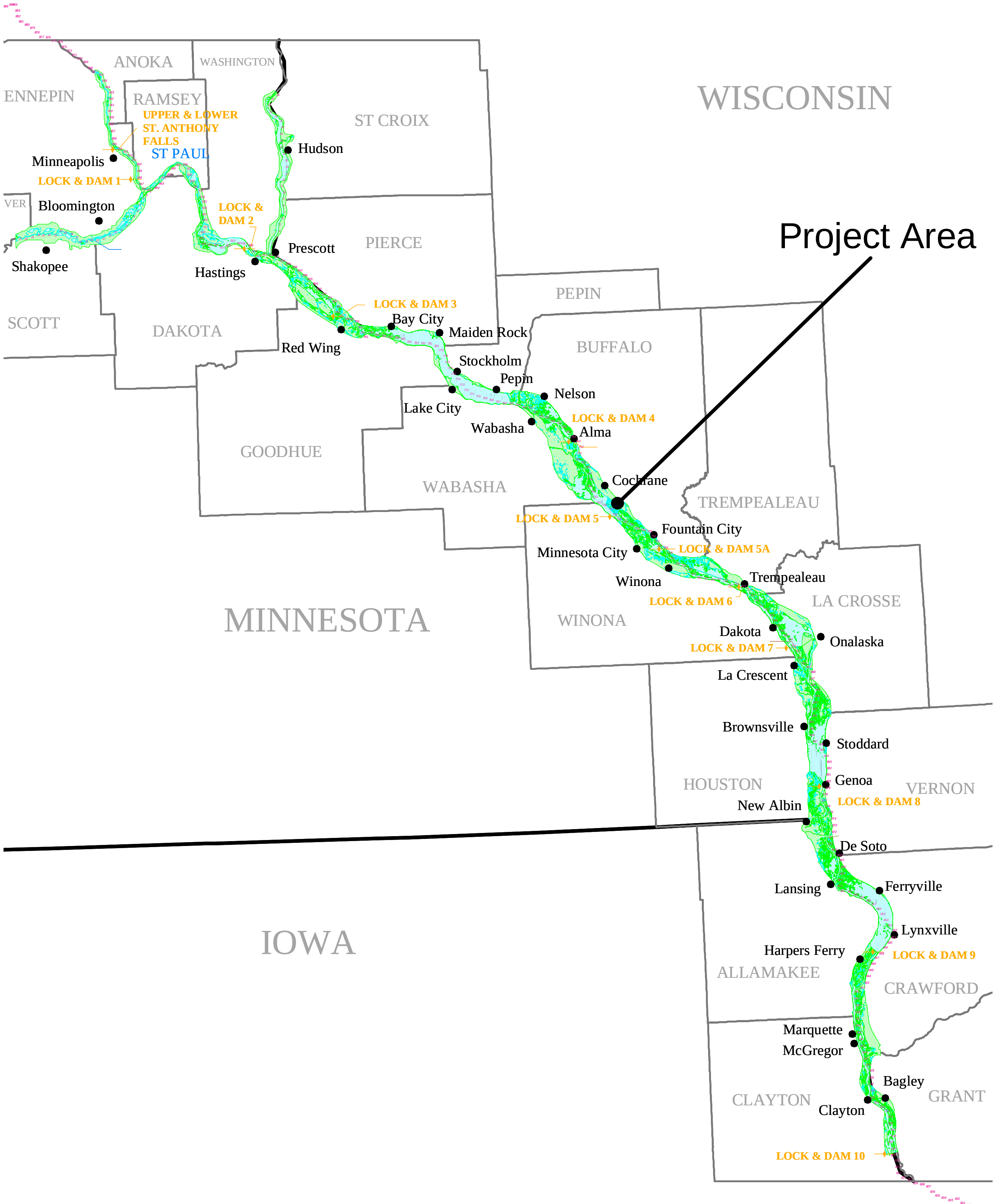
Plates

Attachment 1



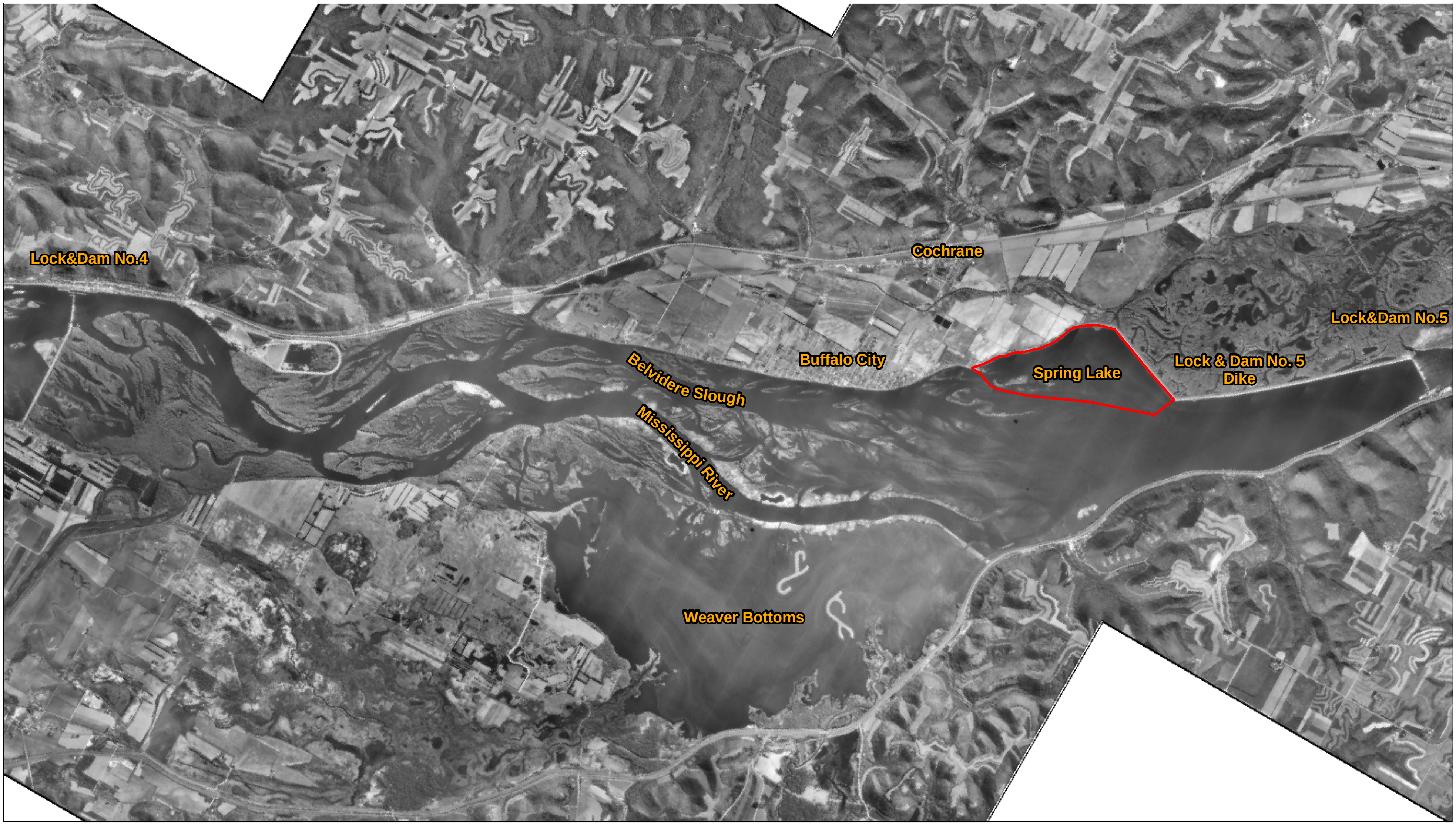
St. Paul District
GIS CENTER
US Army Corps
of Engineers

UPPER MISSISSIPPI RIVER SYSTEM

9 - Foot Navigation Channel Project Area

Plate 1

N



Mississippi River Pool 5

St. Paul District
GIS CENTER
US Army Corps
of Engineers

0 2,250 4,500 9,000 13,500 18,000
Feet

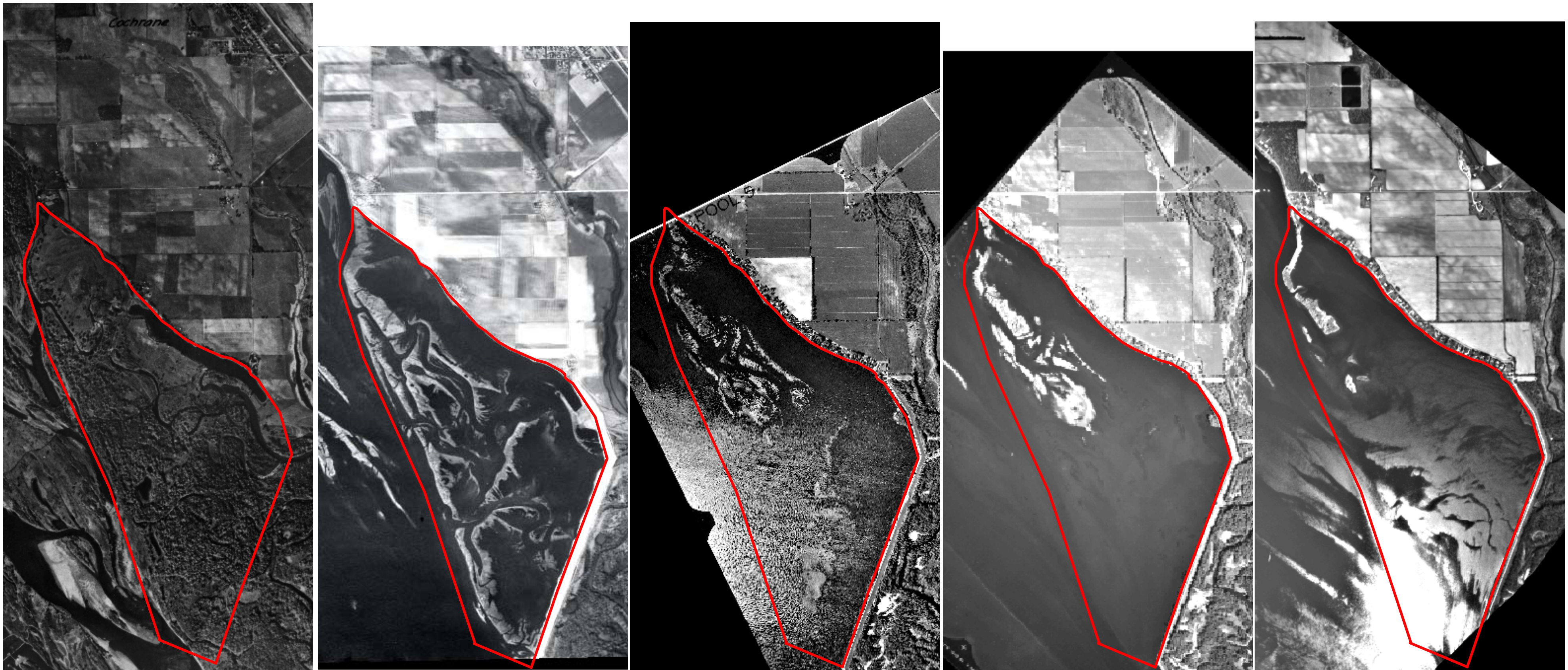
Spring Lake Islands Project Area

N

Plate 2

PME 62540 C:/BYRON/ARCMAP_PROJECTS/NOVAC_SPLK.MXD BGW 4/15

Plate 3



1930	1939	1989	1994	1998

Pool 5 Spring Lake Island

2,000 1,000 0 2,000 4,000 6,000 Feet

Project Area

Plate 4

N

St. Paul District
GIS CENTER
US Army Corps
of Engineers®

0 350 700 1,400 2,100 2,800
Feet

St. Paul District
GIS CENTER
US Army Corps of Engineers®

Spring Lake Islands Change Detection

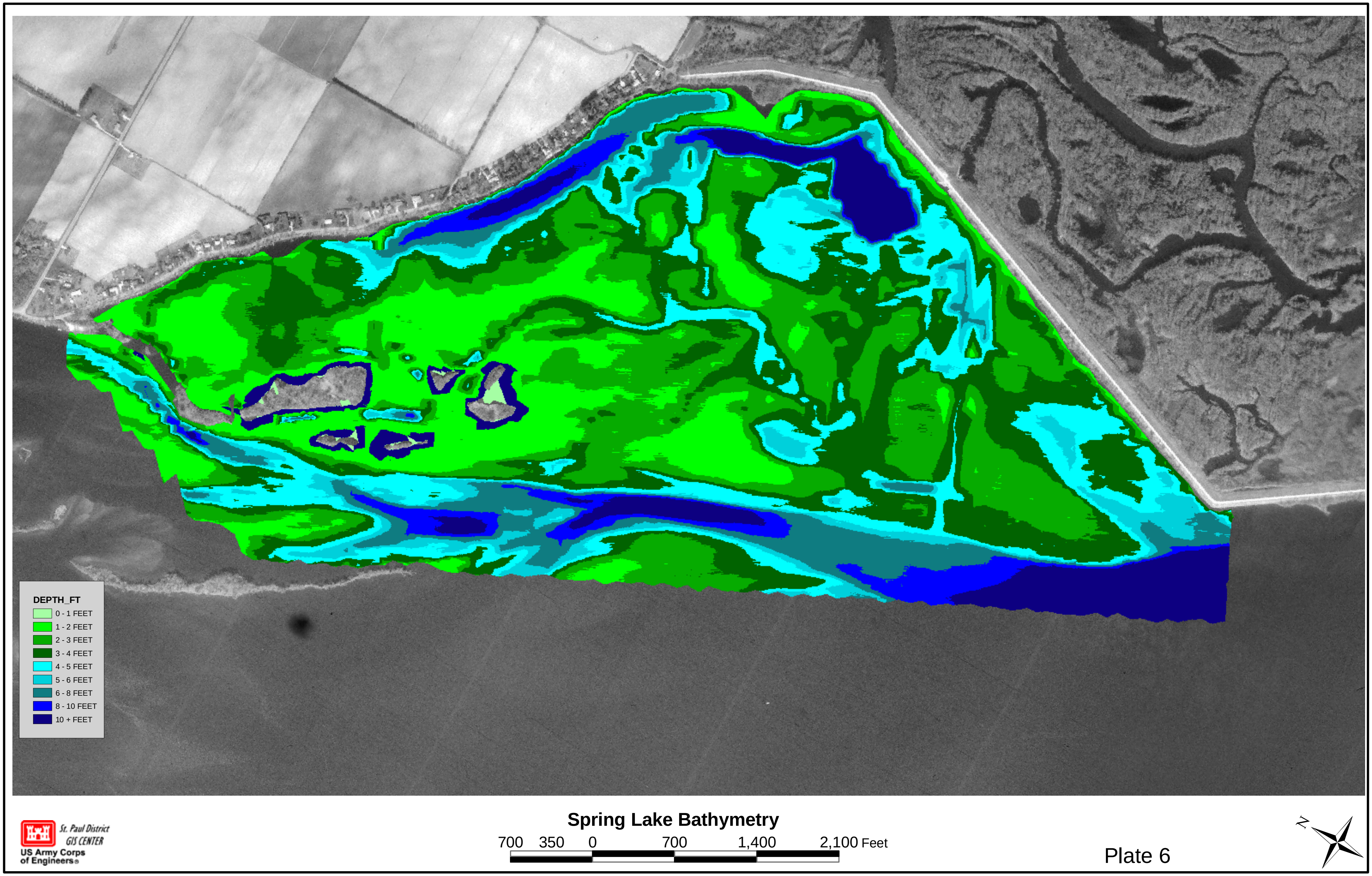
Image Data:USGS Digtil Orthophoto 5 May 1992

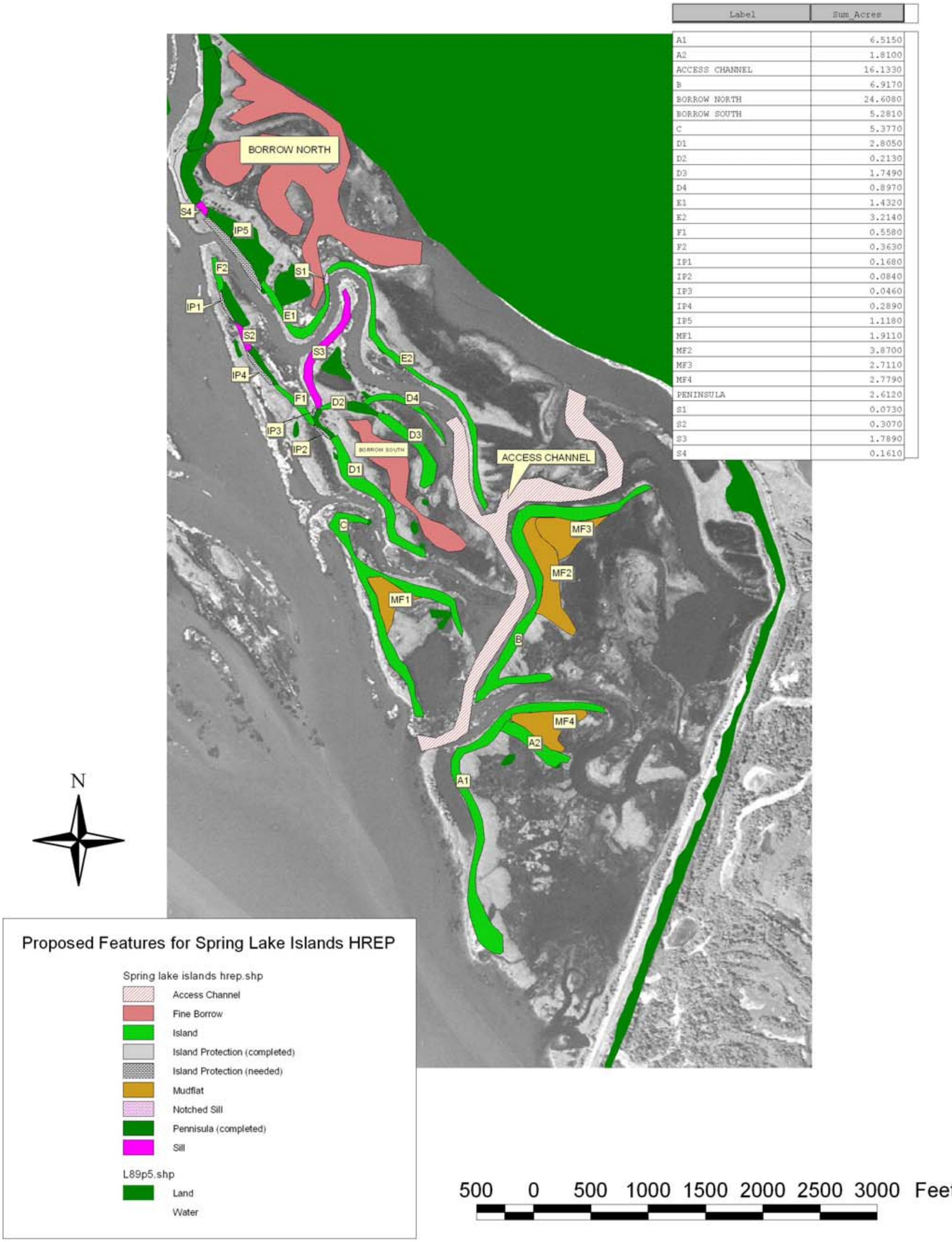
1998
1994
1989
1939

PLATE 5

N

PME 62540 G:/PROJECT_DATA/NOVAK_SP_LK/ SPRINGLAKE.MXD BGW


DEPTH_FT
0 - 1 FEET
1 - 2 FEET
2 - 3 FEET
3 - 4 FEET
4 - 5 FEET
5 - 6 FEET
6 - 8 FEET
8 - 10 FEET
10 + FEET
St. Paul District
GIS CENTER
US Army Corps of Engineers
Spring Lake Bathymetry
700 350 0 700 1,400 2,100 Feet
Plate 6
N



Label	Sum_Acres
A1	6.5150
A2	1.8100
ACCESS CHANNEL	16.1330
B	6.9170
BORROW NORTH	24.6080
BORROW SOUTH	5.2810
C	5.3770
D1	2.8050
D2	0.2130
D3	1.7490
D4	0.8970
E1	1.4320
E2	3.2140
F1	0.5580
F2	0.3630
IP1	0.1680
IP2	0.0840
IP3	0.0460
IP4	0.2890
IP5	1.1180
MF1	1.9110
MF2	3.8700
MF3	2.7110
MF4	2.7790
PENINSULA	2.6120
S1	0.0730
S2	0.3070
S3	1.7890
S4	0.1610

