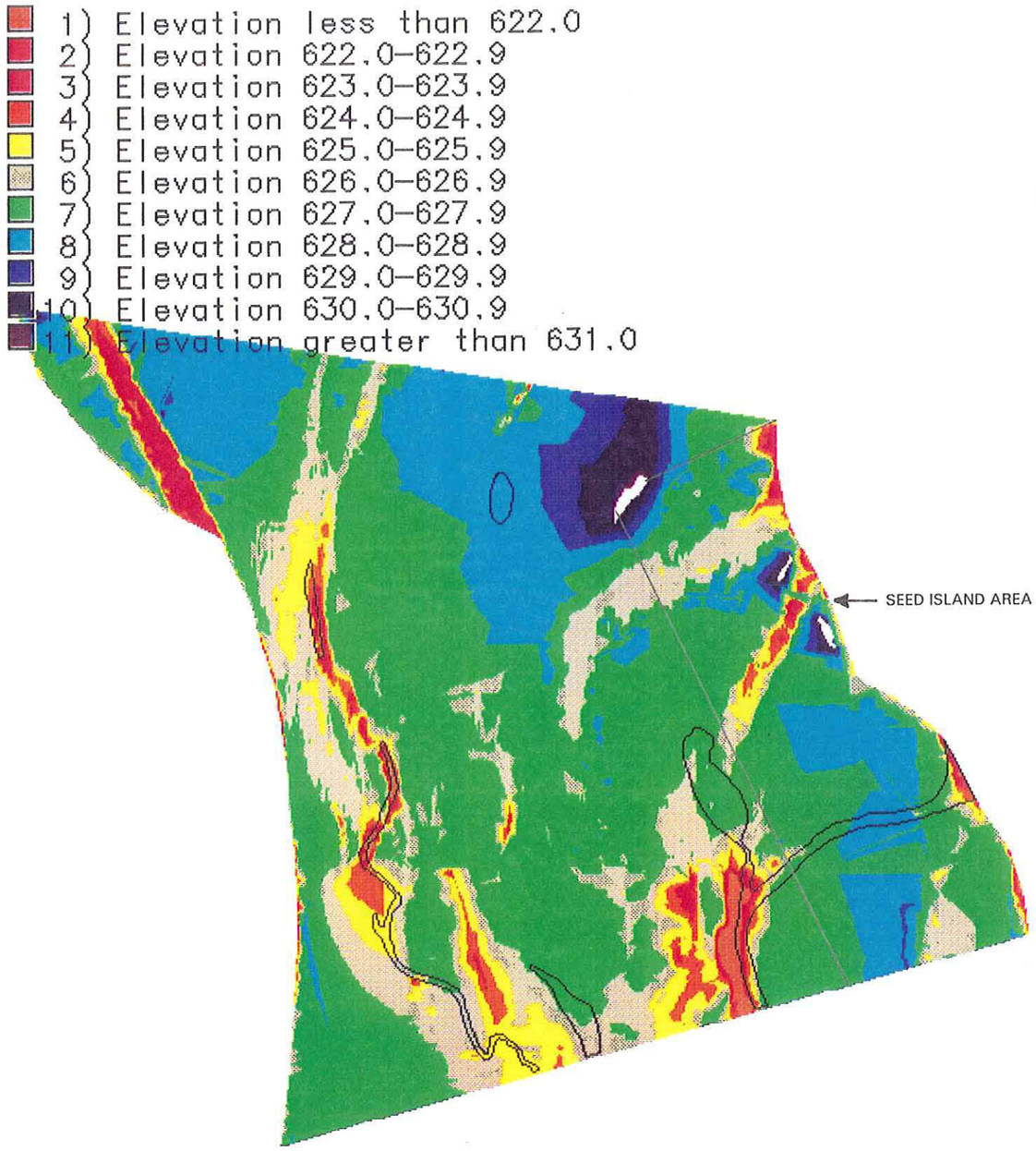


GENERAL LEGEND

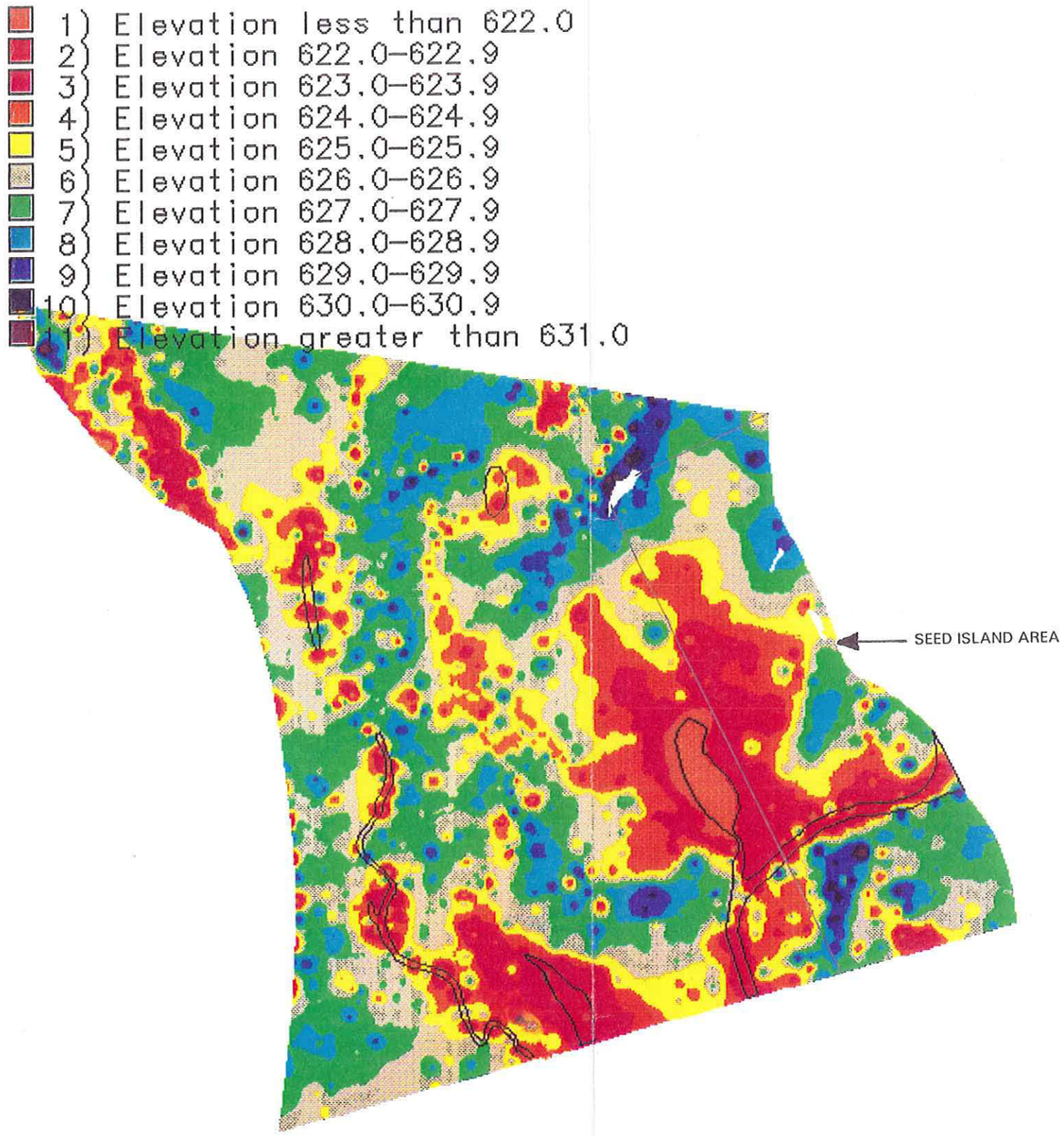
EXISTING SEED ISLANDS	VELOCITY VECTOR
5′ CONTOURS	684 RIVER MILE
1′ CONTOURS	△ DAYMARK
LAND	SLOUGH
	WINGDAM

FIGURE 23 SEED ISLANDS EXISTING FLOW VELOCITY AND DIRECTION

FIGURE 23



Raft Channel East
1991 Bathymetric Data

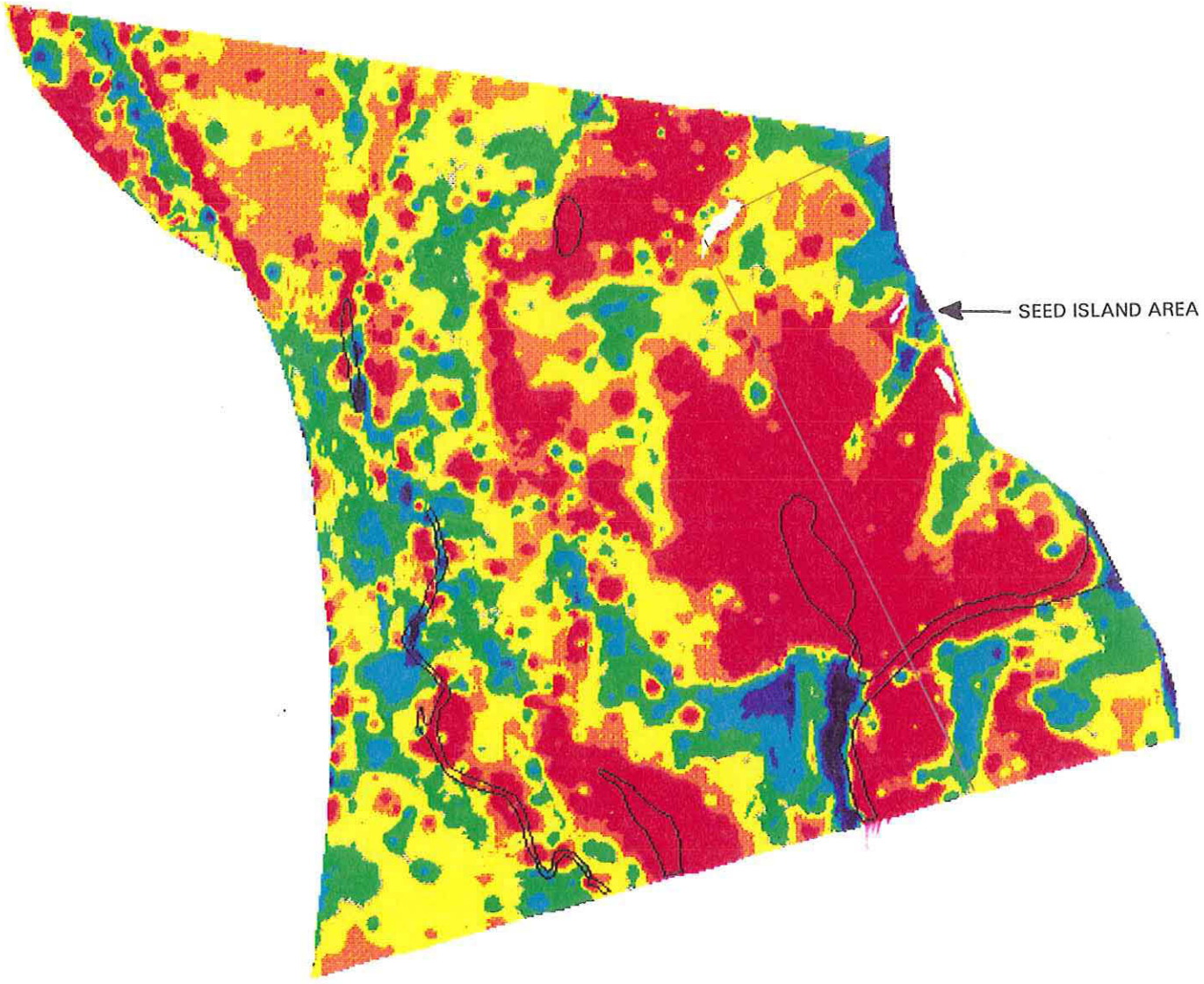


Raft Channel East
1932 Bathymetric Data

SEED ISLAND
BATHYMETRY
1932 AND 1991

FIGURE 24

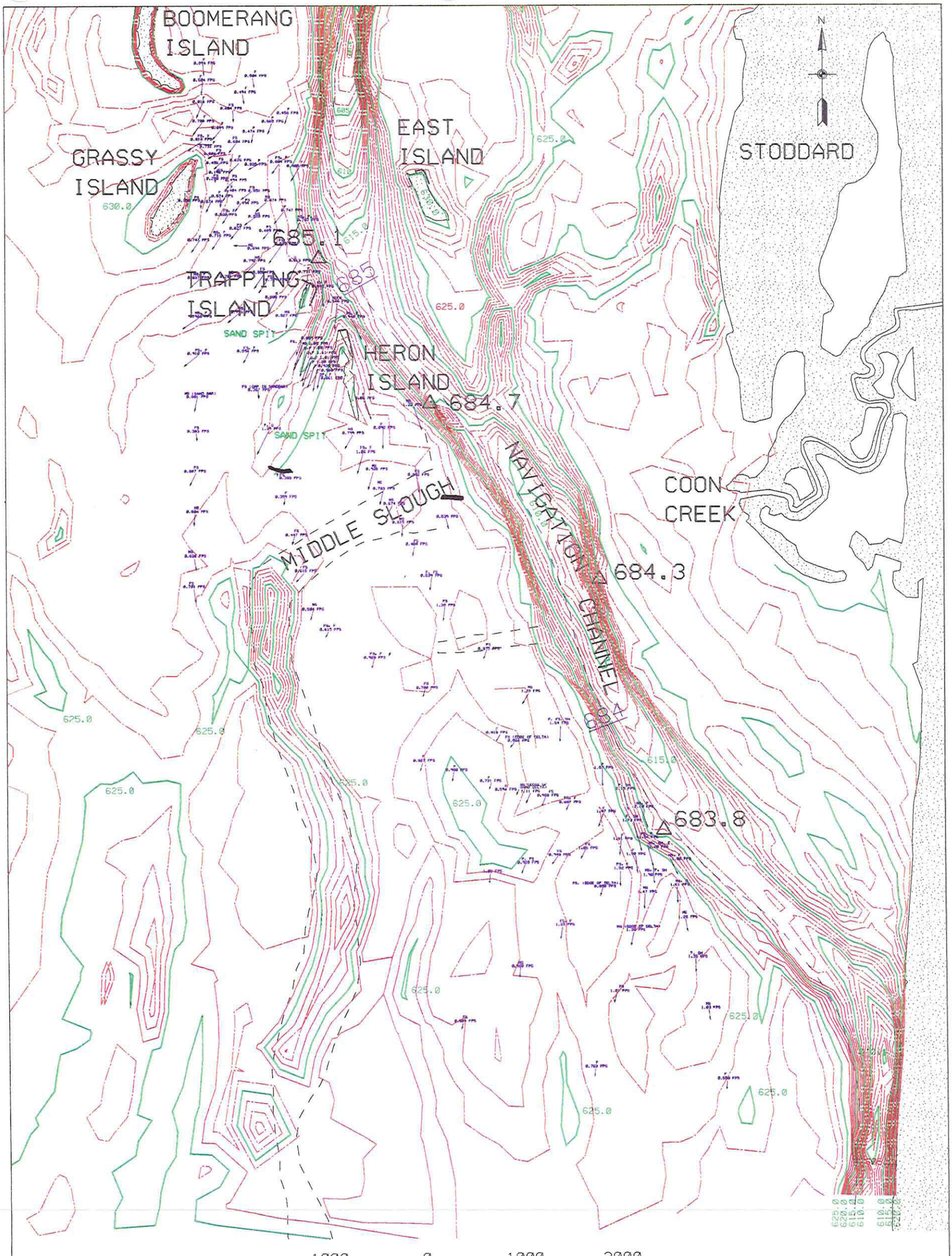
1) Erosion greater than 5.0 feet
2) Erosion of 3.1 to 5.0 feet
3) Erosion of 1.1 to 3.0 feet
4) Erosion of 0.1 to 1.0 feet
5) No Change
6) Deposition of 0.1 to 1.0 feet
7) Deposition of 1.1 to 2.0 feet
8) Deposition of 2.1 to 3.0 feet
9) Deposition greater than 3.0 feet



Raft Channel East
1932–1991 Depth Changes

SEED ISLAND
EROSION AND DEPOSITION
1932 TO 1991

FIGURE 25



GENERAL LEGEND

- EXISTING SEED ISLANDS
- 5' CONTOURS
- 1' CONTOURS
- LAND
- VELOCITY VECTOR
- 684 RIVER MILE
- △ DAYMARK
- SLOUGH
- WINGDAM

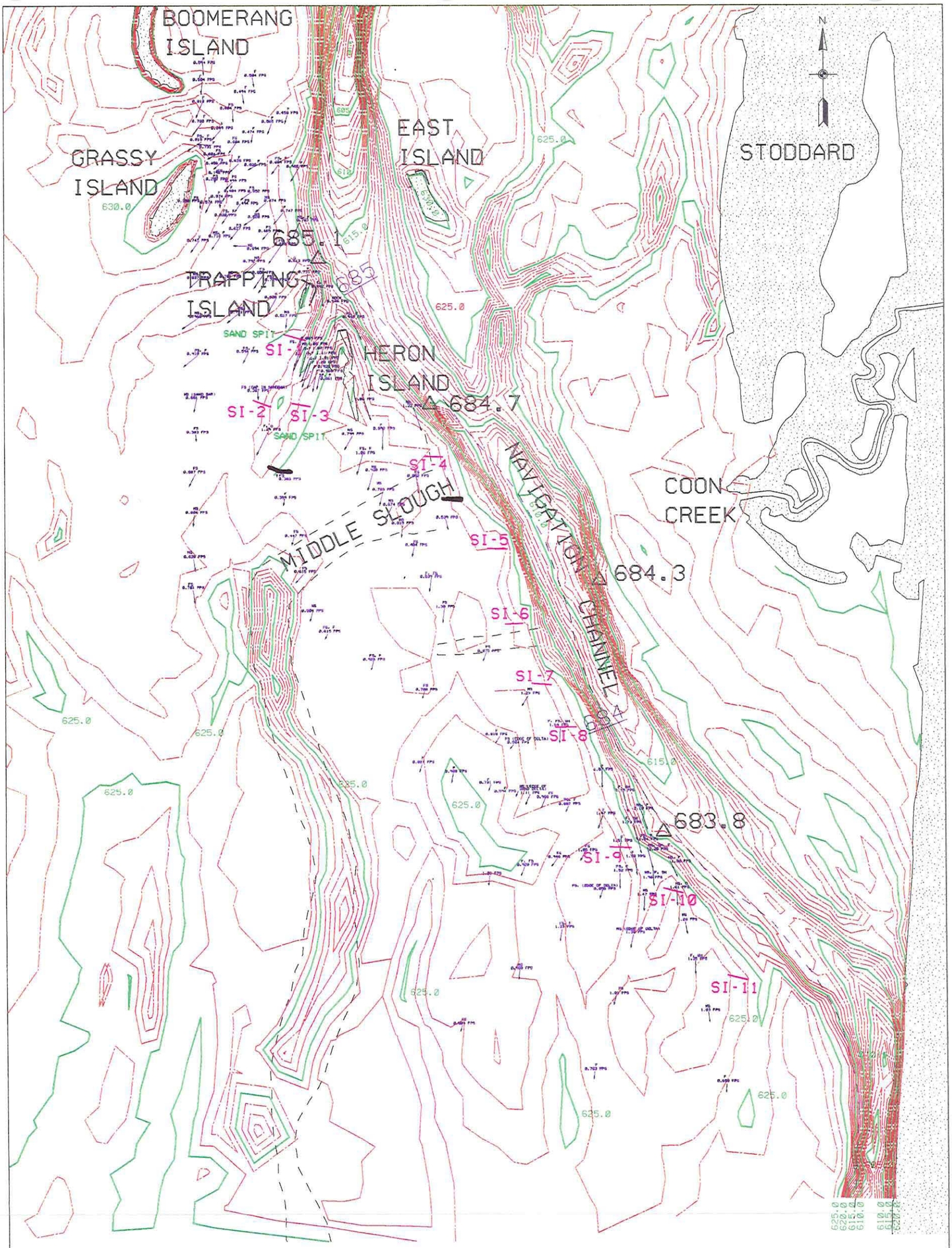
SEDIMENT LEGEND

- FS = FINE SAND
- MS = MEDIUM SAND
- G = GRAVEL
- F = FINES
- SH = SHELLS

FIGURE 26

SEED ISLAND SEDIMENT TYPES

FIGURE 26



GENERAL LEGEND

- PROPOSED SEED ISLANDS
- EXISTING SEED ISLANDS
- 5' CONTOURS
- 1' CONTOURS
- LAND
- VELOCITY VECTOR
- 684 RIVER MILE
- △ DAYMARK
- – – SLOUGH
- WINGDAM

SEDIMENT LEGEND

- FS = FINE SAND
- MS = MEDIUM SAND
- G = GRAVEL
- F = FINES
- SH = SHELLS

FIGURE 27

PLAN VIEW OF SEED ISLANDS

FIGURE 27

ATTACHMENT 6

GEOTECHNICAL APPENDIX

TABLE OF CONTENTS

GENERAL: 6-1

PHYSIOGRAPHY: 6-1

GENERAL GEOLOGY: 6-2

SELECTED PLAN SUMMARY: 6-2

SUBSURFACE INVESTIGATIONS: 6-2

ROCK SILL: 6-3

SLOPE STABILITY: 6-3

SETTLEMENT: 6-3

MATERIAL SOURCES: 6-4

ALTERNATIVE ANALYSIS: 6-4

ROCK SOURCES: 6-5

ROCK GRADATION: 6-5

FUTURE WORK: 6-5

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

POOL 8 PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL8, UPPER MISSISSIPPI RIVER
VERNON COUNTY, WISCONSIN AND
HOUSTON COUNTY, MINNESOTA

ATTACHMENT NO. 6
GEOTECHNICAL DESIGN

1. **GENERAL:** The geologic information was taken from The Physical Geography of Wisconsin, by Lawerence Martin, Wisconsin Geological and Natural History Survey and U.S.G.S. Hydrologic Investigations Atlas HA-474, by Young and Borman.

2. **PHYSIOGRAPHY:** The Mississippi River Navigation Pool No. 8 Islands, Habitat Rehabilitation and Enhancement Project (HREP) is located in the vicinity of river mile 686, adjacent to the village of Stoddard, Wisconsin in northern Vernon County. Along this portion of it's course, the Mississippi River Valley is located in the Central Lowlands Physiographic Province of the U.S. This physiographic province may be further subdivided into the Western Uplands Physiographic Region of Wisconsin. Approximately 3/4 of the Wisconsin Western Uplands was never overridden by ice during Pleistocene glaciation. This unique, unglaciated region is known as the Driftless Area. Topographic features evident in the Driftless Area today are thought to reflect conditions as they were over much of Wisconsin prior to glaciation.

3. The uplands region adjacent to the river has been dissected into a system of ridges and valleys with practically no broad upland areas remaining. Northern Vernon County is dominated by this ridge and valley topography, with ridge top elevations not exceeding 1100 to 1300 feet. The steep sided valleys are known locally as coulees.

4. Coon Creek cuts it's way through the Driftless Area as it flows west to join the Mississippi River at Stoddard. The grade of the creek is gentle enough so that it was once used as a railway route from Stoddard to Viroqua, Wisconsin.

5. The Mississippi River lies in a broad, bedrock gorge or trench. The gorge is a relatively youthful, U-shaped feature with steep-sided limestone bluffs rising 400-500 feet above river level on either side. In the Stoddard area the gorge is about 3 miles across. The river gradient is quite low, averaging less than 2 inches per mile during typical flow conditions. Side channels, meanders, and sloughs that typify low gradient conditions are conspicuously absent at the project location however. Well-developed sand and gravel terraces parallel the river, and a remnant of one is located in the Stoddard area.

6. **GENERAL GEOLOGY:** Although the Mississippi River gorge probably existed as long as 180 million years ago, the major geologic event that created the valley we see today occurred approximately 10,000 years ago, near the end of Pleistocene glaciation. During this period the Mississippi gorge was filled with glacial outwash sand and gravel deposits. After deposition of the outwash sediments, large volumes of meltwater from the southward outflow of glacial Lake Agassiz eroded the sands and gravels while simultaneously scouring and deepening the bedrock valley. As the meltwaters diminished, the deeply eroded gorge filled with up to 200 feet of river sands, gravels, clays, and silts. The large supply of sediment from the Mississippi headwaters and its tributary streams, coupled with a diminished water supply at the end of glacial melting, led to the development of a braided stream environment. River conditions were characterized by numerous channels, swampy depressions, natural levees, islands, and shallow lakes. Completion of Lock and Dam No. 8 (in 1935) flooded the area and obscured the braided stream characteristics. Lake-type sediments now form a relatively thin, stratified, veneer of organics, silts, sands, and clays over most of the present river bottom.

7. Bedrock exposures are readily observable along the Mississippi River bluffs. Ordovician period dolomites and limestones of the Prairie du Chien Formation cap the bluffs and ridges. In descending order, the cliffs and hillsides consist of the Jordan Sandstone, the St. Lawrence Formation dolomites and siltstones, Franconia Formation sandstones, and Dresbach Formation sandstones of the Cambrian period.

8. The bedrock Mississippi gorge is entrenched into the lowermost Cambrian period rock; the Dresbach Formation. This unit is comprised of marine-deposited quartz sandstones. The sandstone is relatively easy to erode, and this erodibility helps to account for the wide, U-shaped geometry of the bedrock gorge. Older Precambrian sedimentary and crystalline rocks lie below the Dresbach Formation and are assumed to be thousands of feet thick.

9. The structural geology of this portion of the Mississippi gorge has not been determined in detail. The sedimentary rocks dip gently and thicken to the southwest, conforming to the Precambrian basement. Solution weathering in the Ordovician period dolomites is common. Stress relief joints that tend to parallel the trend of the Mississippi gorge may also be observed in the river bluffs. This region is considered structurally stable and without tectonic disturbances of regional or local magnitude.

10. **SELECTED PLAN SUMMARY:** The selected plan is Alternative G with the seed islands. The plan view of Alternative G is shown on Plate 14 with the cross sections shown on Plate 15 and 16. The plan view of the seed islands is shown on Plate 18 with the cross sections shown on Plate 15. The selected plan includes a total of 2,800 feet of rock sill with a trapezoidal cross section shown on Plate 15. The plan also includes a total of 11,125 feet of islands with a cross section shown on Plate 16. Costs for alternative G are shown on p. 54 and the cost estimate for the seed islands is on p. 57

11. **SUBSURFACE INVESTIGATIONS:** A total of 46 borings and 15 surface probes were

obtained for the Pool 8 project. The borings were taken by the Corps and the surface probes were taken by the Wisconsin Department of Natural Resources (WSDNR). The locations for all the borings and probes taken are shown on Plates 6-1 , 6-2, and 6-3 with the logs shown on Plates 6-3 through 6-12. Borings 95-40M, 90-16M, 90-15M, and 95-41M were taken near the alignment of the proposed islands. These borings show an upper layer of soft to very soft fine grained material followed by a layer of sand mixed with fine grained soil and generally the last layer is a clean to silty, sand.

12. **ROCK SILL:** A geotextile will be placed with-in both the rock sills to reduce the flow through them to the goal of 0.3 cm/second. The geotextile should have a permittivity no greater than 0.4/second. The alternatives to this plan that were looked at and rejected are as follows:

- Sand core with geotextile filter. At shallow locations there would be no core. Also, the layer of rock would allow too much flow through it. The top of rock cannot be raised either, because the conveyance is needed for flood flows.

- Using bentonite plugs as used for bore holes. There is no way of prohibiting the top of the plug from starting to erode during overtopping of the structure. Once the top of the plug started eroding, it would only take a short time for the entire plug to erode.

- Smaller rock gradation or "dirtier" gradation. Slightly smaller rock would not reduce velocities to the desired goal. A gradation with a high percentage of fines would be expensive to place in a manner that would retain the fines.

- Sheetpile is obviously far too expensive.

13. **SLOPE STABILITY:** A slope stability analysis using EM 1110-2-1913 was completed for only Case I: end-of-construction conditions because this is the only case that applies. An analysis of the typical proposed island cross section, the estimated critical cross section during construction, and the spillway cross section was done. These analyses used the computer program UTEXAS3 and the soil stratigraphy from boring 95-40M. The shear-strength parameter used was from the unconfined compression test shown on Plate 6-13. Results of the computer analyses are shown on Plates 6-14 to 6-16. All of the sections were stable assuming a shear strength of 700 psf. Only one sample was tested, though, so the soil strength in some locations may be below 700 psf. In areas where the shear strength of the soil is below 200 psf, the factor of safety of the critical section will be below the 1.3 that is required. If there are areas of weaker soils, they may slump during construction. This will necessitate special construction techniques and/or greater quantities of fill.

14. **SETTLEMENT:** The potential settlement of the islands was estimated using the CSETT computer program. The consolidation test results are shown on Plate 6-17 with the CSETT assumptions and results shown on Plate 6-18. Soil stratigraphy from boring no. 95-40M was assumed because it was the boring with the thickest clay layer making it the worst case. A negligible amount (under 2 inches) of settlement was computed for this stratigraphy. The

displacement of the rock and sand was assumed to be one foot. A one foot displacement was used for estimating the quantity of riprap to be placed for the Pool 9 EMP Project and that estimate was close to the actual quantities placed.

15. **MATERIAL SOURCES:** All the borrow area locations are shown in the main report. The majority of borrow for the pervious fill will come from the Crosby Slough. The rest of the pervious fill will come from a borrow area by the Stoddard boat landing. Borings 91-34M, 91-35M, and 95-44M show that this area will provide satisfactory pervious fill. More borings will be taken during Plans and Specifications to define the quantity of pervious fill in this area. Several surface probes were taken in the proposed fine-grained borrow areas and they show up to three feet of suitable borrow. Also, boring no. 95-46 located near one borrow area shows a top layer of fines.

16. **CONSTRUCTIBILITY:** This project proposes constructing islands by hydraulicly placing sand dredged from Crosby Slough. Pool 8 Islands Phase I was constructed by the same technique in an area just across the Mississippi River which has a similar geologic history. The construction was completed with a minimum of difficulty. Islands A, B, and C will be placed in locations where islands have existed in the past so the soils in this area will be at least somewhat over-consolidated. The construction of islands D and E will also be slightly over-consolidated.. The seed islands will be constructed of rock with one access location for each island. One way of constructing them would be to construct a rock platform up to the water surface, first, and then build the rest of the island up to the water surface out from there. The rest of the rock, up to the proposed crest could then be placed from the end of the island back to the access location. A second way of constructing them is to access dredge to the center point of the island and construct the whole island from there with a large enough piece of equipment. This was the method used by the contractor that constructed the first seed islands we built in another contract.

17. **ALTERNATIVE ANALYSIS:** An alternate method of constructing Island E2 was evaluated. The method involved simply side casting adjacent material to build the island. This method had the potential of being much less expensive than the normal construction method while being more advantageous for the fish habitat. The method was rejected for the following reasons:

a. The channel bottom in the area of Island E2 is covered with a layer of either lean clay or silt which when placed underwater would be suspended when placed under water. Side slopes would be very gradual under the water thus increasing the reach required for the construction equipment and the amount of time required to build the island.

b. The material to be side casted is extremely erodible. As the fill emerged from the water, even very small waves would start to erode it.

c. For the Peoria Lake EMP Project in the Rock Island District, islands were constructed by sidecasting and it was found that a seven cubic yard bucket was needed even for sidecasting highly plastic clays. The Swan Lake EMP Project in the St. Louis District is

currently being constructed. Its contract documents require the contractor to use a seven cubic yard bucket because of the Peoria Lake experience. The bids for the Swan Lake EMP Project were about four times as high as for normal construction methods.

18. **ROCK SOURCES:** Both rockfill and riprap are available locally. Numerous limestone and dolomite quarries have been developed near the Mississippi River valley. Acceptable quality rock for this project is available within a 10 mile radius of the Pool 8 project.

19. **ROCK GRADATION:** The calculation of the minimum weight of the 50 percent-less-than-by-weight rock for the rockfill is explained in the Hydraulic Appendix. This weight was increased because of the Fish and Wildlife Service's concern that vandals would move the rock, greatly reducing the project's effectiveness. The selected gradation is shown on Plate 6-19 and in the table below.

Table: Rock Gradation

Percent Less than by Weight:	Maximum (lbs.)	Minimum (lbs.):
100	630	200
50	170	70
15	60	15
5	42	5

20. **FUTURE WORK:** Additional borings will be taken during the preparation of Plans and Specifications to refine the definition of the pervious-fill borrow area near the Stoddard boat landing. Further design will also be completed on the geotextile with-in both of the rock sills.

PLAN

2000 0 2000

SCALE IN FEET

REFERENCES:

BORING LOGS

DWG NO.

10/13 THRU 10/18

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER

POOL 8 VERNON COUNTY, WISCONSIN

POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2

BORING LOCATION

ED-D: DESIGNED: JJG; CHECKED: JBM; DRAWN: GRS

ED-CH: DESIGNED: AMK; CHECKED: DWR

DATE: JULY 1991

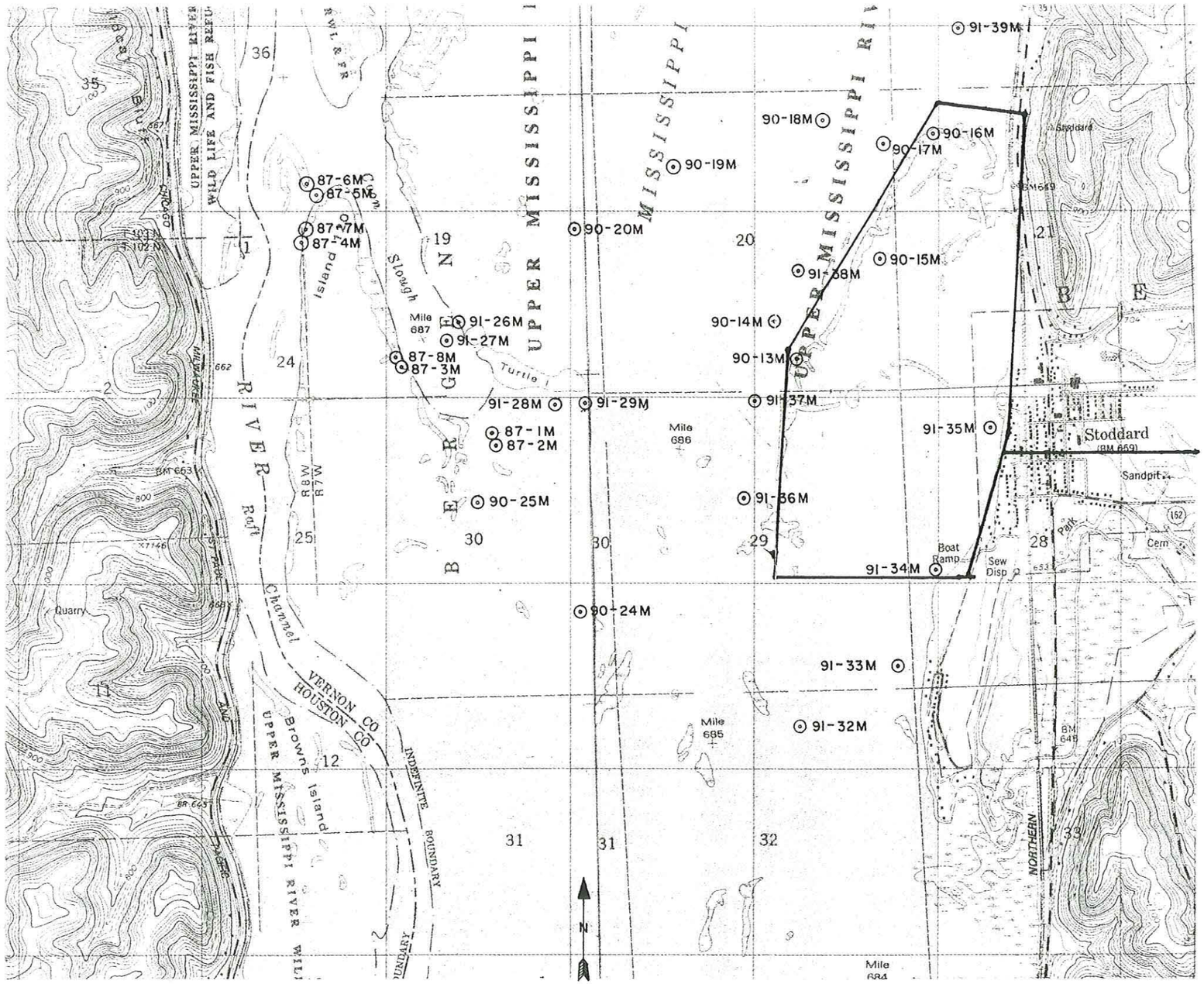
CAD FILE NAME:

SPEC NO:

PLATE 6-1

SHT OF

EN ENG
HYD
HYDR
EOTECH
ENG
MEA



PLAN

2000 0 2000

SCALE IN FEET

Detail of this area is shown on Plate 6-3 which shows locations of 95-40M through 96-51M and locations of surface probes ST01 through ST14.

REFERENCES:
BORING LOGS

DWG NO.
10/13 THRU 10/18

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

ENVIRONMENTAL MANAGMENT PROGRAM-MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN

POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2
BORING LOCATION

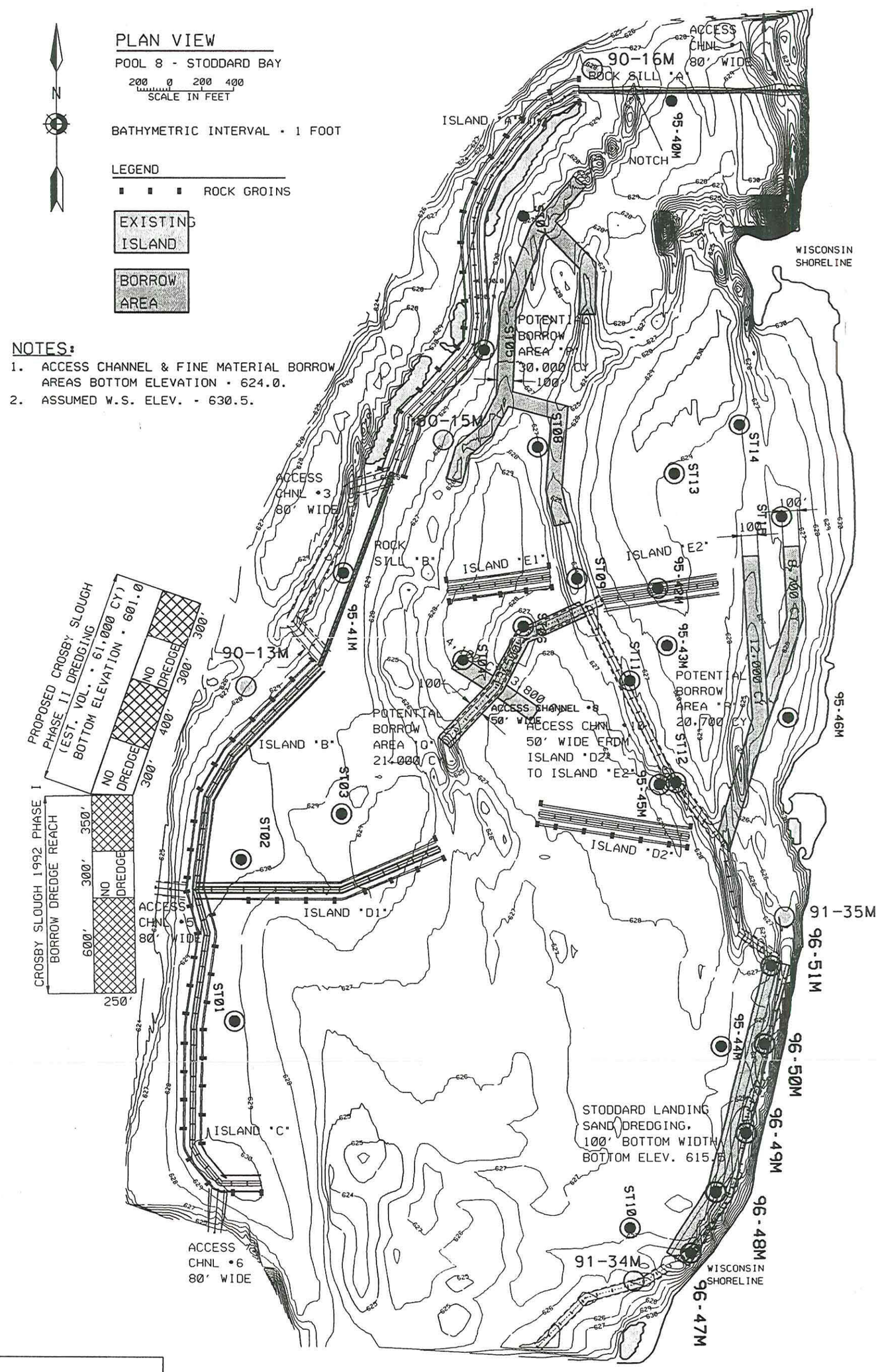
ED-D: DESIGNED: JJG; CHECKED: JBM; DRAWN: GRS
ED-CM: DESIGNED: AMK; CHECKED: DWR; DATE: JULY 1991

CAD FILE NAME:
SPEC NO:

PLATE 6-2

SHT
OF

EN ENG
HYD
HYDR
EOTECH
R ENG
MEA



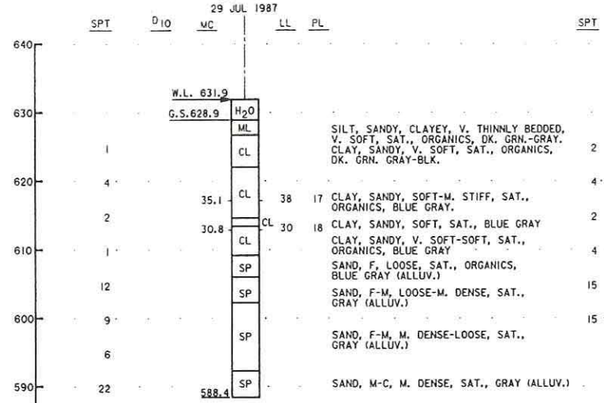
POOL 8 ISLANDS PHASE II

PLATE 6-3

Boring No. 90-13M, 90-15M, 90-16M, 91-34M, and 91-35M are also shown on Plate 6-2

87-1M

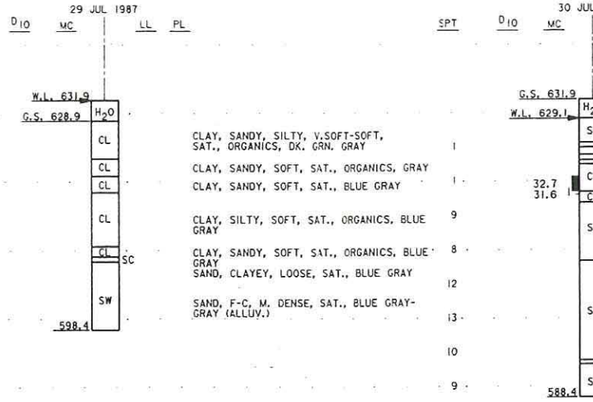
29 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

87-2M

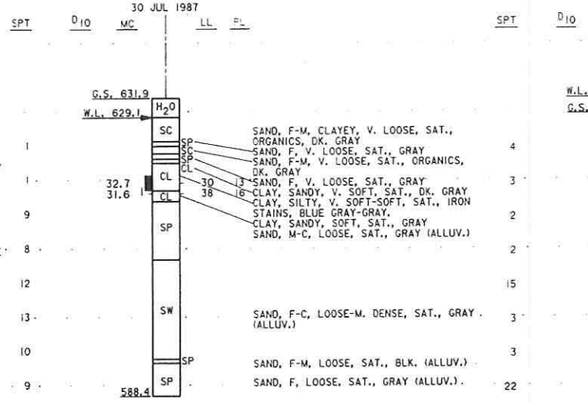
29 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

87-3M

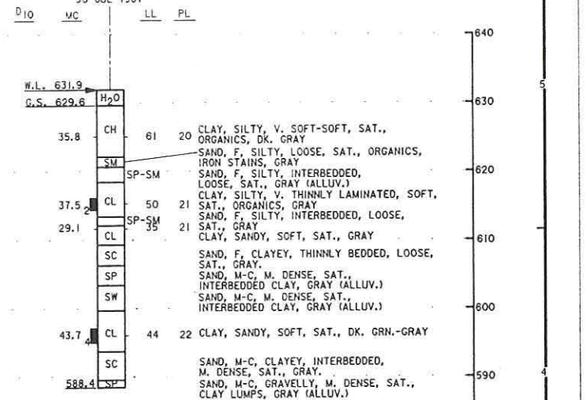
30 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. 5-INCH UNDISTURBED SAMPLE OBTAINED IN OFFSET HOLE.
4. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
5. HOLE DRILLED FROM A BARGE.

87-4M

30 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. 5-INCH UNDISTURBED SAMPLES OBTAINED IN OFFSET HOLE.
4. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
5. HOLE DRILLED FROM A BARGE.

GENERAL BORING LEGEND

84-1M — YEAR OF BORING-BORING NUMBER, BORING TYPE (EG: M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER).

1 MAY 1984 — DATE OF BORING

G.S. 1020.2 — GROUND SURFACE ELEVATION AT BORING

GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURE, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS, LIQUID LIMIT LESS THAN 50
MH	INORGANIC SILTS, LIQUID LIMIT GREATER THAN 50
CL	INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY, LIQUID LIMIT LESS THAN 50
CH	INORGANIC CLAYS, HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
OL	ORGANIC SILTS OR CLAYS, LOW PLASTICITY, LIQUID LIMIT LESS THAN 50
OH	ORGANIC SILTS OR CLAYS, MEDIUM TO HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
PT	PEAT
SP-SM	BORDERLINE MATERIAL
SP&SM	STRATIFIED MATERIAL
1	LOCATION AND SAMPLE NUMBER FOR UNDISTURBED SAMPLE
	NO RECOVERY
W.L. 726.7	WATER LEVEL ON DATE OF BORING
700	ELEVATION AT BOTTOM OF BORING

GENERAL BORING NOTES

1. GENERAL: THE UNIFIED SOIL CLASSIFICATION SYSTEM IS USED TO IDENTIFY BASIC SOIL TYPE. THE LEGEND REPRESENTS ONLY THE BASIC SOILS. TO COMPLETE THE CLASSIFICATION, PERTINENT INFORMATION IS ADDED TO THE RIGHT OF THE BORING STAFF. NOTES PERTAINING TO A SPECIFIC BORING ARE SHOWN BELOW THE BORING STAFF.

2. MOISTURE CONTENT: THE NATURAL MOISTURE CONTENT IN PERCENT OF DRY WEIGHT (MC) IS SHOWN TO THE LEFT OF THE BORING STAFF.

3. BLOW COUNT (SPT): BLOW COUNTS ARE SHOWN TO THE LEFT OF THE BORING STAFF AND, EXCEPT AS NOTED, ARE THE NUMBER OF BLOWS NECESSARY TO DRIVE THE SAMPLER USED A DISTANCE OF 12". STANDARD BLOW COUNTS ARE FOR A STANDARD PENETRATION TEST (SPT) USING A 1-3/8" X 2" SAMPLER, 140 LB. HAMMER AND A 30" DROP. FOR NON-STANDARD BLOW COUNTS, SAMPLER SIZE, HAMMER WEIGHT AND HEIGHT OF DROP ARE AS SHOWN.

4. ATTERBERG LIMITS: LIQUID LIMIT (LL) AND PLASTIC LIMIT (PL) ARE SHOWN TO THE RIGHT OF THE BORING STAFF.

5. D_{10} SIZE: THE GRAIN SIZE IN MILLIMETERS OF WHICH 10% OF THE SAMPLE IS FINER IS SHOWN TO THE LEFT OF THE BORING STAFF.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL: _____

ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER

POOL 8 — VERNON COUNTY, WISCONSIN

POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2
BORING LOGS
BORING LEGEND, GENERAL NOTES, LOGS 87-1M THRU 87-4M

ED-D: DESIGNED: ; CHECKED: ; DRAWN: GRS
ED-CH: DESIGNED: AMK/PAW ; CHECKED: AMK/TJH
DATE: 07-12-91

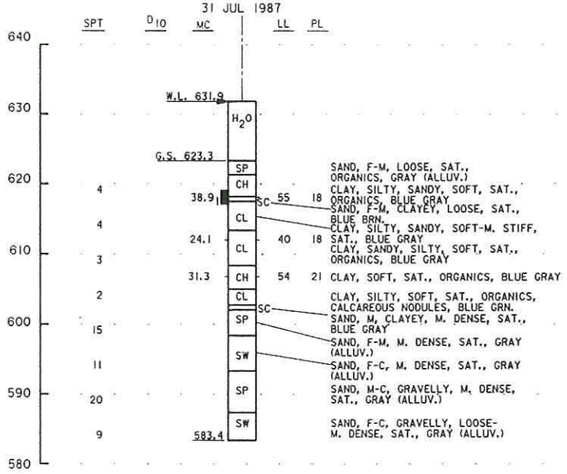
CAD FILE NAME: M8I8P000.DGN
SPEC NO: DACW37-91-B-0009

PLATE 6-4

SHT
OF

87-5M

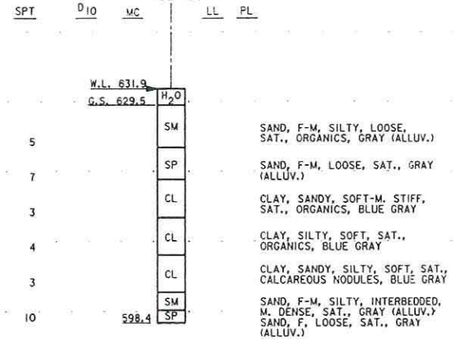
31 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. 5-INCH UNDISTURBED SAMPLES OBTAINED IN OFFSET HOLE.
4. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
5. HOLE DRILLED FROM A BARGE.

87-6M

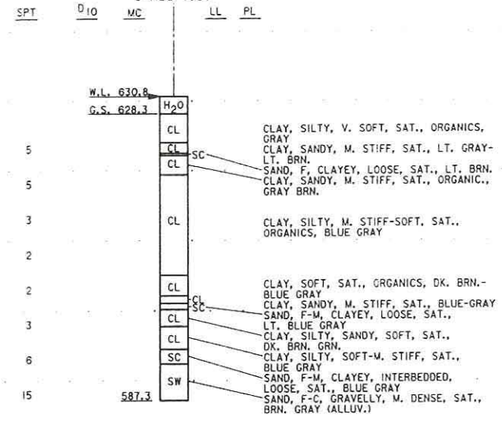
31 JUL 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 618.9 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

87-7M

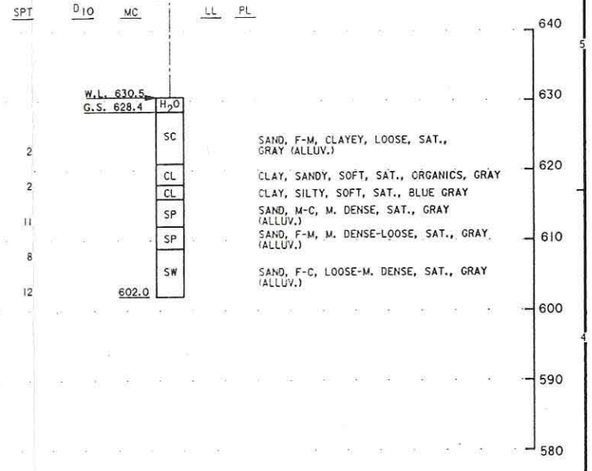
3 AUG 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 617.8 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

87-8M

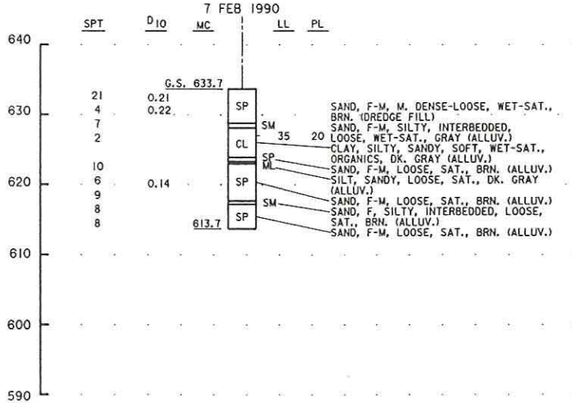
4 AUG 1987



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 617.5 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

90-9M

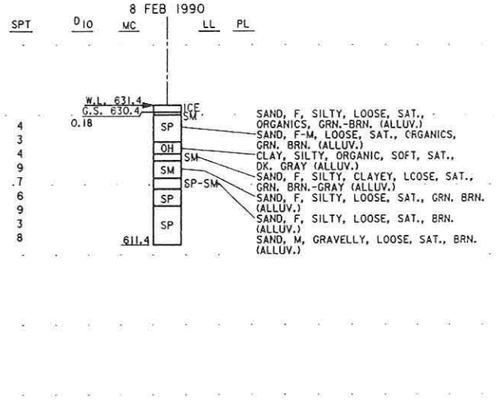
7 FEB 1990



NOTES:
1. WATER LEVEL NOT DETERMINED.
2. HSA ADVANCED TO EL. 627.7 AND DRILLING MUD USED BELOW.
3. HOLE BACKFILLED WITH BENTONITE DRILLING MUD AND SAND BELOW EL. 628.7 AND SAND ONLY ABOVE EL. 628.7.

90-10M

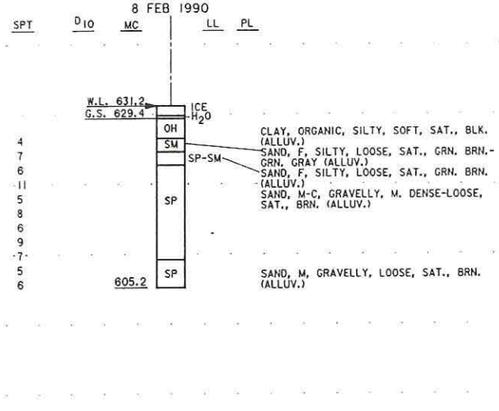
8 FEB 1990



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. HSA ADVANCED TO EL. 626.4 AND DRILLING MUD USED BELOW.
3. HSA REMOVED AND HOLE ALLOWED TO CAVE IN.

90-11M

8 FEB 1990



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. HSA ADVANCED TO EL. 621.2. DRILLING MUD USED BELOW EL. 626.2.
3. HSA REMOVED AND HOLE ALLOWED TO CAVE IN.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

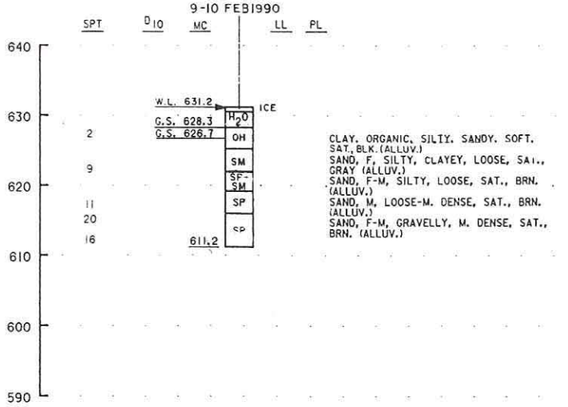
AE APPROVING OFFICIAL:

ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN
POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2
BORING LOGS
LOGS 87-5M THRU 87-8M AND 90-9M THRU 90-11M

ED-D: DESIGNED: | CHECKED: | DRAWN: GRS
ED-CH: DESIGNED: AMK/PAW | CHECKED: AMK/TJH
DATE: 07-12-91
CAD FILE NAME: M8I8POOL.DGN
SPEC NO: DACW37-91-B-0009
SHT
OF

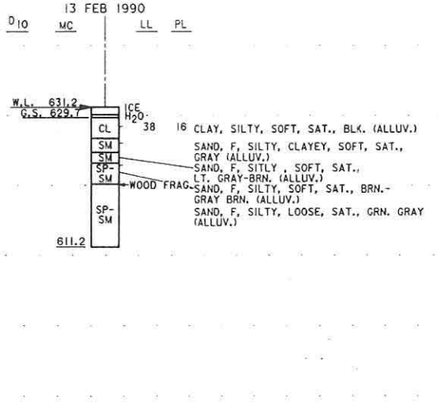
PLATE 6-5

90-12M
9-10 FEB 1990



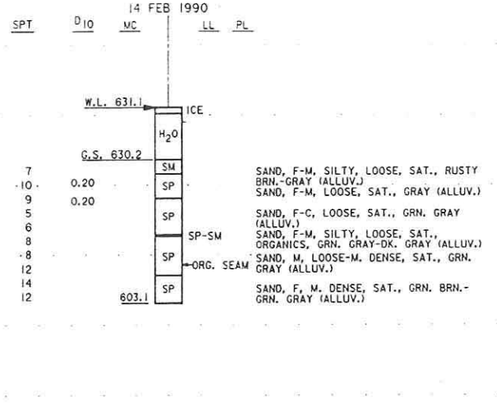
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 621.2. DRILLING MUD USED BELOW EL. 626.2.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-13M
13 FEB 1990



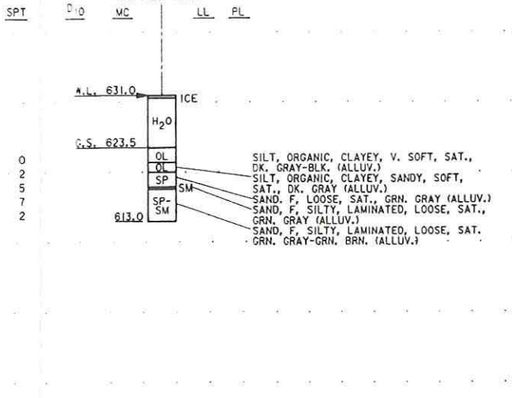
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 617.2. DRILLING MUD USED BELOW EL. 627.2.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-14M
14 FEB 1990



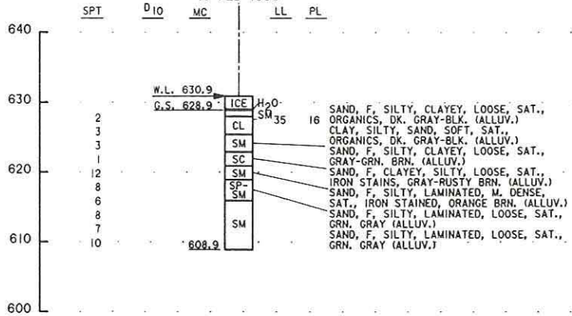
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING SET TO EL. 621.1 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-15M
15 FEB 1990



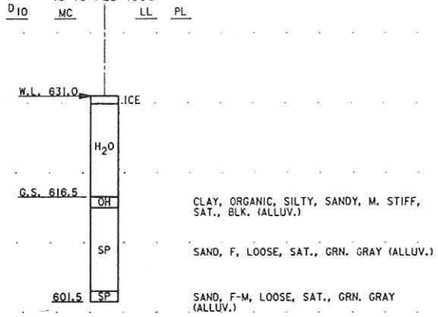
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING SET TO EL. 621.0 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-16M
15 FEB 1990



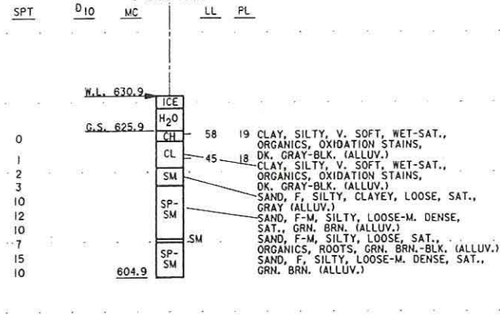
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 620.9. AND DRILLING MUD USED BELOW EL. 626.9.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-17M
15-16 FEB 1990