PLATE 7

Proposed Design Features - Corps Plan

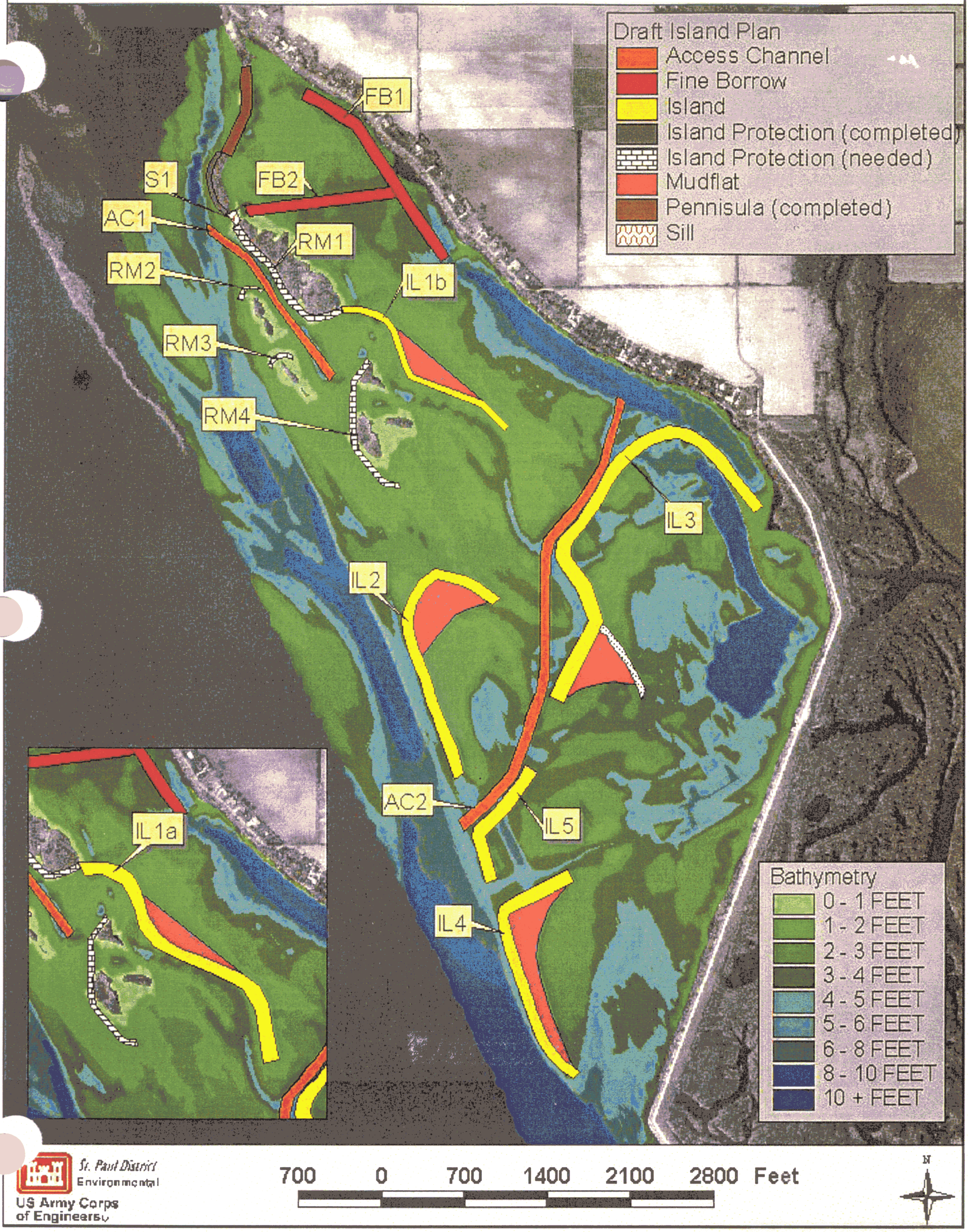
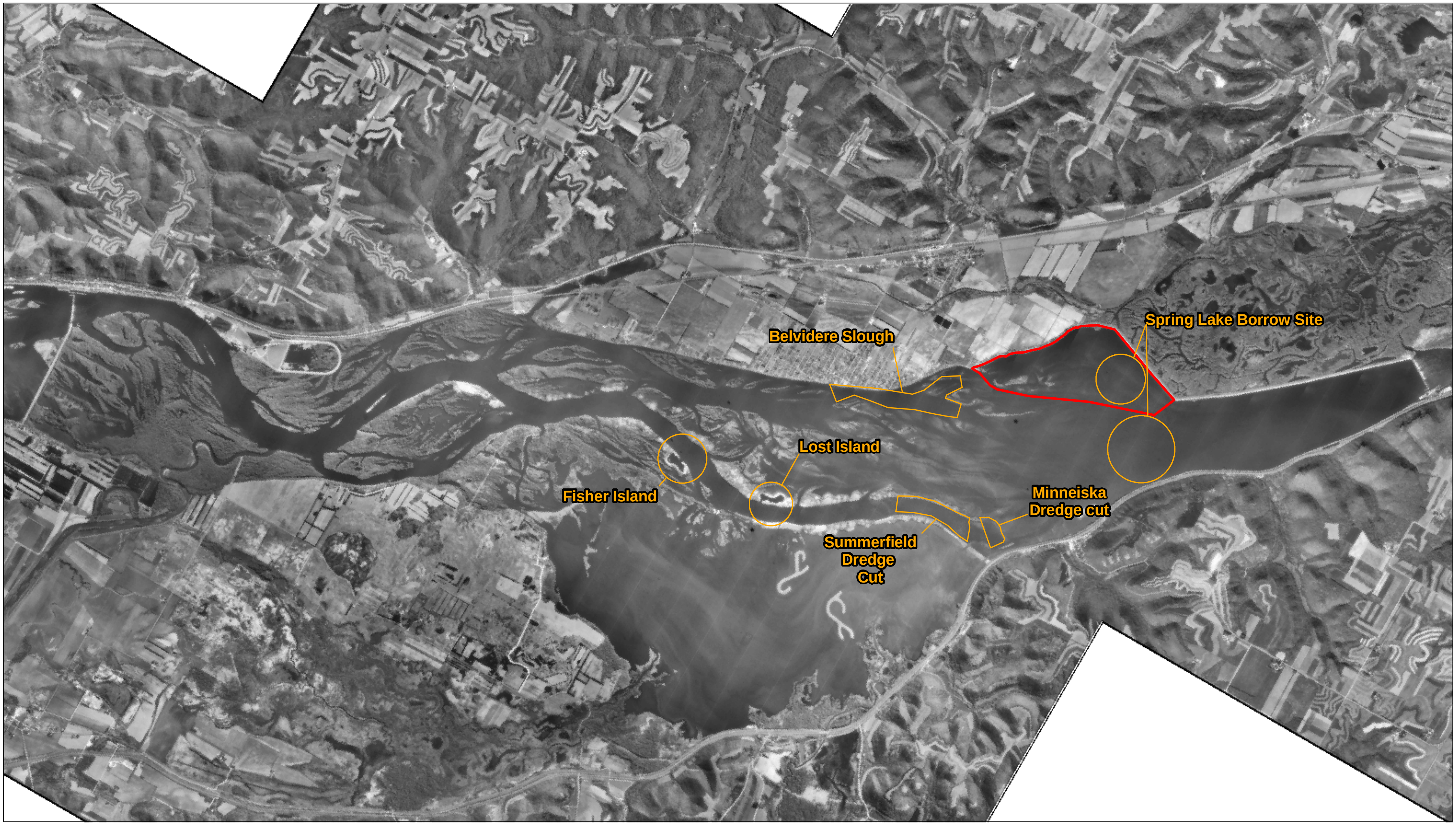


Plate 7.1



St. Paul District
GIS CENTER
US Army Corps
of Engineers

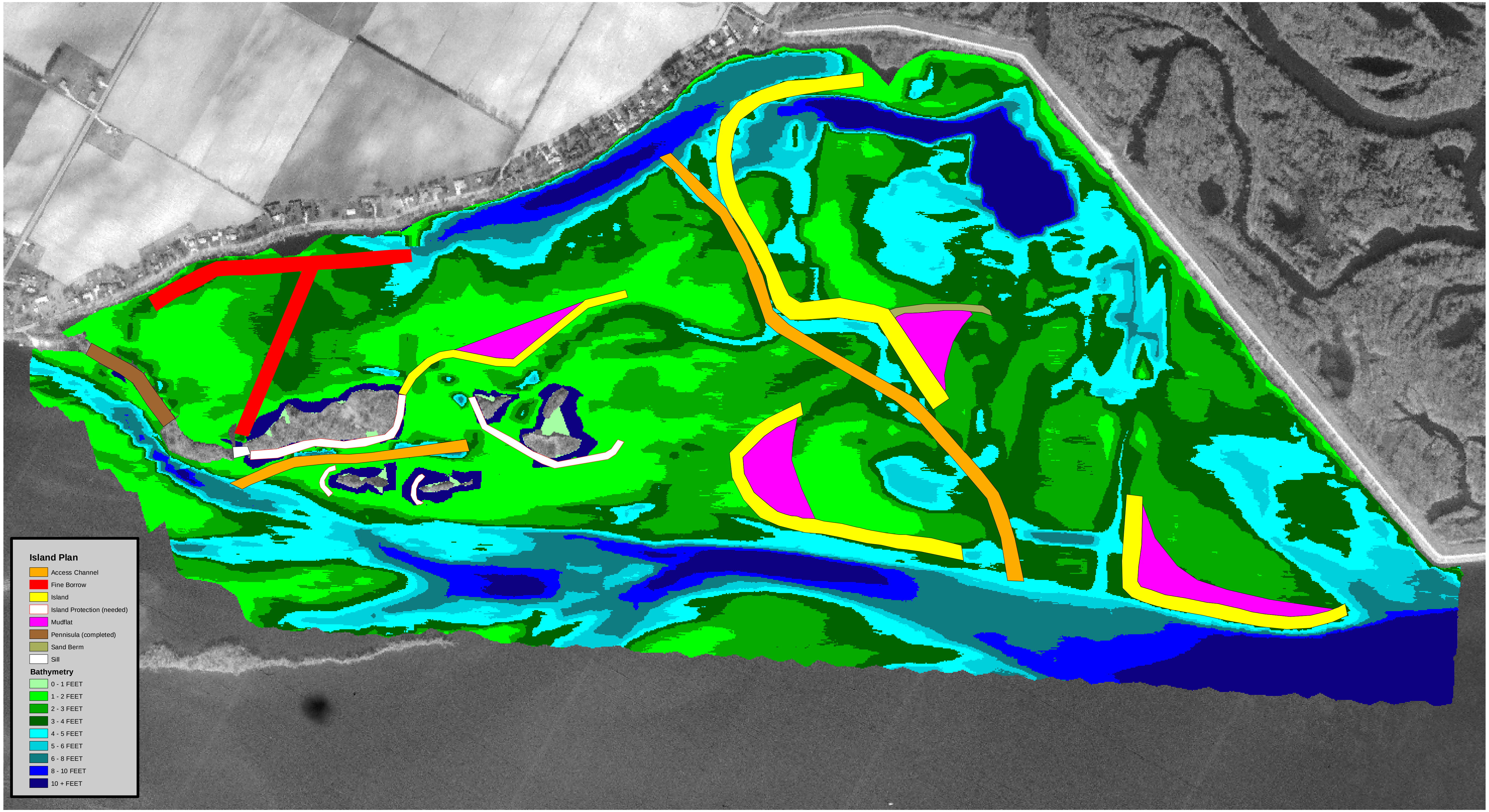
PME 62540 C:/BYRON/ARCMAP_PROJECTS/NOVAC_SPLK.MXD BGW 4/15

Borrow Material Sites

0 2,250 4,500 9,000 13,500 18,000
Feet

Spring Lake Islands Project Area

Plate 8



St. Paul District
GIS CENTER
US Army Corps
of Engineers®

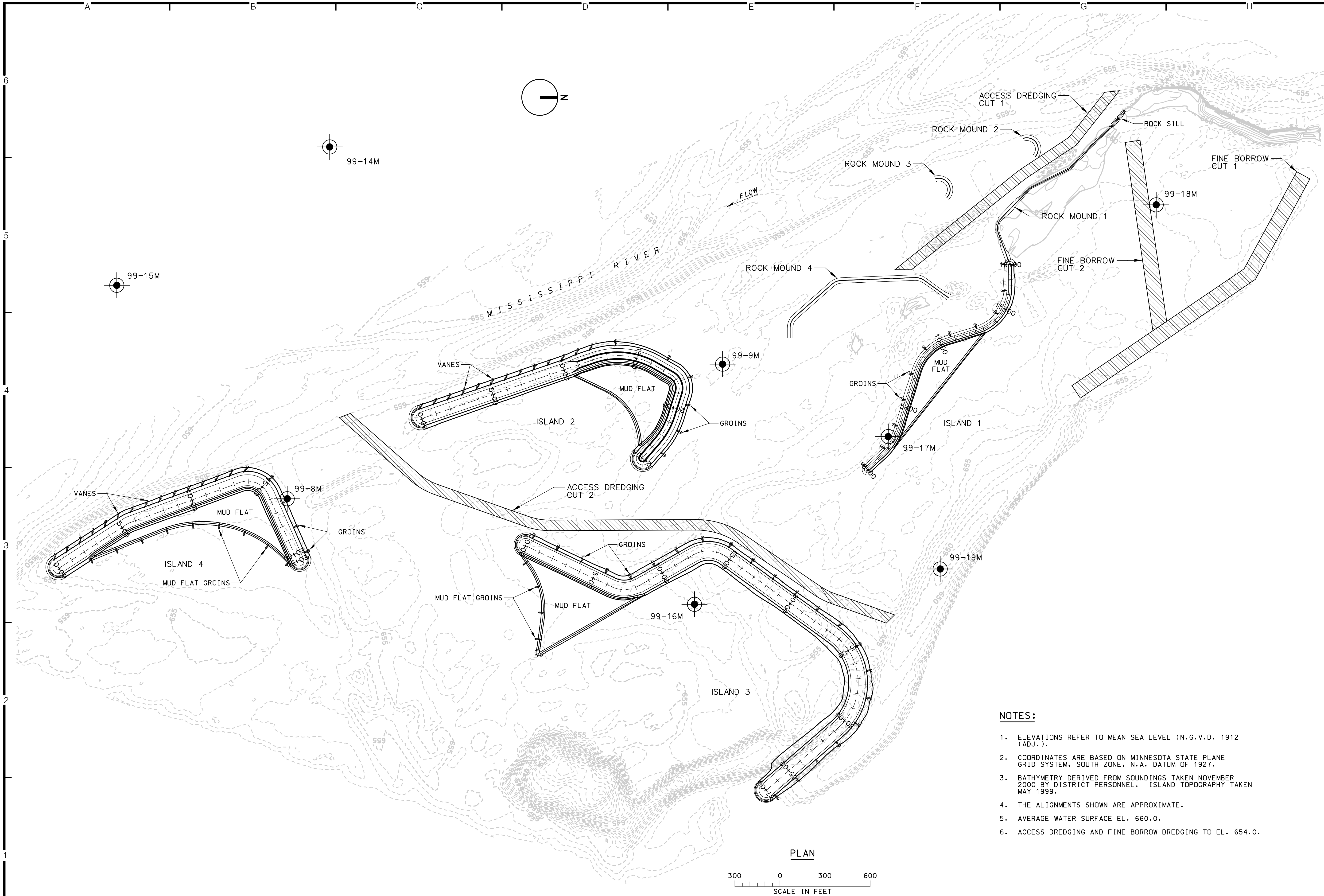
Spring_lake.mxd BGW 3/4/03

Spring Lake Island Selected Plan

0 350 700 1,400 2,100 2,800
Feet

N

Plate 9



NOTES:

1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 (ADJ.).
2. COORDINATES ARE BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.
3. BATHYMETRY DERIVED FROM SOUNDINGS TAKEN NOVEMBER 2000 BY DISTRICT PERSONNEL. ISLAND TOPOGRAPHY TAKEN MAY 1999.
4. THE ALIGNMENTS SHOWN ARE APPROXIMATE.
5. AVERAGE WATER SURFACE EL. 660.0.
6. ACCESS DREDGING AND FINE BORROW DREDGING TO EL. 654.0.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

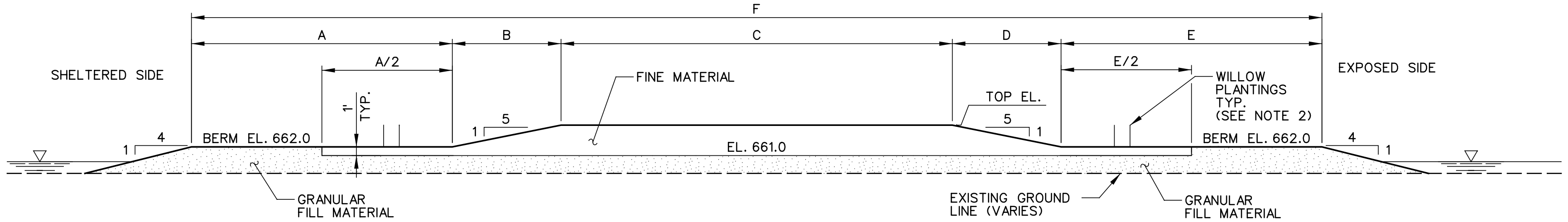
DESIGNED: LKT/JJF
CHECKED: TMG
DRAWN: LKT
DESIGNED: KLL
CHECKED: JSH
ED-D ED-H

SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: M5RC10401.DGN
SOL. NO.:
AE APPROVING OFFICIAL:

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
SITE LAYOUT

DRAWING NUMBER:
PLATE 10
SHT OF



NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

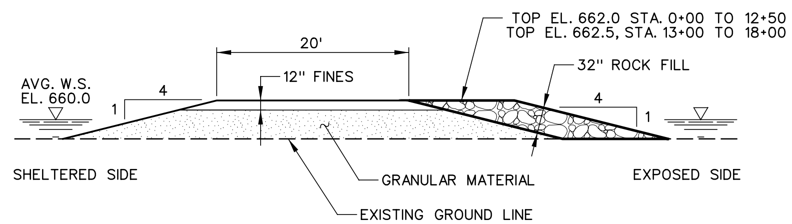
SECTION

ISLANDS 2, 3 & 4

SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

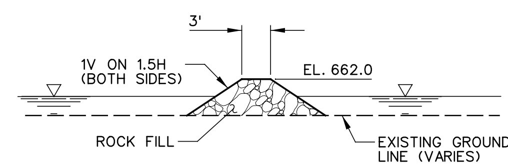
ISLAND DIMENSIONS (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND 2 STA. 0+00 TO 10+50	45	0	40	0	30	115	662.0
ISLAND 2 STA. 11+00 TO 23+00	45	5	40	5	20	115	663.0
ISLAND 2 STA. 23+50 TO 24+00	45	5	40	5	30	125	663.0
ISLAND 3 STA. 0+00 TO 7+75	30	0	65	0	30	125	662.0
ISLAND 3 STA. 8+25 TO 37+00	30	0	65	0	20	115	662.0
ISLAND 4 STA. 0+00 TO 2+00	45	0	40	0	30	115	662.0
ISLAND 4 STA. 2+50 TO 18+50	45	0	40	0	20	105	662.0



TYPICAL SECTION

ISLAND 1

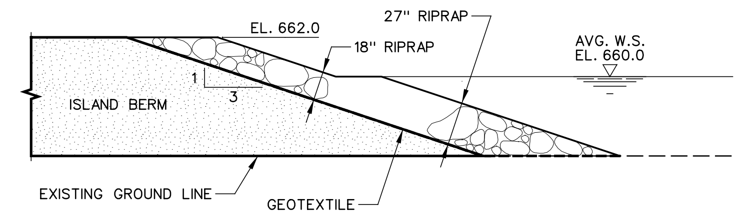
SCALE: 1" = 10'-0"



TYPICAL SECTION

ROCK MOUND ISLAND PROTECTION

SCALE: 1" = 10'-0"



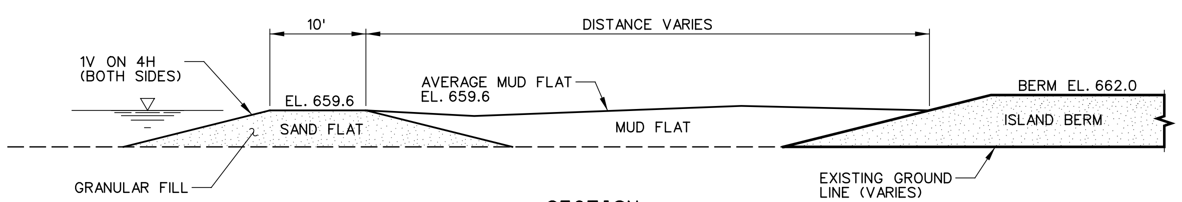
1. RIPRAP REQUIRED TO TOP OF ISLANDS 2, 3 & 4 AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL

ISLAND RIPRAP END PROTECTION

SCALE: 1" = 5'-0"

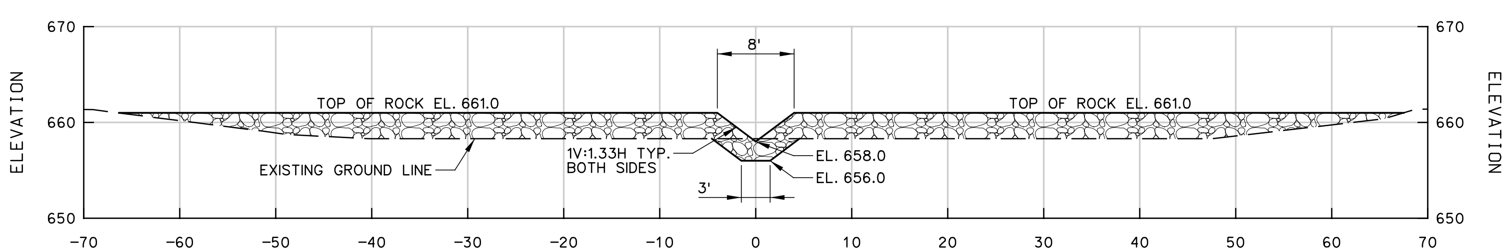
5 0 5 10
SCALE IN FEET



SECTION

TYPICAL MUD/SAND FLAT

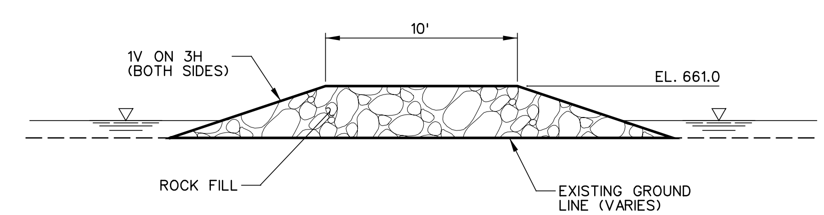
SCALE: 1" = 10'-0"



LONGITUDINAL SECTION

ROCK SILL

SCALE: 1" = 10'-0"



TYPICAL CROSS SECTION

ROCK SILL

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol | Description | Date | Appr.

DESIGNED: ED-D | CHECKED: | DRAWN: | DESIGNED: ED-H | CHECKED:

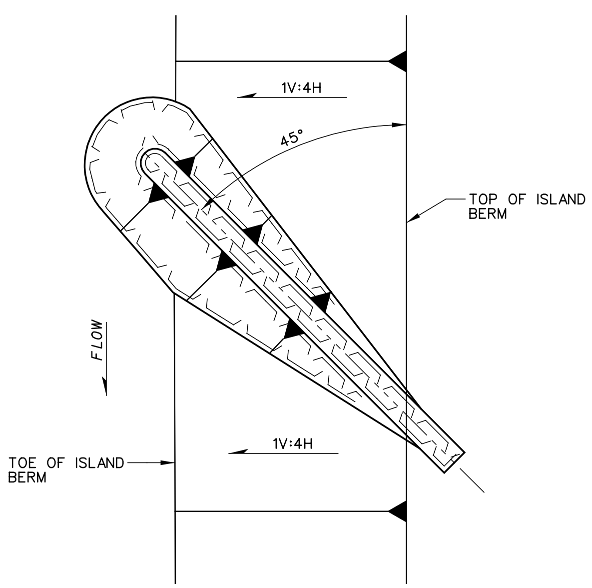
SCALE: AS SHOWN | DATE: APR 2002 | CADD FILE NAME: m0rc30402.DGN | SOL. NO.: | AE APPROVING OFFICIAL:

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
ISLAND
TYPICAL SECTIONS & DETAILS

DRAWING NUMBER:
PLATE 11

SHT OF



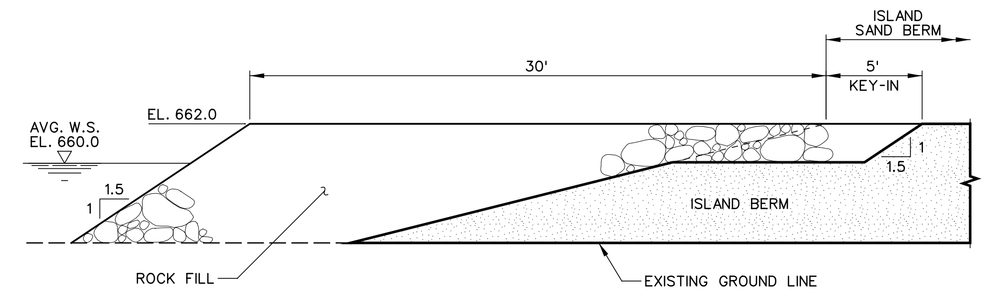
PLAN

TYPICAL ROCK VANE

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



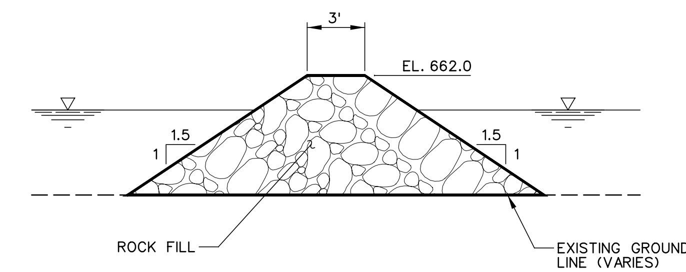
NOTES:

1. TOP OF MUD FLAT GROINS AT EL. 659.6.
2. ROCK GROINS SHALL BE PLACED PERPENDICULAR TO THE ISLAND.

LONGITUDINAL SECTION

ROCK GROIN

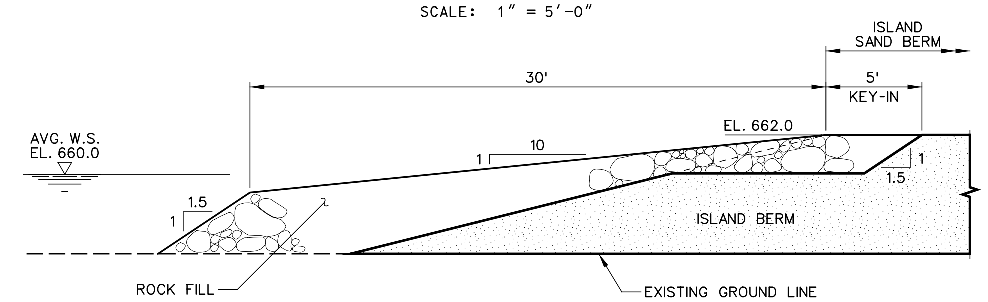
SCALE: 1" = 5'-0"



CROSS SECTION

TYPICAL ISLAND ROCK GROIN

SCALE: 1" = 5'-0"



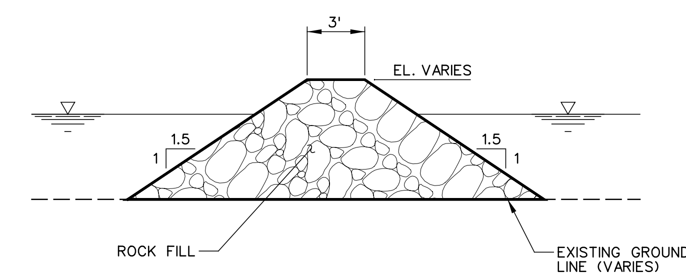
LONGITUDINAL SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

5 0 5 10

SCALE IN FEET



CROSS SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

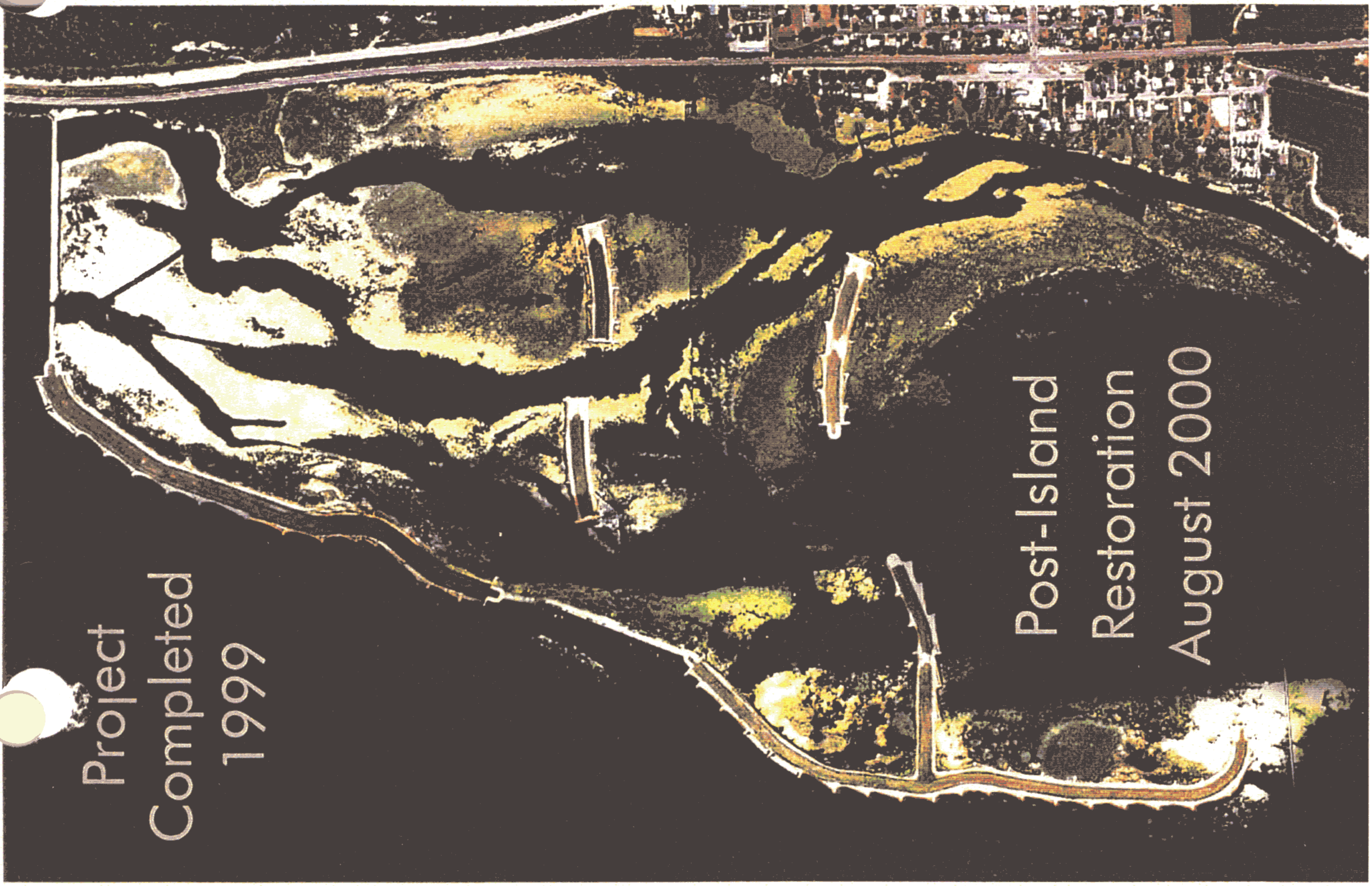
DATE: APR 2002
SCALE: AS SHOWN
CADD FILE NAME: MSRC3043.DGN
SOL. NO:
AE APPROVING OFFICIAL:
DESIGNED: CHECKED: ED-D
DRAWN: DESIGNED: CHECKED: ED-H

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
GROIN & VANE DETAILS

DRAWING NUMBER:
PLATE 12

SHT OF


Project Completed 1999
Post-Island Restoration August 2000

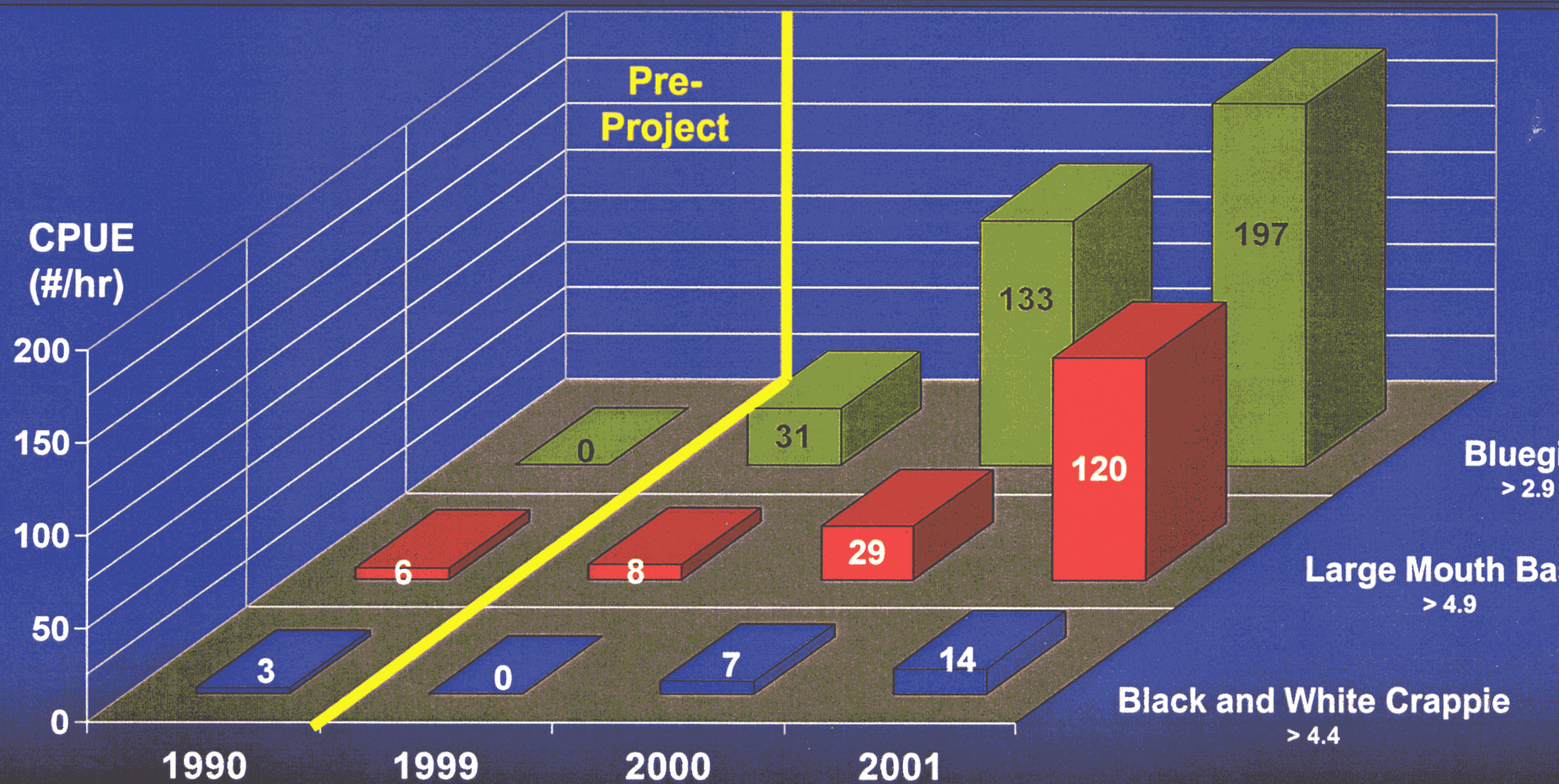

Historical Islands October 1961


Pre-Island Restoration August 1994

Plate 13

US Army Corps of Engineers
St. Paul District

Pool 8 Islands Phase II



Cost Estimate Appendix

Attachment 2

APPENDIX

SPRING LAKE - EMP
COST ESTIMATE

GENERAL

1. This appendix contains a summary of the detailed cost estimate prepared for the Spring Lake Environmental Management Program (EMP) project in Pool 5 on the Wisconsin side of the Upper Mississippi River, just upstream of the Lock and Dam No. 5 embankment. The estimate includes construction; planning, engineering and design, and construction management costs. The estimate prepared for this report was developed after review of the project plans, discussions with the design team members, and review of costs for similar construction projects. Guidance for the preparation of the estimate 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 estimate was prepared using Micro-Computer Aided Cost Estimating System (MCACES) and is presented in accordance with the Civil Works Breakdown Structure as presented in the Models database for MCACES.

PRICE LEVEL

2. Project element costs are based on May 2002 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.

PROJECT DESCRIPTION

3. This project consists of backwater dredging, island building, erosion protection using riprap, turfing and willow plantings and construction of riprap control structures. The work is in a backwater area on the left descending bank of the Mississippi River, in an area referred to as Spring Lake.
4. The goal of this project is to maintain and/or improve fish and wildlife habitat in Pool 5 by maintaining the existing area of islands and backwater areas. This will be accomplished by constructing islands and rock mound protection structures.
5. The main report and other attachments contain more detailed descriptions of the project features and address their intended functions.

COST RELATIONSHIPS

6. Mobilization and demobilization was included to represent the costs associated with transporting mechanical dredging equipment and hydraulic dredging equipment to the project site. Mechanical dredging plant will be used to construct rock riprap mounds and bank protection. Hydraulic plant will be used for dredging and placement of sand for construction of the islands. A small hydraulic dredging plant will also be used for placement of fines, which will be obtained from the fine borrow area. Required access dredging will be used as random fill for the island mudflat areas.

7. The construction costs in this estimate are based on assigning a production rate to a crew suited to accomplish the work. Material prices have been included in each feature. Costs associated with movement of equipment between individual features have been included in each feature's construction cost. Including the costs associated with movement of equipment between features in the cost for each feature, allows the individual features to be added and removed without affecting the basic mobilization and demobilization cost.

8. Hydraulic dredging costs include the costs associated with assembling and breaking down pipe as well as the cost for dredging.

CONTINGENCY DISCUSSION

9. After review of the 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 30 percent

10. 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 contingencies assigned to mobilization line items are primarily based on the unknown mobilization distance.

      2. The contingency assigned to the hydraulic dredging portions of the estimate is based on the available information on the availability of sand in the project area. Dredging production is based on pumping distances, so a change in the location and/or quantity of sand at a particular location will have a direct impact on the unit price for sand.

      3. The contingency assigned to the rock mounds and rock erosion protection are based on the bathymetric data available.

      4. The contingencies assigned to the planting portions of the project are based on the minimal design work that is completed, as well as the limited number of subcontractors available to do this type of work.

CONSTRUCTION METHODS

11. General. Since both marine and land based equipment will be required for the project, it was generally assumed that marine equipment would be available to transport land based equipment to remote sites that would otherwise be inaccessible. Ten hour work days are assumed throughout the estimate.

12. Hydraulic Dredging. Hydraulic dredging methods were assumed to be used for all sand dredging / island building, access dredging and the fines dredging obtained from the fine borrow area.

13. Mechanical Dredging Equipment. Mechanical dredging equipment was assumed to be used for all rock placement activities.

14. Access. Transportation to and from the project area will be by barge. For access to individual islands, various amounts of access dredging will be required. Access dredging can be accomplished using hydraulic dredging equipment for the random fill required for the mudflat areas. The mudflat areas can be adjusted in size to accommodate changes in the amount of access dredging.

15. Sand. A source of sand for island building was identified as the area between Island 2 and Island 4.

16. Fines / Topsoil. After the fines have been dredged and placed on the islands, they will require time to dry before being spread by land based equipment. It was assumed that mechanical equipment would have to be mobilized the second year for reworking and spreading the fines.

MCACES COST ESTIMATE

17. Both a hard copy and an electronic copy of the detailed MCACES estimate are available for review. To reduce reproduction requirements, a copy of the detailed MCACES estimate is not included in this appendix but can be reviewed by contacting the Cost Engineering and Specifications Section.

OPERATIONS AND MAINTENANCE ESTIMATE

18. A detailed operation and maintenance cost estimate for this project has been prepared and is included at the end of this appendix. The estimate is for O&M costs for the new features only. The estimate is based on the assumption that 5% of the rock would be replaced every 10 years.

PROJECT COST SUMMARY SHEET - SPRING LAKE EMP

Environmental Management Program

Project: Spring Lake EMP
Location: Pool 5 - Mississippi River

Date: May 24, 2002

PREPARED BY: Jeffrey L. Hansen, CEMVP-ED-D

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specification Section

No.	Description	Total Estimated Amount	Contingency Amount	Contingency Percent	Estimated Amount Plus Contingency	Index Factor To 10 / 2002	Index Cost To 10 / 2002	Midpoint Of Featue Year	Index to Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
06	Fish and Wildlife Facilities	$2,085,900	$652,900	31%	$2,738,800	0.011	$2,769,000	JAN 2005	0.011	$2,132,000	$667,000	$2,799,000
30	Planning, Engineering and Design	$316,000	$80,500	25%	$396,500	0.021	$405,000	JUL 2003	0.037	$335,000	$85,000	$420,000
31	Construction Management	$130,200	$33,400	26%	$163,600	0.021	$167,000	JAN 2005	0.102	$146,000	$38,000	$184,000
	Estimated Project Cost	$2,532,100	$766,800	30%	$3,298,900		$3,341,000			$2,613,000	$790,000	$3,403,000

NOTES: Costs are based on May 2002 unit pricing.

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake

23-May-2002
ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies

This estimate is based on a source of **sand from an area within Spring Lake** on the upstream side of the dike at L/D 5. This preliminary estimate is based on conceptual plans to compare the relative cost of the different islands, rock mounds and access dredging. Quantities are based on X-sections similar to other EMP projects. Contingecies are based on the level of detail design and some estimated quantities. Prices are based on historical and average bid prices from similar island building projects. This estimate should not be used for budget purposes.
The project is located entirely within the backwaters of the Mississippi River.