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 611.0. DRILLING MUD USED BELOW EL. 614.5.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-18M
9 JAN 1990



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 618.9
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

ED-D
DESIGNED:
CHECKED:
DRAWN: GRS

CON
DESIGNED: AMK/PAW
CHECKED: AMK/TJH
DATE: 07-12-91

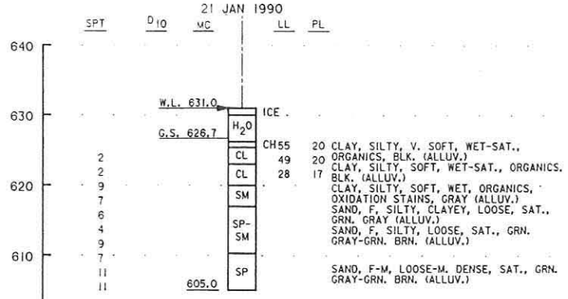
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN
POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2
BORING LOGS
LOGS 90-12M THRU 90-18M

CAD FILE NAME: M8I8P002.DGN
SPEC NO: DACW37-91-B-0009

PLATE 6-6

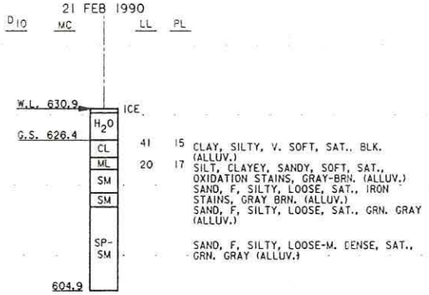
SHT
OF

90-19M
21 JAN 1990



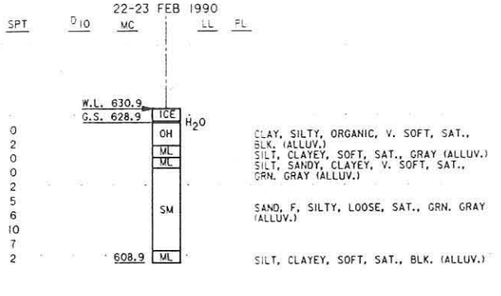
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 621.0. DRILLING MUD USED BELOW EL. 625.0.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-20M
21 FEB 1990



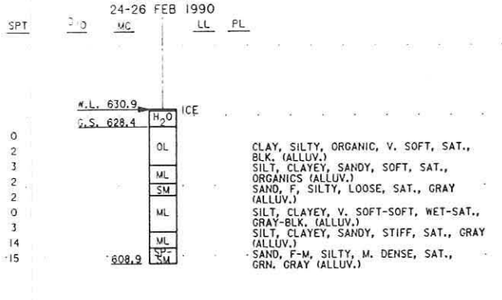
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 620.9. DRILLING MUD USED BELOW EL. 624.9.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-21M
22-23 FEB 1990



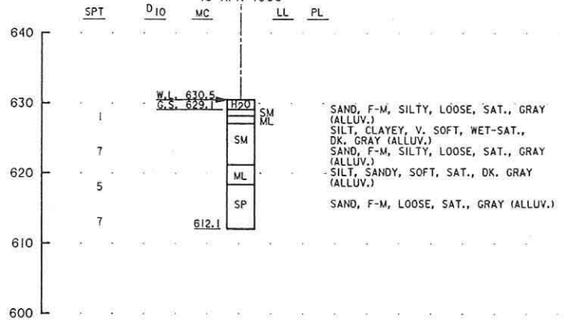
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 620.9. DRILLING MUD USED BELOW EL. 626.9.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-22M
24-26 FEB 1990



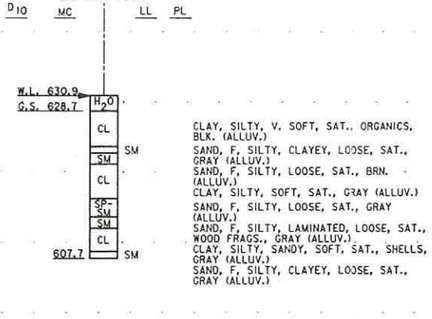
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 3-INCH CASING ADVANCED TO EL. 620.9. DRILLING MUD USED BELOW EL. 626.9.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-23M
18 APR 1990



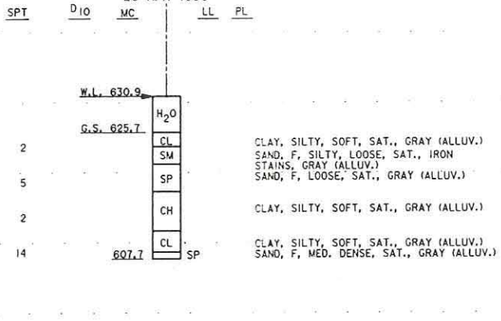
NOTES:
1. WATER LEVEL = AVERAGE BETWEEN L/D 7 TAILWATER (630.96) AND L/D 8 HEADWATER (630.12).
2. 4-INCH CASING SET TO EL. 623.1 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

90-24M
20 APR 1990



NOTES:
1. WATER LEVEL ESTIMATED FROM L/D 7 TAILWATER AND L/D 8 HEADWATER GAGES.
2. 4-INCH CASING SET TO EL. 623.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.
4. HOLE DRILLED FROM A BARGE.

90-25M
20 APR 1990



NOTES:
1. WATER LEVEL ESTIMATED FROM L/D 7 TAILWATER AND L/D 8 HEADWATER GAGES
2. 4-INCH CASING SET TO EL. 623.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.
4. HOLE DRILLED FROM A BARGE.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

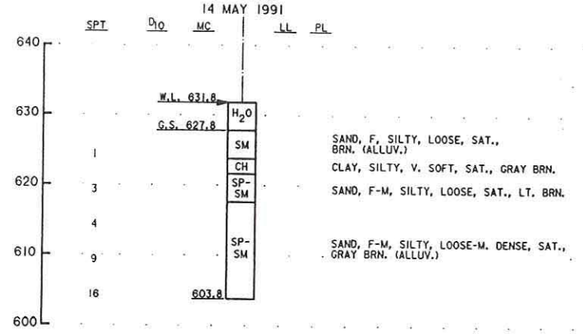
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN
POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2
BORING LOGS
LOGS 90-19M THRU 90-25M

ED-D: DESIGNED:; CHECKED:; DRAWN: CRS
ED-GH: DESIGNED: AMK/PAW; CHECKED: AMK/TJH
DATE: 07-12-91
CAD FILE NAME: M818P003.DGN
SPEC NO: DACW37-91-B-0009

PLATE 6-7

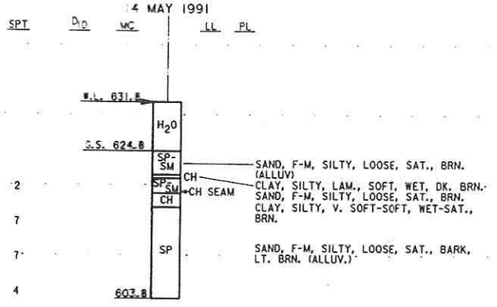
SHT
OF

91-26M
14 MAY 1991



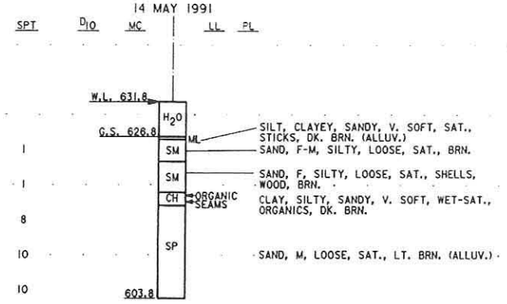
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 624.8 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-27M
14 MAY 1991



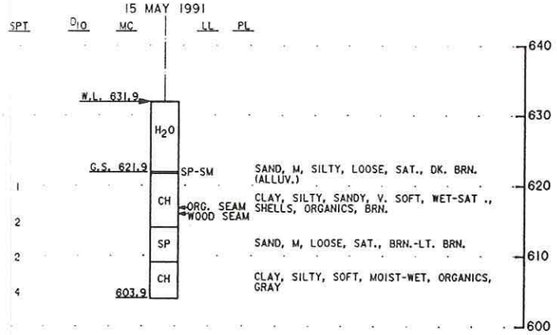
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING SET TO EL. 619.8 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-28M
14 MAY 1991



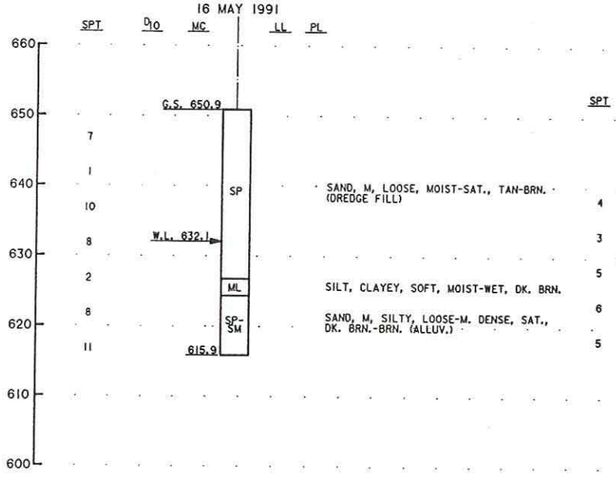
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING SET TO EL. 624.8 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-29M
15 MAY 1991



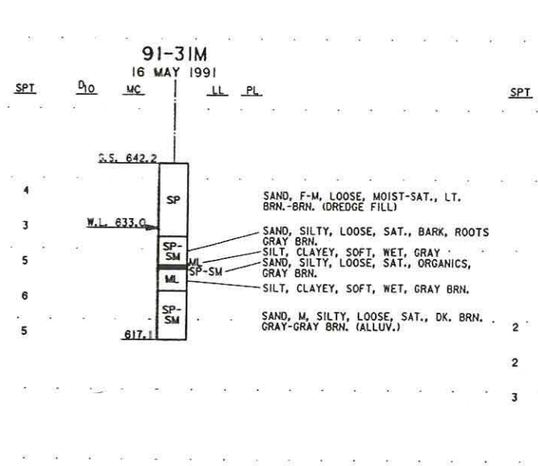
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING SET TO EL. 619.9 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-30M
16 MAY 1991



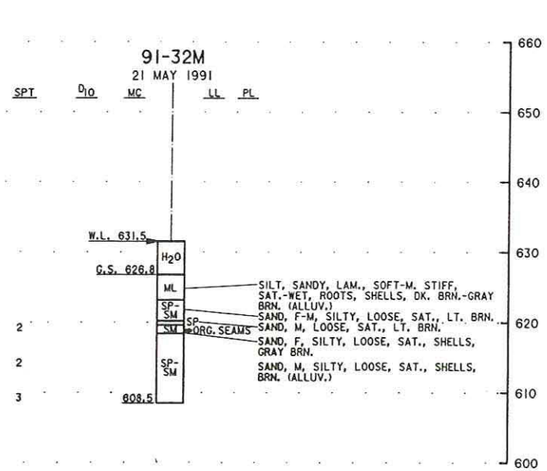
NOTES:
1. WATER LEVEL DETERMINED AFTER 1 HOUR WITH:
   BOTTOM OF HSA AT EL. 632.3
   BOTTOM OF HOLE AT EL. 631.4
   AFTER SAMPLING TO EL. 625.9.
2. HSA ADVANCED TO EL. 630.9, THEN RESET TO EL. 631.9 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE AFTER PULLING HSA. COMPLETED BACK FILL WITH NATURAL MATERIAL.

91-31M
16 MAY 1991



NOTES:
1. WATER LEVEL DETERMINED AFTER 30 MIN. WITH:
   BOTTOM OF HSA AT EL. 632.0
   BOTTOM OF HOLE AT EL. 632.1
   AFTER SAMPLING TO EL. 627.2.
2. HSA ADVANCED TO EL. 632.2, THEN RESET TO EL. 633.2 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE AFTER PULLING HSA. COMPLETED BACK FILL WITH NATURAL MATERIAL.

91-32M
21 MAY 1991



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING SET TO EL. 624.5 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL: _____

ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN

POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2

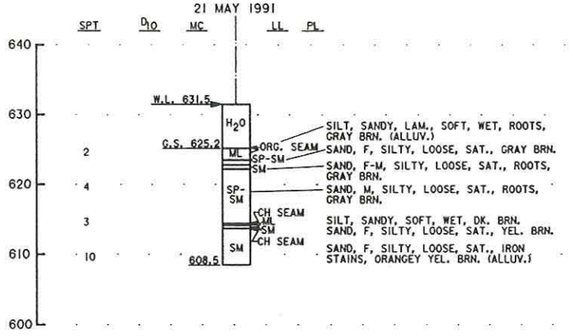
BORING LOGS
LOGS 91-26M THRU 91-32M

ED-D: DESIGNED: ; CHECKED: ; DRAWN: GRS
ED-CH: DESIGNED: AMK/PAW ; CHECKED: AMK/TJH
DATE: 07-12-91
CAD FILE NAME: M8I8P004.DGN
SPEC NO: DACW37-91-B-0009

PLATE 6-8

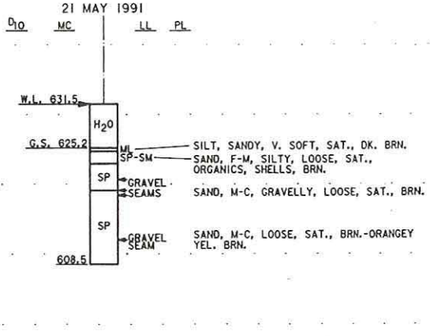
SHT
OF

91-33M
21 MAY 1991



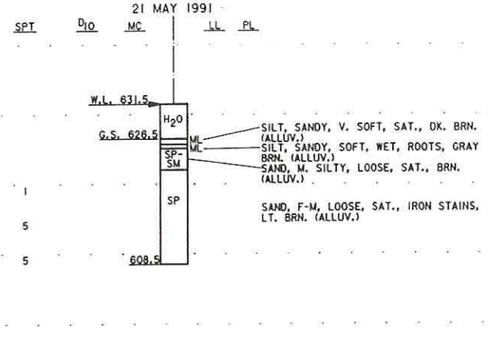
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 619.5. DRILLING MUD USED BELOW EL. 623.5.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-34M
21 MAY 1991



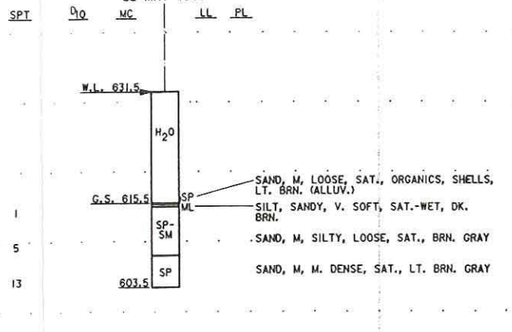
NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 619.5. DRILLING MUD USED BELOW EL. 623.5.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-35M
21 MAY 1991



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING SET TO EL. 624.5 AND DRILLING MUD USED BELOW.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-36M
22 MAY 1991



NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
3. HOLE DRILLED FROM A BARGE.

91-37M
22 MAY 1991

NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING ADVANCED TO EL. 614.5. DRILLING MUD USED BELOW EL. 618.5.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-38M
22 MAY 1991

NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. CASING ADVANCED TO EL. 614.5. DRILLING MUD USED BELOW EL. 618.2.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

91-39M
23 MAY 1991

NOTES:
1. WATER LEVEL ESTIMATED FROM RIVER GAGES.
2. 4-INCH CASING ADVANCED TO EL. 614.5. DRILLING MUD USED BELOW EL. 619.5.
3. HOLE ALLOWED TO CAVE IN WHEN CASING PULLED.
4. HOLE DRILLED FROM A BARGE.

GENERAL NOTES:
1. ELEVATIONS REFERENCED TO N.G.V.D., 1912 ADJ.
2. BORING LOCATIONS SHOWN ON DWGS. M-P8-10/11 M-P8-10/12.
3. SEE M-P8-10/13 FOR GENERAL BORING LEGEND AND GENERAL BORING NOTES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

ED-D
DESIGNED:
CHECKED:
DRAWN: LJL

ED-GH
DESIGNED: AMK/PAW
CHECKED: AMK/TJH
DATE: 07-12-91

ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 8 VERNON COUNTY, WISCONSIN

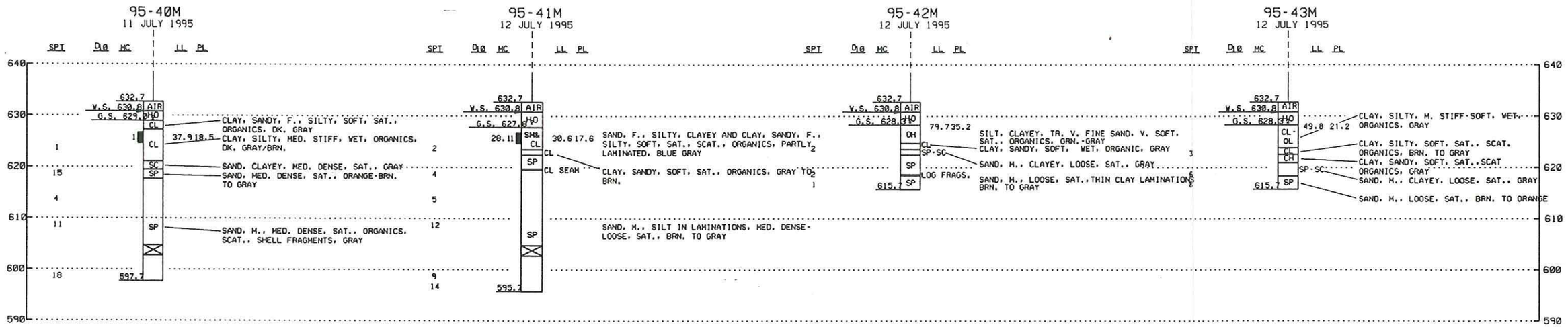
POOL 8 ISLAND CONSTRUCTION - PHASE I, STAGE 2

BORING LOGS
LOGS 91-33M THRU 91-39M

CAD FILE NAME: M818P005.DGN
SPEC NO: DACW37-91-8-0009

PLATE 6-9

SHT
OF



NOTES

1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-11-95.
2. 4 INCH ALUM. CASING SET TO EL. 627.7'. H_2O USED TO STABILIZE HOLE TO EL. 617.7'. BENTONITE DRILLING FLUID USED BELOW EL. 617.7'.
3. 3 INCH SHELBY TUBE TAKEN IN OFFSET HOLE.
4. CASING PULLED AND HOLE ALLOWED TO CAVE.

NOTES

1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-12-95.
2. 4 INCH ALUM. CASING SET TO EL. 622.7'. BENTONITE DRILLING FLUID USED BELOW.
3. 3 INCH SHELBY TUBE TAKEN IN OFFSET HOLE.
4. CASING PULLED AND HOLE ALLOWED TO CAVE.

NOTES

1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-12-95.
2. 4 INCH ALUM. CASING SET TO EL. 622.7'. HOLE STABILIZED WITH BENTONITE DRILLING FLUID BELOW.
3. CASING PULLED. HOLE ALLOWED TO CAVE.

NOTES

1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-12-95.
2. 4 INCH ALUM. CASING SET TO EL. 622.7'. HOLE STABILIZED

GENERAL BORING LEGEND

84-1M — YEAR OF BORING-BORING NUMBER, BORING TYPE (EG: M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER).

1 MAY 1984 — DATE OF BORING

G.S. 1020.2 — GROUND SURFACE ELEVATION AT BORING

GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURE, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS, LIQUID LIMIT LESS THAN 50
MH	INORGANIC SILTS, LIQUID LIMIT GREATER THAN 50
CL	INORGANIC CLAYS, LOW TO MED. PLASTICITY, LIQUID LIMIT LESS THAN 50
CH	INORGANIC CLAYS, HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
OL	ORGANIC SILTS OR CLAYS, LOW PLASTICITY, LIQUID LIMIT LESS THAN 50
OH	ORGANIC SILTS OR CLAYS, MED. TO HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
PT	PEAT
SP-SM	BORDERLINE MATERIAL
SP&SM	STRATIFIED MATERIAL
1	LOCATION AND SAMPLE NUMBER FOR UNDISTURBED SAMPLE
	NO RECOVERY
W.L. 726.7	WATER LEVEL ON DATE OF BORING
700.0	ELEVATION AT BOTTOM OF BORING

GENERAL BORING NOTES

1. GENERAL: THE UNIFIED SOIL CLASSIFICATION SYSTEM IS USED TO IDENTIFY BASIC SOIL TYPE. THE LEGEND REPRESENTS ONLY THE BASIC SOILS. TO COMPLETE THE CLASSIFICATION, PERTINENT INFORMATION IS ADDED TO THE RIGHT OF THE BORING STAFF. NOTES PERTAINING TO A SPECIFIC BORING ARE SHOWN BELOW THE BORING STAFF.
2. MOISTURE CONTENT: THE NATURAL MOISTURE CONTENT IN PERCENT OF DRY WEIGHT (MC) IS SHOWN TO THE LEFT OF THE BORING STAFF.
3. BLOW COUNT (SPT): BLOW COUNTS ARE SHOWN TO THE LEFT OF THE BORING STAFF AND, EXCEPT AS NOTED, ARE THE NUMBER OF BLOWS NECESSARY TO DRIVE THE SAMPLER USED A DISTANCE OF 12". STANDARD BLOW COUNTS ARE FOR A STANDARD PENETRATION TEST (SPT) USING A 1.4" X 2" SAMPLER, 140 LB. HAMMER AND A 30" DROP. FOR NON-STANDARD BLOW COUNTS, SAMPLER SIZE, HAMMER WEIGHT AND HEIGHT OF DROP ARE AS SHOWN.
4. ATTERBERG LIMITS: LIQUID LIMIT (LL) AND PLASTIC LIMIT (PL) ARE SHOWN TO THE RIGHT OF THE BORING STAFF.
5. D_{10} SIZE: THE GRAIN SIZE IN MILLIMETERS OF WHICH 10% OF THE SAMPLE IS FINER IS SHOWN TO THE LEFT OF THE BORING STAFF.
6. ELEVATIONS REFERENCED TO N.G.V.D., (1912 ADJUSTED).
7. THE BORINGS SHOW SUMMARIES OF INFORMATION RECORDED ON THE ORIGINAL FIELD LOGS. THESE LOGS ARE AVAILABLE FOR INSPECTION AT THE ST. PAUL DISTRICT OFFICE. ARRANGEMENTS TO INSPECT LOGS CAN BE MADE BY CALLING (612) 290-5599.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

POOL 8 ISLANDS - PHASE 2

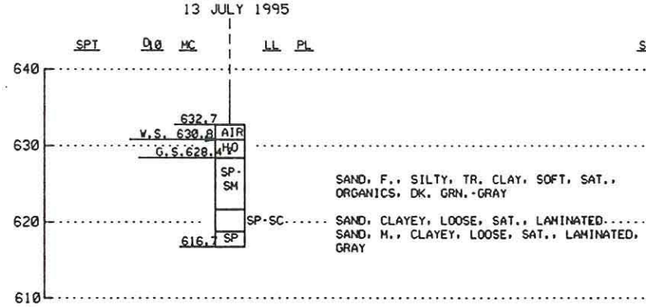
EMP - MISSISSIPPI RIVER

GENERAL BORING LOGS, GENERAL BORING NOTES AND BORING LOGS
95-40M, 95-41M, 95-42M, 95-43M

PE-D	DESIGNED: KSN	
	CHECKED: GAR	
	DRAWN: MKC/GRS	
PE-HH	DESIGNED:	
	CHECKED:	
CAD FILE NAME: P8TB000.DGN	DRAWING NUMBER: PLATE 6-10	SHT 1 OF 3
DATE: NOVEMBER 1995	SOL. NO.: DACW37-94-B-0000	

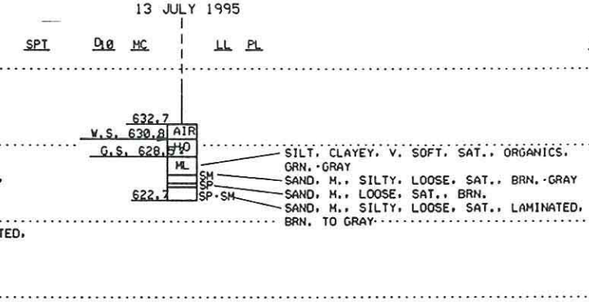
EN ENG
HYD
HYDR
EOTECH
TR ENG
MEA

95-44M
13 JULY 1995



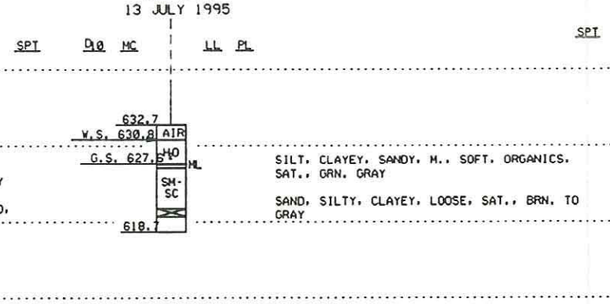
NOTES
1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-13-95.
2. 4 INCH ALUM. CASING SET TO EL. 622.7'. HOLE STABILIZED WITH H_2O BELOW.
3. HOLE HEAVED BELOW EL. 618.7'.
4. ALL CASING PULLED AND HOLE ALLOWED TO CAVE.

95-45M
13 JULY 1995



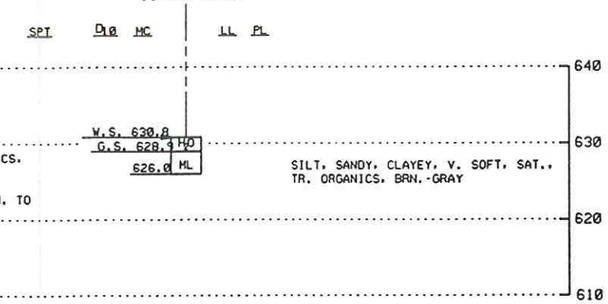
NOTES
1. WATER SURFACE PRORATED FROM POOL 8 EL. ON 7-13-95.
2. 4 INCH ALUM. CASING WAS SET TO EL. 624.7'.
3. ALL CASING REMOVED AND HOLE ALLOWED TO CAVE.

95-46M
13 JULY 1995



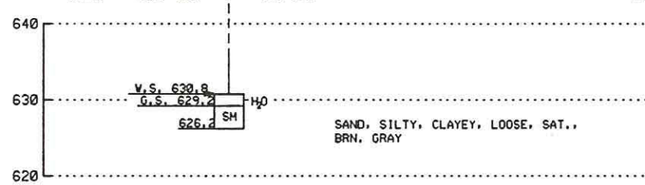
NOTES
1. WATER SURFACE PRORATED FROM POOL 8 ON 7-13-95.
2. 4 INCH ALUM. CASING SET TO EL. 621.7'. HOLE HEAVING BELOW.
3. ALL CASING REMOVED AND HOLE ALLOWED TO CAVE.