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	%	Total w/ Contingencies
06	**FISH AND WILDLIFE FACILITIES**							
06 03	WILDLIFE FACILITIES AND SANCTUARY							
06 03 73	HABITAT AND FEEDING FACILITIES							
06 03 73 02	SITEWORK							
06 03 73 02 01	**Mobilization and Demobilization**							
06 03 73 02 01	Base Mob / Demob	1	JOB	****	$227,000	$68,100	30%	**$295,100**
06 03 73 02 02	**Rock Sill**							
06 03 73 02 02	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 02	Riprap	193	CY	$46.24	$8,900	$2,700	30%	
06 03 73 02 02	Subtotal Construction for Rock Sill				$13,400	$4,300		
30 01	Planning, Engineering & Design (17%)				$2,300	$800	35%	
31 01	Construction Management (7%)				$900	$300	35%	
	Total Estimate - Rock Sill				**$16,600**	**$5,400**		**$22,000**
06 03 73 02 03	**Rock Mound 1**							
06 03 73 02 03	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 03	Riprap	1,308	CY	$46.24	$60,500	$18,200	30%	
06 03 73 02 03	Subtotal Construction for Rock Mound 1				$65,000	$19,800		
30 01	Planning, Engineering & Design (17%)				$11,100	$2,800	25%	
31 01	Construction Management (7%)				$4,600	$1,200	25%	
	Total Estimate - Rock Mound 1				**$80,700**	**$23,800**		**$104,500**
06 03 73 02 04	**Rock Mound 2**							
06 03 73 02 04	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 04	Riprap	618	CY	$46.24	$28,600	$8,600	30%	
06 03 73 02 04	Subtotal Construction for Rock Mound 2				$33,100	$10,200		
30 01	Planning, Engineering & Design (17%)				$5,600	$1,400	25%	
31 01	Construction Management (7%)				$2,300	$600	25%	
	Total Estimate - Rock Mound 2				**$41,000**	**$12,200**		**$53,200**

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake

23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	%	Total w/ Contingencies
06 03 73 02 05	**Rock Mound 3**							
06 03 73 02 05	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 05	Riprap	590	CY	$46.24	$27,300	$8,200	30%	
06 03 73 02 05	Subtotal Construction for Rock Mound 3				$31,800	$9,800		
30 01	Planning, Engineering & Design (17%)				$5,400	$1,400	25%	
31 01	Construction Management (7%)				$2,200	$600	25%	
	Total Estimate - Rock Mound 3				**$39,400**	**$11,800**		**$51,200**
06 03 73 02 06	**Rock Mound 4**							
06 03 73 02 06	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 06	Riprap	2,796	CY	$46.24	$129,300	$38,800	30%	
06 03 73 02 06	Subtotal Construction for Rock Mound 4				$133,800	$40,400		
30 01	Planning, Engineering & Design (17%)				$22,700	$5,700	25%	
31 01	Construction Management (7%)				$9,400	$2,400	25%	
	Total Estimate - Rock Mound 4				**$165,900**	**$48,500**		**$214,400**
06 03 73 02 07	**Island 1**							
06 03 73 02 07	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 07	Sand	8,182	CY	$2.85	$23,300	$7,000	30%	
06 03 73 02 07	Fines	1,600	CY	$15.80	$25,300	$8,900	35%	
06 03 73 02 07	Sand Berm	671	CY	$5.70	$3,800	$1,100	30%	
06 03 73 02 07	Mud Flat (from access dredging)	4,458	CY	$7.04	$31,400	$9,400	30%	
06 03 73 02 07	Rock Groins - 11	451	CY	$50.96	$23,000	$6,900	30%	
06 03 73 02 07	Riprap Ends - 1	195	CY	$46.24	$9,000	$2,700	30%	
06 03 73 02 07	Plantings - Willows	1,800	EA	$2.00	$3,600	$1,300	35%	
06 03 73 02 07	Turf	1.00	AC	$3,240.00	$3,200	$1,000	30%	
06 03 73 02 07	Subtotal Construction for Island 1				$131,800	$41,500		
30 01	Planning, Engineering & Design (17%)				$22,400	$6,700	30%	
31 01	Construction Management (7%)				$9,200	$2,800	30%	
	Total Estimate for Island 1				**$163,400**	**$51,000**		**$214,400**
06 03 73 02 08	**Island 2**							
06 03 73 02 08	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 08	Sand	50,328	CY	$2.85	$143,400	$43,000	30%	
06 03 73 02 08	Fines	9,414	CY	$15.80	$148,700	$52,000	35%	
06 03 73 02 08	Sand Berm	836	CY	$5.70	$4,800	$1,400	30%	
06 03 73 02 08	Mud Flat (from access dredging)	10,194	CY	$4.15	$42,300	$12,700	30%	
06 03 73 02 08	Rock Groins - 7	287	CY	$50.96	$14,600	$4,400	30%	
06 03 73 02 08	Riprap Ends - 2	496	CY	$46.24	$22,900	$6,900	30%	
06 03 73 02 08	Rock Vanes - 13	367	CY	$56.10	$20,600	$6,200	30%	
06 03 73 02 08	Plantings - Willows	2,400	EA	$2.00	$4,800	$1,700	35%	
06 03 73 02 08	Turf	4.30	AC	$3,240.00	$13,900	$4,200	30%	
06 03 73 02 08	Subtotal Construction for Island 2				$425,200	$135,700		
30 01	Planning, Engineering & Design (17%)				$72,300	$18,100	25%	
31 01	Construction Management (7%)				$29,800	$7,500	25%	
	Total Estimate for Island 2				**$527,300**	**$161,300**		**$688,600**

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake

23-May-2002
ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	%	Total w/ Contingencies
06 03 73 02 09	**Island 3**							
06 03 73 02 09	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 09	Sand	97,821	CY	$2.85	$278,800	$83,600	30%	
06 03 73 02 09	Fines	12,854	CY	$15.80	$203,100	$71,100	35%	
06 03 73 02 09	Sand Berm	2,568	CY	$5.70	$14,600	$4,400	30%	
06 03 73 02 09	Mud Flat (from access dredging)	13,319	CY	$4.15	$55,300	$16,600	30%	
06 03 73 02 09	Rock Groins - 22	902	CY	$50.96	$46,000	$13,800	30%	
06 03 73 02 09	Riprap Ends - 3	576	CY	$46.24	$26,600	$8,000	30%	
06 03 73 02 09	Mudflat Groins - 4	56	CY	$50.96	$2,900	$900	30%	
06 03 73 02 09	Plantings - Willows	3,700	EA	$2.00	$7,400	$2,600	35%	
06 03 73 02 09	Turf	7.40	AC	$3,240.00	$24,000	$7,200	30%	
06 03 73 02 09	Subtotal Construction for Island 3				$667,900	$211,400		
30 01	Planning, Engineering & Design (17%)				$113,500	$28,400	25%	
31 01	Construction Management (7%)				$46,800	$11,700	25%	
	Total Estimate for Island 3				**$828,200**	**$251,500**		**$1,079,700**
06 03 73 02 10	**Island 4**							
06 03 73 02 10	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 10	Sand	47,025	CY	$2.85	$134,000	$40,200	30%	
06 03 73 02 10	Fines	5,037	CY	$15.80	$79,600	$27,900	35%	
06 03 73 02 10	Sand Berm	3,155	CY	$5.70	$18,000	$5,400	30%	
06 03 73 02 10	Mud Flat (from access dredging)	10,093	CY	$4.15	$41,900	$12,600	30%	
06 03 73 02 10	Rock Groins - 3	123	CY	$50.96	$6,300	$1,900	30%	
06 03 73 02 10	Riprap Ends - 2	505	CY	$46.24	$23,400	$7,000	30%	
06 03 73 02 10	Riprap Vanes - 15	424	CY	$56.10	$23,800	$7,100	30%	
06 03 73 02 10	Mudflat Groins - 8	112	CY	$50.96	$5,700	$1,700	30%	
06 03 73 02 10	Plantings - Willows	1,850	EA	$2.00	$3,700	$1,300	35%	
06 03 73 02 10	Turf	3.50	AC	$3,240.00	$11,300	$3,400	30%	
06 03 73 02 10	Subtotal Construction for Island 4				$356,900	$111,700		
30 01	Planning, Engineering & Design (17%)				$60,700	$15,200	25%	
31 01	Construction Management (7%)				$25,000	$6,300	25%	
	Total Estimate for Island 4				**$442,600**	**$133,200**		**$575,800**
06	**Subtotal Construction**				**$2,085,900**	**$652,900**	**31%**	
30	**Subtotal Planning, Engineering & Design**				**$316,000**	**$80,500**	**25%**	
31	**Subtotal Construction Management**				**$130,200**	**$33,400**	**26%**	
Total Estimated Preliminary Cost for Spring Lake EMP Using sand obtained from the Spring Lake Area					**$2,532,100**	**$766,800**		**$3,298,900**

Notes: Unit prices are at May 2002 price levels unless otherwise noted.

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake

23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies

Mob / Demob + Site Prep is local moving of equipment from one feature work area to another.
Quantities from conceptual design based on other similar EMP projects.
Sand unit price based on an area within Spring Lake.
Fines unit price based on transporting up to 6,000 LF from fine borrow area. (Wilds Bend Polander)
Sand berms unit price based on 50% increase over Sand unit price due to small x-sectional area.
Mud Flats unit price based on access dredging and minimal handling.
Rock unit price based on quotes for delivery at Buffalo City or Minieska
Willows unit price based on simliar projects (Pool 8 Phase III DPR)
Turf unit price based on simliar projects.

POOL 5 - SPRING LAKE QUANTITIES										
ISLAND	**STATION**	**LENGTH (FT)**	**TOTAL FILL (CY)**	**RANDOM (CY)**	**FINES (CY)**	**GRAN-ULAR (CY)**	**TURF (AC)**	**ROCK (CY)**	**GEO- TEXTILE (SY)**	**WILLOWS (EA)**
ROCK SILL	0+00 TO 1+35	135						193		
ROCK MOUND 1	0+00 TO 12+95	1,295						1,308		
ROCK MOUND 2	0+00 TO 2+00	200						618		
ROCK MOUND 3	0+00 TO 2+00	200						590		
ROCK MOUND 4	0+00 TO 13+00	1,300						2,796		
ISLAND IL1	0+00 TO 18+00	1,800	12,783		1,600	8,182		3,001		1,800
RIPRAP ENDS (1)								195		
GROINS (11)								451		
SAND BERM						671				
MUD FLAT					4,458					
TOTAL IL1			12,783	-	6,058	8,853	-	3,647	-	1,800
ISLAND IL2	0+00 TO 24+00	2,400	59,742		9,414	50,328				2,400
RIPRAP ENDS (2)								496		
GROINS (7)								287		
VANES (13)								367		
SAND BERM						836				
MUD FLAT				9,250	944					
TOTAL IL2			59,742	9,250	10,358	51,164	-	1,150	-	2,400
ISLAND IL3	0+00 TO 37+00	3,700	110,675		12,854	97,821				3,700
RIPRAP ENDS (3)								576		
GROINS (22)								902		
MUDFLAT GROINS (4)								56		
SAND BERM						2,568				
MUD FLAT				13,319						
TOTAL IL3			110,675	13,319	12,854	100,389	-	1,534	-	3,700
ISLAND IL4	0+00 TO 20+50	1,850	52,062		5,037	47,025				1,850
RIPRAP ENDS (2)								505		
GROINS (3)								123		
MUDFLAT GROINS (8)								112		
VANES (15)								424		
SAND BERM						3,155				
MUDFLAT				10,093						
TOTAL IL4			52,062	10,093	5,037	50,180	-	1,164	-	1,850
TOTAL ISLANDS			**235,262**	**32,662**	**34,307**	**210,586**	**-**	**13,000**	**-**	**9,750**

ISLAND	STATION	LENGTH (FT)	TOTAL FILL (CY)	RANDOM (CY)	FINES (CY)	GRAN-ULAR (CY)	TURF (AC)	ROCK (CY)	GEO- TEXTILE (SY)	WILLOWS (EA)
DREDGE CUT		LENGTH (FT)		TOTAL CUT (CY)	TOTAL CUT (CY)					
ACCESS DREDGING										
AC1		1,835		14,657						
AC2		2,300		18,006						
TOTAL ACCESS DREDGING		4,135		32,663	-					
FINE BORROW										
FB1		2,150			19,998					
FB2		1,240			14,165					
TOTAL FINE BORROW		3,390		-	34,163					
TOTAL DREDGING		7,525		32,663	34,163					

OPERATION AND MAINTENANCE

Life Cycle 50 Years
Rate of Return 6.125%

Date Prepared 23-May-2002

SPRING LAKE - EMP

CODE	ITEM DESCRIPTION	ESTIMATED O&M CYCLE	QUANTITY FACTOR	PROJECT QUANTITY	O&M QUANTITY	UNIT	UNIT PRICE	AMOUNT	PRESENT VALUE	ANNUAL COST	COMMENTS
			O&M and MAJOR REPLACEMENT COSTS						EQUIVALENT AVERAGE ANNUAL O&M / MAJOR REPLACEMENT VALUE		
									$146,008	$9,425	Percentage of Construction 0.34%
	Inspections										
	Periodic Inspections										
	1st 5 years	1 Year	1.00	1	1	JOB	$12,000	$12,000	50,377	3,252	4 people at $1,000 per day for 3 days each = $12,000
	Year 7, 9 and 11	2 Years	1.00	1	1	JOB	$9,000	$9,000	15,887	1,026	Cost of periodics decreases after the 1st 5 years.
	Every 5 years beginning year 15	5 Years	1.00	1	1	JOB	$9,000	$9,000	13,018	840	
	Routine Annual Inspections	1 Year	1.00	1	1	JOB	$2,500	$2,500	38,727	2,500	
	Total Inspections								118,010	7,618	
	Rock Mounds and Rock Sill										
	Rock Sill										
	Riprap	10 Years	0.05	193.00	9.65	CY	$46.24	$446	521	34	
	Rock Mound 1										
	Riprap	10 Years	0.05	1,308.00	65.4	ACRE	$46.24	$3,024	3,533	228	
	Rock Mound 2										
	Riprap	10 Years	0.05	618.00	30.9	ACRE	$46.24	$1,429	1,669	108	
	Rock Mound 3										
	Riprap	10 Years	0.05	590.00	29.5	ACRE	$46.24	$1,364	1,594	103	
	Rock Mound 4										
	Riprap	10 Years	0.05	2,796.00	139.8	ACRE	$46.24	$6,464	7,553	488	
	Island 1										
	Rock Groins	10 Years	0.05	451.00	22.55	CY	$50.96	$1,149	1,343	87	
	Riprap Ends	10 Years	0.05	195.00	9.75	CY	$46.24	$451	527	34	
	Island 2										
	Rock Groins	10 Years	0.05	287.00	14.35	CY	$50.96	$731	854	55	
	Riprap Ends	10 Years	0.05	496.00	24.8	CY	$46.24	$1,147	1,340	86	
	Rock Vanes	10 Years	0.05	367.00	18.35	ACRE	$56.10	$1,029	1,203	78	
	Island 3										
	Rock Groins	10 Years	0.05	902.00	45.1	CY	$50.96	$2,298	2,685	173	
	Riprap Ends	10 Years	0.05	576.00	28.8	CY	$46.24	$1,332	1,556	100	
	Mudflat Groins	10 Years	0.05	56.00	2.8	CY	$50.96	$143	167	11	
	Island 4										
	Rock Groins	10 Years	0.05	123.00	6.15	CY	$50.96	$313	366	24	
	Riprap Ends	10 Years	0.05	505.00	25.25	CY	$46.24	$1,168	1,364	88	
	Rock Vanes	10 Years	0.05	424.00	21.2	CY	$56.10	$1,189	1,390	90	
	Mudflat Groins	10 Years	0.05	112.00	5.6	CY	$50.96	$285	333	22	
	Total O&M								**$146,008**	**$9,425**	

Section 404(b)(1) Evaluation

Attachment 3

SECTION 404(b)(1) EVALUATION

SPRING LAKE ISLANDS HABITAT REHABILITATION AND ENHANCEMENT PROJECT
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 5, UPPER MISSISSIPPI RIVER, WISCONSIN

I. PROJECT DESCRIPTION

A. Location

Spring Lake is a 500-acre backwater lake located on the Wisconsin side of the Upper Mississippi River (UMR) in lower pool 5, about 1 mile south of Buffalo, Wisconsin. The Spring Lake project area is triangular in shape, bounded by Belvidere Slough to the west, the Wisconsin shore to the east, and the lock and dam 5 dike to the south **(Plate 2).**

B. General Description

This evaluation addresses the impacts resulting from the placement of fill or dredged material in waters of the United States, in compliance with Section 404 of the Clean Water Act. The following actions are being recommended for implementation as part of the Spring Lake Habitat Rehabilitation and Enhancement Project:

1. Construct rock features to protect existing terrestrial and aquatic habitat in upper Spring Lake. The only alternative to these options evaluated was the "no action" alternative, which was not selected because it does not meet the project goals and objects.

2. Construct four island features in Spring Lake to protect/enhance wetland and aquatic habitat. Many alternatives were analyzed during the planning phase of this project. The chosen alternative provided the most benefits at an acceptable cost.

3. Construct four mud flats/shallow-water habitats to increase habitat diversity and provide suitable locations for dredged material placement. The "no action" alternative was not selected because it does not meet the project goals and objectives.

4. Dredge within Spring Lake to provide material for island construction and to allow construction equipment access to the project features.

C. Authority and Purpose

The proposed project would be funded and constructed under authorization of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The overall purpose of this project is to rehabilitate, enhance, and maintain diverse riverine habitat for fish and wildlife.

D. General Description of Dredged or Fill Material

1. General Characteristics of Material

The material that would be dredged and used for construction of the islands is sand with a low content of silt, clay, and organic material. Fine material dredged from within Spring Lake would be used to top the islands. All island protection and sill(s) would be constructed with quarry-run rock.

2. Quantity of Material

Approximately 210,586 cubic yards of pervious fill material (sand) and 34,307 cubic yards of fine material would be needed to construct the project features. Approximately 13,000 cubic yards of quarry-run rock would be used for protection of the features. Approximately 32,662 cubic yards of random fill material would be dredged for access and used to construct the mud flat features. If more access dredging is required than what is shown in the design, mud flat 2 may be enlarged to hold an additional 10,000 cubic yards of random fill material.

3. Source of Material

The material would be obtained from two different sources. The island bases would be constructed with sand from areas within Spring Lake. The mud flats would be constructed with "random fill" material dredged for access from the interior of Spring Lake. The islands would be topped with fine material from the interior of NE Spring Lake **(Plate 9).** Riprap used for the project features would be obtained from local quarries.

E. Description of the Proposed Discharge Sites

1. Location

The disposal areas for dredged material are located within Spring Lake in pool 5, UMR mile 740.5 to 743. More precise feature (disposal) locations can be found on **Plate 8.**

2. Size

The overall project area is about 500 acres. The placement of fill material would likely affect about 52 acres of habitat. If additional access dredging is needed, mud flat 2 may be increased to cover about 9 acres. In that case, the placement of fill material would likely affect about 57 acres of habitat.

3. Type of Site

Spring Lake is primarily contiguous backwater habitat with a silt and sand bottom. In 2001, the study area included about 13 acres of terrestrial floodplain habitat, 6 acres of emergent aquatic vegetation, 34 acres of rooted floating aquatic vegetation, 117 acres of submerged aquatic vegetation, and 324 acres of open water habitat.

4. Types of Habitat

The habitat types directly affected by the project are contiguous backwater habitat, terrestrial island habitat, and wetland habitat.

F. Description of Disposal Method

Dredging and the placement of fill would be done with a combination of mechanical and hydraulic methods. Rock would be placed mechanically.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope

The islands would have side slopes that vary from 1 vertical on 4 horizontal to 1 vertical on 5 horizontal. Above-water top widths of islands would vary from about 105 to 125 feet, and top elevations would vary from 662 to 663 feet above mean sea level. Mud flats would have an average elevation of 659.6 feet above mean sea level. For more detail, see Plate 11.

2. Sediment Type

Substrate in Spring Lake is predominantly silts and clays over sand. There are, however, areas of relatively clean sand near the surface covered by little or no silt.

3. Dredged/Fill Material Movement

Secondary movement of fill material used to construct the project would be negligible because the constructed features are designed to be stable. Also, the amount of material unintentionally redeposited during mechanical or hydraulic dredging would be negligible because techniques would be used to minimize this impact.

4. Physical Effects on Benthos

Any organisms in the filled and dredged areas would be destroyed. However, the overall project impact to these organisms would be positive because of the improved habitat conditions.

5. Actions Taken to Minimize Impacts

A number of procedures would be used to minimize impacts where needed. Berms would be used to contain dredged material within the designated placement sites. Construction may be restricted to times of the year that do not interfere with organisms of special interest. Silt screens may be used to minimize secondary dredged material movement. It would be required that Wisconsin water quality limitations and monitoring requirements be followed during discharge.

B. Water Circulation, Fluctuation, and Salinity Determination

1. Water

The use of clean fill materials should preclude any significant impacts on water chemistry.

Some minor, short-term decreases in water clarity are expected from the proposed fill activities. The long-term effect from the proposed project features would likely be a minor improvement in water clarity in Spring Lake over present conditions.

The proposed fill activities would likely have no effect on water color, odor, or taste.

Over the long term, the project would likely decrease the winter dissolved oxygen levels in Spring Lake. The decrease in dissolved oxygen levels should be minor because some circulation of water would be maintained to prevent winter fish kills.

The proposed fill activities would likely have no effect on nutrient levels in the water or on the eutrophication rate of Spring Lake.

Over the long term, the proposed fill activities would likely cause a slight increase in winter water temperatures in Spring Lake over those found in the present condition. This would be a positive impact to habitat conditions for backwater fishes.

2. Current Patterns and Circulation

a. Current Velocity and Patterns

The proposed project features would increase the diversity of current velocities within Spring Lake by creating areas with higher and lower velocities than those present now. The current pattern within Spring Lake would also change slightly, but the overall current pattern would remain the same.

b. Stratification

The project would not significantly affect stratification in Spring Lake.

c. Hydrologic Regime

The proposed project would not significantly alter the existing hydrologic regime within the project area or pool 5.

3. Normal Water Level Fluctuations

The proposed fill activities would not likely have a significant effect on normal water level fluctuations in the project area.

4. **Salinity Gradient**

Not applicable.

5. **Actions Taken to Minimize Impacts**

No special actions would be taken to minimize the effects of the proposed project on current patterns or flow. The anticipated impacts to current patterns and flow would likely be beneficial.

C. **Suspended Particulate/Turbidity Determination**

1. **Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site**

Minor increases in suspended particulates and turbidity levels would occur from the placement of fill material and dredging in the immediate project vicinity. Upon completion of construction activities, suspended particulates and turbidity levels would return to pre-project conditions or may decrease slightly.

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

Project construction would result in localized turbidity plumes. Related short-term effects of this would be decreased light penetration and reduced aesthetic qualities near the construction site. Suspended particulates are not expected to cause a change in dissolved oxygen, toxic metals, organisms, or pathogens in the water column after project completion.

3. **Effects on Biota**

The proposed project would likely decrease the amount of sediment entering or being resuspended in Spring Lake. This material would cover substrate and change habitat conditions in the lake more rapidly than with the proposed project in place. Temporary increases in turbidity during construction would likely impair feeding activity of sight-feeding fish and may cause them to temporarily leave the area. These localized short-term increases in turbidity may have a negative impact on mussels in the immediate vicinity of these activities.

4. **Actions Taken to Minimize Impacts**

No special actions would be taken to minimize the impacts of the proposed project on suspended particulates or turbidity.

D. **Contaminant Determinations**

There is some sediment-quality data available for Spring Lake and the immediate vicinity (Table 404-1). Contaminants of concern were found to be comparable to those of other backwater sediments in pool 5. No PCB's or chlorinated hydrocarbons were detected in Spring Lake. Most metal concentrations were within acceptable levels in Spring Lake; however, the chromium concentration in one sample collected in 1991 was higher than that normally accepted. However, because of the relatively low values of other contaminants in the same sample, the value for chromium is suspect of being erroneous. Even so, there is no reason to believe that the proposed project activities would have a significant detrimental impact on contaminant levels in Spring Lake or pool 5.

E. Aquatic Ecosystem and Organism Determination

1. Effects on Plankton

During construction, increases in turbidity and suspended solids near the dredged and filled areas would have a localized suppressing effect on phytoplankton productivity. However, these local effects would be short-term and minor. The plankton populations would recover quickly once construction activities have ceased.

2. Effects on Benthos

The proposed project would affect approximately 69 acres of benthic habitat. The benthic organisms in the affected area would either be covered or dredged. Benthic organisms would quickly be replaced in the dredged areas and would quickly colonize the new rock substrate provided by the riprap. This rock substrate would increase the benthic habitat diversity in the area. The overall conditions for benthic organisms would likely be improved in the project area, mainly because of the increased protection from sediment resuspension.

3. Effects on Nekton

During construction, increases in turbidity and suspended solids near the dredged and filled areas would have a localized suppressing effect on nekton productivity. However, these effects would be local, short-term, and minor. The nekton populations would recover quickly once construction activities have ceased.

4. Effects on Aquatic Food Web

The burial and dredging of existing benthos and localized impacts on plankton productivity could cause a temporary minor impact on the local food web. However, benthos and plankton would recover quickly, and there would likely be no long-term negative effects on the aquatic food web. The anticipated increase in aquatic vegetation coverage and diversity would likely improve the aquatic food web.

Table 404-1.

Parameter	Units	R-Weaver Bottoms	Somerfield Island	Somerfield Island	Belvidere Slough	Somerfield Island	R-Lower Weaver Bottoms	L-Behind Is N&W Spring Lake	N Spring Lake Below Closure	N Spring Lake Below Closure	N Spring Lake Below Closure	N Spring Lake Below Closure	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light
River Mile		743.9	743.22	743.1	743.1	743	742.8	742.4	742.4	742.4	742.4	742.4	741.82	741.81	741.8	741.51	741.5
Collection Date	year	1984	1974	1994	1999	1980	1985	1985	1991	1991	1991	1991	1978	1978	1978	1979	1979
Record #		179	180	975	99-11M	181	709	710	1	2	3	4	182	183	184	185	186
Habitat type		3	1	1	3	1	3	3	3	3	3	3	1	1	1	1	1
Total Organic Carbon	%	NA	NA	0.027	0.7	NA	NA	NA	1.60	1.90	0.63	2.40	NA	NA	NA	NA	NA
Moisture Content	%	NA	NA	22.7	NA	NA	NA	NA	27.5	36.9	25.0	33.0	NA	NA	NA	NA	NA
Volatile Solids	%	NA	NA	0.76	2.5	NA	NA	NA	2.1	2.9	1.5	2.5	NA	NA	NA	NA	NA
Sand (>0.200 mm)	%	4	100	99.6	83.1	96	NA	NA	51	58	66	50	99	99	92	95	98
Silts & Clays	%	96	0	0.4	16.9	4	NA	NA	49	42	34	50	1	1	8	5	2
Arsenic	ppm	11	<0.6	0.83	1.6	NA	<7	<7	0.4	1.1	0.8	0.7	ND	NA	ND	ND	ND
Cadmium	ppm	2	<0.7	0.39	0.16	1.43	<0.3	0.6	0.05	0.1	0.05	0.2	<10	NA	<10	<10	<10
Chromium	ppm	24	33	4.6	9.8	28	19	29	9.3	11	57	9.5	<10	NA	<10	<10	<10
Copper	ppm	12	5	2.1	5.9	4.48	11	22	5.6	7.3	3.4	7.1	<10	NA	<10	<10	<10
Cyanide	ppm	NA	NA	<0.06	<11	NA	NA	NA	<0.5	<0.5	<0.5	<0.5	NA	NA	NA	NA	NA
Lead	ppm	20	<7	1.6	4.5	0.12	14	21	3.4	4.2	<2.5	4.3	<10	NA	<10	<10	<10
Manganese	ppm	NA	NA	170	430	NA	<1020	<825	140	180	56	120	170	NA	270	290	200
Mercury	ppm	NA	0.4	<0.05	0.028	<0.01	0.05	0.05	<0.02	<0.02	<0.02	<0.02	ND	NA	0.75	0	0
Nickel	ppm	20	26	3.9	6.6	22.6	18	20	4.7	6.9	1.9	3.3	20	NA	<10	<10	<10
Ammonia	ppm	NA	NA	NA	0.59	NA	NA	NA	0.4	1.1	0.8	2.0	NA	NA	NA	NA	NA
Zinc	ppm	48	13	10.1	22	75.4	61.5	83.2	24	28	14	22	4	NA	<10	10	10
a-BHC	ppb	NA	NA	<0.25	<0.048	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
b-BHC	ppb	NA	NA	<0.25	<0.048	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
g-BHC	ppb	NA	NA	<0.25	<0.041	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
d-BHC	ppb	NA	NA	<0.25	<0.042	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
Chlordane	ppb	<0.5	<10	<0.25	<6.1	<0.4	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDD	ppb	<0.5	<10	<0.5	<0.087	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDE	ppb	<0.5	<10	<0.5	<0.084	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDT	ppb	<0.5	<10	<0.5	<0.098	<0.4	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Dieldrin	ppb	<0.5	<10	<0.5	<0.084	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Endrin	ppb	<0.5	<10	<0.5	<0.094	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Heptachlor	ppb	NA	NA	0.25	<0.043	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
Aroclor – 1006	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1221	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1232	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1242	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1248	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1254	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor - 1260	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Total PCBs	ppb	14	ND	NA	ND	ND	ND	ND	NA	NA	NA	NA	ND	ND	6	ND	3

Habitat type: 1 = main channel, 3 = backwater; NA – Not available; ND – Not Detected

5. Effects on Special Aquatic Sites

The proposed project activities would temporarily have a negative impact on wetland-type habitat within the project area. However, in the long term, the proposed project would likely have a positive impact on this habitat by increasing its diversity.

6. Threatened and Endangered Species

Two federally protected species have historically been known to inhabit the general project area: the bald eagle (*Haliaetus leucocephalus*) and the Higgins' eye pearlymussel (*Lampsilis higginsii*). In 2000 and 2001, the Corps of Engineers conducted mussel surveys in and near the proposed project area (see attached mussel survey report). No Higgins' eye pearlymussels were collected during these efforts. Furthermore, *Lampsilis higginsii* has not been collected in pool 5 in recent years. Therefore, it is unlikely that the proposed project would affect this species. There are currently no active bald eagle nests in the general project vicinity, and use of the area by bald eagles for feeding and perching is not significant. Therefore, it is unlikely that the proposed project would affect this species. It is the St. Paul District's determination that there would be no project related impacts to the Higgins' eye pearly mussel or the bald eagle. Concurrence by the U.S. Fish and Wildlife Service would be obtained prior to project construction.

Four State-listed mussel species were collected in or near the project area during sampling in 2000 and 2001. One round pigtoe mussel (*Pleurobema coccineum*), listed as threatened in Minnesota, was collected within the project area. Six additional round pigtoe mussels were collected outside, but near the project area. Other State-listed species collected near but outside the project area were: one black sandshell mussel (*Ligumia recta*), listed as special concern in Minnesota; two hickorynut mussels (*Obovaria olivaria*), listed as special concern in Minnesota; and three monkeyface mussels (*Quadrula metanevra*), listed as threatened in Minnesota and Wisconsin. Because only one individual of a State-listed species was collected within the project area, it is unlikely that the proposed project would have a significant effect on any State-listed or non-listed mussel species.

7. Other Wildlife

The proposed project would likely have a positive long-term effect on other wildlife such as waterfowl, shorebirds, turtles, and other wildlife species that would utilize habitat in the project area.

8. Actions Taken to Minimize Impacts

No special actions are required.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination

Dredged material placement, and dredging to obtain borrow material and equipment access would cause a minor increase in turbidity levels in the immediate project vicinity. However, no long-term adverse impacts to water quality would likely occur from any of the proposed project features/activities.

2. Determination of Compliance with Applicable Water Quality Standards

It is not anticipated that the proposed project would violate Wisconsin's water quality standards for toxicity. Rock riprap would be obtained from approved pits and quarries in the project area, and the sand fill that would be used is likely clean. This area does not have a history of contamination, which should insure that State water quality standards would not be violated during placement of this material. Water quality certification would be obtained from Wisconsin prior to project construction.

3. Potential Effects on Human Use Characteristics

a. Municipal and Private Water Supply

No municipal or private wells would be affected by the proposed project.

b. Recreational and Commercial Fisheries

The proposed project is designed in part to improve habitat for fishes in Spring Lake. Therefore, the proposed project would likely have a positive impact on recreational fishing in the area. The proposed project would not likely have a significant effect on commercial fishing.

c. Water Related Recreation and Aesthetics

The proposed habitat improvements would likely have a positive impact on recreation in the project area. Construction equipment access dredging would also provide access for recreational boat traffic. The proposed island features and the resulting improvements to aquatic vegetation would be viewed as aesthetically pleasing to most. However, the proposed rock features may be viewed as aesthetically displeasing.

d. Cultural Resources

Interest in the archaeological record of the Upper Mississippi River valley, including the area around Spring Lake in pool 5, has been ongoing since the middle of the nineteenth century (e.g., Lapham 1855). By the later part of the twentieth century, several cultural resource investigations had been conducted within and around the proposed project area. Most of these investigations were on terraces and upland landforms. Nine precontact and 11 historic sites have been identified within 1 mile of the proposed project area (e.g., Penman 1981; Rusch and Penman 1982). As of 1990, there were no cultural resources determined eligible or listed on the National Register of Historic Places. Two cultural resource surveys have been conducted along the floodplain of pool 5 (Johnson and Hudak 1975; Pleger 1997). The pool 5 surveys mainly consisted of visual inspection of shorelines. No cultural resources have been identified within the limits of the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) area, and none of the previously identified sites will be affected by the proposed project.

A Phase I cultural resources survey was conducted in 1990 across land areas designated to be affected by the dike and closure structures according to plans proposed in the Definite Project Report/Environmental Assessment (SP-12) issued in August 1991 (Withrow 1990). The Phase I survey consisted of a literature review and subsurface testing. No cultural resources were identified.

Only a portion of the current Spring Lake HREP was examined in the 1990 cultural resource survey. Areas previously surveyed include the boat landing area at the far northern end of Spring Lake, the existing portion of the original peninsula upstream from sill 1, and the two existing islands proposed for protection by rock mounds 2 and 3 (Plate 9). The current Spring Lake HREP proposes to place island protection (rock mounds 1 and 4) along two island complexes that will require a cultural resource survey.

A Phase I cultural resource survey of the Spring Lake HREP land areas not previously investigated will be conducted during the 2002 field season. Any cultural resources sites identified in the project construction limits will be evaluated for eligibility to the National Register of Historic Places. Potential project impacts to eligible properties will be mitigated prior to construction, if said impacts cannot be avoided.

G. Determination of Cumulative Effects on the Aquatic Ecosystem

A number of factors will affect the future environment of the UMR and, in this case, Spring Lake. Some of those factors include the continued operation and maintenance of the navigation system, hydrologic and hydraulic processes in an altered environment, commercial traffic, public use, point and nonpoint source pollution, commercial and residential development, agricultural practices and watershed management, and exotic species. The factors most likely to affect the future of Spring Lake are those related to sedimentation in the project area. The proposed project would likely decrease the sedimentation rate in the project area only slightly. Because of the general decrease in backwater habitat on the UMR, this would be viewed as a positive effect. The project would increase the habitat diversity in pool 5, which would be a positive effect on the ecosystem of the UMR.

H. Determination of Secondary Effects on the Aquatic Ecosystem

No significant secondary effects on the aquatic ecosystem would be expected from the proposed action.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The proposed fill activity would comply with the Section 404(b)(1) guidelines of the Clean Water Act. The placement of fill is required to provide the desired benefits.

3. There are no practical and feasible alternatives to the placement of fill in the proposed sites that would meet the objectives and goals of this project.

4. The proposed fill activity would comply with State water quality standards. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

5. The proposed projects would not harm any endangered species or their critical habitat.

6. The proposed fill activities would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing. The proposed activities would not adversely affect plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur.

7. To minimize the potential for adverse impacts, dredged material not required to construct project features would be trucked to an approved upland placement site. Because the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

8. On the basis of this evaluation, I specify that the proposed disposal site complies with the requirements of the guidelines for discharge of fill material.

____
Date

ROBERT L. BALL
Colonel, Corps of Engineers
District Engineer

REFERENCES CITED

Johnson, E. and G.J. Hudak
1975 *Archaeological Survey of 1975 Season Dredge Spoil Deposit Sites in Mississippi River Pools USAF, 1, 2, 3, 4, and 5.* The Science Museum of Minnesota. St. Paul.

Lapham, I.A.
1855 *The Antiquities of Wisconsin, as Surveyed and Described.* Smithsonian Contributions to Knowledge 7. Washington, D.C.

Penman, J.T.
1981 *Archaeology of the Great River Road: Survey and Testing in Buffalo, Pepin, and Pierce Counties.* Wisconsin Department of Transportation, Archaeological Report No. 5. Madison.

Pleger, T.
1997 *A Phase I Archaeological Survey of the Floodplain of Pool Nos. 5, 5A, and 6 of the Upper Mississippi River Valley.* Reports of Investigations No. 248 of the Mississippi Valley Archaeology Center at the University of Wisconsin-La Crosse. La Crosse.

Rusch, L.A. and J.T. Penman
1982 *Historic Sites Along the Great River Road.* Wisconsin Department of Transportation, Archaeological Report No. 7. Madison.

Withrow, R.M.
1990 A Phase I Cultural Resources Investigation: Field Reconnaissance and Testing of Islands in Spring Lake, Pool 5, near Buffalo City, Buffalo County, Wisconsin. Reports of Investigations Number CENCS-PD-ER-42, St. Paul District, Corps of Engineers. St. Paul.

Habitat Evaluation Appendix

Attachment 4

HABITAT EVALUATION PROCEDURE AND INCREMENTAL ANALYSIS
SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) and the U.S. Fish and Wildlife Service (USFWS) have determined that the primary management objectives for the Spring Lake HREP are the improvement of habitat for backwater centrarchids and waterfowl. Secondarily, habitat improvements for riverine fish species, turtles, shorebirds, mussels, invertebrates, and terrestrial plant and animal species would be enhanced where possible, and as a result of the primary management objectives. A number of features were evaluated to meet these habitat goals (Table HEP-1).

Table HEP-1. Spring Lake HREP Proposed Feature List.

ID	Feature Type	Primary Purpose(s)
S1	Sill	Reduce winter flows behind peninsula.
RM1	Rock Mound	Prevent erosion of the peninsula.
RM2-4	Rock Mound	Prevent the erosion of the small islands.
IL1a	Island	Reduce wind fetch and provide protection from winter flows.
IL1b	Island	Reduce wind fetch and provide protection from winter flows.
IL2	Island	Reduce wind fetch to promote a diverse vegetation community.
IL3	Island	Reduce wind fetch and provide protection from winter flows.
IL4	Island	Reduce wind fetch to promote a diverse vegetation community.
IL5	Island	Reduce wind fetch to promote a diverse vegetation community.
FB1-2	Fine Borrow	Fine sediment dredged to top islands.
AC1-2	Access Dredging	Dredging to provide access during construction of features.

This is an evaluation of the potential habitat benefits that would result from the construction of the proposed project features. Because the primary management objectives are to improve backwater centrarchid and waterfowl habitat, the potential benefits of the proposed project features were evaluated using species models that would reflect habitat benefits to those species.

METHODS

The U.S. Fish and Wildlife Service's 1980 version of Habitat Evaluation Procedures (HEP) was used to quantify and evaluate the potential project effects and benefits. The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). Habitat Units (HUs) are calculated by multiplying the number of acres of available habitat by the HSI (1 acre of optimum habitat = 1 HU). The HUs are added over the life of the project and then divided by the project life (usually 50 years) to obtain the Average Annual Habitat Units (AAHUs). By comparing the AAHUs available in a project area without a proposed feature to those available with a proposed feature, the incremental benefits of different features can be quantified.

Multiplying the total cost by the current interest rate for a 50-year project life gives the average annual cost of the project (AAC). The AAC is divided by the AAHUs, which results in the AAC/HU for the project. The project cost is justified if the AAC/HU is within an acceptable range. During the planning and implementation of Environmental Management Program habitat projects within the St. Paul District, an AAC/HU of $2000 has generally been accepted as justifiable, although an $3000 has been accepted in some circumstances.

Two HSI models were used in this evaluation. A bluegill habitat suitability index model developed by the USFWS with a modification for winter conditions developed by Gary Palesh and Dennis Anderson of the U.S. Army Corps of Engineers (USACE) was used to evaluate centrarchid habitat in Spring Lake. A dabbling duck migration model for the upper Mississippi River developed by Randall Devendorf of the USACE was used to evaluate waterfowl habitat in Spring Lake. This model was developed to evaluate the quality of fall migration habitat, was distributed for peer review, and the final draft was completed on May 4, 2001.

The HSI models require a wide variety of data to quantify the habitat of a study area. Bathymetric, land use, vegetation, and water quality data used in this evaluation were in the possession of the USACE or obtained from several sources including the Upper Midwest Environmental Science Center in La Crosse, WI, and the WDNR. Most of this data was available in, or converted to a GIS format to facilitate the analysis.

The proposed project features were placed into groups that were subsequently analyzed for potential habitat benefits and costs. Features were grouped together based on function, and/or interdependence. Rock features were placed into two groups defined by their influence on small island or peninsula habitat. Mudflat features were assumed to be a part of their corresponding island features. Fine-borrow and access-dredging features were not analyzed separately because they would be needed for the construction of other features. Therefore, the costs of the fine-borrow and access-dredging features are included with the costs of other features, and do not require separate analyses.

Features IL1a and IL1b were two alternative designs for a single island feature (IL1) in upper Spring Lake. The habitat benefits and costs for these features were compared to facilitate a decision on the most cost-effective alternative.

To aid the analysis, a priority was assigned to each of the proposed features. First, it was determined that it would be most important to protect the existing terrestrial habitat from further erosion. Therefore, it was determined that RM1 and S1 would be the most important features to construct, with RM2-4 being next important. All other project features are dependent on the construction of these features. The four island features were more difficult to assign a priority. However, doing so was less important because the effects of those features are largely independent of each other with a few exceptions.

Nevertheless, a priority was assigned to these features in the following order of highest to lowest: IL1 because it is “adding” to the benefit of the existing peninsula and would potentially have the greatest benefit for the least cost; IL2 because it would be constructed at the outer boundary of Spring Lake and would benefit a large area; IL4 for the same reason as IL2, but would protect a smaller area than IL2; IL3 because it is being built on the interior of Spring Lake and would likely have a high cost-benefit ratio; IL5 because it would have the least benefit and would likely be constructed after IL2 and IL4.

Most features would be dependent on the prior construction of other features based on their priority and interdependence (see Table HEP-2). Multiplicative effects were accounted for by subtracting the effect of a preceding feature from the effect of the feature being analyzed. This way, the same effect on a particular area would not be attributed to two features and, thereby, counted twice. For example, IL3 would be constructed after IL2, both of which provide wind fetch protection to a small overlapping area. Because IL3 is dependent on construction of IL2, the wind fetch benefits to the overlapping area are only attributed to IL2.

Table HEP-2. Feature Grouping (in order of descending priority) and Assumed Relationship (Dependence) to Other Feature Groups.

Feature Group	Dependent Features
S1 and RM1	None – analyzed over existing conditions.
S1 and RM1-4	None – analyzed over existing conditions.
IL1	S1 and RM1-4.
IL2	S1 and RM1-4.
IL4	S1 and RM1-4.
IL3	S1, RM1-4, IL2.
IL5	S1, RM1-4, IL2, IL4.

HUs were calculated for the project area for target year 0 (TY0) (existing conditions), TY1 (first year after construction), TY 10, and TY 50 (assumed end of project life). The HUs gained by each feature were calculated for the entire project area, rather than dividing the project area into sub-areas for each feature. The incremental gain in HUs was calculated for each feature as the increase over the HUs that would be gained by the dependent (preceding) feature listed in Table HEP-2. Therefore, the HUs for a single species can be calculated for the proposed project area by adding the incremental gains in HUs of any combination of features providing the rules of dependence in Table HEP-2 are followed.

There were a number of broad assumptions made during this analysis: 1) the present forces acting on Spring Lake would remain constant throughout the life of the project; 2) the period of analysis for the project (project life) was 50 years; 3) the models used in the analysis adequately represent the habitat requirements of the respective species. More specific assumptions made for calculating the HUs for each feature include: 1) without the project, the small islands in upper Spring Lake would erode within 10 years, and the unprotected portion of the peninsula would erode within 50 years; 2) the shallow water at the east end of IL3 would freeze nearly to the bottom in winter, thereby effectively cutting off flows; 3) a cut would not form through the shallow water area east of IL3 except possibly during the most extreme flooding events; 4) in the absence of IL3 the area around it would not be protected well enough to establish a diverse vegetation community with only IL1 and IL2 in place because of shallow water, relatively long wind fetch, and unconsolidated substrates; 5) mudflats would likely succeed to emergent vegetation within 10 years of project construction; 6) in the absence of project features, the bathymetric diversity of Spring Lake would be greatly reduced because of bottom leveling by wind and wave action; 7) the operation of the 9-Foot Channel Navigation Project would not change; 8) the HSI models used in this evaluation are adequate for characterizing habitat in Spring Lake. The HSI calculations were completed for each proposed project feature based on these assumptions and others as indicated in attached Habitat Suitability Matrices (Enclosure 1).

The HSI for the existing (no-action) condition and that attributable to each feature was calculated for each target year (Table HEP-3). These values were used to calculate the AAHUs gained by each proposed project feature. The “Incr. Gain - AAHU” in Table HEP-3 for each feature is the incremental gain in AAHUs over the AAHUs attributable to the dependent features listed in Table HEP-2. A cost estimate was then obtained for each feature that was used to calculate the corresponding AAC/HU. Features proposed for construction are highlighted in Table HEP-3 for the HSI evaluation model that identified the most cost-effective habitat outputs.

RESULTS

The results of the HEP analysis can be found in the Habitat Suitability Matrices and in Table HEP-3. The bluegill and dabbling duck models analyses produced 158 and 102 AAHUs respectively, for the no-action alternative. All feature group analyses showed likely improvements in the AAHUs for the dabbling duck model, whereas all but three feature group analyses showed improvements in AAHUs for the bluegill model. The feature group that would likely produce the greatest incremental gain in combined benefits for bluegills and dabbling ducks was RM1-4 & S1 with a total gain of 69 AAHUs. Incidentally, this was the feature group that was determined to have highest priority. The feature with the next greatest overall gain was IL3 with 64 AAHUs. The feature that would likely provide the least overall gain was IL5 with a total of 2 AAHUs.