ST-01
18 MAY 1995



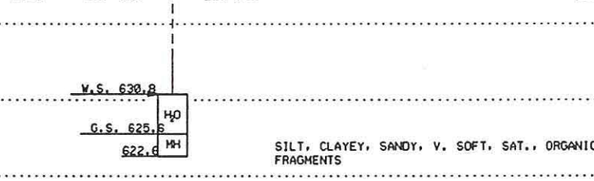
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-02
5 MAY 1995



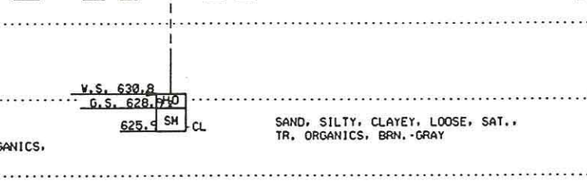
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-03
5 MAY 1995



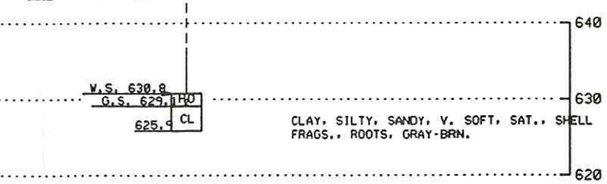
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-04
5 MAY 1995



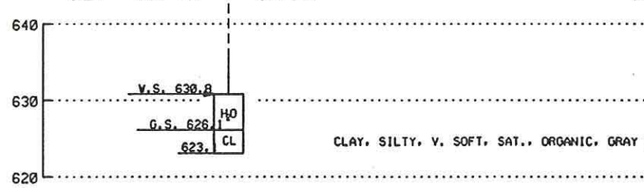
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-05
5 MAY 1995



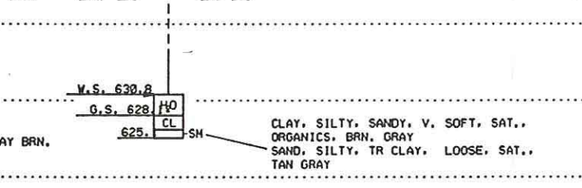
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-06
5 MAY 1995



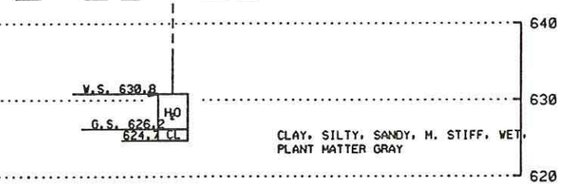
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-07
5 MAY 1995



NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-08
5 MAY 1995



NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

GEN ENG
HYD
HYDR
GEOTECH
STR ENG
MEA

SYMBOL	DESCRIPTION	DATE	APPROVAL

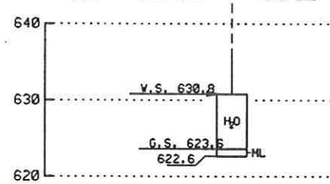
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

POOL 8 ISLANDS : PHASE 2
EMP - MISSISSIPPI RIVER
BORING LOGS
95-44M THRU 95-46M, ST1 THRU ST8

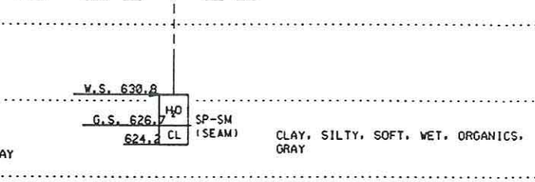
PE-D	DESIGNED: KSN		
	CHECKED: GAR		
	DRAWN: MKC/GRS		
PE-ND	DESIGNED:		
	CHECKED:	CAD FILE NAME: P8TB001.DGN	DRAWING NUMBER: PLATE 6-11
DATE: NOVEMBER 1995		SOL. NO. DACW37-93-B-0000	SHT 2 OF 3

ST-09
5 MAY 1995



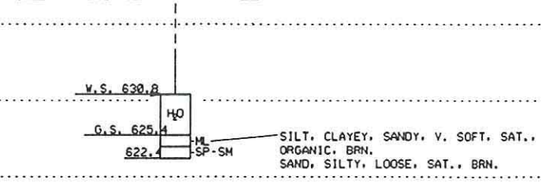
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TP COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-10
5 MAY 1995



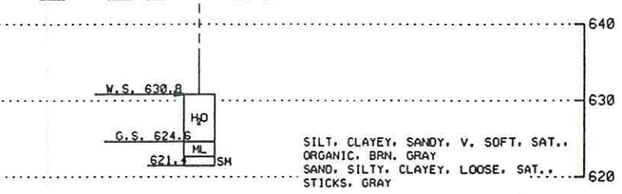
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-11
18 MAY 1995



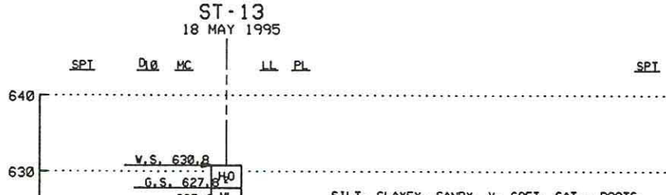
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-12
18 MAY 1995



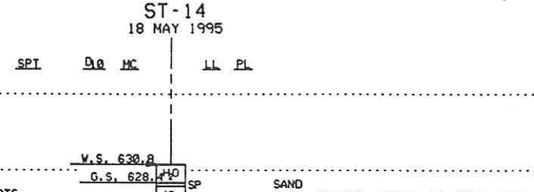
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-13
18 MAY 1995



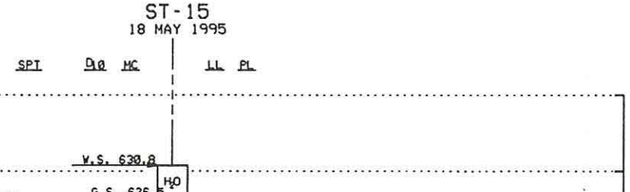
NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-14
18 MAY 1995



NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

ST-15
18 MAY 1995



NOTES
1. WATER SURFACE WAS PRORATED FROM POOL 8 ELEVATION, AND IS APPROXIMATE.
2. A TWO INCH CONDUIT PUSHED BY HAND WAS USED TO COLLECT SAMPLES. SOME SAMPLES WERE COMPOSITED.
3. THIS LOG IS A RESULT OF ORIGINAL FIELD NOTES FROM WISCONSIN DNR & COMPOSIT SAMPLES.

GEN ENG
HYD
HYDR
GEOTECH
TR ENG
MEA

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

AE APPROVING OFFICIAL:

POOL 8 ISLANDS : PHASE 2

EMP - MISSISSIPPI RIVER

BORING LOGS
ST9 THRU ST15

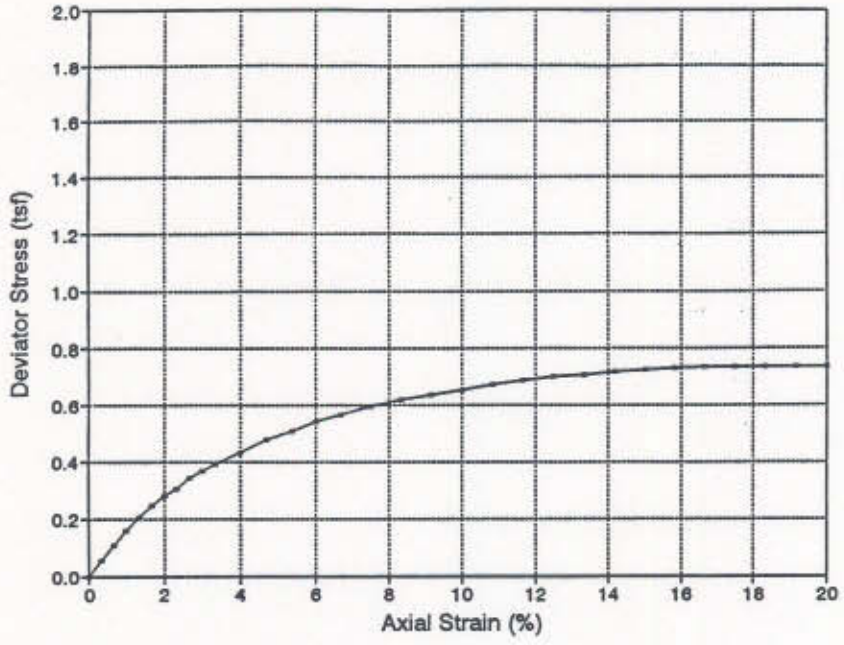
PE-D: DESIGNED: KSN; CHECKED: GAR; DRAWN: MKC/GRS
PE-HH: DESIGNED:; CHECKED:

CAD FILE NAME: P8TB002.DGN
SOL. NO. DACW37-93-B-0000
DRAWING NUMBER: PLATE 6-12
SHT 3 OF 3
DATE: NOVEMBER 1995

Confined - STRESS/STRAIN CURVES - Unconfined

Project: POOL 8 PHASE II EMP P.O. #DACW37-95-M-1002

Location: _____ **Date:** 09-19-95 **Job No:** 2571



Boring No.: 95-40MU Sample No 1

Depth(ft): 6.0 - 7.6 (Bottom)

Soil Type: Lean Clay w/Some Oganics (CL)

Type of Specimen: 3T

Diam.(in): 2.86 Ht. (in): 6.00

Test Type: Unconfined Compression

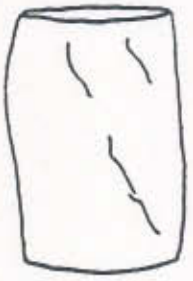
Confining Pressure: _____ (tsf)

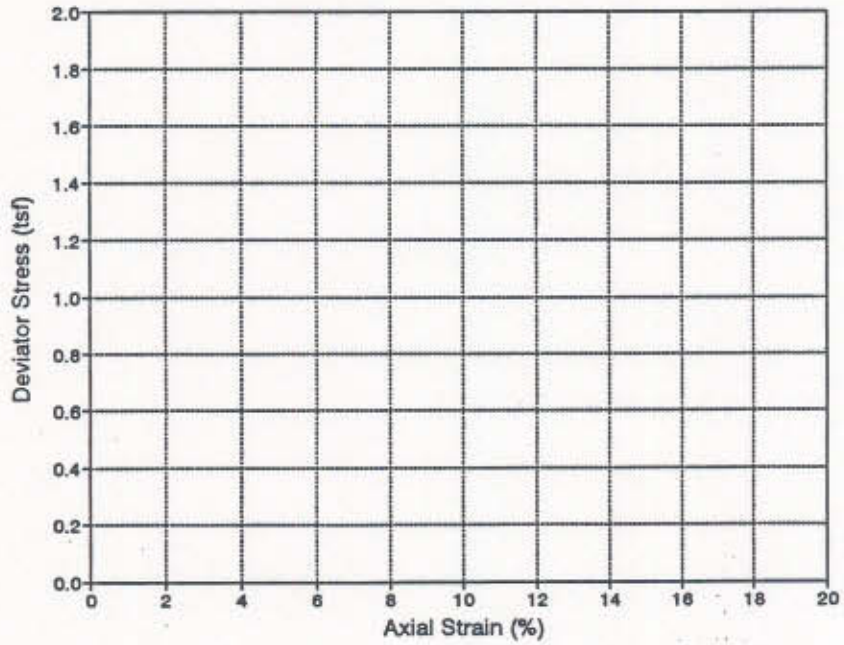
Max. Deviator Stress: 0.74 (tsf)

WC (%)	29.2
Yd (pcf)	93.2
LL (%)	47.9
PL (%)	21.8
PI	26.1
Gs (*)	2.62

* = Actual Value

Sketch of Specimen After Failure





Boring No.: _____ Sample No _____

Depth(ft): _____

Soil Type: _____

Type of Specimen: _____

Diam.(in): _____ Ht. (in): _____

Test Type: _____

Confining Pressure: _____ (tsf)

Max. Deviator Stress: _____ (tsf)

WC (%)	
Yd (pcf)	
LL (%)	
PL (%)	
PI	
Gs ( )	

Sketch of Specimen After Failure

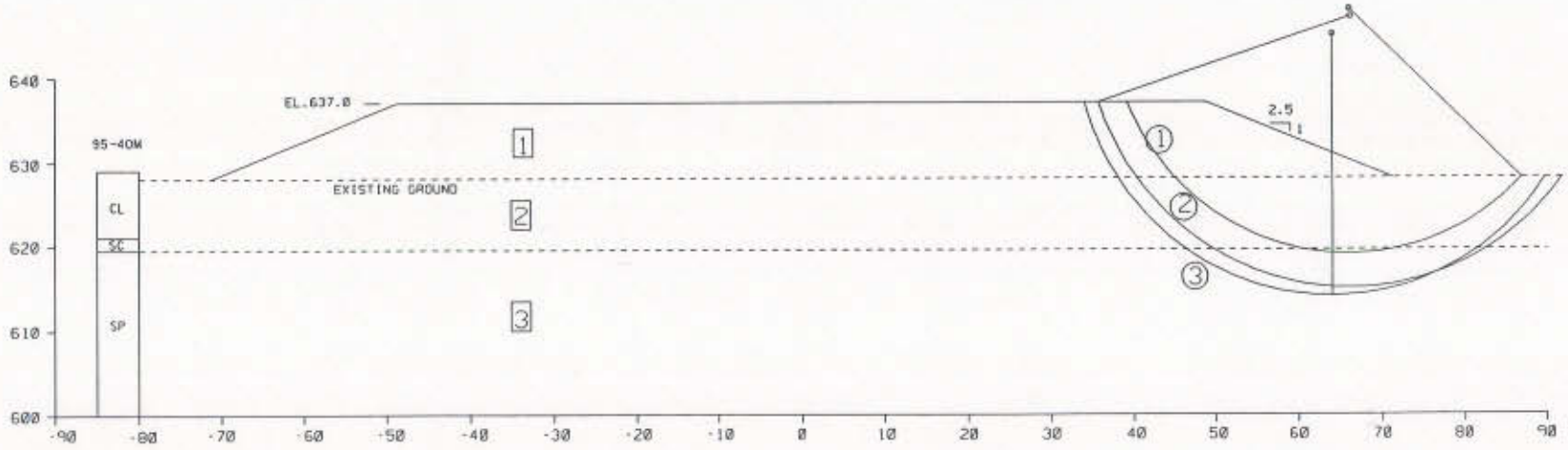
10:17 AM 19-Sep-95

9301 Bryant Avenue South Suite 107

OIL ENGINEERING TESTING, INC.

ARC NO.	CENTER COORDINATES X	Y	RADIUS	FACTOR OF SAFETY*
①	66.0	648.0	29.0	3.01
②	66.2	647.1	32.1	2.60
③	64.0	645.0	31.0	2.63

* - REQUIRED FACTOR OF SAFETY IS 1.3



SOIL NO.	DESCRIPTION	UNIT WEIGHT MOIST	SATURATED	ESTIMATED Q-STRENGTH C (PSF)	PHI (DEGREE)
1	SAND FILL	115.0	120.0	0	30.0
2	SOFT CLAY	100.0	100.0	700	0
3	LOOSE SAND	115.0	120.0	0	27.0

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

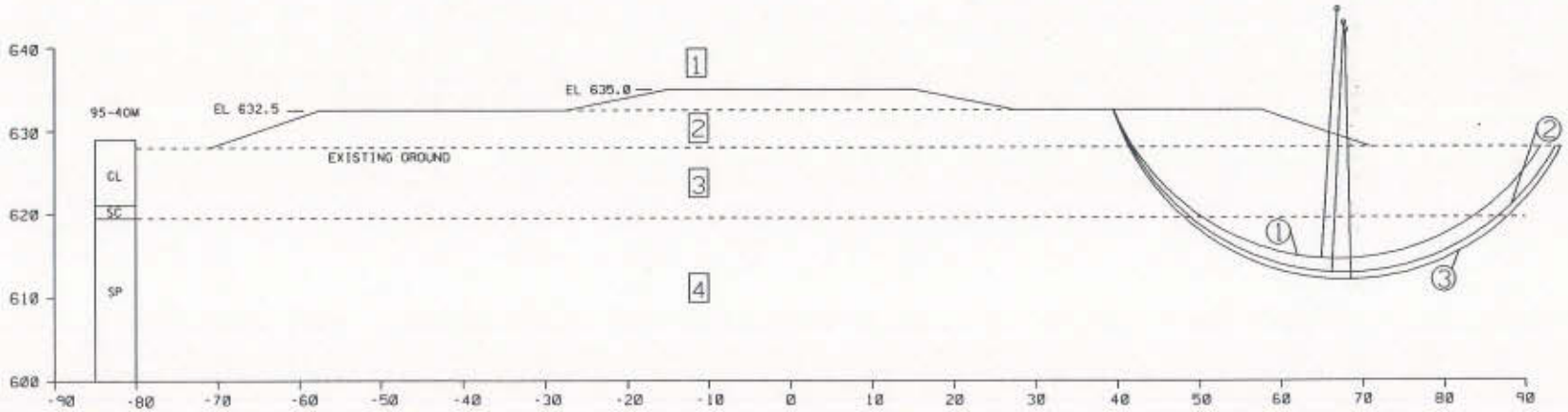
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
POOL 8 ISLANDS PHASE II
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 10 VERNON COUNTY, WI

STABILITY ANALYSIS-
ASSUMED CRITICAL ISLAND SECTION

PLATE 6-14

ARC NO.	CENTER COORDINATES X	Y	RADIUS (FT.)	FACTOR OF SAFETY*
①	67.0	644.5	30.0	4.69
②	67.8	642.9	30.0	4.62
③	68.0	642.0	30.0	4.63

* - REQUIRED FACTOR OF SAFETY IS 1.3



SOIL NO.	DESCRIPTION	UNIT WEIGHT MOIST	SATURATED	ESTIMATED Q-STRENGTH C (PSF)	PHI (DEGREE)
1	FINES FILL	95.0	100.0	100	0
2	SAND FILL	115.0	120.0	0	30.0
3	SOFT CLAY	100.0	100.0	700	0
4	LOOSE SAND	115.0	120.0	0	27.0

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

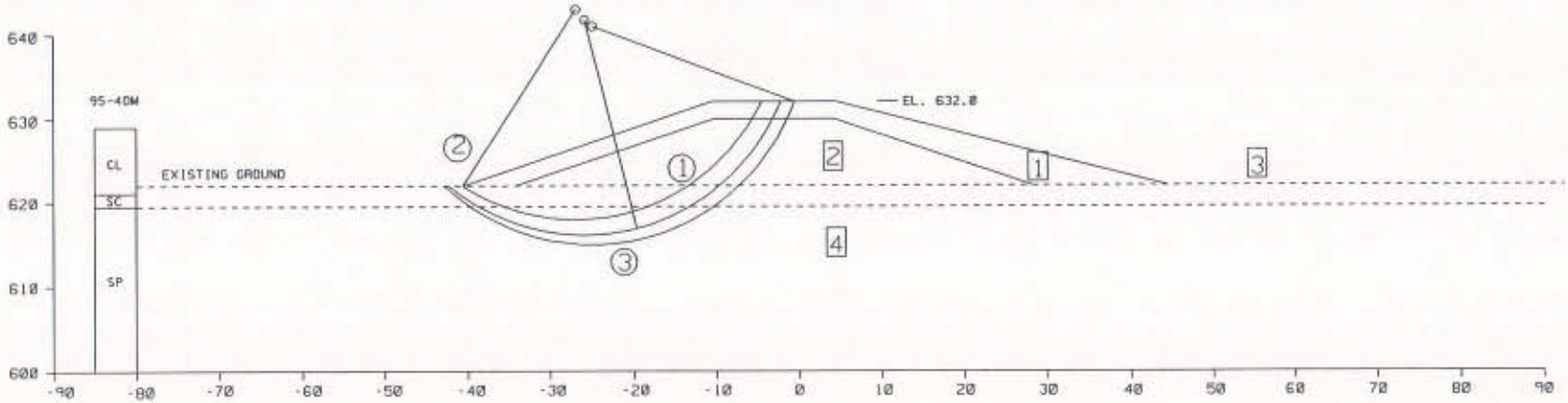
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
POOL 8 ISLANDS PHASE II
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
WINONA COUNTY, MN
POOL 8

STABILITY ANALYSIS
PROPOSED ISLAND SECTION

DRAWING NUMBER
PLATE 6-15

ARC NO.	CENTER COORDINATES X	Y	RADIUS	FACTOR OF SAFETY
①	-27.0	643.0	25.0	1.45
②	-25.9	641.8	25.6	1.32
③	-25.0	641.0	26.0	1.36

* - REQUIRED FACTOR OF SAFETY IS 1.3



SOIL NO.	DESCRIPTION	UNIT WEIGHT MOIST	SATURATED	ESTIMATED Q-STRENGTH C (PSF)	PHI (DEGREE)
1	ROCK FILL	135.0	135.0	0	38.0
2	SAND FILL	115.0	120.0	0	30.0
3	SOFT CLAY	100.0	100.0	300	0
4	LOOSE SAND	115.0	120.0	0	27.0

SYMBOL | DESCRIPTION | DATE | APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
POOL 8 ISLANDS PHASE II
ENVIRONMENTAL MANAGEMENT PROGRAM - MISSISSIPPI RIVER
POOL 10 VERNON COUNTY, WI

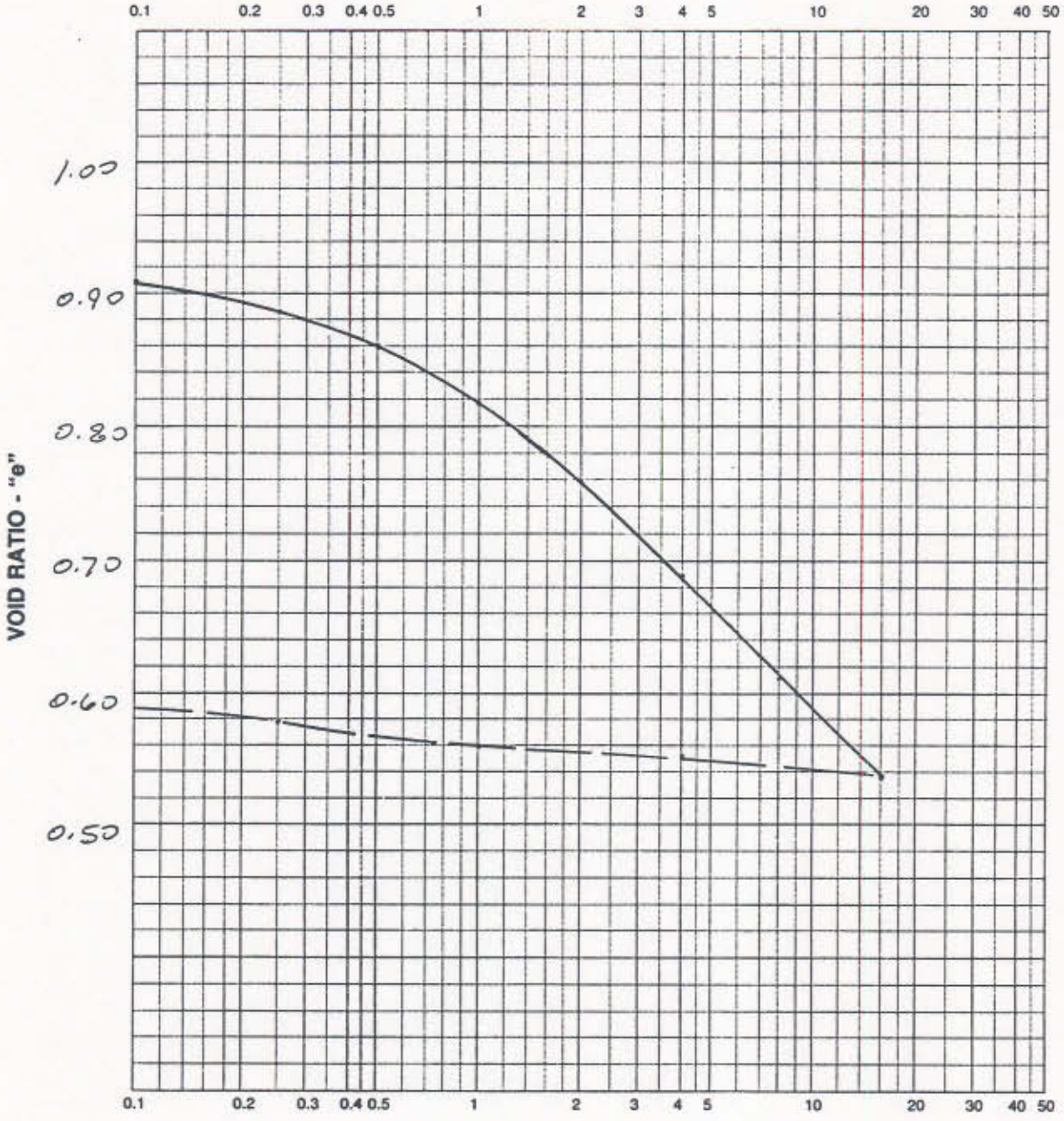
STABILITY ANALYSIS
SPILLWAY SECTION

DESIGNED: JJF
CHECKED:
DRAWN:
CHECKED:
DATE:

PLATE 6-16

CONSOLIDATION TEST

VOID RATIO VS. LOG OF PRESSURE



Project POOL 8 PHASE II EMP

Date 9-18-95 Job No. 2571 Boring No. 95-40MW Sample No. 1 Depth (ft.) 6.0-7.6 (TOP)

Soil Type LEAN CLAY W/SAND & SOME ORGANICS (CL)

Initial Water Content (%) 34.5 Dry Density (pcf) 85.6 Liquid Limit 47.9 Plastic Limit 21.8 Plasticity Index 26.1

Specific Gravity 2.62 Organic Content (%) _____ Initial Specimen Height (in.) 0.807 Diameter 2.501

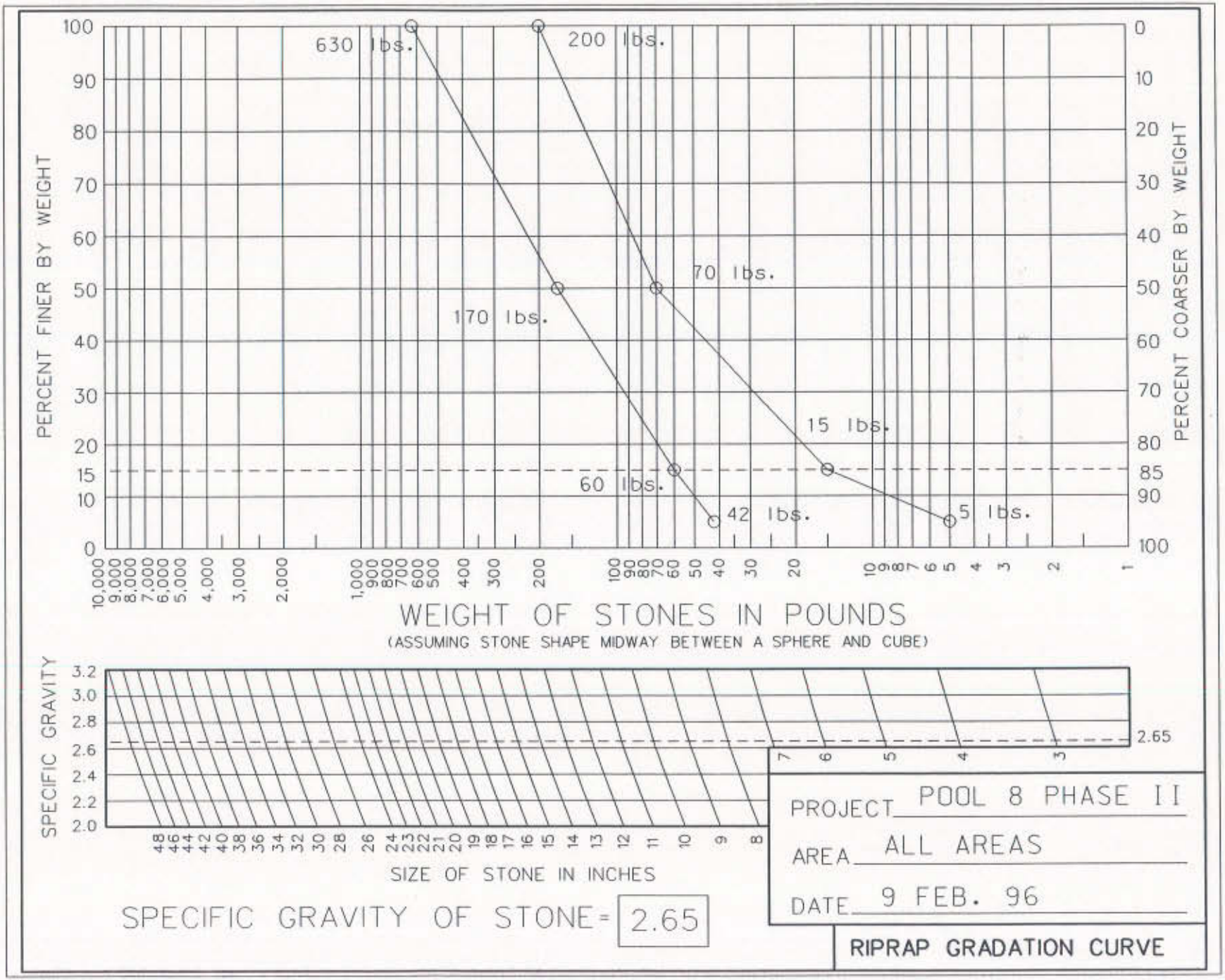
Preconsolidation Pressure (Pc) 1.1 tsf Compression Index (Cc) 0.25 Recompression Index (Cr) ≃ 0.06

Remarks: e_o = 0.910 ; INUNDATED AFTER APPLYING 0.1 tsf LOAD.

```
PROGRAM CSETT - VERTICAL STRESS INDUCTION AND SETTLEMENT PROGRAM
DATE: 22-SEP-1995                                    TIME: 12.00.22

I.  INPUT DATA
1. TITLE - Using Actual Void Ratio vs. Pressure Curve

2. BOUSSINESQ SOLUTION WILL BE USED TO COMPUTE INDUCED STRESSES.
   THE MAXIMUM DEPTH TO WHICH THE ANALYSIS WILL BE EXTENDED
   IS   50.00 FEET.

  PROFILE NUMBER  1 :NUMBER OF POINTS=  6
                     BEGINNING TIME OF APPLICATION =  .0000 YRS.
                     ENDING TIME OF APPLICATION =  .0000 YRS.
                     EFFECTIVE UNIT WEIGHT OF SOIL LOAD=  115.00 PCF

                     POINT NO.     X          Y
                                  (FT.)      (FT.)
                         1    -9999.00     629.00
                         2      -21.00     629.00
                         3      -10.00     635.00
                         4       10.00     635.00
                         5       21.00     629.00
                         6     9999.00     629.00

3. SOIL DATA
STRATA EL. OF TOP  DRAINAGE  EFF UNIT  RECOMPR.  COEF.OF   POISSON'S
  NO.  OF STRATUM  CONDITION  WEIGHT    INDEX     CONSOL.    RATIO
       (FEET NGVD)            (PCF)              (SQFT/YR)
    1     629.00       N      46.00
    2     627.00       S      37.00    .06000   25.00000    .32000

4. STRESS-STRAIN DATA
      STRATUM NO.  1
      -------------
   INCOMPRESSIBLE STRATUM

      STRATUM NO.  2
      -------------
  COMPRESSION INDEX=  .25000
RECOMPRESSION INDEX=  .06000
  INSITU VOID RATIO=  .91000
  INSITU OVERBURDEN= 2200.00 PSF

II.  OUTPUT DATA
1. SUMMARY OF ULTIMATE SETTLEMENTS.
    STRATA   MID-DEPTH     IN-SITU     DELTA      ULTIMATE
      NO.    OF STRATA   OVERBURDEN    SIGMA    SETTLEMENT
              (FEET)     (LB/SQ FT)  (LB/SQ FT)   (FEET)
    ------   ---------  ----------  ----------  ----------
       1         1.00       46.00      689.90       .000
       2         5.00      203.00      677.20       .119

2. TIME-SETTLEMENT SUMMARY.
           (SETTLEMENT IN FEET AT SPECIFIED TIMES)
STRATA    ULT    .10     .50    1.00    2.00    5.00
  NO            (YRS.)  (YRS.)  (YRS.)  (YRS.)  (YRS.)
------    ---   ------  ------  ------  ------  ------
   1     .000    .000    .000    .000    .000    .000
   2     .119    .035    .078    .101    .116    .119
TOTALS:  .119    .035    .078    .101    .116    .119
```

PLATE 6-18

PLATE 6-19


630 lbs.
200 lbs.
70 lbs.
170 lbs.
15 lbs.
60 lbs.
42 lbs.
5 lbs.
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
WEIGHT OF STONES IN POUNDS
(ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE)
SPECIFIC GRAVITY
2.65
SIZE OF STONE IN INCHES
SPECIFIC GRAVITY OF STONE = 2.65
PROJECT POOL 8 PHASE II
AREA ALL AREAS
DATE 9 FEB. 96
RIPRAP GRADATION CURVE

ATTACHMENT 7

MEMORANDUM OF AGREEMENT

DRAFT

MEMORANDUM OF AGREEMENT

BETWEEN

THE UNITED STATES FISH AND WILDLIFE SERVICE

AND

THE DEPARTMENT OF THE ARMY

FOR

ENHANCING FISH AND WILDLIFE RESOURCES

OF THE

UPPER MISSISSIPPI RIVER SYSTEM

POOL 8 ISLANDS PHASE II

VERNON COUNTY, WISCONSIN

I. PURPOSE

The purpose of this memorandum of agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (USFWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Pool 8 Islands Phase II separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. The project area is managed by the USFWS and is on land managed as a national wildlife refuge. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Pool 8 Islands Phase II project are 100 percent Federal, and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, all costs of operation and maintenance for the Pool 8 Islands Phase II project are 100 percent Federal.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of rehabilitating and improving the fish and wildlife habitat in lower pool 8 of the Mississippi River. The project consists of constructing seven islands and two rock sills in the Stoddard Bay area of lower pool 8. The project area encompasses approximately 500 acres. The purpose of these structures are to improve fish and wildlife habitat by reducing flows in the area, improving conditions for the growth of aquatic plants, and increasing overall habitat diversity by restoring islands lost to erosion.