The results of the incremental analysis can also be found in Table HEP-3. All features but one were less than $2000/AAHU when evaluated with the bluegill model, the dabbling duck model, or both. Feature IL5 did not provide measured bluegill benefits and the AAC/HU calculated by the dabbling duck model was $17,027.

Two designs for IL1 were evaluated. The bluegill model analysis provided the most benefits for both alternatives and therefore was used in the following comparison. The analysis of design alternative IL1a produced 24 AAHUs with an AAC/HU of $2527. The analysis of design alternative IL1b produced 14 AAHUs with an AAC/HU of $1017. While design IL1a would provide 10 more AAHU than design IL1b, it has an additional

AAC of $46,007. This means that the additional HUs gained by design IL1a would cost $4600/AAHU.

Total project mobilization costs were allocated to each feature group based on the proportionate cost of that feature group. It could be argued that the mobilization cost would be incurred if only one feature group were constructed. Therefore, as a check, an incremental analysis was completed with all of the mobilization costs added to the cost of feature group RM1-4 & S1, the likely minimum project. This resulted in an AAC/HU of $1226 for that feature group.

DISCUSSION

For bluegills and migrating ducks, the project area currently lacks some important habitat qualities that would decline further by the end of the project life with the no-action alternative. Quality overwintering habitat is the primary bluegill deficiency in the project area. More specifically, the area lacks habitat protected from winter flow with relatively warm water. The poor conditions for these two habitat variables account for the majority of low suitability for bluegill habitat in the project area. For migrating ducks the project area is lacking a diversity of plant communities and total acreage of aquatic plants, and each of these variables would likely decline further by the end of the project life. Also lacking, are visual barriers that would provide security, and thermal protection (wind protection) that would prevent energy loss.

Any of the presented feature groups would have differing impacts on these key variables of bluegill and migrating duck habitat. Some feature groups do a better job of affecting some variables than others, while some affect all variables. While the resource (bluegills or ducks) that would benefit the most by the construction of a given feature group is presented as feature justification, some feature groups provide multiple benefits that are not captured by the methods used here. What follows is a description of all the more obvious benefits that would likely result from the construction of each feature group.

It is important to note that bluegill benefits derived from dredging borrow material were not included in the numerical HSI analyses. It was not included because the many uncertainties in quantities, borrow areas, and borrow area configurations made such estimates problematic. However, these benefits are real and should be considered while selecting features for construction, just as other factors such as combined bluegill and duck benefits should be considered.

RM1-4 & S1

The rock mounds would serve to protect the existing islands from further erosion, thereby stabilizing the northern end of the project area. This would also prevent the future loss of the aquatic plant beds currently being protected by these islands. The sill (S1) would decrease flows into upper Spring Lake. This would increase the winter habitat suitability for bluegills in this area by decreasing velocities and by reducing the inflow of cold water. However, there would still be some limitation of the habitat quality for overwintering bluegills in the upper end of Spring Lake because of the relatively shallow water. Dredging borrow material in this area for other features would rectify this deficiency.

IL1 and Mudflat: This island feature would be constructed as an extension of the existing peninsula. Its greatest habitat benefit would be the increase in area protected from winter flows for bluegills. While this island would not be positioned in a fashion to provide good wind fetch protection, it would likely elicit a small vegetation response and would provide some thermal protection for ducks. The mudflat would provide some shallow water for ducks and some loafing habitat. It would also become vegetated with emergents, thereby increasing the acreage of a vegetation community with little coverage now. Also, the required fill would be taken from within the project area, thereby creating additional deepwater habitat. Topsoil for the island would be taken from upper Spring Lake and would improved overwintering habitat there.

IL2 and Mudflat: The primary benefits gained by constructing this feature would be to migrating ducks. Because of its configuration relative to the flow direction, there would be little area protected from winter flows for bluegills. This island feature, however, is positioned to provide good protection from prevailing winds and would likely elicit a good vegetation response. It would also provide a visual barrier and thermal protection for migrating ducks. The associated mudflat would provide loafing and shallow-water habitat and would become vegetated with emergents. Fill required for construction of this feature group would benefit fish by providing deepwater habitat.

IL3 and Mudflat: This island feature would provide many benefits to bluegills and migrating ducks. There would likely be a significant area on the downstream side of the island protected from winter flows, thereby creating habitat with low velocities and warmer temperatures. The curved arm at the far eastern end of the island is positioned so that the shallow water between the island and shore would freeze nearly to the bottom, thereby cutting off cold winter flows. Also, much borrow material would be needed to construct this feature, some of which would be taken from upper Spring Lake. This would provide deep water required for quality overwintering habitat there. This island feature would protect a large area from wind and would likely elicit a good vegetation response over that area. It would also provide a visual barrier and thermal protection from many directions for migrating ducks. The mudflat would provide shallow-water habitat and would become vegetated with emergents.

IL4 and Mudflat: This feature group would provide much of the same types of benefits as the IL2 feature group would, only in a different location. There would be little benefit to overwintering bluegills, but significant benefits to migrating ducks. These benefits would be provided by the improvement in vegetation and the increase in areas with visual barriers and thermal protection.

IL5: Because this feature would protect little or no area from winter flow, it would provide few or no benefits to bluegills. This feature would provide some protection from prevailing winds and would likely elicit a good vegetation response.

However, it would provide some protection to an area that would likely already be protected by IL2. This feature would provide some limited thermal protection and a small visual barrier. It does not include a mudflat but borrow material used in island construction would be dredged from within Spring Lake and would provide additional deepwater habitat.

There are many additional benefits attributable to these features that were not captured by the habitat models or the previous discussion. The island features would provide habitat for many terrestrial animals. Turtles would likely nest on the islands and minor features such as sand deposits would likely be added to facilitate this. Island features would be placed to enhance existing flowing-channel habitat to improve localized conditions for riverine species of fish and mussels. Numerous species of aquatic insects would benefit by the increase in vegetation coverage and diversity. Overall, the proposed project would provide many habitat benefits to a wide array of organisms.

Table HEP-3. Spring Lake HREP HEP and Incremental Analysis.

Bluegill Model - 485 acres of available habitat						**Cumulative Habitat Units**				**Incr. Gain**	**Total Cost**	**AAC**	**AAC/HU**
Feature Group	**TY0 HSI**	**TY1 HSI**	**TY10 HSI**	**TY50 HSI**	**Exist HU**	**TY0-TY1**	**TY1-TY10**	**TY10-TY50**	**AAHU**	**AAHU**	**($1,000)**	**($)**	**($)**
No Action	0.35	0.35	0.35	0.28	170	170	1537	6174	158	0	0	0	0
The incremental gain in AAHU for the following features was calculated using the no action "base" with 158 AAHU.													
RM1 & S1	0.35	0.41	0.41	0.4	170	184	1790	7857	197	39	139	8,665	**222**
RM1-RM4 & S1	0.35	0.41	0.41	0.4	170	184	1790	7857	197	39	489	30,484	**782**
The incremental gain in AAHU for the following features was calculated using RM1-RM4 & S1 as a "base project" with 197 AAHU.													
IL1a	0.35	0.46	0.46	0.45	170	196	2008	8827	221	24	973	60,657	**2527**
IL1b	0.35	0.44	0.44	0.43	170	192	1921	8439	211	14	235	14,650	**1017**
IL2	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	756	47,129	ND
IL3	0.35	0.45	0.44	0.44	170	194	1942	8536	213	17	1186	73,935	4393
IL4	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	632	39,399	ND
IL5	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	543	33,851	ND

Dabbling Duck Model - 497 acres of available habitat						**Cumulative Habitat Units**				**Incr. Gain**	**Total Cost**	**AAC**	**AAC/HU**
Feature Group	**TY0 HSI**	**TY1 HSI**	**TY10 HSI**	**TY50 HSI**	**Exist HU**	**TY0-TY1**	**TY1-TY10**	**TY10-TY50**	**AAHU**	**AAHU**	**($1,000)**	**($)**	**($)**
No Action	0.27	0.27	0.22	0.17	134	134	1096	3877	102	0	0	0	0
The incremental gain in AAHU for the following features was calculated using the no action "base" with 102 AAHU.													
RM1 & S1	0.27	0.27	0.22	0.19	134	134	1096	4075	106	4	139	8,665	2179
RM1-RM4 & S1	0.27	0.27	0.27	0.26	134	134	1208	5268	132	30	489	30,484	1014
The incremental gain in AAHU for the following features was calculated using RM1-RM4 & S1 as a "base project" with 132 AAHU.													
IL1a	0.27	0.3	0.3	0.28	134	142	1342	5765	145	13	973	60,657	4749
IL1b	0.27	0.29	0.29	0.28	134	139	1297	5666	142	10	235	14,650	1489
IL2	0.27	0.3	0.32	0.32	134	142	1387	6362	158	26	756	47,129	**1841**
IL3	0.27	0.34	0.36	0.37	134	152	1566	7256	179	47	1186	73,935	**1564**
IL4	0.27	0.3	0.31	0.31	134	142	1364	6163	153	21	632	39,399	**1861**
IL5	0.27	0.27	0.27	0.27	134	134	1208	5368	134	2	543	33,851	**17027**

Notes:

ND = not defined

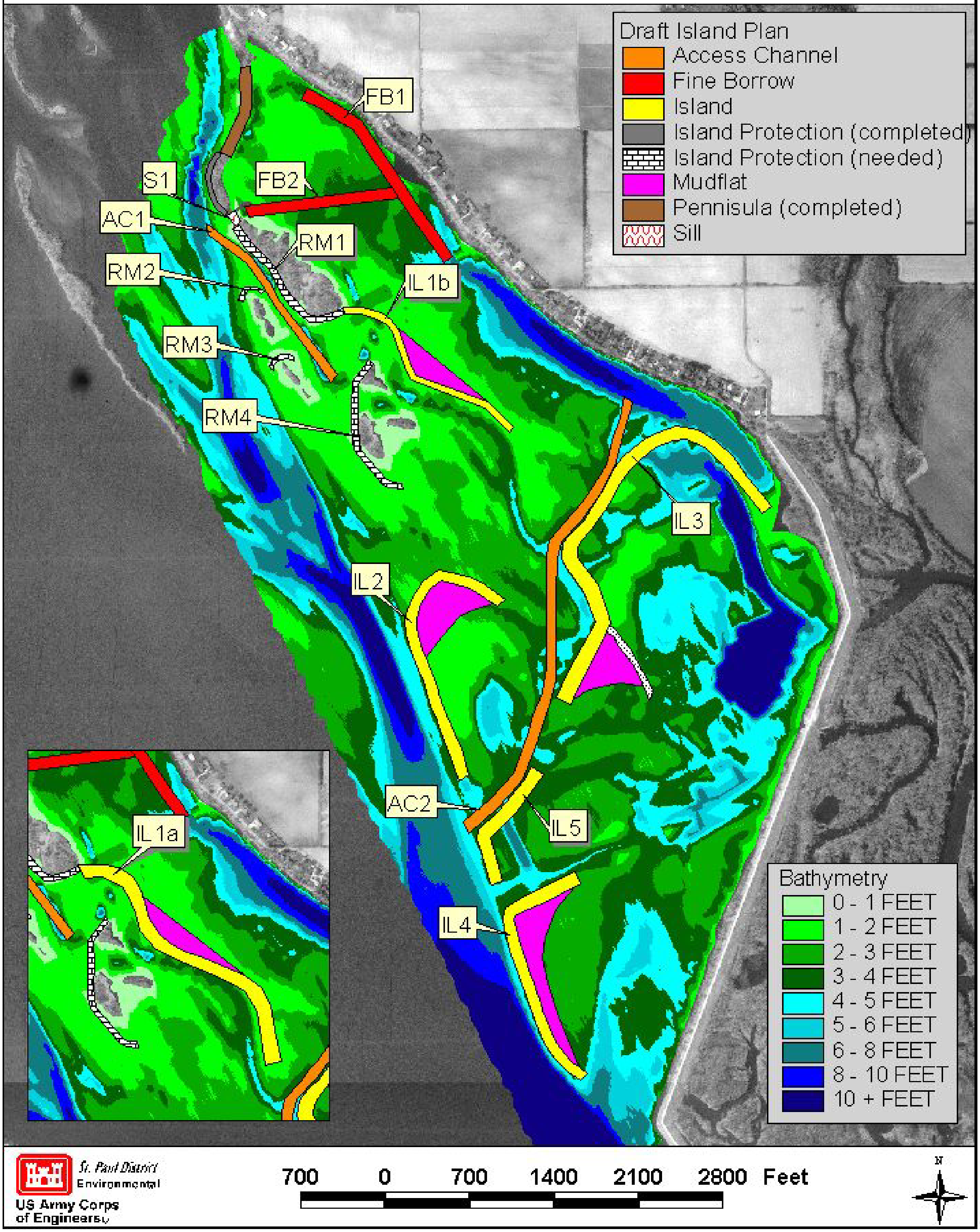
Highlighted features are those proposed for construction and the evaluation model that produced the lowest AAC/HU.

Even though the combined feature group of RM1-RM4 & S1 is justified based on the bluegill model, the incremental increase from RM1 & S1 (the addition of RM2 - RM 4) would be justified based on the dabbling duck model at a cost of $839/AAHU.

The AAC/HU for all features are independent of those features not listed as dependent in Table HEP-2.

Project mobilization costs were allocated to each feature based on the proportionate cost of each feature.

Figure 1. Spring Lake HREP Island Plan



Existing Conditions - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - 150 acres of cover.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	ave-0.4 C	0.15	1995 Winter Monitoring Data from WDNR-LTRM
Vd	Current Velocity	ave-2 cm/s	0.19	1995 Winter Monitoring Data from WDNR-LTRM
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	~31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	ave-0.4 C	0.15	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vd	Current Velocity	ave-2 cm/s	0.19	1995 Winter Monitoring Data from WDNR-LTRM - no change
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres; Available Bluegill Habitat - 488 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.7	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still greater than 15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.6	loss of some depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	<0.4 C	0.15	loss of small islands has minimal effect on cold water flows
Vd	Current Velocity	>2 cm/s	0.19	loss of small islands has minimal effect on flows
	Winter Cover (Cw-c)		0.6	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres; Available Bluegill Habitat - 490 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.65	loss of "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no appreciable change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no appreciable change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no appreciable change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no appreciable change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no appreciable change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no appreciable change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.55	loss of depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	<0.4 C	0.1	decrease in area protected from cold water flows with loss of peninsula
Vd	Current Velocity	>2 cm/s	0.15	decrease in area protected from flows with loss of peninsula
	Winter Cover (Cw-c)		0.55	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.70	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.1	Cw-ot = Vd
	Winter HSI		0.41	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.1	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.28	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Existing Conditions - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		64 acres or 13%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		15.5 acres or 3% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year One Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		>89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of small islands.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Five communities present, but 4 are relatively limited.
b) 4 - 6 vegetation communities present	6	ENTER	1995 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 4	Loss of one community with loss of small islands.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of small islands in upper SL would result in the
a) >75%	10		loss of one species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 4	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 110.4

TOTAL= 20
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.22

Target Year 50 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		>89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of peninsula.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Only submergent community and one other remains.
b) 4 - 6 vegetation communities present	6	ENTER	Likely limited amounts of floating-leaved rooted
c) 2-4 vegetation communities present	4	VALUE= 2	aquatics.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of large island in upper SL would result in further
a) >75%	10		loss of species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 2	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Loss of island but shallow water areas increase.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Loss of islands would result in a decrease in the
b) <5% of the area protected	3		thermal protection.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497 TOTAL= 15
Habitat Units = 82.83 MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.17

Target Year One Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.7	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still greater than 15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.6	loss of some depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.6	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.

Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.65	loss of "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no appreciable change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no appreciable change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no appreciable change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no appreciable change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no appreciable change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no appreciable change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.55	loss of depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.55	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		64 acres or 13%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		15.5 acres or 3% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of small islands.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Five communities present, but 4 are relatively limited.
b) 4 - 6 vegetation communities present	6	ENTER	1995 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 4	Loss of one community with loss of small islands.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of small islands in upper SL would result in the
a) >75%	10		loss of one species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 4	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		Loss of small islands but increase in shallow water.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 107.7

TOTAL= 20
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.22

Target Year 50 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No significant change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Three communities remain but two are limited.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 3	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Species composition remains constant but coverage
a) >75%	10		of important species decreases in unprotected areas.
b) 50 -75%	8		
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 3	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		No significant change.
b) 5% - 10%	2		
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 96.64

TOTAL= 18
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.19

Target Year One Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.71	small islands protect some pool (~9 acres)
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.61	small islands protect some pool
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.61	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	small islands protect some pool (~9 acres) - no change
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.56	small islands protect some pool - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.56	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 50 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - <u><</u>10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 127

TOTAL= 23
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.26

Target Year One Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.46	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.71	loss of some "pool" area to due leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.62	loss of some "pool" area to due leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.46	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.57	loss of some "pool" area due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.45	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 476 acres - Terrestrial (islands/mudflats) 21 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	Still <20%
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		slightly increased due to mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with Island and Mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 147.4

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		May decrease with mudflat succession to emergent veg.
c) >10% - <15%	7		Value is still 1.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Increased coverage of emergent and floating-leaved
c) 25 - 40%	7		vegetation.
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 50 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased due to mudflat.
c) >10% - <15%	7		Assumed no further change.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24.5 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 140.8

TOTAL= 26
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.28

Target Year One Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.71	loss of some "pool" area to due leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.62	loss of some "pool" area to due leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.52	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.57	loss of some "pool" area due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.43	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 476 acres - Terrestrial (islands/mudflats) 21 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	Still <20%
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		slightly increased due to mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with Island and Mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 144.7

TOTAL= 26
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.29

Target Year 10 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		May decrease with mudflat succession to emergent veg.
c) >10% - <15%	7		Value is still 1.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Increased coverage of emergent and floating-leaved
c) 25 - 40%	7		vegetation.
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 146.3

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.29

Target Year 50 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased due to mudflat.
c) >10% - <15%	7		Assumed no further change.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24.5 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 138.1

TOTAL= 25
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.28

Target Year One Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.72	island protects some "pool" area from wind and wave action (~ 9 acres)
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	island protects existing vegetation - no increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.62	island protects some "pool" area from wind and wave action (~ 9 acres)
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.67	island protects some "pool" area from wind and wave action (~ 9 acres)
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	island protects existing vegetation - no increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.57	island protects some "pool" area from wind and wave action (~ 9 acres)
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	Still <20%.
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~7 acres - ArcView analysis of bathymetry and mudflat.
b) >5% - ≤10%	5		Still <5%
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Slight increase with island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics (~8 acres).
d) 40 - 60%	10	ENTER	~ 87%
e) 60 -75%	7	VALUE= 4	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 157.4

TOTAL= 29
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.32

Target Year 50 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics.
d) 40 - 60%	10	ENTER	No further change.
e) 60 -75%	7	VALUE= 4	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 157.4

TOTAL= 29
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.32

Target Year One Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.45	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.73	Significant area protected by island
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	>31%	0.95	~10 acre increase in dense vegetation.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.63	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.82	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.63	Significant area protected by island
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.63	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.68	Loss of some "pool" habitat in unprotected areas.
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	>31%	0.95	~10 acre increase in dense vegetation.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.58	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.79	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.58	Loss of some "pool" habitat in unprotected areas.
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.58	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.52	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~6 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased by mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		~28 acres or 6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 168.4

TOTAL= 31
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.34

Target Year 10 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		
c) 25 - 40%	7		1/4 of the area protected from wave action will convert
d) 40 - 60%	10	ENTER	to emergent and/or rooted floating aquatics (~20 acres)
e) 60 -75%	7	VALUE= 4.5	~85%
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		28 acres or ~6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	No change.
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	No significant change.
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 179.5

TOTAL= 33
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.36

Target Year 50 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		
c) 25 - 40%	7		1/4 of the area protected from wave action will convert
d) 40 - 60%	10	ENTER	to emergent and/or rooted floating aquatics.
e) 60 -75%	7	VALUE= 4.5	No further change.
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Minor increase in important food plant coverage.
a) >75%	10		
b) 50 -75%	8		
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6.5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		~28 acres or 6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	No change.
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	No significant change.
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 182.2

TOTAL= 33
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.37

Target Year One Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.72	island protects some area from wind and wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	Island protects existing dense veg - no significant increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.62	island protects some area from wind and wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.67	loss of "pool" area due to leveling by wave action in unprotected areas
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	island protects existing veg - some loss in other areas
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.57	loss of "pool" area due to leveling by wave action in unprotected areas
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		Still <20%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~8 acres - ArcView analysis of bathymetry and mudflat.
b) >5% - <u><</u>10%	5		Still <5%
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)<u>></u>50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) <u><</u>5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) <u>></u>30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Slight increase with island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics (~3 acres).
d) 40 - 60%	10	ENTER	~88%
e) 60 -75%	7	VALUE= 3.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 154.6

TOTAL= 28
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.31

Target Year 50 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics.
d) 40 - 60%	10	ENTER	No further change.
e) 60 -75%	7	VALUE= 3.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 154.6

TOTAL= 28
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.31

Target Year One Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.71	small area protected from wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.61	small area protected from wave action that would not be protected by IL2 or IL4
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.61	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of much "pool" in unprotected areas
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.56	loss of depth due to leveling by wave action in unprotected areas
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.56	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Insignificant decrease with island.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants) (multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 136.4

TOTAL= 25
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 136.4

TOTAL= 25
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 50 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5.5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 133.6

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Spring Lake Mussel Survey Report **November 2001**

A Habitat Rehabilitation and Enhancement Project (HREP) is being planned for pool 5 Spring Lake near Buffalo City, Wisconsin. A major part of this project involves the construction of islands to protect this backwater from the effects of wind and wave action, and cold winter flows. These constructed islands would help restore some of the habitat qualities that were lost as the natural islands in the area eroded over time.