In addition, six "seed islands" constructed of rock would be placed on the right descending side of the navigation channel below Heron and Trapping Islands. The purpose of the seed islands is to allow natural river processes to recreate islands in an area where there has been extensive loss of islands due to erosion.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction: Construction of the project which consists of seven islands (Islands A, B, C, D1, D2, E1, and E2) and two rock sills (A & B) in the Stoddard Bay area of lower pool 8. An estimated 11,125 linear feet of island would be constructed using sand (150,000 c.y.) and fine sediments (70,000 c.y.) dredged from Crosby Slough and from within Stoddard Bay. Approximately 5,800 c.y. of rock would be placed on the islands for stabilization. The islands would be seeded and planted with willows and trees for stabilization and habitat purposes.

The two rock sills would be 1,500 and 1,300 feet in length respectively. These sills would be constructed entirely of rock (11,240 c.y.). The six seed islands would be approximately 200 feet long and each require about 730 c.y. of rock.

2. Major Rehabilitation: The Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the Definite Project Report and that is needed as a result of specific storm or flood events.

3. Construction Management: Subject to and using funds appropriated by the Congress of the United States, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, DOA will construct the Pool 8 Islands Phase II project as described in the Definite Project Report/Environmental Assessment, Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project, dated May 1996, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the project, DOA will promptly notify USFWS of such delays.

4. Maintenance of Records. The DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the project to the extent and in such detail as will properly reflect total costs. The DOA shall maintain such books, records, documents, and other evidence for a minimum of three years after completion of construction of the project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the USFWS.

B. USFWS is responsible for operation, maintenance, and repair: Upon completion of construction as determined by the District Engineer, St. Paul, the USFWS shall accept the project and shall operate, maintain, and repair the project as defined in the Definite Project Report/Environmental Assessment entitled "Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project," dated May 1996, in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties.

USFWS: Regional Director
U.S. Fish and Wildlife Service
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, Minnesota 55111-4056

DOA: District Engineer
U.S. Army Corps of Engineers, St. Paul District
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

BY: _____
(signature)
J. M. WONSIK
Colonel, Corps of Engineers
St. Paul District

DATE: _____

THE U.S. FISH AND WILDLIFE SERVICE

BY: _____
(signature)
WILLIAM F. HARTWIG
Regional Director
U.S. Fish and Wildlife Service

DATE: _____

ATTACHMENT 8

PROJECT PERFORMANCE EVALUATION

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

PERFORMANCE EVALUATION PLAN

GENERAL

Performance evaluation of habitat rehabilitation projects is required to determine if the project meets habitat goals and objectives established during project planning. The information obtained from project performance monitoring will also be useful in the planning and design of future habitat rehabilitation and enhancement efforts.

PROJECT GOALS AND OBJECTIVES

Project performance monitoring should monitor parameters that will allow for measurement of whether the goals and objectives are met. The project goals and objectives for this project are attached as exhibit A. Table 1 shows the selected parameters to be monitored for each of the objectives.

Table 1
Monitoring Parameters

Objective	Parameter(s)
1A(1)	dissolved oxygen
1A(2)	current velocity
1A(3)	water temperature
1A(4)	water depths
1B(1)	dissolved oxygen
1B(2)	aquatic vegetation coverage
1C(1)	dissolved oxygen
1C(2)	current velocity
1C(3)	aquatic vegetation
1C(4)	substrate type
2(1)	aquatic vegetation coverage
2(2)	**
2(3)	acres of beaches, mudflats, etc.
3(1)	acres of island vegetated to grasses, shrubs, & trees
3(2)	aquatic vegetation coverage
3(3)	acres of beaches
3(4)	acres of sloping beach habitat
3(5)	aquatic vegetation coverage
3(6)	acres of mature trees

** objective not met by the project

MONITORING PLAN

The proposed monitoring plan covers the entire projected 50-year project life of the Pool 8 Islands Phase II project. The UMRS-EMP authorization expires in 2002. If the UMRS-EMP authorization expires, other parties such as the Wisconsin DNR, the U.S. Fish and Wildlife Service, or the National Biological Service would have to conduct all of the post-2002 monitoring, if it is to be completed.

DISSOLVED OXYGEN, CURRENT VELOCITY, AND WATER TEMPERATURE

A number of the project objectives involve the parameters of dissolved oxygen, current velocity, and water temperature. Therefore, a comprehensive monitoring plan for these parameters encompassing the entire Stoddard Bay area has been developed. A series of stations will be established in Stoddard Bay where these parameters will be monitored on a regular basis. Monitoring will begin in October 2000 and continue through September 2002. Monitoring will be done on a bi-weekly basis during the months of Dec-Mar and Jul-Aug. During other months, monitoring will be conducted on a monthly basis. Monitoring for these parameters should be conducted two year later, and then once every ten years post-construction (i.e., 2006, 2010, 2020, 2030 etc.)

BATHEMETRY

Objective 1A(4) is a water depth objective. It is unlikely that there will be any appreciable post-project changes in water depths during the current authorization of the UMRS-EMP. A bathymetric survey of Stoddard Bay will be completed in 2001 to document post-construction conditions. The bathymetric survey should be repeated 10, 30, and 50 years post-construction.

AQUATIC VEGETATION

A number of project objectives relate to aquatic vegetation. Aquatic vegetation changes are not expected to occur immediately. An aquatic vegetation survey of Stoddard Bay will be completed in 2001 to document post-construction conditions, followed by another survey in 2006. The aquatic vegetation survey should then be repeated every 10 years post-construction.

SUBSTRATE TYPE

Objective 1C(4) is to provide suitable spawning substrate for Centrarchids in the form of sand and/or gravel. The underwater slopes of the islands will eventually provide 7-8 acres* of sand substrate within Stoddard Bay with water depths up to 3 feet. Monitoring should be performed every 10 years post-construction to determine if these areas remain sand, or if they become covered with fine sediments.

* 25 foot strip on interior of barrier islands and on both sides of interior islands

BEACHES

It is estimated that construction of the islands will provide approximately 22,000 linear feet of beaches. Monitoring should be performed every 10 years post-construction to determine if these areas remain beach habitat.

VEGETATED ISLANDS

The islands will be seeded to grasses and legumes, with tree plantings on some (or all) of the islands. The seeding and plantings are not designed with any particular successional stage as a target. It is recognized that as the islands undergo natural succession, they will provide habitat for wildlife adapted to the vegetation community present at the time. Monitoring should be performed 5 years and 10 years post-construction, and every 10 years thereafter to document the rate of succession and changes in the vegetation community over time.

Exhibit A

Pool 8 Islands Phase II Project Goals and Objectives

GOAL 1

Improve habitat conditions for backwater fish species with an emphasis on habitat for Centrarchids.

Objective 1A

Create 200 acres of overwintering habitat meeting the following criteria:

(1) Dissolved oxygen levels > 3 mg/l

(2) Current velocity < 0.3 cm/sec over 80 % of the area

(3) Water temperature as follows:

4° C over 35 % of the area
2-4° C over 30 % of the area
0-2° C over 35 % of the area

(4) Water depths > 4 feet over 40% of the wintering area in year 25

Objective 1B

Enhance and/or create Centrarchid summer habitat meeting the following criteria:

(1) Dissolved oxygen levels > 5 mg/l

(2) Aquatic vegetation cover in the range of 25-50%

Objective 1C

Enhance and/or create shallow and protected spawning, rearing, and juvenile Centrarchid habitat in three locations, approximately 5 acres in size, meeting the following criteria:

(1) Dissolved oxygen levels > 5 mg/l

(2) Current velocity < 0.5 cm/sec

(3) Aquatic vegetation cover of approximately 80%

(4) Substrates of sand and/or gravel available for spawning

GOAL 2

Increase high quality waterfowl habitat to 600 acres and then maintain.

Objective 2

Increase and then maintain 600 acres of habitat meeting the following:

(1) Aquatic plant growth covering approximately 60 percent of the area with a mix and interspersion similar to conditions that existed in 1975.

(2) Create 2-3 acres of nesting habitat isolated from land-based predators and with a vegetative cover having an average obscurity rating of 1.5 dm within 2 years.

(3) Protected sites (i.e., beaches, mudflats, and logs) for birds to get out of the water to loaf and rest totalling approximately 6 acres.

GOAL 3

Create habitat for migratory birds other than waterfowl (Neotropical migrants, marsh and water birds, and shorebirds); increase turtle nesting habitat; restore habitat for mammals (primarily beaver, mink, and muskrats), reptiles, and amphibians; and improve conditions for the reestablishment of roosting habitat for species such as bald eagles, peregrine falcons, and other raptors.

Objective 3

When planning/designing habitat features for the Stoddard area, the following habitat types or conditions should be provided.

(1) For Neotropical migrants (grassland and woodland), provide islands seeded to grass and/or planted to trees.

(2) For marsh and water birds, provide habitat consisting of an interspersion of submergent, rooted floating aquatics, emergent plants, and open water, in proximity to islands.

(3) For shorebirds provide gradual sloping beaches and/or shallow backwater lagoons.

(4) For nesting turtles, provide isolated islands having gently sloping beaches with sparse vegetation and a substrate capable of maintaining high soil moisture.

(5) For aquatic and semi-aquatic mammals, reptiles, and amphibians provide wetland habitat consisting of an interspersion of submergent, rooted floating aquatics, emergents, and open water in proximity to islands.

(6) For raptors, accelerate succession on islands to mature trees as much as practical.

ATTACHMENT 9

COORDINATION/CORRESPONDENCE

The draft Definite Project Report/Environmental Assessment or Notice of Availability (*) was sent to the following agencies, interests, and individuals.

Congressional
Sen. Russell Feingold (Middleton Office)
Sen. Rod Grams (Anoka Office)
Sen. Herbert Kohl (Madison Office)
Sen. Paul Wellstone (St. Paul Office)
Rep. Steve Gunderson (Black River Falls Office)
Rep. Gil Gutknecht (Rochester Office)
State Sen. Brian Rude (La Crosse Office)

Federal
Department of the Interior - OEA (Washington, D.C.)
Environmental Protection Agency (Chicago)
Department of Transportation (Homewood, Des Plains)
U.S. Coast Guard (St. Louis)
U.S. Geological Survey (Madison)
National Park Service (Omaha)
National Resource Conservation Service (Madison)
Advisory Council on Historic Preservation (Wash DC)
U.S. Fish and Wildlife Service - (Twin Cities - Hartwig, Lewis, Dobrovolny; Winona - Fisher, Beseke; Onalaska - Nissen)
National Biological Survey (Onalaska - Delaney, Barko)
National Fish Research Laboratory (La Crosse)

State of Wisconsin

Department of Natural Resources (Madison - Meyers; La Crosse - Moe, Janvrin, Benjamin, Endris, Wetzel, Nerva*; Eau Claire - Bourget; Onalaska - Dukerschein)
Department of Administration
Department of Transportation (La Crosse)
State Historic Preservation Office

State of Minnesota

Department of Natural Resources (St. Paul - Sando, Balcom, Johnson; Lake City - Davis; Winona - Gulden)
Pollution Control Agency

State of Iowa

Department of Natural Resources (Des Moines - Szcodronski)

Local

Village of Brownsville, MN
Chaseburg Post Office*
Genoa Township*
La Crosse Post Office*
Stoddard Post Office*
Vernon County Commissioners
Brownsville Post Office*
Genoa Post Office*
Houston County Board of Commissioners*
Marquette Post Office*
Village of Stoddard
Vernon County Engineer

Other Interests

Minnesota-Wisconsin Boundary Area Commission (Hudson)
Upper Mississippi River Conservation Committee (Rock Island)
Sierra Club (Madison)
Izaak Walton League (Edina)
Upper Mississippi River Basin Association (St. Paul)
Mississippi River Regional Planning Commission (La Crosse)
Ducks Unlimited (La Crosse, Stoddard, LaCrescent)
Nature Conservancy (Madison)
Badger State Sportsman's Club
Gopher State Sportsman's Club
La Crosse County Conservation Alliance
Chaseburg Rod and Gun Club
Brice Prairie Conservation Association
Lake Onalaska Protection and Rehabilitation District
La Crosse County Harbor Commission
Lawrence Lake Marina

Media/Libraries

Allamekee Journal and Lansing Mirror*
Cochrane - Fountain City Recorder*
Guttenberg Press*
Winona Daily News
Prairie du Chien Courier Press
Vernon County Broadcaster-Censor*
Waukon Newspapers*
KQAL Radio (Winona)*
WLSU Radio (La Crosse)*
WKTY Radio (La Crosse)*
WKBT TV (La Crosse)*
WLAX TV (La Crosse)*
Guttenberg Public Library
Lansing Public Library
Wabasha Public Library
Buffalo County Journal*
Galesville Republican*
Houston County News*
La Crosse Tribune
North Iowa Times*
Wabasha Herald*
KAGE Radio (Winona)*
KWNO Radio (Winona)*
WLXR Radio (La Crosse)*
WPRE Radio (Prairie du Chien)*
WXOW TV (La Crosse)*
Alma Public Library
La Crosse Public Library
McGregor Public Library
Winona Public Library

Individuals

Calvin Barstow*
George Blask*
Kathleen Brosins*
Dave Corcoran*
Willie Fernholz*
Paul Gettelman
Kevin Gobel*
Dave Hanifl*
Tim Hanratty*
Clarence Haydysch*
Lester Helgerson*
Norman Hoschiel*
Arnold Idecker*
Jerry Kathar*
Norman Krause*
Darryl Mathews*
Pat Middleton*
Ron Nicklaus*
Ron Otto*
Jere Plumley*
Gerald Sandry*
Shirley Sedlman*
Bud Veale*
Larry Webinger*
Jim Willenberg*
Warren Wolfe*
Rudy Wopat*

Paul Benson*

Jeff Ceason*
Rick Denstad*
Fred Funk*
Tom Gianoli*
George Goodsell*
R.E. Hanratty*
Marian Havlik
Brian Haydysch*
Allen Hitching*
Dick Hobelsberger*
Richard Jensen*
Raymond Klafke*
Art Lotz*
Harry Meinking*
Don Morrison*
Randy Otto*
David Peterson*
Gary Raabel*
Mark Schultz
Daryl Steinke*
Blair Voter*
Al Wernecke*
Dave Wollin*
Bob Woodhouse*

October 27, 1994

Management and Evaluation Branch
Engineering and Planning Division

Mr. Keith Beseke
Habitat Project Coordinator
U.S. Fish and Wildlife Service
51 East 4th Street
Winona, Minnesota 55987

Dear Mr. Beseke:

Enclosed are three copies of the draft Problem Appraisal Report (PAR) for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project. The purpose of this report is to document existing and projected future habitat conditions and problems, define habitat goals and objectives for the project area, and identify alternative measures that would address the goals and objectives.

As you are aware, a public information meeting for this project is scheduled for the evening of December 8, 1994, in Stoddard, Wisconsin. A separate meeting notice will be provided at a later date. The information and views obtained from the public will be considered in preparing the final PAR.

We request that you provide your comments on the draft PAR by December 15, 1994. If you have any questions, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

/s/

Enclosures

Charles E. Crist
Chief, Management and Evaluation Branch

Identical letters sent to:

Mr. Jeff Janvrin
Habitat Projects Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Mr. Mike Davis
Habitat Projects Coordinator
Minnesota Department of Natural Resources
1801 South Oak Street
Lake City, Minnesota 55041

Dr. John Barko
Environmental Management Technical Center
National Biological Service
575 Lester Drive
Onalaska, Wisconsin 54650

PUBLIC MEETING

for the

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

at the
STODDARD AMERICAN LEGION POST 315

THURSDAY, DECEMBER 8, 1994
at
6:30 P.M.

A public information meeting to discuss the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project is scheduled to be held at the Stoddard American Legion Post 315, 414 Broadway Street, Stoddard, Wisconsin. The meeting is being held by the St. Paul District, Corps of Engineers, in cooperation with the U.S. Fish and Wildlife Service and the Wisconsin and Minnesota Departments of Natural Resources.

The Pool 8 Islands Phase II habitat rehabilitation and enhancement project is being studied under the Upper Mississippi River System Environmental Management Program. The current study is a continuation of the overall Pool 8 Islands project in lower pool 8 (see map on reverse). Construction of Phase I of the Pool 8 Islands project was completed in 1993. The Phase II study began in December 1993. To date, studies have focused on collecting baseline information and data, identifying habitat problems, identifying habitat changes that have taken place, and identifying the processes causing these changes.

The purpose of the meeting is to provide the public with the information that has been developed from the studies conducted to date, and to obtain public views and input concerning habitat problems in the general study area. The meeting will be conducted as informally as practical to facilitate the exchange of information and ideas between the Federal and State agencies involved in the study and the public. From 6:30 p.m. to 7:00 p.m. there will be an open house during which time the public can view various items of information that will be on display. At 7:00 p.m, the presentation portion of the meeting will commence.

If you are unable to attend the meeting, feel free to contact Gary Palesh, St. Paul District study manager, at (612) 290-5282 if you wish to receive information concerning any aspects of the Pool 8 Islands Phase II habitat project.

RECORD OF ATTENDANCE

Meeting POOL 8 ISLANDS PHASE II Date DEC. 8, 1994

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
LESTER HELGESON	STODDARD WIS	
WARREN WOLFE	STODDARD, WI.	
RANDY OTTO	2545 So. 17TH LA CROSSE WI 54601	
ALLEN HITCHINGS	372 - 5th Ave No. Onalaska 54650	
BUD VEALE	P.O. BOX 281 STODDARD W 54658	
Ron Otto	2323 PINE LA CROSSE, WI	
JACK BLASK	R1 BOX 217 GENOA, WI 54632	Conservation Congress Vernon County
Paul Gettelman	930 HICKORY LA STODDARD, WI 54658	
Tim Hanratty	2516 So 15th La Crosse WI 54601	
Paul Benson	226 PEARL ST Stoddard Wi 54658	
Shirley Sedlmayr	140 Pearl 54658 Stoddard Wis	
Don Morrison	Box 114 Stoddard 54658	

RECORD OF ATTENDANCE

Meeting POOL 8 ISLANDS PHASE II Date DEC. 8, 1994

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
RON NICKLAUS	RT 1 BOX 304 LENOA 54632	DUCKS UNLIMITED
Kathleen Brosius	Stoddard WISC	Pool 8 of "The old man"
Pam Thiel	51 E 4th St Winona MN 55987	FWS
John Wetzel	DWR, 3550 Mormon Coulee Rd, LaCrosse 54601	DNR
David Petersen	P.O. Bx 240 Stoddard wis	
R.E. Hannaty	1903 Adams Lo X	
Jeanne T. (Terry) Dukerschein	575 Lester Ave Onalaska, WI 54650	WDNR/LTRMP

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

PHONE NO. (612) 345-3331
FAX (612) 345-3975

FILE NO.

Section of Ecological Services
1801 S. Oak St.
Lake City, MN 55041
December 14, 1994

Charles E. Christ
Chief, Management and Evaluation Branch
St. Paul District, Corps of Engineers
190 5th St. East
St. Paul, MN 55101-1638

Dear Mr. Christ:

The Minnesota Department of Natural Resources has reviewed the draft Problem Appraisal Report (PAR) for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project. We have the following comments:

1 | **3.3** last sentence - suggest a change to ...was characterized by ~~this braided~~ a stream system that consisted of multiple channels, swampy depressions,...

2 | **4.5.3** This section should include a discussion of the impacts that navigation altered hydrology has had on the river. Altered hydrograph (lack of low water cycles), sediment erosion and deposition processes that caused "islands" to be located in the lower pools - such as channel levee formation.

3 | **5.2.1** OBJECTIVE S-1: There is no depth criteria here. water shallower than 3-feet at normal pool will not be "wintering habitat". Can 200 acres of water over 3-4 foot depth be found in the project area? Perhaps the goal and objective should be adjusted to better reflect the number of acres of potential wintering habitat.

4 | **6.3.4.2** Sand from the Brownsville containment site is not acceptable to us for use in the Raft Channel West Area. Obtaining sand from the river creates aquatic habitat and offsets aquatic volume lost during island construction.

AN EQUAL OPPORTUNITY EMPLOYER

GENERAL

5 We are interested in constructing "seed islands" in the Raft Channel East Area. They are far cheaper to build than larger sand islands and promise to produce features more complex in soil structure and physical form than those built by engineers. Utilizing opportunities to work with the river's energy and material resources in these projects just makes economic and ecological sense. In addition to experimental seed islands, opportunities to free the river to scour new channels and create levee islands should be pursued.

6 If islands are built in the Raft Channel West Area they should be configured to duplicate channel levee islands that would occur naturally in a normal river situation.

7 This project should not cause channels within the Stoddard Area to fill in over time. In order to retain or increase depth diversity, river flows must be allowed to scour these channels periodically (as in floods).

Thank you for the opportunity to comment.

Sincerely,

Mike Davis
HREP Coordinator, MN DNR

c: Steve Johnson
Nick Gulden
Tim Schlagenhaft
Keith Beseke, FWS
Jeff Janvrin, WDNR

Responses to Minnesota Dept. of Natural Resources

1. This has been changed as suggested.

2. A discussion commensurate with the scope of this report has been added.

3. Based on the discussions at the February 15, 1995, interagency coordination meeting, a depth criteria has been added to the objective.

4. We recognize the desire to borrow island material in a manner that will provide habitat benefits. That is our primary objective also. However, we recognize that there may be technical, environmental, or fiscal constraints that prevent this, requiring us to consider other sources. We consider the Brownsville Site and the main channel as potential sources of sand if this material can not be obtained from another source for whatever reason(s).

5. We intend to incorporate the seed island concept where there is adequate sand transport to facilitate island formation. At present, it appears the best opportunity for this concept is on the right decending side of the main channel in the area below Trapping and Heron Islands.

6. Concur.

7. Concur.

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

State Office Building
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

December 21, 1994

St. Paul District, Corps of Engineers
Floodplain Management and Small Projects, Planning Division
ATTN: Mr. Gary Palesh
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Palesh:

We have completed review of the draft Problem Appraisal Report for the Pool 8 Islands, Phase II, Habitat Rehabilitation and Enhancement Project, dated October, 1994. Following are our comments on the PAR.

1 | Page 8: 3.2.2. Crosby Slough flows in a southeasterly direction, not a southwesterly direction as stated.

2 | Page 10: 3.5. We suggest adding scientific names for plants, animals and fish, or provide an appendix listing scientific names for those mentioned in the report. We suggest that a reference be provided for discussion of common plant species found in the study area.

3 | Page 11: 3.7. Change reference to "Wilcox (1993)."

4 | Page 14-15: 4.1. State that the loss of islands also means that terrestrial habitat was lost in the lower pools. This is implied in the present text, but should be stated.

5 | Page 17: 4.2.1.3. Aerial photography doesn't reliably pick up submersed species. Water transparencies, light conditions, wind, species life form, time of year and other factors combine to determine if submergent beds can be detected by aerial photos. We recommend that a sentence be added stating some of the limitations of aerial photo interpretation in delineating submersed aquatic vegetation beds.

6 | Page 19: 4.2.1.4. Under present conditions, lack of spawning, rearing and juvenile habitat may be a limiting factor for some backwater species due to lack of vegetation, cover or suitable substrate. Examples include: bluegill, northerns, largemouth bass, etc.

7 | Page 29: 4.3.1.3. Second to last sentence. Mention of game is not necessary. There is a lack of protected, vegetated shallows that are important nursery areas for backwater and some riverine fish species. Please omit "game" and add "backwater and some riverine."

Page 52: 5.2.1. Stoddard area goals and objectives. After review of the goals and objectives presented, and discussion within our agency, we recommend the following criteria be added to

Objective S-1, and the following Objectives be added to the report. Addition of these items will need to be discussed at the next inter-agency planning meeting.

8

4. Diversity of depths with maximum "edge" along water > 3 feet deep. Suggested breakdown of depths for the area are, interspersion of these depths is also important:

0-2 feet 20 %
2-4 feet 30 %
4-6 feet 40 %
6-8 feet 10 %

5. Water depth > 4 feet over ≥40 % of the wintering area in year 25.
6. In-water habitat (trees, stumps, rock) present for colonization by invertebrates and protection.

9

OBJECTIVE S.X: Enhance and/or create centrarchid summer habitat meeting the following criteria:

1. Dissolved oxygen levels > 5 mg/l
2. 50:50 interspersion of open water and vegetation (submergent, floating, and emergent)
3. Water depth > 2 feet over 80% of the area.
4. In-water habitat (trees, stumps, rock) present for colonization by invertebrates and protection.

10

OBJECTIVE S.X: Enhance and/or create shallow and protected spawning, rearing and juvenile fisheries habitat at 3 locations (Approx. 5 acres each) meeting the following criteria:

1. Next to summer habitat (see objective 2)
2. Dissolved oxygen levels > 5 mg/l
3. Current velocity < 0.1 cm/sec over 75% of the area
4. 80:20 interspersion of vegetation and open water
5. Water depth 2-4 feet over 80% of the area.
6. Substrate type of hard sand and/or gravel

11

Goals and Objectives for both Raft Channel areas: (Pages 57-64) Descriptions of existing habitat conditions for all three study areas provide documentation on loss of depth diversity as one habitat roblem common to all areas. The discussion of estimated future conditions (4.5.4) states, "...the loss of bathymetric diversity seen in the past is expected to continue into the future." This reduction in depth diversity is caused by erosion of shallow areas (<2-3 feet) by wave action and resuspension, and sedimentation of deeper areas (>5 feet) unaffected by resuspension by wave action. Since loss of bathymetric diversity and sedimentation of deep water habitat is one of the habitat problems clearly defined throughout the PAR, we recommend that rehabilitation/creation of deep water habitat be included as a high priority goal for the Raft Channel East and Raft Channel West study areas.

12

Page 65: 6.2.3. There may be extensive mussel resources in many areas of the Raft Channel. Add a sentence stating that this may be a constraint for using the Raft Channel as a sand borrow source. We recommend that mussel surveys, preferably by divers and not "the sled", be done prior to borings to identify areas of mussel concentrations in the Raft Channel.

Page 69: 6.3.3.4. Borrow Sources. We will not support the further use of material from the Brownsville dredged material containment area for the construction of habitat features in any phases of the Pool 8 Islands project that are constructed using EMP funds. References to the use of material from the Brownsville dredged material containment area must be eliminated from the problem appraisal report and forthcoming DPR. If, during the development of Plans and Specification for the project, Channel Maintenance would like to take the opportunity to off-load the Brownsville site by constructing Raft Channel features using this material, we would consider
13 the proposal if the following criteria are met: 1) Funds for island construction will not be from EMP sources; 2) The islands must be capped with fine materials the same year as construction; 3) The islands must be constructed to specifications developed by the interagency planning team.

Using the main channel as a borrow source for sand is also unacceptable to us, barely ranking higher than use of material from Brownsville. We will only support the main channel alternative if borings indicate there is no source of suitable island construction material located within the study area or adjacent areas.

Discussions at the many planning meetings held for this project indicate that construction of islands in all areas is the most likely alternative to meet many of the goals and objectives. Areas sheltered by the islands will become depositional areas, thereby increasing the spatial extent of "shallow" water habitat over time. Studies being conducted by the EMTC indicate that scouring is occurring around the ends of the islands. However, we are skeptical that islands alone in the Raft Channel
14 East area will be able to affect river currents significantly enough to greatly increase scouring and creation of deep water habitat. If loss of deep water habitat in the study areas is considered a habitat problem, as stated in the PAR, then the sand source for construction of the islands must be from a backwater or riverine lake area within the study areas. This project should incorporate rehabilitation of deep water habitat into the planning process and should be added as a goal for both the Raft Channel East and West areas. To us, this is a high priority goal.

15 Page 70: 6.3.4.2. See comments for page 69, 6.3.3.4.

16 Page 73: 6.5.1.3. See comments for page 69, 6.3.3.4.

17 Page 74: 6.5.2.3. See comments for page 69, 6.3.3.4.

18 General comment: Many of the tables lack references for where the information was obtained. All table using information from sources other than COE should be referenced.

Thank you for the opportunity to comment on the PAR. Please contact me at (608) 785-9005 if your have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Keith Beseke, USFWS
Pam Theil, USFWS
Jim Nissen, USFWS
Terry Dukerschein, WI DNR
Mike Davis, MN DNR

PE-M

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

State Office Building
3550 Mormon Coulee
La Crosse, WI
TELEPHONE 608-785-
TELEFAX 608-785-9990

June 6, 1995

St. Paul District, Corps of Engineers
Floodplain Management and Small Projects, Planning Division
ATTN: Mr. Gary Palesh
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Palesh:

We have completed review of the goals and objectives for Pool 8 Islands-Phase II, and Raft Channel East and West you presented to us at a meeting on May 11, 1995. Overall, the goals and objectives are consistent with what has been discussed or presented in the past. We only have a few comments to offer.