Constructing islands involves the placement of material in aquatic environments, covering substrates and the organisms inhabiting them. Also, the material to construct these features is usually dredged in the near vicinity, an activity that will also disturb the sediments and kill benthic organisms. Mussels are an important group of benthic organisms that have undergone a decline in both the numbers and species in the river since the construction of the locks and dams. For these reasons, it is important to assess the mussel population in and near the proposed construction area of Spring Lake to help prevent the further decline of this group of animals.

Mussel surveys were conducted in and near Spring Lake in 2000 and 2001. Twenty-two transects were conducted with a skimmer dredge (mussel sled) (Table 1). Mussels were identified, enumerated, and returned to the water. The path of the skimmer dredge was recorded by GPS and reproduced in ArcView (Figure 1).

Within the interior of Spring Lake, nine species of mussels were collected. Most were found in relatively small numbers. The most common species collected were threeridge (*Amblema plicata*), threehorn (*Obliquaria reflexa*), and pigtoe (*Fusconaia flava*). One round pigtoe (*Pleurobema coccineum*), a species listed as threatened in Minnesota, was collected at site 2001081610. No Wisconsin or federally listed species was collected within the interior of Spring Lake. It is likely that although construction of islands within Spring Lake would destroy some mussels, the impact to the population would be small, and therefore outweighed by the environmental benefits gained by the project.

During project planning, an area southwest of Spring Lake was identified as a possible source of sand for island construction. Four mussel transects were conducted in this area in 2001 (ID#: 2001080812, 2001080813, 2001080814, 2001081618). These transects produced 12 species and 465 individuals. Four state-listed species were collected: (1) black sandshell (*Ligumia recta*), (1) hickorynut (*Obovaria olivaria*), (1) monkeyface (*Quadrula metanevra*), (2) round pigtoe. Dredging in this area would destroy many mussels that may be part of a source population for pool 5. Therefore, borrow material will not be taken from this site.

Five transects were collected outside the proposed project area. Nine mussel species were collected, two of which are state-listed: (1) hickorynut, (2) monkeyface. Also, overall numbers of mussels collected in these transects were good. No project features are being proposed for this area.

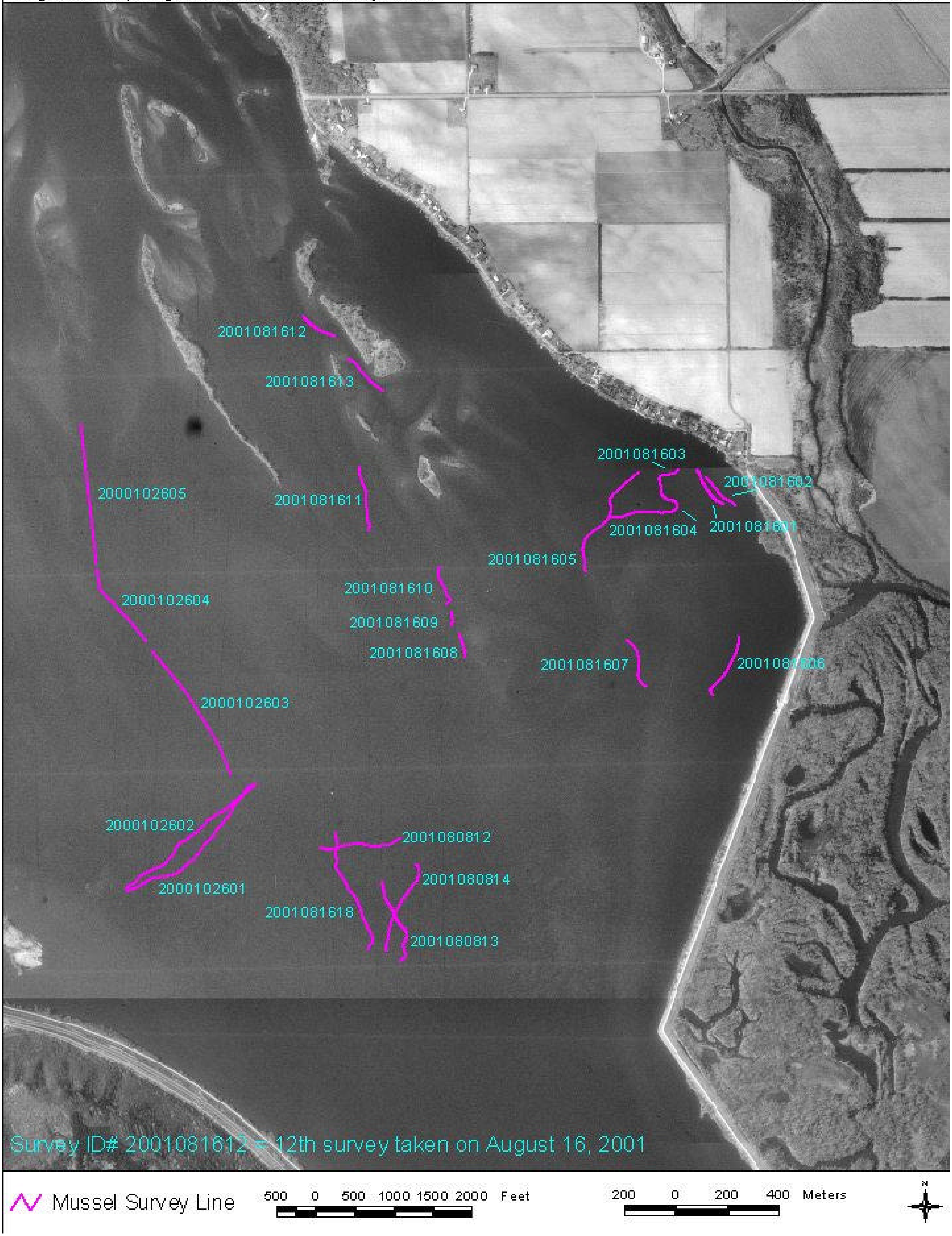
Table 1.

						Spring Lake Mussel Survey Data															
		STATUS				Transects Within Spring Lake															
SPECIES	COMMON	FED	WI	MN	IA	2001081601	2001081602	2001081603	2001081604	2001081605	2001081606	2001081607	2001081608	2001081609	2001081610	2001081611	2001081612	2001081613			
Ligumia recta	BLACK SANDSHELL			**SC**																	
Ellipsaria lineolata	BUTTERFLY		**E**	**T**	**T**																
Truncilla truncata	DEERTOE															2					
Lampsilis siliquoidea	FAT MUCKET																				
Truncilla donaciformis	FAWNFOOT																				
Anodonta suborbiculata	FLAT FLOATER																				
Leptodea fragilis	FRAGILE PAPERSHELL								1						1			1			
Anodonta grandis	GIANT FLOATER																				
Obovaria olivaria	HICKORYNUT			**SC**																	
Lampsilis higginsi	HIGGINS' EYE	**E**	**E**	**E**	**E**																
Taxolasma parvus	LILLIPUT																				
Quadrula quadrula	MAPLELEAF																				
Quadrula metanevra	MONKEYFACE		**T**	**T**																	
Actinonaias ligamentina	MUCKET			**T**																	
Anodonta imbecillis	PAPER FLOATER																				
Fusconaia flava	PIGTOE					4		1	1				4	8		17	3	3			
Quadrula pustulosa	PIMPLEBACK															1	1				
Potamilus alatus	PINK HEELSPLITTER																				
Potamilus ohiensis	PINK PAPERSHELL																				
Tritogonia verrucosa	PISTOLGRIP		**T**	**T**	**E**																
Lampsilis cardium	POCKETBOOK															1					
Arcidens confragosus	ROCKSHELL		**T**	**E**	**E**																
Pleurobema coccineum	ROUND PIGTOE			**T**											1						
Elliptio dilatata	SPIKE			**SC**																	
Strophitus undulatus	STRANGE FLOATER				**T**																
Obliquaria reflexa	THREEHORN					4	2	1					4		1	12	1	1			
Amblema plicata	THREERIDGE					31	3	3	7	1		4		4	1	30	2	4			
Quadrula nodulata	WARTYBACK		**T**	**E**																	
Megalonaias nervosa	WASHBOARD			**T**																	
Lasmigona complanata	WHITE HEELSPLITTER						1														
Lampsilis teres	YELLOW SANDSHELL		**E**	**E**	**E**																
Live Mussels Absent																					
Survey Method (S = mussel sled, D = diver)						S	S	S	S	S	S	S	S	S	S	S	S	S			
Minimum Depth (m)						0.4	0.4	0.4	0.3	0.4	2.3	0.3	0.4	0.4	0.4	0.5	0.3	0.3			
Maximum Depth (m)						1.0	1.9	2.2	2.0	1.9	8.8	0.7	1.8	1.9	0.8	1.5	3.0	1.0			

Table 2.

SPECIES	COMMON	STATUS				Spring Lake Mussel Survey Data								
		STATUS				Proposed Borrow Site				Outside Project Area				
		FED	WI	MN	IA	2001080812	2001080813	2001080814	2001081618	2000102601	2000102602	2000102603	2000102604	2000102605
Ligumia recta	BLACK SANDSHELL			**SC**					1					
Ellipsaria lineolata	BUTTERFLY		**E**	**T**	**T**									
Truncilla truncata	DEERTOE					2		3	33	2	2	1		2
Lampsilis siliquoidea	FAT MUCKET													
Truncilla donaciformis	FAWNFOOT													
Anodonta suborbiculata	FLAT FLOATER													
Leptodea fragilis	FRAGILE PAPERSHELL										1			1
Anodonta grandis	GIANT FLOATER													
Obovaria olivaria	HICKORYNUT			**SC**					1			1		
Lampsilis higginsi	HIGGINS' EYE	**E**	**E**	**E**	**E**									
Taxolasma parvus	LILLIPUT													
Quadrula quadrula	MAPLELEAF					1								
Quadrula metanevra	MONKEYFACE		**T**	**T**					1		1	1		
Actinonaias ligamentina	MUCKET			**T**										
Anodonta imbecillis	PAPER FLOATER													
Fusconaia flava	PIGTOE					32	11	2	13	3	13	5	1	1
Quadrula pustulosa	PIMPLEBACK					12		7	6		4	1		1
Potamilus alatus	PINK HEELSPLITTER													
Potamilus ohiensis	PINK PAPERSHELL								1					
Tritogonia verrucosa	PISTOLGRIP		**T**	**T**	**E**									
Lampsilis cardium	POCKETBOOK					4		3	2		1			
Arcidens confragosus	ROCKSHELL		**T**	**E**	**E**									
Pleurobema coccineum	ROUND PIGTOE			**T**		4			2					
Elliptio dilatata	SPIKE			**SC**										
Strophitus undulatus	STRANGE FLOATER				**T**									
Obliquaria reflexa	THREEHORN					28	3	14	24	2	16	3	2	
Amblema plicata	THREERIDGE					108	26	25	95	10	36	12		
Quadrula nodulata	WARTYBACK		**T**	**E**										
Megalonaias nervosa	WASHBOARD			**T**										
Lasmigona complanata	WHITE HEELSPLITTER					1								
Lampsilis teres	YELLOW SANDSHELL		**E**	**E**	**E**									
Live Mussels Absent														
Survey Method (S = mussel sled, D = diver)						S	S	S	S	S	S	S	S	S
Minimum Depth (m)						3.0	1.5	1.5	3.0	2.0	2.0	4.0	3.5	2.8
Maximum Depth (m)						3.5	4.0	4.0	4.0	3.5	4.7	5.0	4.5	3.8

Figure 1. Spring Lake Mussel Survey Data November 2001



Hydraulics Appendix

Attachment 5

Table of Contents

List of Figures

List of Tables

INTRODUCTION

This Appendix summarizes the hydrodynamic analyses completed for the Spring Lake Islands, Habitat Rehabilitation and Enhancement Project (HREP). This project is located about 1.25 miles below the center of Buffalo City, Wisconsin. A natural peninsula extends from the Wisconsin shore at the upper end of Spring Lake, and a series of barrier islands form the west side of the upper half of the lake. In the past, the peninsula had been breached by floods, allowing flow into the upper end of the lake. The Spring Lake Peninsula habitat project closed the breach and provided rockfill protection for the remaining peninsula and for 450 feet of existing barrier island. The west side of the lower half of the lake is open to Belvidere Slough and pool 5. The Wisconsin shoreline forms the east boundary of the lake and the lock and dam 5 dike forms the lower boundary. The ultimate goal of this project is to restore and maintain backwater fisheries habitat and enhance aquatic plant bed development in Spring Lake for fish and wildlife. This will be accomplished by reducing winter flows through the area and reducing wave induced erosion and resuspension of bottom sediments. A series of islands, rock closures and mudflats will be employed to achieve these goals. The design and layout specifications are discussed in further detail in the following sections.

SPRING LAKE

EXISTING PHYSICAL CONDITIONS

The Spring Lake project area is 460 acres in size and has a mean depth of 4.0 feet. In 1995, an island was constructed in upper Spring Lake, effectively repairing a breach in the natural peninsula. The western boundary of the project area is defined by the peninsula and series of island remnants in upper Spring Lake and Belvidere Slough in mid to lower Spring Lake. The Lock & Dam 5 dike defines the eastern and southern boundaries of the project area.

HYDROLOGY

DISCHARGE-DURATION, DISCHARGE FREQUENCY, AVERAGE DISCHARGE

Discharge-duration and stage-duration data for Spring Lake is shown in Table 5-2. This Discharge-duration data, from Lock & Dam 5, is equivalent to the discharge duration at Spring Lake. Stage data was added based on the Spring Lake stage-discharge curve developed for this project. The discharges corresponding to the 2, 5, 10, 50, 100 and 500 year floods are given in Table 5-1. The average discharge in the project area is approximately 40,000 cfs.

Table 5-1. Discharge – Frequency at Spring Lake.

Time of Return (Years)	Discharge (cfs)
2	82,000
5	125,000
10	150,000
50	210,000
100	240,000
500	310,000

Table 5-2. Lock and Dam 5 Discharge – Duration and Stage – Duration Data (1972-2001)

Time of Return	WSE (ft)	Flow (cfs)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year	Apr-Oct
		185000				0.46										
		180000				0.69										
		175000				0.80										0.11
		170000				0.92										0.13
		165000				1.26	0.33	0.46							0.17	0.29
		160000				1.61	0.44	0.69							0.23	0.39
		155000				1.95	0.44	0.69	0.22						0.27	0.47
10 yr		150000				2.18	0.56	0.69	0.33						0.31	0.53
		145000				2.53	0.67	0.80	0.44						0.37	0.63
		140000				2.99	0.89	0.80	0.67						0.44	0.76
		135000			0.11	3.33	0.89	0.80	0.78		0.34				0.52	0.87
		130000			0.22	4.02	1.00	0.80	0.89		0.46	0.22			0.63	1.05
5 yr	662.00	125000			0.67	5.40	1.45	0.92	1.78		0.57	0.33			0.93	1.48
	661.60	120000			1.00	6.32	2.11	0.92	1.89		0.57	0.44			1.11	1.74
	661.40	115000			1.11	7.13	2.89	1.03	2.11		0.69	0.44			1.28	2.03
	661.30	110000			1.56	8.28	3.89	1.03	2.11		0.69	0.56			1.51	2.35
	661.20	105000			1.78	10.92	5.01	1.03	2.11		0.80	0.67			1.86	2.92
	661.10	100000			2.34	15.29	6.79	1.72	2.11		0.80	0.67			2.47	3.88
	661.00	95000			2.89	19.43	8.57	2.76	2.78	0.11	0.80	1.11			3.20	5.04
	660.90	90000			4.23	24.37	11.68	3.68	3.23	0.22	0.92	1.89			4.18	6.53
2 yr	660.85	85000			5.67	29.31	15.57	4.37	3.89	0.33	0.92	2.22			5.20	8.04
	660.75	80000			7.90	33.91	19.47	4.94	4.34	0.44	0.92	2.89	0.11		6.25	9.51
	660.65	75000			9.90	40.11	26.59	6.55	5.01	0.56	1.15	3.56	0.23		7.82	11.88
1.5 yr	660.55	70000			11.79	45.63	32.37	9.66	7.34	1.67	1.38	4.00	0.46		9.55	14.52
	660.45	65000		0.24	14.02	52.87	40.49	12.07	10.46	3.78	1.72	5.12	1.15		11.86	18.01
	660.35	60000		0.61	17.13	59.66	45.72	16.55	14.02	5.12	2.53	6.56	3.79		14.35	21.38
	660.30	55000		0.73	20.13	65.63	50.61	23.33	20.47	6.34	5.29	9.90	5.98	0.11	17.43	25.86
	660.20	50000		0.85	24.92	71.49	54.62	32.18	27.70	8.34	8.05	13.46	8.62	1.23	21.02	30.74
AVG	660.10	45000		1.46	29.48	76.21	60.51	40.34	33.93	12.46	12.87	15.80	12.87	2.13	24.91	35.92
WSE	660.00	40000	0.11	1.95	35.04	80.00	66.74	51.38	43.27	17.58	18.97	20.58	18.16	4.48	29.95	42.54
	659.90	35000	0.56	3.66	43.83	82.76	72.75	64.25	50.61	26.47	27.47	27.14	31.49	10.87	36.93	50.10
	659.88	30000	4.78	5.24	54.28	87.82	78.09	74.14	61.51	36.48	36.78	36.82	46.67	20.96	45.44	58.70
	659.85	25000	17.58	13.90	65.07	93.45	83.76	79.20	69.97	49.50	47.82	48.05	61.26	39.01	55.88	67.31
	659.90	20000	36.04	33.54	77.09	98.16	90.99	84.25	76.75	65.52	61.84	63.29	76.44	57.29	68.57	77.20
	659.90	15000	67.74	70.24	90.55	99.54	95.11	91.95	84.54	80.53	78.16	76.08	91.15	74.66	83.38	86.51
	659.95	10000	93.10	91.10	98.11	100.00	100.00	97.59	93.66	91.21	95.06	94.77	95.86	89.13	94.97	96.02
		5000	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.77	99.22	99.91	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	100.00

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

Information on discharge measurements collected in Pool 5 are contained in reference 1 and summarized below. Sites where discharge measurements have been collected are shown on Figure 5.1. 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 40,000 cfs unless stated otherwise. The accuracy of individual discharge measurements is discussed in reference 1. Usually the measured total river flow was within 10 percent of the calculated Lock and Dam flow.

Table 5-3. Discharge Distribution at Spring Lake inlet sites 3, 4, 5, and 6.

Site	Discharge (cfs)	Percentage of Lock & Dam 5 Discharge
3&4	440	1.10
5	300	0.75
6	0	0.00

STAGE-DISCHARGE

The plan of operation of Lock & Dam 5 is discussed in detail in the Lock & Dam 5 operation manual and is briefly described here.

The primary control point for Pool No. 5 is at river mile 748.5 where project pool, Elevation 660.00, is maintained by the operation of Dam No. 5 until the discharge at the dam exceeds 28,000 cfs. At this flow the maximum allowable drawdown of the pool at the dam, 0.5 foot to Elevation 659.50 is reached, and the regulation of the pool is shifted to secondary control at the dam. As the discharge increases above 28,000 cfs, the pool level at the dam is held at Elevation 659.50, the stage at all other points in the pool is allowed to rise, and the operating head at the dam will decrease. When the discharge exceeds 116,000 cfs, the head at the dam will be reduced to just a swell head of less than a foot, and all the gates are then raised clear of the water. As the flow increases above 116,000 cfs, open river conditions are in effect, 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 659.50, secondary control elevation is maintained at the dam until the water level at the primary control point drops to project pool, Elevation 660.00 at a flow of 28,000 cfs. At the latter flow, control of the pool is returned to the primary control point, and as the discharge decreases, the water surface at the dam will rise, the drawdown will decrease, and the operating head at the dam will increase. The lock miter gates are never used for regulation of the discharge. When the pool level exceeds Elevation 662.5, the gate operating motors must be removed from the machinery pits, and the upper miter gates are kept in the closed position while the lock is out of operation.

Figure 5.2 shows the stage-discharge curves for Lock and Dam 5.

FLOW VELOCITIES

Spring Lake average adjusted velocities were collected at inlet site 5, and inlet site 3 and 4 combined. Inlet locations are shown on Figure 5.1. The average adjusted velocities for the two locations are given in Table 5-4.

Table 5-4. Average Adjusted Velocity at Spring Lake inlet sites 3, 4, and 5.

Date	Avg. Adjusted Velocity (fps)	Lock & Dam 5 Discharge (cfs)	% of Lock & Dam 5 Discharge
Site #5			
18-Apr-95	0.774	65,875	0.87
16-May-95	0.746	72,000	0.81
19-Oct-95	0.658	52,575	0.79
13-Sep-95	0.310	33,625	0.62
Site #3 & #4			
18-Apr-95	0.613	65,750	1.02
16-May-95	0.577	71,600	1.10
19-Oct-95	0.556	52,600	1.25

HYDRAULIC RESIDENCE TIME

The hydraulic residence time in Spring Lake for existing conditions is given in Table 5-5.

Table 5-5. Existing Hydraulic Residence Time - Spring Lake.

Miss. River Disch. (cfs)	Volume (ft^3)	Inflow (cfs)	Hydraulic Residence Time (days)
20,000	78,134,635	220	4.11
40,000	80,150,400	440	2.11
67,000	91,371,456	737	1.43
82,000	96,180,480	902	1.23
125,000	116,218,080	1375	0.98

WAVE ACTION

Wave characteristics of height, length, and period can be determined using "Slope Protection for Dams and Lakeshores" April 1988, Soil Conservation Service. The maximum orbital wave velocity (Um) at the bottom due to wave action can then 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)
H = wave height in transitional water depths (ft)
T = wave period in transitional water depths (s)
l = wave length (ft)
d = local water depth (ft)

Wave characteristics were determined for a constant northwesterly wind speed of 31 mph, a local water depth of 4 feet, and a wind fetch of 6,000 feet. The predominant wind directions in the Spring Lake area are northwesterly and southeasterly. A wind fetch of 6,000 feet is representative of both predominant wind directions. The highest wind stress factor is for a northwesterly wind (31 mph), so a northwesterly wind will produce the highest orbital velocity. The 31 mph wind speed doesn't represent a maximum wind speed, however based on wind data from meteorological stations at Rochester, MN, it exceeds 95 percent of the recorded wind speeds. Wave characteristics are shown in Table 5-6.