1 | OBJECTIVE S-1A: Based on the discussions held at the last interagency meeting, we recommend that the current velocity in this objective be changed to < 0.3 cm/sec.

2 | OBJECTIVE S-2: The constraints presented for the nesting island are design criteria. The planning team has taken the stated constraints into consideration when proposing placement of the nesting island. The present placement of the nesting island is > 0.5 miles from large land areas, relatively isolated from disturbance and of a size small enough that land based predators are less likely to be year-round residents. We recommend that the last two sentences of the paragraph describing constraints on the location of nesting islands be removed from this section and edited to be included in the section under design criteria.

3 | OBJECTIVE RCE-1 (2): Editorial change, "...nesting habitat in 2-3 acre increments..."

4 | OBJECTIVE RCW-1: The present boundary of the RCW area does not present any good opportunities to construct nesting islands in this area. This is based on the constraints presented and design criteria outlined by the agencies. However, if the RCW project area was expanded, nesting islands may be considered. We recommend nesting islands be removed from this section or the paragraph on nesting islands be modified as stated in the comments for Objective S-2.

Please contact me at (608) 785-9005 if you have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Jim Nissen, USFWS
Keith Beseke, USFWS
Mike Davis, MN DNR

RECEIVED
JUN 1995
CORPS OF ENGINEERS
ST. PAUL DISTRICT
REGULATORY BRANCH

Responses to Wisconsin Dept. of Natural Resources

Letter dtd December 21, 1994

1. This has been corrected.

2. Due to time constraints, we have not done this for the Problem Appraisal Report. We will add scientific names in the Definite Project Report.

3. This has been corrected.

4.- 6. This information has been added.

7. This has been changed as suggested.

8.- 11. These recommendations were discussed at the February 15, 1995, interagency coordination meeting and the objectives have been modified based on those discussions.

12. The need to consider potential impacts on mussel resources has been added to the planning constraints section.

13. We recognize the desire to borrow island material in a manner that will provide habitat benefits. That is our primary objective also. However, we recognize that there may be technical, environmental, or fiscal constraints that prevent this, requiring us to consider other sources. We consider the Brownsville Site and the main channel as potential sources of sand if this material can not be obtained from another source for whatever reason(s).

14. See response to comments 8. thru 11.

15. - 17. See response to comment 13.

18. We have tried to indicate on all tables where the information was obtained. If there is no notation, it should be assumed that the information was generated within the St. Paul District.

letter dtd June 6, 1995

1. - 4. The objectives and/or supporting narative have been changed as recommended.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River Refuge Complex
51 East 4th Street
Winona, Minnesota 55987

IN REPLY REFER TO:

May 9, 1995

Mr. Gary Palesh
NCS-PE-M
Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101

Dear Gary:

Pursuant to the request made in the Pool 8 Island Phase II Interagency Coordination Meeting Agenda, the U.S. Fish and Wildlife Service requests that the Corps of Engineers continue to study the Raft Channel East and West study areas as part of the Phase II package. We request this recognizing and respecting that completing a habitat project in the Stoddard Bay area remains Wisconsin's top priority. We do not propose to interfere with that priority.

We recommend a continuation of studies in Raft Channel East and West for the following reasons:

* Since the Stoddard Bay project will probably exceed $2 million, it will be sent to Washington for review and approval. If this is the case, it would be more efficient to send the entire package, including proposals for the Raft Channels East and West areas. Constructing the entire project may also reduce construction costs through savings on mobilizing/demobilizing and reduced unit cost as a result of larger dredged quantities.

* Studying Lower Pool 8 using a more system-oriented approach may produce a better overall project for the entire area. A holistic approach to planning and implementing a project for this area would not only improve cost:benefit ratios for the entire project, but it would enhance the continuity between what would otherwise be separate projects, and it would move construction schedules for the entire project ahead.

Please call Keith Beseke or Jim Nissen if you have questions or would like to discuss this matter further. Thank you.

Sincerely,

James R. Fisher

James R. Fisher
Complex Manager

c:\wp51\jf\pool8

Responses to U.S. Fish and Wildlife Service

1. We propose to continue to focus the Pool 8 Phase II study on the Stoddard area until we receive a concensus from the Federal and State agencies involved in the St. Paul District HREP program that we should continue to include the Raft Channel East and West areas in a larger scoped project. The reason for this position is that including the Raft Channel East and West areas as part of the Phase II project will increase project costs by an estimated $3-4 million. As we have fully programmed our HREP funds through the current authorized life of the UMRS-EMP, expanding the scope of the Phase II project to essentially incorporate the Pool 8 Phase III project area will likely result in other currently programmed HREP projects not being constructed due to lack of funds. The result would be a defacto reprioritization of HREP projects without concurrence of all of the participating agencies or endorsement by the River Resources Forum. We consider adjusting project priorities within our District management purview if it results in simply delaying or accelerating a project a year or two to adjust to funding or other constraints. However, in this instance, where changing project priorities will mean some projects already selected for the program may never be constructed, we need the concurrence of all the participating agencies.

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

June 15, 1995

Management and Evaluation Branch
Engineering and Planning Division

Mr. Keith Beseke
Habitat Projects Coordinator
U.S. Fish and Wildlife Service
51 East 4th Street
Winona, Minnesota 55987

Dear Mr. Beseke:

Enclosed are three copies of the final Problem Appraisal Report (PAR) for the Pool 8 Island Phase II Habitat Rehabilitation and Enhancement Project. The PAR identifies habitat problems, goals, and objectives for the original Phase II project area (Stoddard area), and for a large part of the Phase III project area (Raft Channel East and Raft Channel West areas). Potential alternative measures to meet habitat objectives within these three areas are also identified.

We propose to focus the remainder of the Phase II study on the Stoddard area, consistent with existing project priorities and public views. We are suspending further work on the Raft Channel East and West areas. We have fully programmed our HREP funds through the current authorized life of the UMRS-EMP. Proceeding further with a larger scoped Phase II project to incorporate portions of the Phase III project area, or advancing the Phase III project in priority, will likely result in other currently programmed HREP projects not being constructed due to lack of funds. This would be a substantial de facto reprioritization of HREP projects without concurrence of all of the participating agencies or endorsement by the River Resources Forum. We believe a change in project priorities of this nature should have the concurrence of all the participating agencies.

We do propose to continue consideration of the seed island concept for the Raft Island East and/or Raft Channel West areas. Inclusion of these relatively low cost features would have minimal impact on the funding of other projects in our HREP program. This concept has the potential for providing long-term island creation benefits at a very low cost.

The preliminary draft Definite Project Report for the Phase II project is currently scheduled for completion in December 1995. If the progress experienced to date on the study continues, we may be able to complete the preliminary draft as early as October. We appreciate the support and cooperation provided by your agency in the conduct of this study. If you have any questions, please contact Mr. Gary Palesh at (612) 290-5282.

Sincerely,

/s/ 6/19/95

Enclosures

Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

9-19

Identical letters sent to:

Mr. Jeff Janvrin
Habitat Projects Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Mr. Mike Davis
Habitat Projects Coordinator
Minnesota Department of Natural Resources
1801 South Oak Street
Lake City, Minnesota 55041

Dr. John Barko
Environmental Management Technical Center
National Biological Service
575 Lester Drive
Onalaska, Wisconsin 54650

PUBLIC MEETING

for the

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

at the
STODDARD AMERICAN LEGION POST 315

THURSDAY, SEPTEMBER 28, 1994

OPEN HOUSE - 6:30 P.M.

PUBLIC MEETING - 7:00 P.M.

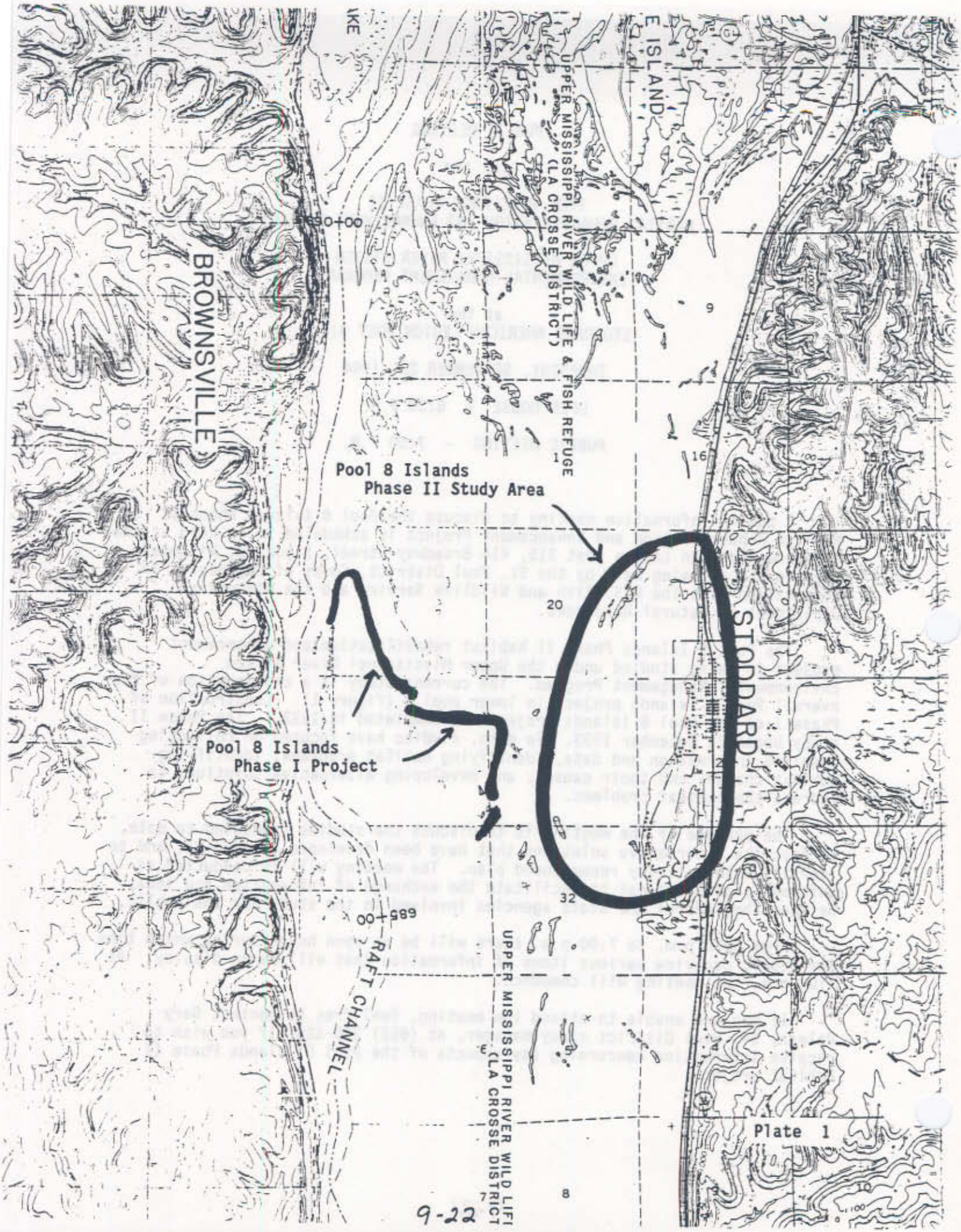
A public information meeting to discuss the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project is scheduled to be held at the Stoddard American Legion Post 315, 414 Broadway Street, Stoddard, Wisconsin. The meeting is being held by the St. Paul District, Corps of Engineers, in cooperation with the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

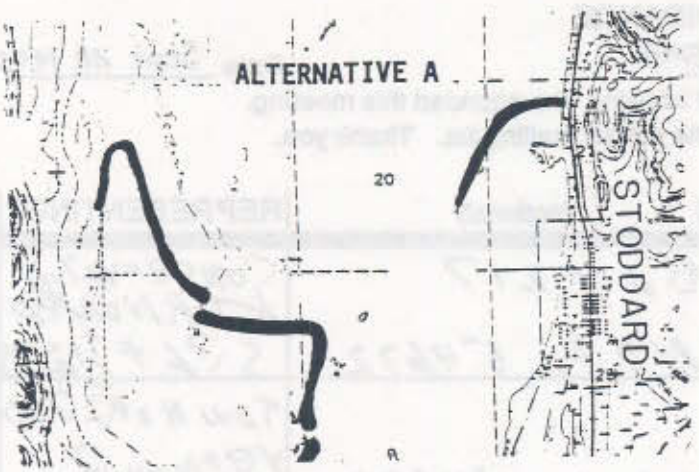
The Pool 8 Islands Phase II habitat rehabilitation and enhancement project is being studied under the Upper Mississippi River System Environmental Management Program. The current study is a continuation of the overall Pool 8 Islands project in lower pool 8 (figure 1). Construction of Phase I of the Pool 8 Islands project was completed in 1993. The Phase II study began in December 1993. To date, studies have focused on collecting baseline information and data, identifying habitat problems, identifying habitat changes and their causes, and developing alternative solutions to address the habitat problems.

The purpose of the meeting is to discuss the studies conducted to date, to describe alternative solutions that have been developed (figure 2), and to identify a tentatively recommended plan. The meeting will be conducted as informally as practical to facilitate the exchange of information and ideas between the Federal and State agencies involved in the study and the public.

From 6:30 p.m. to 7:00 p.m. there will be an open house during which time the public can view various items of information that will be on display. At 7:00 p.m, the meeting will commence.

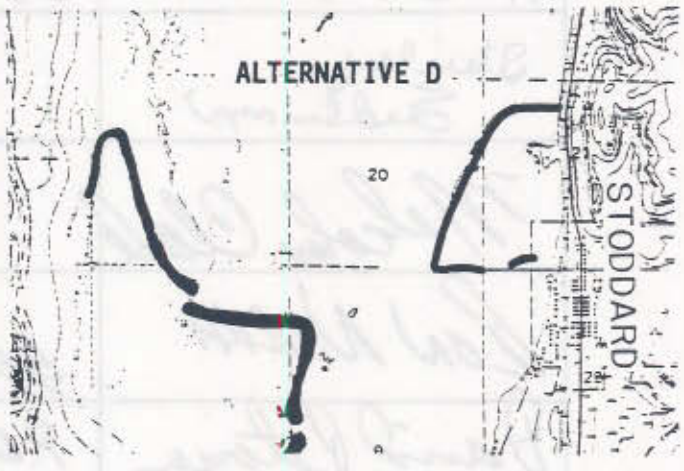
If you are unable to attend the meeting, feel free to contact Gary Palesh, St. Paul District study manager, at (612) 290-5282 if you wish to receive information concerning any aspects of the Pool 8 Islands Phase II habitat project.

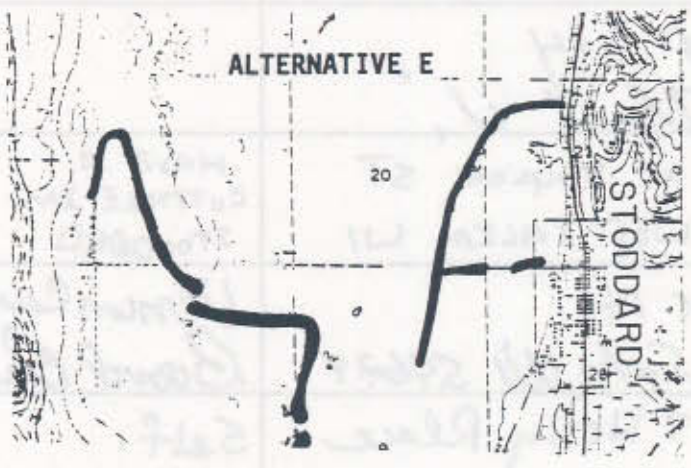

BROWNSVILLE
UPPER MISSISSIPPI RIVER WILD LIFE & FISH REFUGE
(LA CROSSE DISTRICT)
E ISLAND
Pool 8 Islands
Phase II Study Area
Pool 8 Islands
Phase I Project
STODDARD
RAFT CHANNEL
UPPER MISSISSIPPI RIVER WILD LIFE
(LA CROSSE DISTRICT)
Plate 1

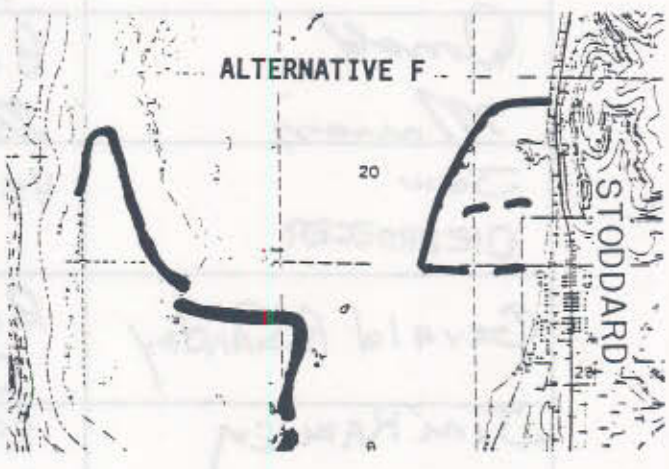

ALTERNATIVE A
20
STODDARD

ALTERNATIVE B
20
STODDARD

ALTERNATIVE C
20
STODDARD


ALTERNATIVE D
20
STODDARD


ALTERNATIVE E
20
STODDARD


ALTERNATIVE F
20
STODDARD

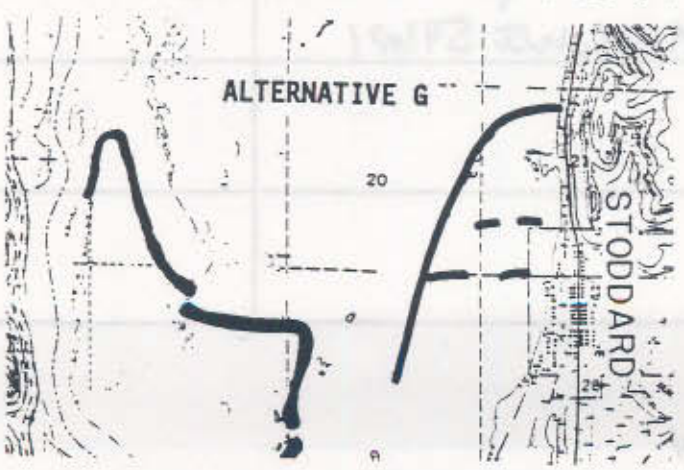

ALTERNATIVE G
20
STODDARD

Plate 2

RECORD OF ATTENDANCE

Meeting Pool 8 Islands Phase II EMP Date Sept 28, 1995

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
JACK BLASK	R1 BOX 217 GENOA, 54632	CONSERVATION VERNON CO SPL + Town of Genoa
RAYMOND NICKELATTI	R1 GENOA WI 54632	TOWN OF GENOA VERNON CO.
Shirley Sedlmayr	Stoddard	~~[illegible]~~
Malcolm Clark	Stoddard	
RON NERVA	GENOA	—
David Petersen	P.O. Bx 140 Stoddard Wis	
Donald Morrison	Box 114 Stoddard Wi	
JOHN DIEKROEGER	450 N YOULON ST WEST SALEM WI	HAVE A COTTAGE IN STODDARD
Gerald R. Sandry	BOX 14 DeSoto, WI 54624	Vernon County Board Chair
Jim Ramsey	2907 Holly Place LaCrosse, WI 54601	Self.

RECORD OF ATTENDANCE

Meeting Pool 8 Islands Phase II EMP Date Sept 28, 1995

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
Bud Veale	PO 281 Stoddard Wi 54658	
Ron Westplate	5920-107 St Kenosha, Wi. 53142	
Paul Gettelman	930 Hickory LA Stoddard, Wi 54658	
Daryl Steinke	248 N. Main St Stoddard, WI 54658	
Richard Withrow	202 So. Pearl St. Stoddard Wi 54658	
Jeff Ceason	R.R. 2 Stoddard Bx 694 54658	
Kevin Gobel	Box 203 Stoddard Wi 54658	
Warren Wolfe	RR 1 Box 52 Stoddard, Wi. 54658	
Craig Banasik	RR 1 Stoddard, Wi.	
Bob Ganley	134 Pearl St Stoddard 54658	
Bill Howe	Box 149 Prairie Av Rich 53871	Mrs Cor Cong
Gary Ackerman	Gattenberg, Ia	IA DNR

CENCS-PE-M 5 October 1995

MEMO FOR RECORD

SUBJECT: Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project

1. On the evening of 28 September 1995, a public meeting for the subject project was held at the Stoddard American Legion Post 315, Stoddard, Wisconsin. The St. Paul District was represented by Jon Hendrickson (PE-H), Randy Devendorf (PE-M), and the undersigned. The public meeting was co-sponsored with the District by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources. Representatives of these agencies assisted in the meeting presentation.

2. The meeting was attended by 21 private citizens. Units of government, agencies, or groups represented included:

Vernon County Board
Village of Stoddard
Town of Genoa
Wisconsin Conservation Congress
Vernon County Conservation Alliance
Ducks Unlimited
Iowa Department of Natural Resources

3. The District presented information concerning the habitat changes, habitat problems, and habitat goals and objectives for the project area. Seven alternative plans for habitat restoration were presented, addressing the components of each alternative, expected construction methods, costs, and habitat benefits. The projected hydrologic and hydraulic effects of the alternatives were also presented. Information was also presented on the status of project planning and design, e.g., work completed and remaining decisions to be made, and a preliminary schedule for completion of the project.

4. The salient questions or concerns expressed by the public were as follows.

a. Would the project induced lower velocities increase sedimentation in Stoddard Bay?

b. Would the project affect flows above Stoddard Bay?

c. Would the project affect the Phase I islands (cause erosion)?

d. Would the project affect springs located in or above Stoddard Bay?

e. Would the project affect boat access to the Waters Edge motel and harbor?

f. The size of the notch in rock sill A was questioned.

g. The height of the islands was questioned, with the view expressed that we should be considering higher island elevations.

h. We should consider constructing islands with more topographic relief, instead of relatively flat islands.

i. Were fish using the deep holes dredged in Crosby Slough for Phase I island borrow?

j. Were we considering placing rock on the Stoddard shoreline?

k. Why were plans and specifications and construction management cost estimates so high?

l. Did the Phase I islands result in any bathymetric changes behind those islands?

m. It takes too long to plan and implement habitat projects, with particular emphasis on the Phase II project.

n. Where is the access dredging?

o. We should maximize the amount of sand taken from the Stoddard Landing area.

District or agency representatives were able to respond to all of the questions or concerns expressed. In some instances, the questioner may not have agreed with the response, but no significant disagreements arose.

5. As a result of the public input, the following will be considered further in project design.

a. We will consider elevating portions of the islands to provide additional topographic diversity.

b. We will try to maximize the use of sands from the Stoddard Landing area vs. Crosby Slough, subject to cost considerations.

c. Review expected hydraulic and sedimentation effects to insure we are not impacting areas of concern expressed by the public.

6. With respect to the concern expressed with plans and specifications and construction management costs, we explained that the current estimates use a straight percentage of construction costs, and that this inflated the estimates for these features. For example, plans and specifications costs for a $4 million island project would not cost twice as much as the plans and specifications costs for a $2 million island project. (As a note, we have been developing better cost estimates for these features, recognizing the problems with using a straight percentage).

7. We indicated that the final selection of alternatives for Stoddard Bay appears to be between Alternative E (five islands) and Alternative G (seven islands). Those in attendance who expressed an opinion were in favor of Alternative G.

8. We discussed two minor additional project features, seed islands and a nesting island. The public was in favor of pursuing seed islands in lower pool 8. They were noncomittal concerning the nesting island.

9. In summary, the public had a number of questions and concerns to which we were able to respond. There is very strong public support for the Pool 8 Islands Phase II project, and as noted above, the public prefers the larger of the alternatives being considered.

10. At this and previous public meetings the public has expressed concern with the time it is taking to implement this project. The planning for this project will take two years from the initial meeting with the agenicies to completion of the draft report (Dec 93 - Dec 95). While this may seem like a long time to the public, it is actually less time than it has taken to plan previous habitat projects of similar scope and complexity. However, because of the public interest in this project and the concern expressed, we need to insure that progress on this project continues as rapidly as possible.

Gary Palesh
Technical Manager

PE-M/Palesh
vjs inbox:fn:pool8-4

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

December 26, 1995

Management and Evaluation Branch
Engineering and Planning Division

Mr. Keith Beseke
Habitat Projects Coordinator
U.S. Fish and Wildlife Service
51 East 4th Street
Winona, Minnesota 55987

Dear Mr. Beseke:

Enclosed is a preliminary draft of the Definite Project Report/Environmental Assessment, including the Finding of No Significant Impact and Section 404(b)(1) evaluation of the proposed Pool 8 Islands Phase II Environmental Management Program Habitat Project. This report is being sent to you for review and comment. It is being reviewed concurrently by the National Biological Service and the Wisconsin and Minnesota Departments of Natural Resources.

Please review the enclosed document and provide any comments on the proposed plan by January 31, 1996. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. Your letter would be included in the draft report for public review, scheduled to be released in February 1996. A letter indicating support of the proposed project has also been requested from the Wisconsin and Minnesota Departments of Natural Resources.

If you have any questions or need additional information, please contact Mr. Gary Palesh, at (612) 290-5282.

Sincerely,

/s/
Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

Enclosure (6 copies)

Printed on Recycled Paper

9-29

PE-M/Palesh
vjs inbox:fn:pool8-4

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

December 26, 1995

Management and Evaluation Branch
Engineering and Planning Division

Mr. Jeff Janvrin
Habitat Projects Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Dear Mr. Janvrin:

Enclosed is a preliminary draft of the Definite Project Report/Environmental Assessment, including the Finding of No Significant Impact and Section 404(b)(1) evaluation of the proposed Pool 8 Islands Phase II Environmental Management Program Habitat Project. This report is being sent to you for review and comment. It is being reviewed concurrently by the U.S. Fish and Wildlife Service, National Biological Service, and the Minnesota Department of Natural Resources.

Please review the enclosed document and provide any comments on the proposed plan by January 31, 1996. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. Your letter would be included in the draft report for public review, scheduled to be released in February 1996. A letter indicating support of the proposed project has also been requested from the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources.

If you have any questions or need additional information, please contact Mr. Gary Palesh, at (612) 290-5282.

Sincerely,

/s/
Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

Enclosure (6 copies)

Printed on Recycled Paper

PE-M/Palesh
vjs inbox:fn:pool8-4

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

December 26, 1995

Management and Evaluation Branch
Engineering and Planning Division

Mr. Mike Davis
Habitat Projects Coordinator
Minnesota Department of Natural Resources
Lake City, Minnesota 55041

Dear Mr. Davis:

Enclosed is a preliminary draft of the Definite Project Report/Environmental Assessment, including the Finding of No Significant Impact and Section 404(b)(1) evaluation of the proposed Pool 8 Islands Phase II Environmental Management Program Habitat Project. This report is being sent to you for review and comment. It is being reviewed concurrently by the U.S. Fish and Wildlife Service, National Biological Service, and the Wisconsin Department of Natural Resources.

Please review the enclosed document and provide any comments on the proposed plan by January 31, 1996. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. Your letter would be included in the draft report for public review, scheduled to be released in February 1996. A letter indicating support of the proposed project has also been requested from the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

If you have any questions or need additional information, please contact Mr. Gary Palesh, at (612) 290-5282.

Sincerely,

/s/

Enclosure (3 copies)

Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

Printed on Recycled Paper

PE-M/Palesh
vjs inbox:fn:pool8-4

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

December 26, 1995

Management and Evaluation Branch
Engineering and Planning Division

Dr. John Barko
Environmental Management Technical Center
National Biological Service
575 Lester Drive
Onalaska, Wisconsin 54650

Dear Dr. Barko:

Enclosed is a preliminary draft of the Definite Project Report/Environmental Assessment, including the Finding of No Significant Impact and Section 404(b)(1) evaluation of the proposed Pool 8 Islands Phase II Environmental Management Program Habitat Project. This report is being sent to you for review and comment. It is being reviewed concurrently by the U.S. Fish and Wildlife Service and the Wisconsin and Minnesota Departments of Natural Resources.

Please review the enclosed document and provide any comments on the proposed plan by January 31, 1996. If you have any questions or need additional information, please contact Mr. Gary Palesh, at (612) 290-5282.

Sincerely,

/s/
Charles E. Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division

Enclosure (2 copies)

Printed on Recycled Paper

State Historical Society of Wisconsin
Division of Historic Preservation
816 State Street • Madison, Wisconsin 53706-1488
☎ (608) 264-6500 • FAX (608) 264-6404

January 2, 1996

Mr. Robert Whiting
U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101-1638

SHSW#: 94-0455/Ve
RE: Phase II: Pool 8 Islands Environmental Management Program on the Mississippi River at Stoddard, Wisconsin

Dear Mr. Whiting,

We have reviewed the plans to construct seven islands and two rock sills to stabilize erosion in Pool 8 of the Mississippi River.

There are two historic shipwrecks (Northern Light and Envoy) near the proposed project area. We concur with your finding that the proposed undertaking will have no effect on the two shipwrecks mentioned above as the proposed dredge cuts are in areas that were not formerly navigable.

Should any archeological materials, including submerged features, artifacts, or structural materials be encountered, construction or dredging activities should be halted. Please report the discovery immediately to the State Underwater Archeologist at (608) 264-6493. Should human bone be discovered, you must contact the Burial Sites Preservation Office at 1-800-342-7834 for compliance with Wis. Stat. §157.70(1991) which provides for the protection of human burial sites.

If you have any questions concerning these matters, please call me at (608) 264-6507.

Sincerely,

Sherman Banker

Sherman Banker
Compliance Archeologist

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Donald R. Winter, District Director

State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
FAX 608-785-9990

February 1, 1996

St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
ATTN: Mr. Gary Palesh
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Palesh:

We have completed review of the preliminary draft Definite Project Report/Environmental Assessment for Pool 8 Islands-Phase II, dated December 1995. Following are our comments on the preliminary draft DPR.

1 **Page 3:** Please include the following staff from the WDNR RTA station:
Andy Bartels, Fisheries Specialist
Terry Dukerschein, RTA Station Team Leader
Jim Fischer, Water Resource Management Specialist
Heidi Langrehr, Vegetation Specialist

2 **Page 22:** 4.1.2.3 Plate 7 should be referenced in this section.

3 **Page 37:** Edit the description for nesting turtles to clarify soil moisture requirement: "...capable of maintaining soil moisture suitable for turtle egg incubation."

4 **Pages 46 & 47:** 5.5.2.1.5 & 5.5.2.2 Add Stoddard Bay as a second potential source for sand borrow.

5 **Page 50-53:** 5.5.2.3.3; 5.5.2.4.1; 5.5.2.5.2; 5.5.2.6.1 Add Stoddard Bay as a second potential sand borrow source for A and B islands.

6 **Page 52:** Add a more detailed description of what the E islands are intended to do with regard to scour and deposition.

7 **Page 57:** 5.5.4 We suggest the final selection of which seed islands to construct be made during preparation of plans and specs. This will allow for selection of sites based on any new information gained through EMTC's monitoring of the two seed islands constructed in the fall of 1995.

8 The use of seed islands should be evaluated for a variety of physical conditions and purposes. The selection of sites presented in the DPR would limit this evaluation. Therefore, we recommend including a group of seed islands (ie. similar to sites 1-3). Placing a group of seed islands together will allow us to evaluate the potential of using this technique to cause erosion and deposition that may develop an "island and channel system" into this portion of lower Pool 8. If, sites 1-3 are determined to be

unsuitable for seed island construction, another "group" of seed islands should be placed in an alternate location.

9 Placement of a group of islands would most likely require some access dredging to reach the last island or two in the group. We propose that one seed island be "nourished" by material obtained through access dredging. This will allow us to evaluate the use of this technique for future seed islands and reduce the cost of having to haul access material to another site.

Page 63: Table 6-2, Objective 1A(4) This objective will be partially met in alternatives E, F, and G. Islands C, D1 and D2 (Alternatives E and G) in combination will provide some additional deep-water habitat protected from flow. Islands E1 and E2 (Alternative F and G) are designed to maintain and/or enhance deep-water habitat. Therefore, we believe that these three alternatives will partially meet this objective. This should be reflected by increasing the relative value in the table from 0 to 1 for Alternatives E and F and to 2 for Alt. G.

10

Page 77-79: Nesting Island: We do not concur with the decision to drop the nesting island as a feature of the Pool 8 Islands Phase II HREP. The term "nesting island" is a descriptive term used to identify small isolated islands that provide benefits to a variety of species other than just nesting waterfowl. This is similar to the use of the term "centrarchid habitat" to describe protected off channel lacustrine habitat, of which centrarchids are only one of the species benefited.

11

We strongly recommend construction of a nesting island as part of the project for the following reasons:

12 a.) The proposed location of the nesting island is based on 15 years of nesting studies conducted on the River. It will be isolated (high visibility index), thus readily found and used by nesting mallards. It will be predator-free because of its isolation and small size. It is in the correct proximity to secure brood cover, thus assuring reasonable brood survival and good number of new homing hens. These criteria are also consistent with research done by other investigators.

13 b.) The two locations shown in Figure 17 place the nesting island in the most suitable sites in lower Pool 8 based on a combination biological, economic and constructability criteria.

14 c.) Construction of a nesting island as a feature of Pool 8 Phase II will allow us to test the criteria for site selection, stability of small constructed islands and to evaluate the feasibility of the technique for future use. To quote from the summary of Section 1103 of the Water Resources Development Act of 1986 provided on page 1 of the DPR, "...a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement..."

15 d.) Existing small isolated islands are rapidly disappearing and are often quite difficult to access, making existing small isolated islands very expensive to protect with rip-rap. This island would be designed for maximum stability and longevity.

16 e.) From an incremental standpoint, if this island in the proposed location is not built during theconstruction of Phase II, the cost will be much greater in the future. In

other words, it would be cheaper to construct it now when the equipment is in the area than do it at another time.

17 f.) This small island will also provide habitat benefits for other species: nesting habitat for greenbacked herons, turtles, shorebirds, loafing sites for migratory waterfowl and fish habitat along the littoral zone and through increasing bathymetric diversity.

18 g.) We believe that the cost per duck is reasonable. The projections used for production on the proposed island are based on results from studies conducted at similar sites on the Mississippi River. These estimates are not optimistic but may be exceeded on an island specifically designed to optimize production.

19 h.) Construction of the nesting island will meet the following objectives of the Upper Mississippi River National Wildlife and Fish Refuge master plan: increase the production of historically nesting waterfowl; contribute to the achievement of national population and distribution objectives identified in the North American Waterfowl Management Plan and Flyway management plans; and maintain or increase the current population and distribution of colonial nesting birds.

Page 81: 20 6.4.3. Planning for the Pool 8 Islands Phase II includes the use of seed islands as a potentially cost-effective approach to restore island habitat. It is important that seed islands be done as part of Phase II to evaluate their potential and possible use at other HREP locations (ie. Pool 11 Islands). The effectiveness of seed islands at any location will be dependent on sediment transport for their formation and longevity. We believe that the river reach in Pool 8 where seed islands are proposed will meet the necessary physical criteria.

21 The habitat benefit of seed islands is from the dynamic forces and disturbance that will result from these islands being in a constant state of change and succession. Constructed islands may also provide zones of succession similar to seed island, however, the rate of succession and habitat creation may or may not be at a slower pace. While seed islands have several habitat benefits in common with constructed islands (ie. reduction in sediment resuspension, creation of terrestrial habitat, etc.), constructed islands serve multiple purposes and recreate/simulate a process of island building that could take hundreds or thousands of years for the River to create naturally.

22 The islands in the Stoddard Bay area are being constructed for different objectives than the seed islands. By using the cost-per-acre benefitted from Stoddard to justify the seed islands is analogous to comparing "apples and oranges." Because of this, comparisons between constructed and seed islands are not appropriate. We believe that the cost of a project (with features designed for a given set of conditions or objectives) should not be used to justify the cost of another project or project feature.

23 Recommendations: Paragraph 2. Delete last two sentences. Paragraph 3. Delete first and last sentence. Paragraph 4. Delete paragraph. We do not have any biological monitoring to document that seed islands, "...will be significantly more diverse in structure and character than any man-made island could be." Furthermore, depending on the terrestrial habitat type we are targeting to create (ie. oak ridges vs. sandbar), seed islands may not be more valuable. Seed islands provide sandbar

habitat and early successional stages uncommon in some River reaches since inundation, particularly in the lower reach of a pool.

24 **Page 404-1:** I.A. Brownsville is west/northwest of the project area.

25 I.B. Second Paragraph, Last Sentence. Edit: "...island complex could eventually total up to 60 acres."

26 I.C. Last sentence incomplete.

27 **Page 404-2:** I.E.1. Second Paragraph. Seed islands will be located along the right descending bank.

28 **Page 404-3:** I.E.4. Last Sentence. Construction involving rock work (rock sills, groins, seed islands) could be allowed during high flows to reduce or eliminate access dredging using mechanical equipment. Mechanical access dredging could also be allowed at this time if the disposal site was above water. Edit text to incorporate these comments.

29 I.F. Second Paragraph, Last Sentence. Effluent may need to be released to the Stoddard Bay side of the island to meet water quality limits. Release to the Stoddard Bay side would allow the use of a temporary berm from islands B to D1 or silt curtain parallel to the island to create a secondary settling area to increase retention time beyond what could be achieved on top of the island. This secondary settling area may provide mudflat habitat for shorebirds. There also may be the need to provide a site for hydraulic removal of any overburden of fines (previous discussions have identified the area bordered by islands B and D1). We recommend editing the last sentence so the method described above could be an option and adding language to accommodate disposal of fines.

30 **Page 404-4:** I.F. Sixth Paragraph. The opening in sill A should be referenced in this section.

31 II.A.2. Second Paragraph, Last Sentence. Edit: "...up to 60 acres of islands could..."

32 **Page 404-6:** II.C.1. Second Paragraph. Add, "A localized short-term increase in suspended particulate or turbidity levels may also occur due to any access dredging needed to construct seed islands."

33 **Page 404-8:** II.E.5. Edit: "...would have no appreciable..."

34 **Page 404-9:** II.E.8. There should be no need to restrict construction activities during spring migration periods. Delete reference to spring migration.

35 II.F.1. Edit: "...channel flow, and near ambient conditions..."

36 **Page 404-10:** III. Third Paragraph. Edit: "...include timing of dredging activities to..." and "...avoiding construction during the hunting season when the Raft Channel East area serves as a sanctuary for waterfowl during fall migration..."

37 **Attachment F:** The correspondences between the Fish and Wildlife Service and Wisconsin DNR were not intended to be included in the DPR. These letters should be removed

from the DPR and the cost:benefit analysis should reference these letters as personal communications.

38 We have been very pleased with the hard work and expertise of staff from the St. Paul District during the planning of this project. We believe the Pool 8 Islands Phase II HREP will be one of the premier projects completed under the Environmental Management Program. We support the many new and innovative ideas to be tried as part of the project, furthering our knowledge of river processes and techniques to improve fish and wildlife habitat. As proposed, this project should meet, or exceed, many of our objectives for improving fish and wildlife habitat in Stoddard Bay.

39 We will provide a formal letter of support for the Pool 8 Phase II HREP after public review of the DPR. Water quality certification will be issued during preparation of plans and specifications following approval of the project from COE higher authority.

Please contact me at the above address or phone (608) 785-9005 if you have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Jim Nissen, USFWS
Keith Beseke, USFWS
Pam Thiel, USFWS
Terry Dukerschein, WDNR
Mike Davis, MN DNR
John Wetzel, WDNR
Bob Gaugush, EMTC

Responses to Wisconsin Department of Natural Resources
Comments of February 1, 1996

1. This information has been added to the report.

2. Concur.

3. The recommended modification has been made.

4. Based on the results of recent borings, it appears highly unlikely that there would be sufficient accessible sand in Stoddard Bay for constructing islands A and B. Therefore, the recommended changes were not made. The detailed discussion in Section 7 concerning construction indicates that we would maximize the borrow of sand from the Stoddard landing area to the degree possible.

5. See response to comment 4.

6. The page reference appears to be incorrect. However, we have added discussion of this point to section 6.4.

7. We need to indicate in the report which seed islands we believe would be constructed based on current information. We concur that as new information becomes available prior to final design and construction, the location for the seed islands can be adjusted.

8. Seed islands 5, 6, and 7 and 9, 10, and 11 are designed to function somewhat as groups. During the preparation of plans and specifications we will continue to evaluate the best locations for the seed islands based on updated bathymetry and the results observed from the seed islands constructed by the Fish and Wildlife Service in 1995.

9. This construction option can be evaluated during the preparation of plans and specifications. This has been noted in those portions of Section 7 of the report addressing seed island construction.

10. The recommended modification has been made.

11. While the "nesting island" may provide some ancillary benefits to other fish and wildlife its primary purpose throughout the planning process has been for waterfowl nesting. If were not for waterfowl nesting habitat, we would not even have considered construction of an island in this location.

Your views concerning the nesting island have been considered fully in the evaluation of this feature. The basic descision to be made is "do the expected benefits justify the costs?" In the realm of natural resource planning there is not always a defintive answer to this question, with this being one of those instances. By necessity, consideration of subjective factors must enter into the decision making process. We have tried to document all of the factors that were considered into the decision making process. We believe in this instance there is ample room for disagreement without there being any right or wrong answer.

12. We do not dispute that the location for the proposed nesting island is the optimum location if a nesting island is to be constructed in this portion of lower pool 8. As noted above, the basic descision still comes down to "do the expected benefits justify the costs?"

13. See response to comment 12.

14. We do not believe that the constructing the proposed nesting island would provide any significant new knowledge that would tip the scales towards construction. Construction of other islands has educated us concerning the problems faced with constructing islands in various riverine settings. The construction of this island is unlikely to provide significant new knowledge concerning waterfowl nesting requirements because it is not part of a larger test using different island designs and locations. If nesting success is high, we will not know if it is because of good project design or a matter of good fortune. If nesting success if poor, we will not know if it is because of poor island design or other unknown factors.

15. We recognize that small islands suitable for waterfowl nesting are uncommon in lower pool 8. It is unlikely that lower pool 8, or the Mississippi River cooridor for that matter, was ever a prime waterfowl production area. The primary value of the Mississippi River for waterfowl was and still is as a migration cooridor. It is unlikely that the construction of one additional small island will result in any appreciable change in overall waterfowl production in lower pool 8, especially since it is not part of any overall plan to increase waterfowl nesting habitat and production in this area.

16. We believe that if the proposed nesting island is not constructed at this time, it will never be constructed (see the No Action alternative). We are unaware of any program or plan by the U.S. Fish and Wildlife Service, Wisconsin Department of Natural Resources, or any other agency to construct waterfowl nesting islands of this type on the Mississippi River.

17. Consideration of these secondary habitat benefits was part of the evaluation process. Because of the small size of the proposed island and the isolated location, we believe these secondary benefits will be minor.

18. We do not concur. We believe the production numbers are optimistic for the reasons indicated in the discussion in attachment 4 and the main report. In addition, these islands are not specifically designed to optimize production. The original islands evaluated at the locations proposed by the Wisconsin DNR were designed to optimize production. However, as indicated in section 5.5.3 of the report, construction of such an island would cost in excess of $400,000, which was considered prohibitive. The proposed islands costing in the range of $150,000 - $240,000 involve some tradeoffs in terms of location, construction materials, and vegetation establishment. Another factor we considered was the presence of comparable projects. If the construction of small nesting islands in the Mississippi River was a cost effective technique for improving waterfowl production, we would expect to see it employed by Federal and State wildlife management agencies. We are unaware that any wildlife management agency is constructing waterfowl nesting islands on the river. This is a strong indication to us that this is not considered a

cost effective management technique by other agencies.

19. We concur that the proposed nesting island would constribute towards meeting these objectives. However, we believe the contribution would be so minor that the overriding decision criteria still must be "do the expected benefits justify the costs?"

20. No response necessary.

21. No response necessary.

22. In this instance we believe the comparison is necessary because of the difficulty in quantifying the benefits of the seed islands. The purpose is to show that the costs of the seed islands are not unreasonably high in terms of the potential area benefitted. We have revised this section to try to make this point clearer.

23. With respect to the first two recommendations, we have modified the paragraphs to try to make the points clearer. However, with a feature such as the seed islands where the benefits can not be quantified to any appreciable degree, we believe it is useful to try to place their costs in some perspective with other habitat projects. With respect to the third recommended modification, we do not concur. We have reworded the paragraph, but we believe it is a valid point in favor of the seed islands that any island created by natural forces is likely to be more diverse in character. No matter the effort, a man-made island can not duplicate the diversity and intricacy of a natural island.

24. through 36. The recommended changes, corrections, etc. have been made.

37. We have removed the informal Wisconsin DNR generated material. The U.S. Fish and Wildlife Service letter is a matter of public record and has been retained.

38. No response necessary.

39. This has been noted in the environmental compliance portion of the environmental assessment.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River Refuge Complex
51 East 4th Street
Winona, Minnesota 55987

IN REPLY REFER TO:

February 8, 1996

Mr. Gary Palesh
St. Paul District, Corps of Engineers
NCS-PE-M
190 Fifth Street East
St. Paul, Minnesota 55101

Dear Mr. Palesh:

This provides U.S. Fish and Wildlife Service (Service) comments on the draft Definite Project Report and Environmental Documentation (SP-20) for the Pool 8 Island, Phase II Habitat Rehabilitation and Enhancement Project. This project will benefit the biological resources of the Upper Mississippi River National Wildlife and Fish Refuge (Refuge).

1 The project is being built on federal lands managed as part of the Refuge, therefore, a Refuge compatibility determination and Refuge approval is required before the project can be constructed. Enclosed is a signed compatibility determination for the alternative discussed in this draft report. Approval of the project will be formally provided by the Regional Director after completion of the final project report.

2 The final draft definite project report must include a copy of the draft Memorandum of Agreement for the operation, maintenance, and rehabilitation. The Service will cover operation and maintenance costs as discussed in this report for the selected sites. The Regional Director's letter on the final draft definite project report will include the certification of support for operation and maintenance.

3 According to our records, virtually all of the project areas appear to be located on U.S. Army Corps of Engineers fee title land managed as part of the Refuge under terms of cooperative agreements. However, a part of Island D1 appears to be located on U.S. Fish and Wildlife Service fee title land. The DPR states in several places that the project areas are owned by the Federal Government and are within the Upper Mississippi River National Wildlife and Fish Refuge, but did not acknowledge U.S. Fish and Wildlife Service (FWS) ownership.

4 FWS should be named as a cooperating agency as defined in 40 CFR 1501.6, since part of the project areas appear to be on land owned by FWS. This situation needs to be addressed, perhaps in Section 1.2. More importantly, the body of the DPR should describe how FWS has participated in the development of this project, rather than just including a copy of the May 9, 1995, letter in the appendix. The FWS should be acknowledged as an equal partner in this project.

Section 5.2.3 ENVIRONMENTAL (page 38)

5 The first paragraph identifies the need to involve the Health Center to review plans for areas created specifically for shorebirds because of the increased risk of promoting conditions favorable for the production of Type C avian botulism. This concern was raised after an avian botulism die-off occurred in the Phase 1 area during construction of Boomerang Island in 1992. An estimated 1,000 ducks, geese, coots, and shorebirds were lost during the die-off. A research team from the Health Center, under the direction of Kathy Converse, visited the site during the outbreak to collect soil and water samples. This was part of a larger nationwide effort to learn more about the disease. Since 1992, the Phase 1 island complex has been monitored annually by crews from the Wisconsin DNR and our office, and no problems have been encountered.

The Health Center was contacted regarding the Phase 2 project features and potential for incurring the same type of problems encountered in 1992. Health Center personnel suggested that the project site must be monitored for the presence of sick/dead waterbirds from about June 15 through October 31. Most outbreaks in the Upper Midwest occur during this time frame (the 1992 outbreak, for example, began in mid-August and ended in late October). The frequency of monitoring should be dependant on what is found, weather conditions, etc. Construction crews should be briefed on what to look for and whom to contact in case birds are found. Prompt notification of the Service must be required as a part of the contract.

Section 6.3.4 PLAN SELECTION AND JUSTIFICATION (page 78 and 79)

6 Reason #3 listed for supporting the no action alternative is in error. As mentioned above, one of the purposes for which the Refuge was established in 1924 was "...(a) as a refuge and breeding place for migratory birds..." Under the Purpose and Need Section of the 1987 Master Plan, Goal II - Migratory Birds, Objective E is to increase production of historically nesting waterfowl. Mallards, blue-winged teal, and Canada geese are among the species of historically nesting waterfowl. According to the Resource Classification System that is part of the Master Plan Technical Appendix, Volume 1 - Wildlife and Habitat, the project is included on Map #8.69. This area has no unit name but is designated Habitat Class A for migrating divers, eagles, swans, green herons and black terns. Waterfowl production is not listed. Also, in the Master Plan Technical Appendix, construction of nesting islands is not listed as a candidate strategy to preserve and improve habitat or increase waterfowl production.

7 In the context of the EMP, the FWS believes that funds would be better expended on habitat management for a diverse group of fish and wildlife species than on single species management. Although we concur that waterfowl production is important, the FWS would prefer an approach in which islands are built which would serve multiple purposes, including waterfowl production. Waterfowl nesting will likely occur on other features of the project. The nesting island is not critical to the success of Phase 2 of the Pool 8 Island Project. Therefore, the FWS supports the Corps decision on the nesting island.

8 Because improving the fisheries habitat of Stoddard Bay on various temporal and spacial scales is the major goal of this project, the highest priority should be given to remove as much sand and fine material from Stoddard Bay as possible. The Crosby Slough site should only be used if there is no suitable material in the Stoddard Bay area.

9 It may be premature to make a final selection in the DPR of which 6 seed islands will be constructed. Final selection of seed islands to be constructed should be made during preparation of plans and specs. This will allow for selection of sites based on any new information gained through additional hydrological and EMTC monitoring of the 2 seed islands constructed under funding by Wisconsin DNR and the FWS. At this time Island 1 or 2 is the highest priority for the FWS.

Endangered Species Act

10 Based on information contained in the Preliminary Draft Definite Project Report and the nature of the proposed project, its location, and the habitat requirements of the federally threatened bald eagle (*Haliaeetus leucocephalus*), endangered peregrine falcon (*Falco peregrinus*), and Higgins' eye pearly mussel (*Lampsilis higginsi*), we concur with your determination that the proposed project is not likely to adversely affect federally listed threatened or endangered species. Should this project be modified or new information indicated that listed species may be affected, consultation with the Service's Twin Cities Field Office should be reinitiated.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the National Environmental Policy Act of 1969 (42 U.S.C. 4321-4327), the Endangered Species Act of 1973, (16 U.S.C. 1531-1543), as amended, and the U.S. Fish and Wildlife Service's Mitigation Policy.

This report illustrates the cooperation evident between the Corps and the Service. The cooperative efforts on this project and the Environmental Management Program as a whole ensure that progress in this area will continue on the Upper Mississippi River System.

Sincerely,

James R. Fisher

James R. Fisher
Complex Manager

Enclosures

cc: TCFO
La Crosse FRO
MN DNR/ WI DNR
La Crosse District
RO -- SS

Upper Mississippi River National Wildlife and Fish Refuge
Established 1924
Compatibility Determination
Pool 8 Islands, Phase II
Rehabilitation and Enhancement Project

Establishment Authority:

Public Law No. 268, 68th Congress, The Upper Mississippi River Wild Life and Fish Refuge Act.

Purposes for Which the Refuge was Established:

"... (a) as a refuge and breeding place for migratory birds... (b)...as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and (c)...as a refuge and breeding place for fish and other aquatic animal life." 43 Stat. 650, dated June 7, 1924

"... shall be administered by him (Secretary of the Interior) directly or in accordance with cooperative agreements ... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife resources thereof, and its habitat thereon, ... "16 U.S.C. 664 (Fish and Wildlife Coordination Act)

"... suitable for--(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. 460k-1 "...the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 [Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended]

"... particular value in carrying out the national migratory bird management program." 16 U.S.C. 667b (An act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes)

Description of Proposed Use:

The proposal is a Habitat Rehabilitation and Enhancement project authorized by the Water Resource Development Act of 1986 (Pub. L. 99-662). The proposed project includes the construction of a barrier island system consisting of a series of islands, combined with two rock sills, to alter water flow into the Stoddard Bay area of Pool 8. Four additional islands will be constructed in the newly protected area to help maintain channel depths and reduce wind fetch.

Also, a series of seed islands will be constructed along the right descending bank of the navigation channel to create conditions that would induce accretion and island growth restoring lost islands which protected a few hundred acres of backwater habitat.

More details of the project, including maps and engineering drawings, are contained in the draft report entitled, "Upper Mississippi River System Environmental Management Program Definite Project Report With Integrated Environmental Assessment (SP-20) Pool 8 Islands, Phase II, Habitat Rehabilitation and Enhancement, Upper Mississippi River, Wisconsin, and Minnesota," prepared by the St. Paul District, Corps of Engineers.

Anticipated Impacts on Refuge Purposes:

As a result of the project fish and wildlife populations should increase which will be a direct benefit toward maintaining and accomplishing refuge purposes. A summary of impacts to the natural resources of the Refuge are as follows:

FISH AND WILDLIFE RESOURCES

The proposed islands/rock sills would improve aquatic habitat on approximately 500 acres in the Stoddard area. Fishery habitat would be improved by providing winter habitat for fish. In addition, the expected vegetation response would improve the area as migration habitat for waterfowl.

The seed islands would improve conditions in an area east of the navigation channel by eventually creating 60 acres of island habitat. The physical effect of these islands would be to improve conditions for aquatic vegetation reestablishment within the zone of the islands' influence.

FISH

The restoration of the islands at Stoddard would substantially improve the quality of the fish habitat in this area. The area currently provides fair summer habitat for centrarchids, but overall the area is considered to be very poor habitat. The primary limiting factor is the poor winter habitat conditions in the project area due to the very high flows and cold temperatures. The construction of the island and the rock sills would substantially change the flow conditions in the area. The flow in the area bounded by the islands would be dramatically reduced. Flow conditions in the winter would be changed from an average of 15 cm/sec to an average of 0.4 cm/sec. It is anticipated the reduced flows would result in somewhat warmer water temperatures. The design flow would result in adequate dissolved oxygen conditions. All of the above conditions result in the development of an area that would provide near optimum winter habitat.

Dredging for island construction materials in Crosby Slough may also provide additional winter habitat. Deep holes located in areas with considerable flow have been identified as important winter habitat for some species, especially catfish. While no detailed studies have been conducted, anecdotal information has indicated that the areas previously dredged in Crosby Slough have been utilized by fish.

Studies have indicated that winter habitat on the river may be a

critical habitat component to maintaining fish populations on the river. Some species have been tracked traveling many miles to winter habitat. The establishment of winter fish habitat in this part of Pool 8 may contribute to maintaining healthy fish populations in this pool.

WATERFOWL

It is anticipated that the construction of the islands in Stoddard Bay will result in conditions conducive to the reestablishment of extensive aquatic vegetation in the project area. This would result in an increase in the value of the project area as waterfowl migration habitat, especially for diving ducks. The model used for this evaluation indicates that the migration habitat value would increase by about 50 percent. Similar effects are expected to occur within the zone of influence of the islands that would develop with the seed islands.

OTHER WILDLIFE

Numerous other wildlife benefits, not quantified by the habitat models, would accrue with project construction. The island and associated vegetation, both in the Stoddard area and the seed island area, would provide habitat for a wide variety of species, including roosting habitat for raptors, migration and nesting habitat for neotropical migrants and nesting habitat for ducks and turtles. The island and associated shallow water zones would provide marsh habitat for marsh and water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and shorebirds. Aquatic and semi-aquatic mammals, such as muskrats, and many species of reptiles and amphibians would have improved habitat conditions with the increased aquatic vegetation and associated marsh habitat that would develop around the islands.

Justification:

The proposed project works toward the accomplishment of the stated objectives of the refuge by improving habitat conditions over approximately 500 acres in the Stoddard Bay area. The islands and rock sills will reduce flows through Stoddard Bay, significantly improving winter habitat conditions for the backwater fish community. The project will reduce flows and reduce the effects of wind and wave action in Stoddard Bay which is expected to substantially improve conditions for the growth of aquatic plants. The islands themselves (26 acres) will provide habitat for wildlife and improve overall habitat diversity in the Stoddard Bay area. The borrow dredging for island construction will provide additional fish habitat benefits in Crosby Slough and Stoddard Bay.

The seed islands are expected to provide benefits to fish and wildlife similar to those provided by the Stoddard Bay islands, though on a much smaller scale, commensurate with the size and cost of these structures. If the seed islands grow as expected, eventually an area of a few hundred acres in lower pool 8 may be benefited by these islands.

Determination: The proposed use is ✓ is not ___ compatible with the purposes for which the refuge was established.

Determined by: James R. Fischer Date: 1/23/96
Complex Manager

Concurred by: Jim Fitzmaurice Date: 1/29/96
Assistant Regional Director
Acting

Responses to U.S. Fish and Wildlife Service
Comments of February 8, 1996

1. No response required.

2. The draft Memorandum of Agreement is contained in attachment 7.

3. The Real Estate section of report has been revised to indicate that most of the U.S. Government owned land is administered by the Corps of Engineers, with a portion administered by the U.S. Fish and Wildlife Service.

4. The discussion of agency participation in section 1.2 has been expanded to include the points contained in the comment.

5. We have deleted the discussion of avian botulism from the planning constraints section because technically it is not a planning constraint, i.e., it did not impact the actual planning process. We can include briefing of the construction crews as part of the pre-construction effort. We will include appropriate language in the construction contract specification to insure the contractor notifies the Fish and Wildlife Service promptly of any problems observed.

6. The referenced discussion has been revised per your comment.

7. No response required.

8. The detailed discussion of design and construction considerations in section 7 of the report indicates the intent to maximize where practicable the use of borrow material from Stoddard Bay.

9. We need to indicate in the report which seed islands we believe would be constructed based on current information. We concur that as new information becomes available prior to final design and construction, the location for the seed islands can be adjusted.

10. No response required.

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

PHONE NO. FILE NO.

(612) 345-3331
Section of Ecological Services
1801 S. Oak St.
Lake City, MN 55041
February 8, 1996

Mr. Gary Palesh
Army Corps of Engineers
190 Fifth St. East
St. Paul, MN 55101-1638

Dear Mr. Palesh:

Review of the DRAFT Definite Project Report/Environmental Assessment for the Pool 8 Islands - Phase II has been completed by our Division of Fisheries and Wildlife and Division of Waters staff.

No detailed comments were received, however the following general observations were made.

1 Constructing seed islands may be a good idea. They are cheaper than other islands constructed under the EMP program, promise to create more complex islands, and perhaps should be considered elsewhere if successful. However, using something other than rock to build some of them (something biodegradable, like trees) should be considered so that, if they don't work, we don't end up with six rock piles scattered over a tract of river bottom forever bearing mute testimony to human hubris.

2 Of the alternatives considered, we concur with that the recommended plan will probably result in the most benefits for the cost.

Sincerely,

Mike Davis,
Habitat Project Coordinator

cc: Jeff Janvrin, WI DNR
Keith Beseke, USFWS
Nick Gulden, MN DNR
Steve Johnson, MN DNR

9-50

Responses to Minnesota Department of Natural Resources
Comments of February 8, 1995

1. We can consider during the preparation of plans and specifications the construction of one or more of the seed islands using biodegradable material such as wood. A concern we have is that it appears necessary to maintain a permanent structure at the heads of these types of islands to prevent their loss through erosion. For example, rock had to be placed at the heads of Heron and Trapping Islands in 1995. Even though these islands were accreting at their lower end, the heads were eroding away.

2. No response required.

United States Department of the Interior

NATIONAL BIOLOGICAL SERVICE
Environmental Management Technical Center
575 Lester Avenue
Onalaska, Wisconsin 54650-8552

IN REPLY REFER TO:

February 9, 1996

Mr. Charles Crist
Chief, Management and Evaluation Branch
Engineering and Planning Division
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Crist:

In accordance with your request, we have reviewed the Definite Project Report for the proposed Pool 8 Islands Phase II Habitat Project. Our collective comments, both general and specific, are enclosed.

Thank you for the opportunity to review this document. If you have any questions please call me at (608) 783-7550, extension 50.

Sincerely,

John W. Barko

John W. Barko, PhD
Science Advisor

Enclosure

GENERAL COMMENTS

1 Given that Objective 1A has been deemed most important, it seems critical to maximize the probability of success. The current DPR leaves two interrelated and critically important variables in doubt; temperature and depth. Given the cost of the project, it would be beneficial to know the likelihood of satisfying the temperature criteria of each alternative. The existing literature suggests that Objective 1A cannot be met unless temperatures significantly above 1 C can be maintained during the winter. Depth may be a critical factor determining whether such temperatures can be maintained. The thermodynamic modeling would be extremely useful in estimating the likelihood of success.

2 The existing criteria for temperature specifies 150 acres (75% of 200 acres) will maintain winter water temperatures warmer than 2 C. It may be worthwhile to reduce this criterion to a smaller area but take measures to insure success in this reduced area. Again, the existing literature suggests that, during winter, fish do concentrate in areas that provide suitable combinations of current, dissolved oxygen and temperature. Therefore, we do not know that 150 acres will provide substantially greater benefit than, say 50 acres or even 25 acres. However, we do know that the 4-foot depth criterion cannot be met over the 80 area objective. It would seem to be desirable to estimate how much area can be created that meets the oxygen, temperature and depth criteria, and then base decisions on that estimate.

3 The seed islands will not help meet Objective 1A, but will help meet Objectives 1B and 1C, and the seed island concept is so innovative that this aspect should receive a high priority.

SPECIFIC COMMENTS

4 Sections 1-3 are essentially boilerplate and no modifications are required.

5 Plates 4 and 5 should be combined into a single figure.

6 A number of the tables in section 4 could be easily converted into bar graphs that would portray the data in a more concise format than in the current tables.

7 Goal 1, Objective 1a: It is going to be very difficult to meet this objective (see also comments above). Experience from the Finger Lakes indicates that the objective's criteria can only be met where there is sufficient depth to hold a reservoir of warmer water, such as in Lower Peterson Lake.

8 Goal 1, Objectives 1b and 1c: These will be much easier to meet than the above, but will be dependent on recovery of aquatic vegetation in the area.

9 Section 6: The dissolved oxygen and current velocity goals can probably be met rather easily, but the temperature criterion is going to be much more difficult to attain. It might be worthwhile to conduct the thermal modelling suggested above in order to determine if the temperature goals can be met in the large areas proposed in the project objectives.

10 Section 6.2.4.1 Meeting Project Objectives: How can the statement that "all of the alternatives would essentially meet the primary fishery objective (1a)" be reconciled with the fact that the post-project winter temperature regime is unknown? Without meeting the temperature criterion anything else the project provides during winter may be pointless.

11 Provision of nesting habitat at a cost of $379 K would appear to produce some rather expensive ducks: a point worth considering.

Responses to National Biological Service
Comments of February 9, 1996

1. We concur that the largest unknown is the effect the project will have on winter water temperatures. We have expanded the discussion of this topic in section 6 of the report. While a thermodynamic model would provide useful information, we are not certain at this point that it would provide information of sufficient value to the decision making process. First, most thermodynamic models are designed for deep reservoirs and lakes that stratify, not shallow systems such as we have in Stoddard Bay. For Stoddard Bay, a vertically averaged 2-D hydrothermal model, with an algorithm that would account for winter ice cover would be required. The CE-QUAL-ICM model, developed at WES, would also be an option, but this model would also have to be modified for ice cover. We question whether a thermodynamic model would be sensitive enough in this situation to accurately identify areas of 1 to 3 degrees Centigrade difference. The cost of setting up and running a thermodynamic model for Stoddard Bay would be at least $50,000.

The bottom line question that must be answered is how much flow needs to be introduced into Stoddard Bay to achieve the balance of providing adequate dissolved oxygen, minimal current velocities, and adequate winter water temperatures. The current estimate is 50 cfs, which is probably on the conservative side to provide sufficient dissolved oxygen while accepting excessive current velocities and low water temperatures in the direct flow path. Thermodynamic modeling may provide some useful information concerning whether or not this flow rate is too high or too low. The more practical approach may be to use post-construction monitoring to answer the question in the field. As the notch is not a fixed concrete structure, it can be readily modified to reduce or increase flow based on the monitoring results. The cost of modifying the notch would be less than the cost of setting up and running the thermodynamic model.

2. The criteria contained in the project goals and objectives were established for planning purposes. They are the "targets" of the planning process, based on what habitat conditions resource managers would like to achieve, tempered by the reality of what actually may be practical to accomplish. Not achieving planning goals and objectives does not mean that we do not pursue implementation of a project. That decision is based on an evaluation of the cost versus the habitat benefits the project is expected to provide. In this instance we can not fully meet project objective 1(A). The decision at hand is "do the habitat benefits associated with partially meeting the objective justify the cost?" Of course, this is an oversimplification in this instance because we have multiple objectives and the alternatives are designed to meet as many of these multiple objectives as practicable. We do not want to revise the planning goals and objectives to match the project we propose as this does not accurately portray the planning process to the public and other reviewers. That we may not actually need as large a area of suitable wintering habitat for fish survival is discussed is section 6.2.1 of the report.

3. Concur.

4. No response necessary.

5. These plates have been replaced by a single bathymetric map.

6. Concur. However, we have not had the time pursue modification of these tables. We will consider the suggested modification for the final report.

7. See responses to comments 1 and 2. We have expanded the discussion in Section 6 of the report to indicate that it is unlikely that this objective can be fully met.

8. Concur.

9. See responses to comments 1, 2, and 7.

10. We have revised the referenced paragraph to more accurately reflect the degree objective 1A may be met by the various alternatives.

11. This was an important consideration in our recommendation of the no action alternative.

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

MAR 2 0 1995

REPLY TO
ATTENTION OF

Management and Evaluation Branch
Engineering and Planning Division

Dear Interested Parties:

Enclosed for your information, review, and comment is the draft Definite Project Report/Environmental Assessment for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project, Vernon County, Wisconsin. The report contains an integrated environmental assessment, draft Finding of No Significant Impact (FONSI), and preliminary Section 404(b)(1) evaluation. We are distributing this report to concerned agencies, local units of government, interested groups, and individuals. If you have any comments on the report or environmental assessment, please provide them within 30 days of the date of this letter.

The Section 404(b)(1) evaluation is being distributed as part of this report in lieu of a separate Section 404 public notice. Anyone may request a public hearing on this project. The request must be submitted in writing within 15 working days of the date of this letter. Interested parties are also invited to submit to this office written facts, arguments, or objections to this project within 30 days of the date of this letter. These statements should clearly state the interest the project would affect and how the project would affect that interest. All statements, oral or written, will become part of the official project file and will be available for public examination.

Questions concerning the Pool 8 Islands Phase II project should be directed to Mr. Gary Palesh, Technical Manager, at (612) 290-5282. Please address all correspondence on this project to the St. Paul District, Corps of Engineers, ATTN: CENCS-PE-M, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Robert F. Post

Enclosure

Robert F. Post, P.E.
Chief, Engineering and Planning Division

Printed on Recycled Paper

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

MAR 2 7 1996

REPLY TO
ATTENTION OF

Management and Evaluation Branch
Engineering and Planning Division

Dear Interested Parties:

This is to inform you that the draft Definite Project Report/Environmental Assessment for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project, Vernon County, Wisconsin, has been completed and is available for public review. The report contains an integrated environmental assessment, draft Finding of No Significant Impact (FONSI), and preliminary Section 404(b)(1) evaluation. The executive summary for the report and maps showing the project features are attached.

The Section 404(b)(1) evaluation is being distributed as part of this report in lieu of a separate Section 404 public notice. Anyone may request a public hearing on this project. The request must be submitted in writing within 15 working days of the date of this letter. Interested parties are also invited to submit to this office written facts, arguments, or objections to this project within 30 days of the date of this letter. These statements should clearly state the interest the project would affect and how the project would affect that interest. All statements, oral or written, will become part of the official project file and will be available for public examination.

A copy of the draft Definite Project Report/Environmental Assessment for the Pool 8 Islands Phase II project can be obtained by contacting Mr. Gary Palesh, Technical Manager, at (612) 290-5282; or by writing to the St. Paul District, Corps of Engineers, ATTN: CENCS-PE-M, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Robert F. Post

Enclosure

Robert F. Post, P.E.
Chief, Engineering and Planning Division

Printed on Recycled Paper

PUBLIC MEETING

for the

POOL 8 ISLANDS PHASE II
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

at the
STODDARD AMERICAN LEGION POST 315

WEDNESDAY, APRIL 10, 1996

OPEN HOUSE - 6:30 P.M.

PUBLIC MEETING - 7:00 P.M.

A public information meeting to discuss the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project is scheduled to be held at the Stoddard American Legion Post 315, 414 Broadway Street, Stoddard, Wisconsin. The meeting is being held by the St. Paul District, Corps of Engineers, in cooperation with the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

The Pool 8 Islands Phase II habitat rehabilitation and enhancement project is being studied under the Upper Mississippi River System Environmental Management Program. The current study is a continuation of the overall Pool 8 Islands project in lower pool 8. Construction of Phase I of the Pool 8 Islands project was completed in 1993. The Phase II study began in December 1993 and has progressed to the point where there is a recommended plan that is currently undergoing public review.

The purpose of the meeting is to discuss the recommend plan for Stoddard Bay and other areas addressed by the study. The meeting will be conducted as informally as practical to facilitate the exchange of information and ideas between the Federal and State agencies involved in the study and the public.

From 6:30 p.m. to 7:00 p.m. there will be an open house during which time the public can view various items of information that will be on display. At 7:00 p.m, the meeting will commence.

If you are unable to attend the meeting, feel free to contact Gary Palesh, St. Paul District technical manager, at (612) 290-5282 if you wish to receive information concerning any aspects of the Pool 8 Islands Phase II habitat project.

RECORD OF ATTENDANCE

Meeting Pool & Islands Phase II Date April 10, 1996

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
Randy Otto	W4751 SPRIG La Crosse	
Darin Schroeder, Aide U.S Senator Feingold	425 State St. #225 La Crosse 54601	
Paul Gettelman	930 Hickory Ln Stoddard, Wi	
Bud Veale	PO 281 Stoddard 54658	
Warren Wolfe	RR1 Box 52 Stoddard Wi. 54658	
Jeff Ceason	RR2 Bx 694 Stoddard 54658	
Mark Peterson	621 Division Stoddard 54658	
Tim Hannatty	2516 So 15th St La Crosse Wi 54601	
Kevin Gobel	228 West St Stoddard Wi 54658	Village of Stoddard.
Ken Manning	820 Bainbridge St LaCrosse Wisc PO Box 2557	J.F Brennan
Fred Funk	W7431 CTH ZB Onalaska Wis	Self 54650
Marc Schultz	W8155 Northshore Dr Onalaska Wi	Self

RECORD OF ATTENDANCE

Meeting Pool & Islands Phase II Date April 10, 1996

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

NAME (please print)	ADDRESS (optional)	REPRESENTING
David Peterson	126 N Main St Stoddard Wis.	
DARYL D. STEINKE	248 N. Main St. Stoddard, WI 54658	
Tom Smith	229 Cottage St. Stoddard, WI 54658	Self
Richard Jensen	228 N. Main St P.O. Box 62 Stoddard, WI 54658	
Gerald Klumb	R. 1, Box 70 Chaseburg WI 54621	
Bill MARSHALL	P.O. 66 Stoddard WI 54658	
John Watzel	DNR	
Cal Barstow	Rt 1 Stoddard, Wi. 54658	

CENCS-PE-M 16 April 1996

MEMORANDUM FOR THE RECORD

SUBJECT: Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project

1. A public meeting for the subject project was held on the evening of 10 April 1996 at the Stoddard American Legion Post 315 in Stoddard, Wisconsin. District representatives besides the undersigned included Randy Devendorf (PE-M), Jon Hendrickson (PE-H), and Joel Face (PE-D). We were assisted in the public meeting by representatives of the U.S. Fish and Wildlife Service (FWS) and the Wisconsin Department of Natural Resources (DNR).

2. This was the third public meeting held for the project, the first taking place in December 1994 and the second in September 1995. Twenty private citizens attended the 10 April meeting. A total of 40 private citizens have attended at least one of the three public meetings for this project. Of this total, 9 individuals attended two of the three meetings, while 4 individuals attended all three meetings. Of the 20 attendees at the 10 April meeting, 10 had attended one or both of the previous meetings.

3. Following introductions, I gave a slide presentation covering the entire study process from initial problem identification through the recommended plan for implementation. The meeting was then opened to questions and discussion.

4. Stoddard Bay - The proposed plan for Stoddard Bay is alternative G which involves construction of seven islands and two rock sills. The following were the points of discussion concerning the Stoddard Bay proposal.

a. One individual emphasized that he would like to see as much of the sand material for island construction come from within Stoddard Bay as possible. The agency representatives concurred that this was desirable, however, extensive borings taken in Stoddard Bay have revealed the presence of readily accessible sand in only two locations. I indicated that we would borrow as much sand from within Stoddard Bay as was practical.

b. An individual asked whether the project was going to have any bathymetric effects in the deep hole at the northeast corner of Stoddard Bay, or in the area immediately above rock sill A. Jon Hendrickson indicated that he did not believe there would be any appreciable effect on these areas.

c. An individual questioned whether we were taking enough credit for the potential diving duck habitat gains associated with the proposed project. Randy Devendorf explained how the diving duck benefits were calculated, indicating that the human disturbance factor was one parameter that was limiting on the potential benefits. We indicated that even with the conservative approach we have taken, there should be sufficient benefits to justify the project.

d. An individual questioned whether there would be any appreciable fish habitat benefits associated with the sand borrow from Crosby Slough. Jeff Janvrin of the Wisconsin DNR indicated that while no fishery surveys have been

conducted of the area dredged in 1992 due to the difficulty in surveying deep water, casual sonar observations indicate that fish are using these deep areas.

e. An individual asked what would happen if a flood or some other natural event damaged the project in the future. I explained that once the project was completed, it would be turned over to the FWS for operation and maintenance. Keith Beseke of the FWS indicated that their agency is committed to maintaining HREP's, and they are requesting funds as part of their budget process for operation and maintenance of these projects. Keith cautioned that there was no guarantee in any given year that the funds would be appropriated.

f. A recent value engineering proposal to eliminate dredging of fine material from the interior of Stoddard Bay was discussed. Those in attendance were opposed to any reduction of dredging within Stoddard Bay. They believed the benefits of such dredging were worth the costs. This included both the public and the other agencies represented at the meeting.

In summary, the private citizens in attendance supported the impementation of alternative G for the Stoddard Bay area. It should be noted that the Stoddard Bay features constitute about 93 percent of the recommended Pool 8 Islands Phase II project.

5. Nesting Island - One feature studied, but not recommended for implementation is the construction of a waterfowl nesting island in the area northwest of Stoddard Bay. The primary reason for not recommending this feature is that the benefits do not appear to justify the costs. Using optimistic production numbers, we estimate that the cost per duck fledged from this island would be about $332 per duck. If less than optimistic production occurred, the cost would be even higher.

There was a general discussion concerning the merits of the nesting island. It is estimated that 4-5 of the private citizens in attendance were in favor of constructing the nesting island despite the cost, while two individuals spoke out against the island as being too costly. The remainder of the attendees were silent on the subject.

6. Seed Islands - The recommended plan is to construct six seed islands in the area below Heron and Trapping Islands. There were no questions concerning these islands, nor any comments concerning their merits. We interpreted this as general concurrence by those in attendance with constructing this feature.

7. I informed those in attendance that the public review period for the draft Definite Project Report/Environmental Assessment was open until 20 April 1996. Following that, the meeting was adjourned.

Gary Palesh
Technical Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:
FWS/ARW-VIM

APR - 8 1996

Colonel J. M. Wonsik
District Engineer
Saint Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Center
190 Fifth Street East
Saint Paul, Minnesota 55101-1638

Dear Colonel Wonsik:

Based on the revised draft Definite Project Report/Environmental Assessment (SP-20), "Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project" dated February 1996, the U.S. Fish and Wildlife Service (Service) will assure operation and maintenance requirements of the project will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986. In accordance with the policies stated in the Fourth Annual Addendum, the Service will perform the operation and maintenance requirements for this project as listed on page 70.

This project is located in part on Refuge-owned land. Therefore, the Service will complete its finding of no significant impact upon learning from you that the public review period produced no substantive changes in the Definite Project Report/Environmental Assessment.

We look forward to continued cooperative efforts in developing habitat rehabilitation and enhancement projects under the Environmental Management Program.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, Minnesota 55155-40__

April 19, 1996

Robert F. Post, Chief
Engineering and Planning Division
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Re: Draft Definite Project Report/Environmental Assessment for Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project
ATTN: CENCS-PE-M

Dear Mr. Post:

The Minnesota Department of Natural Resources (MDNR) has reviewed the above-referenced document and provides the following comments for your consideration.

MDNR staff have been involved with this project over the past several years and most of our concerns have been addressed through the project development process.

The only comment we have at this time relates to island vegetation as discussed on pages 93 and 94 of the document. The Corps proposes (page 93) to plant islands A, B, D1, D2, E1 and E2 with a mixture of smooth brome, alfalfa and sideoats grama, with oats or rye as a nurse crop. These species were selected so as not to compete with the trees that will be planted on the islands. On page 94, the document states that island C will be seeded with a mixture of reed canary grass, birdsfoot trefoil and crown vetch, with oats or rye as a nurse crop.

Except for the sideoats grama, all of these species are exotics and some, such as reed canary grass and crown vetch, are extremely aggressive. We suggest that consideration be given to native species which are adaptable to the various moisture regimes expected. The use of clump-forming grasses would facilitate the planting of trees, whereas if a good cover of brome and alfalfa or crown vetch and reed canary grass is established, tree establishment will become very difficult.

Thank you for the opportunity to review this document. If you have any questions regarding these comments, please contact Ken Wald of my staff at (612) 296-4790.

Sincerely,

Ken Wald

for Thomas W. Balcom, Supervisor
Natural Resources Environmental Review Section
Office of Planning

c: Steve Colvin
Pete Otterson
Bill Johnson
Nick Gulden
Mike Davis

960263-01

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Donald R. Winter, District Director

State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, WI 54601
TELEPHONE 608-785-9000
FAX 608-785-9990

April 23, 1996

St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
ATTN: Mr. Gary Palesh
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Palesh:

We have completed review of the draft Definite Project Report/Environmental Assessment for Pool 8 Islands-Phase II, dated February 1996. Most of the comments we provided to you in a letter dated February 1, 1996, were incorporated into this copy of the DPR or responded to adequately. However, we do not concur with the recommendation to drop the nesting island as a feature of the Pool 8 Islands-Phase II HREP.

We provided several reasons why we believe construction of the nesting island is justified in our letter dated February, 1, 1996. The rational provided in the report for not constructing the nesting island are misleading. One of the reasons for dropping the nesting island is that it is not included in the Refuge Master Plan. This is only a convenient excuse since many constructed and planned HREPs incorporate features that are not specifically identified in the Refuge Master Plan. The purpose of the master plan is to provide guidance for management of the refuge, not set in stone what can and can't be done.

The Refuge Master Plan is not the only document containing recommendations for habitat management on the Mississippi River. A resource publication from the Fish and Wildlife Service entitled "Mitigation and Enhancement Techniques for the Upper Mississippi River and Other Large River Systems" and the "Comprehensive Master Plan for the Management of the Upper Mississippi River System, Technical Report E: Mitigation and Enhancement Handbook" recommend the creation of nesting islands for waterfowl and other colonial nesting birds.

Another reason given is, "...the Corps is unaware that any agency has initiated any type of program for constructing small nesting islands on the river to improve waterfowl production." To state this as a reason for not constructing the nesting island could be interpreted to mean that many of the habitat projects should not be

built because no agency has any type of program other than EMP to pursue similar projects. Furthermore, it is incorrect to assume that we or another agency would not pursue construction of a nesting island on the Mississippi River with funds other than the EMP. The DPR cites several years of monitoring Mississippi River waterfowl production by our agency. This alone is proof that we have been and continue to be committed to improving waterfowl production on the Mississippi River.

We request that you reevaluate the decision regarding the nesting island based on our comments and those presented at the public meeting.

Please contact me at the above address or phone (608) 785-9005 if you have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Jim Nissen, USFWS
Keith Beseke, USFWS
Pam Thiel, USFWS
Terry Dukerschein, WDNR
Mike Davis, MN DNR
John Wetzel, WDNR
Bob Gaugush, EMTC
Mike Neuman, EA/6

13/5 - SB 5/10

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN DEPT. OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary

PO Box 7921
101 South Webster Street
Madison, Wisconsin 53707-7921
TELEPHONE 608-266-2621
FAX 608-267-3579
TDD 608-267-6897

PPM

Original to PE-M

May 3, 1996

Colonel J. M. Wonsik
St. Paul District, U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

Mike

Dear Colonel Wonsik:

The Wisconsin Department of Natural Resources supports construction of the Pool 8 Islands, Phase II, Habitat Rehabilitation and Enhancement Project, Pool 8, Upper Mississippi River.

Upon completion and final acceptance of the project by the Corps of Engineers and the Fish and Wildlife Service, the Wisconsin Department of Natural Resources will cooperate with the Fish and Wildlife Service to assure that operation and maintenance, and any mutually agreed upon rehabilitation, will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986 and the current guidance contained in the Sixth Annual Addendum, May 1991, Appendix D, Section III.A.9 (pp. 21-22).

This project will greatly benefit a variety of Mississippi River fish and wildlife. I look forward to completion of the Pool 8 Islands, Phase II, Habitat Rehabilitation and Enhancement Project and the benefits it will provide to the Upper Mississippi River System.

Sincerely,

George

George E. Meyer
Secretary

c: William Hartwig, Regional Director, USFWS
Terry Moe, Wisconsin DNR, La Crosse

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River Refuge Complex
51 East 4th Street
Winona, Minnesota 55987

IN REPLY REFER TO:

May 14, 1996

Mr. Gary Palesh
St. Paul District, Corps of Engineers
NCS-PE-M
190 Fifth Street East
St. Paul, Minnesota 55101

Dear Mr. Palesh:

We have reviewed our comments submitted to your office regarding the nesting island in the Pool 8 Phase II HREP, and have modified our position.

Although we still have concerns about the biological justification for the island and the cost:benefit ratio, Wisconsin has very strong feelings about keeping it as a part of the HREP. They have agreed to cap the cost of the island at $100,000. If costs exceed that amount, either the State will cover the extra costs or the island will be dropped from the project. Unless the island can be constructed with proper erosion protection, the Service will not assume maintenance responsibilities for it.

If the above conditions are met and this island addition will not cause additional delays in the project, the Service will not object to including the nesting island in the Pool 8 Phase II HREP.

Sincerely,

James R. Fisher

James R. Fisher
Complex Manager

cc: WI DNR

10-15

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

May 16, 1996

Management and Evaluation Branch
Engineering and Planning Division

Mr. Thomas W. Balcom
Supervisor, Natural Resources Environmental
Review Section
Office of Planning
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, Minnesota 55155-4010

Dear Mr. Balcom:

This is in response to your letter of April 19, 1996, commenting on the draft Definite Project Report/Environmental Assessment for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project. We appreciate your agency's participation in the planning and review of this project.

In your letter, you provided comments concerning the species proposed for use in the island planting plans. The species recommended for planting were provided to us by the U.S. Fish and Wildlife Service Refuge Manager. Because the project is located on the Upper Mississippi River Wildlife and Fish Refuge, and the Service will be responsible for operation and maintenance of the project, we usually follow their recommendations in these matters. Your letter has been forwarded to the Refuge Manager for consideration.

The final determination concerning which species will be planted will be made during the preparation of construction plans and specifications. We will review your recommendations with the Refuge Manager at that time. The final recommended planting plan will be coordinated with your Lake City office and with the Area Wildlife Manager in Winona.

If you have any questions, please contact Gary Palesh at 290-5282.

Sincerely,

Charles P. Spitzack
Chief, Management and Evaluation Branch
Engineering and Planning Division

Printed on Recycled Paper

10-15

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

May 23, 1996

Management and Evaluation Branch
Engineering and Planning Division

Mr. Jeff Janvrin
Habitat Projects Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Dear Mr. Janvrin:

This is in response to your April 23, 1996, letter of comment on the draft Definite Project Report/Environmental Assessment (DPR/EA) for the Pool 8 Islands Phase II Habitat Rehabilitation and Enhancement Project. Your agency's views on the proposed nesting island feature have been fully considered. However, we do not believe the nesting island would provide sufficient benefits to justify its cost.

Our decision not to recommend construction of the nesting island is based on the expected benefits versus the anticipated costs. For both benefits and costs, we are working with estimates. In addition, even if we knew the exact number of ducks that would be produced and the exact cost of constructing the nesting island, we still would face the subjective question of what is a reasonable cost to produce a duck. The DPR/EA indicates the cost per duck fledged would range from $470 for a 0.5-acre island to $375 for a 1.0-acre island. A review of the nesting survey results in pools 7 and 8 indicates the production estimates used in identifying these costs may be somewhat optimistic, and it would not be unreasonable to assume that the realized average annual production on the constructed nesting island would likely be closer to 50 percent of the 63 ducks per acre that was cited. This would double the cost per duck fledged on a 0.5-acre island to $940. Whichever production estimate is used, we believe the costs are excessive and do not represent a sound investment of limited Upper Mississippi River System Environmental Management Program (UMRS-EMP) funds.

We looked at other factors that could influence the decision in a positive manner or help us to justify what appear to be excessive costs for the expected benefits. If the Refuge Master Plan had identified waterfowl production as an important management objective for this portion of lower pool 8, it would have lent support to construction of the nesting island. The Master Plan, however, does not do this. The fact that the other

Printed on Recycled Paper

documents referenced in your letter identify nesting islands as a habitat management technique does not imply that the nesting islands should be constructed at any cost.

We considered whether other resource management agencies are constructing nesting islands as part of their waterfowl management programs. If they were, this would indicate nesting islands were considered a cost effective habitat management technique on the Upper Mississippi River. The conclusion we have reached is that other resource management agencies have not been investing in these features, even though nesting islands should be within the budgetary capabilities of most agencies.

The U.S. Fish and Wildlife Service recently has indicated they would not oppose spending up to $100,000 of UMRS-EMP funds for a nesting island. Assuming we could construct a 0.5-acre island for that cost, the cost per duck fledged would be about $280 to $560, depending on the production estimate used. We believe these costs still are excessively high.

An alternative we believe merits consideration is constructing nesting islands using channel maintenance material from the Brownsville area. While the Dredge THOMPSON does not have the capability to reach the area of the proposed nesting island, probably other locations within the Crosby Slough area are within the reach of the THOMPSON and would be suitable sites for nesting islands. A cooperative effort may be possible whereby the Corps of Engineers would deposit the material to form the islands and resource management agencies would be responsible for the seeding and plantings.

We appreciate the effort and assistance you and your agency have provided in the overall planning of the Pool 8 Islands Phase II project. We regret that we could not reach a mutually acceptable conclusion regarding the nesting island feature. Tough choices have to be made concerning use of the limited resources available within the UMRS-EMP habitat projects program. We believe the recommended plan for the project area will accomplish nearly all of the habitat objectives established at the beginning of the study. We consider this a very successful planning effort, given the scope of the resource problems in the area and the diverse habitat objectives. This is a positive reflection on the ability of all the study participants to work together toward common goals and to make compromises, where necessary.

If you have any questions, please contact Gary Palesh at (612) 290-5282.

Sincerely,

/s/

Robert F. Post, P.E.
Chief, Engineering and Planning Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:
FWS/ARW-VIM

JUL 2 - 1996

Colonel J.M. Wonsik
District Engineer
Saint Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Center
190 Fifth Street East
Saint Paul, Minnesota 55101-1638

Dear Colonel Wonsik:

Enclosed is the signed Finding of No Significant Impact for the Pool 8 Islands, Phase II, Habitat Rehabilitation and Enhancement Project. Our Finding is based on your Definite Project Report/Environmental Documentation (SP-20) dated February 1996, and your letter of June 5, 1996.

The Agreement for Operation, Maintenance, and Rehabilitation will be signed upon receipt of the final version of that document. We look forward to continued progress on this project.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

Enclosure: FONSI

10 - 18

FINDING OF NO SIGNIFICANT IMPACT

For the reasons presented below and based on an evaluation of the information contained in the supporting references, I have determined that the Environmental Management Program project, Pool 8 Island, Phase II, Habitat Rehabilitation and Enhancement Project, is not a major Federal action that would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons

The project will improve habitat for fish, waterfowl, and certain other wildlife species. Established mussel beds will be avoided.

Three Federally-listed threatened or endangered species are reported in the area: peregrine falcon, bald eagle, and Higgins' eye pearly mussel. This project will have no adverse effect on any of these species or their critical habitat; nor on Wisconsin-listed endangered species.

The project will have no effect on historic properties, and has no identified long-term adverse environmental impacts.

Supporting References

1. Definite Project Report/ Environmental Assessment (SP-20)
2. Compatibility Determination

Acting

Regional Director

7-1-96
Date

Distribution: AES (Master File)
EHC/BFA--Washington, DC
RHPO
UMR