Table 5-6. Analytical Predictions of Existing Wave Characteristics – Spring Lake.

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Max. Orbital Velocity at Bottom (fps)
6,000	NW	4	1.0	0.85

PROJECT DESIGN

SPRING LAKE GOALS, OBJECTIVES, CRITERIA

Table 5-7. Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 1.

Goal 1: Improve aquatic habitat for Centrarchids.

Objective/Criteria	Design Feature
Optimize distribution of water flows entering Spring Lake.	Closure islands located to reduce inflow in protected areas.
Increase the extent of water >3 feet deep sheltered from river current in proximity to macrophyte beds, with adequate D.O. (>5 mg/l) for centrarchid habitat.	Islands to develop/maintain deep water, low-to-no flow areas in proximity to macrophyte beds. Notched sill will allow very small flow (10 cfs) into Spring Lake to meet D.O. objective.
Maintain or increase the areal extent, interspersion, density, and species composition of macrophyte beds.	Islands located to protect shallow habitat.
Increase island shoreline length.	Gradually sloping shoreline.
Maintain an interspersion of flowing channel habitat.	Islands located adjacent to existing channels.
Provide rock and gravel in flowing channels for lithophillic species.	Offshore rock mound adjacent to existing channels.
Decrease suspended solids concentrations.	Islands located to reduce wind fetch.

Goal 2: Improve wildlife habitat.

Objective/Criteria	Design Feature
Maintain or increase the areal extent, interspersion, density, and species composition of macrophyte beds.	Islands located to protect shallow habitat.
Increase the length of shoreline and area of islands.	Gradually sloping shoreline. Shallow mudflats to increase area.
Decrease suspended solids concentrations.	Islands located to create low flow areas and reduce wind fetch.
Increase areal coverage of sand/mud habitat.	Mudflats.

SPRING LAKE 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. 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.

2. Since one of the goals of the project is to enhance aquatic vegetation growth, islands should target shallower areas where this growth is more likely to occur.

3. Generally, islands should decrease in elevation in the downstream direction so that overtopping begins at the downstream end where hydraulic forces are less.

4. The combination of height and width should be such that the activities of burrowing animals does not result in continuous pathways for water conveyance through the islands. A minimum top width of 40 feet should be utilized.

5. Islands should be constructed in shallow water for shoreline stability. This will also stabilize the shallow water area sheltered by the island.

6. Island side slopes should be 1V:5H or flatter to minimize rill erosion from local runoff.

7. 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.

8. Rocky structures should incorporate woody structures for habitat benefit.

9. A culvert is located in the dike of the southeastern border of Spring Lake. The culvert conveys approximately 300 cfs from Spring Lake into the Whitman Wildlife area. The culvert will pull water through the deep hole in Southern Spring Lake. In order to establish an over-wintering habitat in this area, the flows through the culvert may have to be regulated in the winter. Once the project features are in place, this area will require monitoring to determine the appropriate culvert regulation.

SPRING LAKE DESIGN

The Spring Lake design is based on:

- Previous 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

Island layout was based on the following goals/objectives/criteria:

Overwintering Habitat:

- 3 discrete areas, 20 acres minimum,
- Current velocity <0.3 cm/sec over 80% of the area,
- D.O. > or = to 5 ppm,
- Water depths >4 feet over 40% of the area and >7 feet over 15% of the area,
- Connected to adjacent flowing river habitats.

Spawning, Rearing and Juvenile Habitat:

- D.O.> or = to 5 ppm,
- Current velocity < 0.5 cm/sec,
- Aquatic vegetation cover of ~80%.

Maintain or Increase Areal Extent, Interspersion, Density and Species Composition of Macrophyte Beds:

Provide ≥75 acres meeting the following criteria:

- Water depths <2 feet,
- Protected from dominant wind fetches,
- Current velocities generally <0.5 ft/sec.

Provide ≥ 125 acres meeting the following criteria:

- Water depths <4 feet,
- Protected from dominant wind fetches.

Maintain an Interspersion of Flowing Channel Habitat:

- Continuous flowing channels bordered by islands,
- Areas of scour, eddies and varying velocities,
- Variety of substrates (sand, silt, clay, gravel, cobble, wood, etc.),
- Connected to other channels,
- Variety of water depths.

Decrease Suspended Solids Concentrations:

- Construct islands to reduce wave resuspension of bottom sediments,
- Construct islands to create areas free from flow.

Four islands are incorporated in this design. Island layout is shown in figures 5.3.

Island 1 is designed mainly to train flows to the existing channel and to increase area of water >3 feet deep sheltered from river current. Island 1 will incorporate the existing island remnants and the recently constructed peninsula to isolate upper and mid Spring Lake from river currents.

Island 2 and Island 4 were designed to train flows to existing channel and reduce wave action. The upper portions of the islands are designed to reduce wind fetch in shallow areas, which will reduce wave action and allow establishment of aquatic vegetation. The lower portions of the islands are designed to train flows to existing channels to improve channel habitat.

Island 3 is designed to reduce wave action and increase area of water >3 feet deep sheltered from river current. In addition, the island is located along one of the access channels to improve channel habitat. Island 3 will isolate deep water in the southeastern portion of Spring Lake from river currents. The island does not connect with the shore, thereby allowing a small amount of flow into the deep hole area to meet D.O. objective.
The island also reduces wind fetch in shallow areas to allow establishment of aquatic vegetation.

Island layout was also based on the following additional design factors:

- Locate islands in shallow water to reduce cost and increase stability,
- Place perpendicular to flows and prevailing winds to shelter maximum area,
- Existing islands should be incorporated into new islands for aesthetics.

ISLAND CROSS SECTION

Island cross section data is shown on Figure 5.4. Dimensions for the island cross section are given in Table 5-8.

Table 5-8. Island Cross Section Dimensions - Spring Lake.

Island	a	b	c (feet)	d	e	Top Elev.	Berm Elev.	f
IL1 (above mudflat)*	10	0	0	0	10	662.5	662.5	20
IL1 (below mudflat)*	10	0	0	0	10	662	662	20
IL2 (above mudflat)	45	5	40	5	30	663	662	125
IL2 (@ mudflat)	45	5	40	5	20	663	662	115
IL2 (below mudflat)	45	0	40	0	30	662	662	115
IL3 (@ mudflat)	30	0	65	0	20	662	662	115
IL3 (no mudflat)	30	0	65	0	30	662	662	125
IL4 (@ mudflat)	45	0	40	0	20	662	662	105
IL4 (no mudflat)	45	0	40	0	30	662	662	115

a = least sheltered side berm width
b = side slope
c = top width
d = side slope
e = most sheltered side berm width
f = total width

* Island one cross section differs from islands 2,3, and 4.

ISLAND TOP ELEVATION

Island top elevations were based on the following hydraulic design factors:

- Island elevation should be near or above bankfull elevations,
- Island should be stepped down in elevation in the downstream direction,
- Rock structures should be placed at lower elevation than the sand islands,
- Vary island elevations for vegetation diversity.

ISLAND WIDTH

Island widths were based on the following goals/objectives/criteria:

- Increase length of shoreline and area of islands.

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 width should be maximized to reduce erosion potential during floods.

ISLAND SIDE SLOPES

Island side slopes were based on the following goals/objectives/criteria:

- Increase length of shoreline and area of islands.

Island side slopes were based on the following hydraulic design factors:

- Slopes should be 1V:5H or flatter to minimize rill erosion due to local runoff,
- Where riprap is being used, side slopes should be 1V:3H or steeper to reduce rock quantities.

MUDFLAT LAYOUT

A plan view showing proposed mudflat design is shown on Figure 5.3. Mudflat layout was based on the following goals/objectives/criteria:

- Create sand/mudflats in at least 3 locations which are 2-4 acres in size,
- Sand/mudflats located in proximity to islands,
- Enhance micro-topography within expanses of sand/mudflats.

MUDFLAT TOP ELEVATION

Mudflat top elevations were based on the following goals/objectives/criteria:

- Water depths of 0-0.25 feet during normal summer conditions.

Mudflat top elevations were based on the following hydraulic design factors:

- 4 – 5 inches below average water surface elevations during the fall migration period (Sep. – Nov.).

Mudflat top elevations were set at 659.6. The average fall water surface elevation in Spring Lake is 660. Therefore, the mudflats will be overtopped by 4.8 inches of water during the fall migration period. A tolerance of plus or minus 0.4 feet will be used for construction of mudflats so the micro-topography is created. The specifications for this project should clearly state that this is only a tolerance and that continuously over- or under-building for large reaches of mudflats is unacceptable.

MUDFLAT WIDTH AND AREA

Mudflat widths and areas are shown in Figure 5.3.

Table 5-9. Mudflat Widths and Areas - Spring Lake.

Mudflat	Width (widest point to point) (ft)	Area (Acres)
MF1	935	1.8
MF2	1,115	2.6
MF3	595	2.3
MF4	1082	3.2

SHORELINE STABILIZATION

A plan view showing the proposed shoreline stabilization is shown in Figure 5.5. Shoreline stabilization used at Spring Lake falls into 4 general categories: Rock revetments, rock groins (mudflat stabilization), off-shore rock mounds (existing island remnant stabilization) and rock/biotechnical combinations. Rock revetments will be utilized on all exposed island tips. Unless otherwise specified, revetments will consist of an 18 inch layer of rock on a 1V:3H slope. Rock groins will be utilized to stabilize mudflats where necessary. Off-shore rock mounds will be utilized to stabilize existing island remnants. Rock/biotechnical combinations will be utilized in all other areas where stabilization is necessary. For the rock/biotechnical areas, willows will be planted near the back of the berm for stabilization purposes. The rock/biotechnical areas will also incorporate woody structures in the rock. Approximately every third structure on an island will have a tree with root wad. Figure 5.6 shows the design for groins with trees and Figure 5.7 shows the design for vanes with trees. Table 5-10 provides stabilization dimensions.

Table 5-10. Rock Stabilization Dimensions – Spring Lake.

Rock Feature	Top Elev	Top Width	Side Slope	Length
Revetment	Top of Island	--	1:3	--
Groins (mudflat)	659.6	3	1:1.5	30
Groins/Biotechnical*	662	3	1:1.5	30
Vanes/Biotechnical*	662	3	1:1.5	30
Rock Mounds	662.5	varies	1:1.5	3

*Include a tree with root wad for every third groin and vane.

ROCK SILL

A rock sill was designed to allow flood flows into upper Spring Lake. A notch in the sill was designed to allow 10 cfs of water into upper Spring Lake during the winter season to meet the D.O. criteria of 5 ppm. The dimensions of the rock sill are given in Table 5-11.

Table 5-11. Rock Sill Dimensions – Spring Lake.

Rock Feature	Top Elev.	Top Width	Side Slope	Length
Notched Sill	661	10	1:3	105

TOP ELEVATION

The following goals/objectives/criteria were considered:

- A minimum of 3 discrete areas with a minimum size of 20 acres per site,
- Current velocity <0.3 cm/sec,
- D.O. > 5 ppm.

The following hydraulic design criteria were considered:

- Rock structures should be at a lower elevation than sand islands to act as an overflow spillway.

The primary goal of the project, fisheries, and the main criteria to achieve that goal, reduce winter flows, was considered. Since winter fisheries are the most critical part of the overall fisheries goals, the months October through February were focused on. Twenty years data were utilized to determine the water surface elevation at Spring Lake during the winter months. A sill top elevation of 661 was assumed. The data was then used to determine the number of times the sill would be overtopped in the winter months. Table 5-12 shows this data:

Table 5-12. Number of Overtopping Events During the Winter Months – Spring Lake.

Year	Data Set	Events > 661
00-01	115	0
99-00	155	0
98-99	155	0
97-98	155	0
96-97	144	0
95-96	142	0
94-95	93	0
93-94	1	0
92-93	93	0
91-92	155	8 (3 in Nov., 5 in Dec.)
90-91	93	0
89-90	155	0
88-89	155	0
87-88	155	0
86-87	155	15 (14 in Oct., 1 in Sept.)
85-86	155	5 (5 in Oct.)
84-85	155	0
83-84	155	0
82-83	14	0
81-82	45	0

Total	2445	28 = 1.15%

The 1.15% overtopping rate is acceptable from a winter fisheries standpoint. Therefore, the sill top elevation is set at 661.

SILL NOTCH

The following criteria/goals/objectives were considered:

- D.O. > 5ppm.

The following hydraulic design criteria were considered:

- Notch should allow 10 cfs of water into upper Spring Lake during the winter months (October – February).
- Water depth > 1 foot to avoid freezing.

Notch is 8.0 feet wide, 3 feet deep, with 1:1.33 side slopes.

ACCESS CHANNELS

Main purpose is to provide access for construction equipment barge and rock barge. Also will provide channel habitat.

Table 5-13 shows channel dimensions.

Table 5-13. Access Channel Dimensions – Spring Lake.

Channel	Length (ft)	Width (ft)	Area (ft^2)	Depth (ft)	Volume (ft^3)
AC1	1070	70	74,900	6	449,400
AC2	4180	70	292,600	6	1,755,600
Fine Borrow	2000	70	140,000	6	840,000

REFERENCES

1. Hendrickson, J.S. and F.R. Haase (1997). Upper Mississippi River Hydrodynamics: Discharge Distribution and Water Surface Elevations in Pool 5, 1975-96. Internal Report Compiled by the U.S. Army Corps of Engineers, St. Paul District.

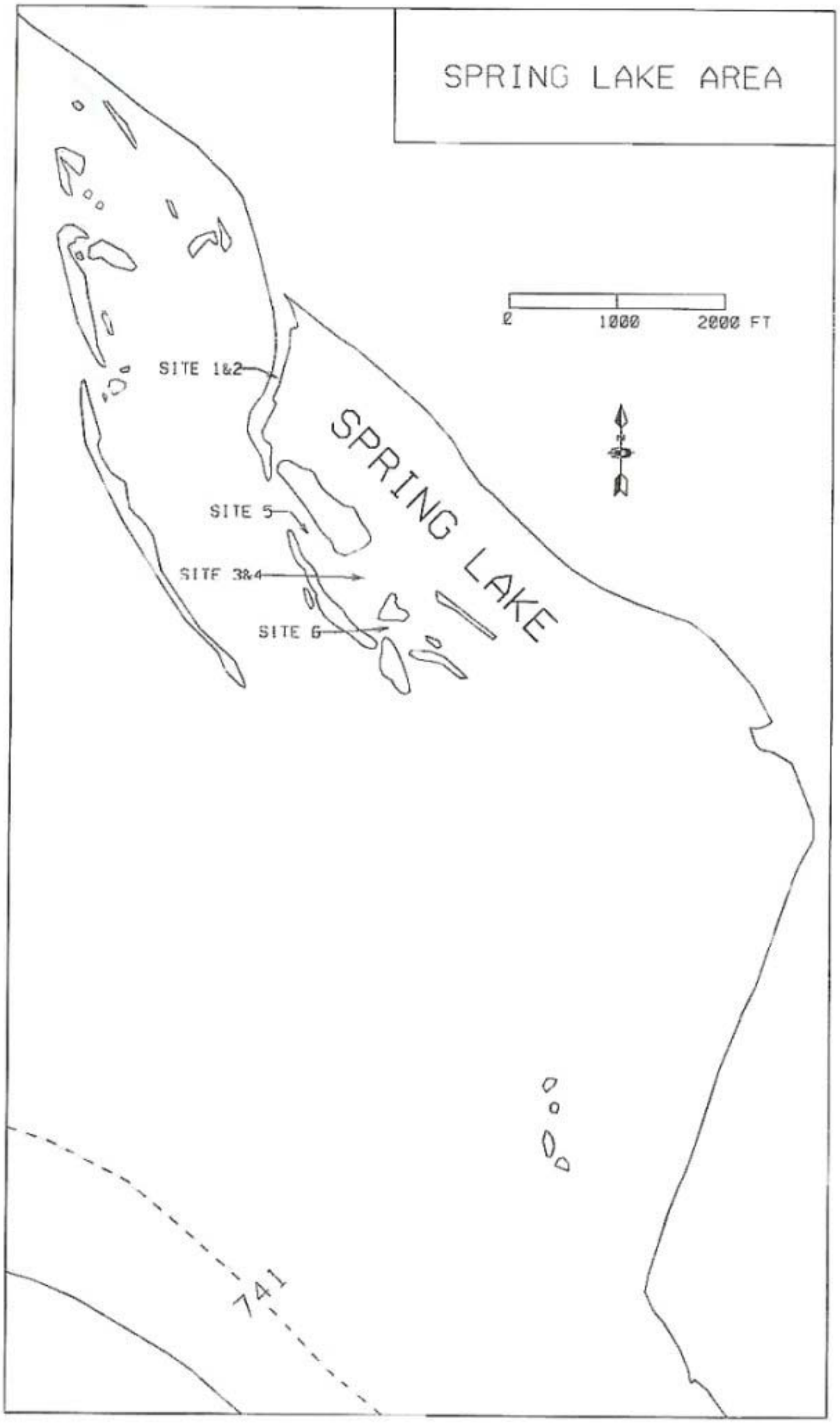
2. Hendrickson, J.S. (1996). Mississippi River Shoreline Stabilization Designs 1987 – 1996. Internal Report compiled by the U.S. Army Corps of Engineers, St. Paul District.

3. *http://www.mvp-wc.usace.army.mil/*

4. Soil Conservation Service (1988). Slope Protection for Dams and Lakeshores.

5. U.S. Army Corps of Engineers, St. Paul District. (1970). Reservoir Regulation Manual – Appendix 5, Lock and Dam No. 5.

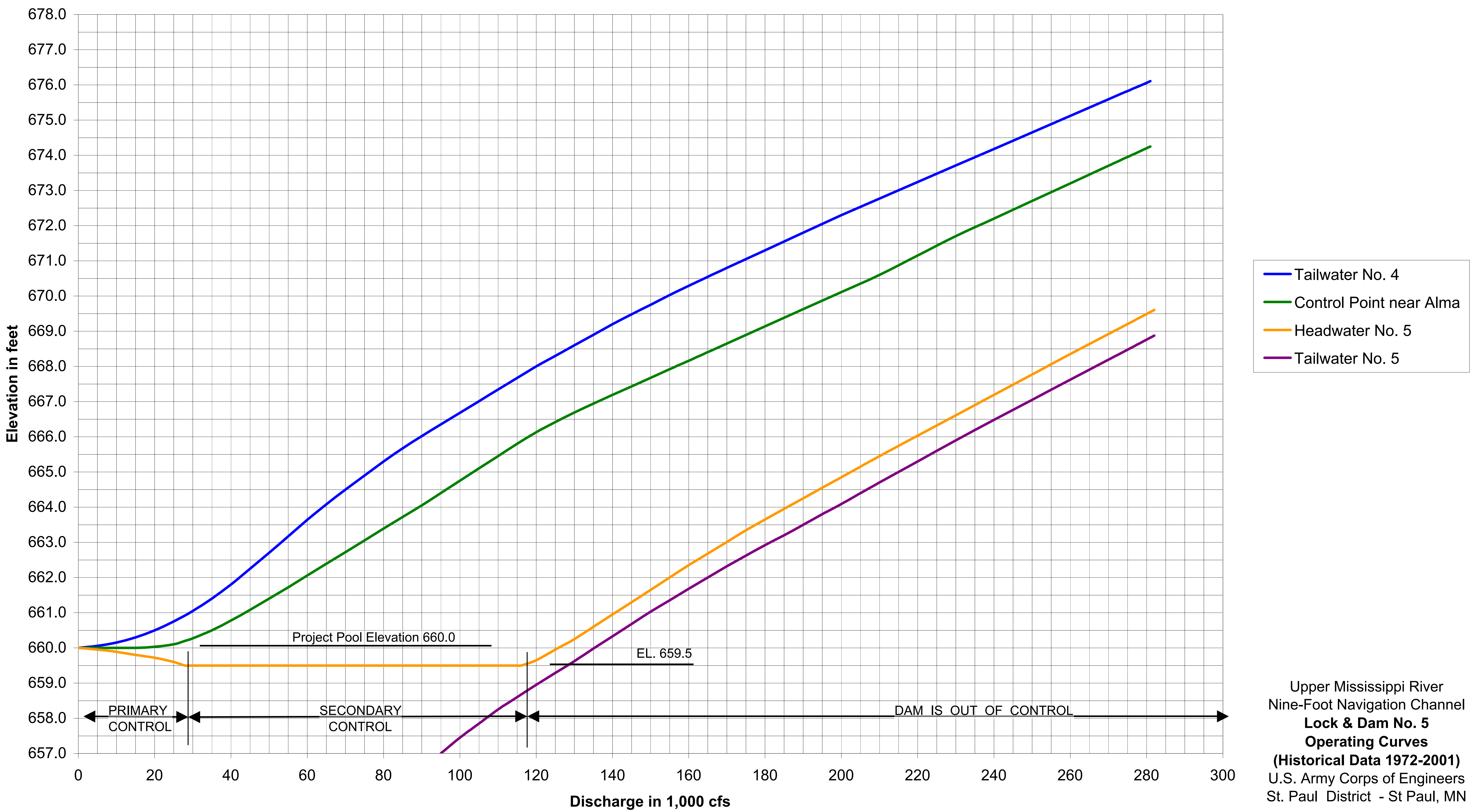
6. *Upper Mississippi River System Environmental Management Program. Definite Project Report/Environmental Assessment (SP-12). Spring Lake Peninsula. Habitat Rehabilitation and Enhancement Project. Pool5, Upper Mississippi River, Buffalo County, Wisconsin.*



SPRING LAKE AREA
0
1000
2000 FT
SITE 1&2
SITE 5
SITE 3&4
SITE 6
SPRING LAKE
741

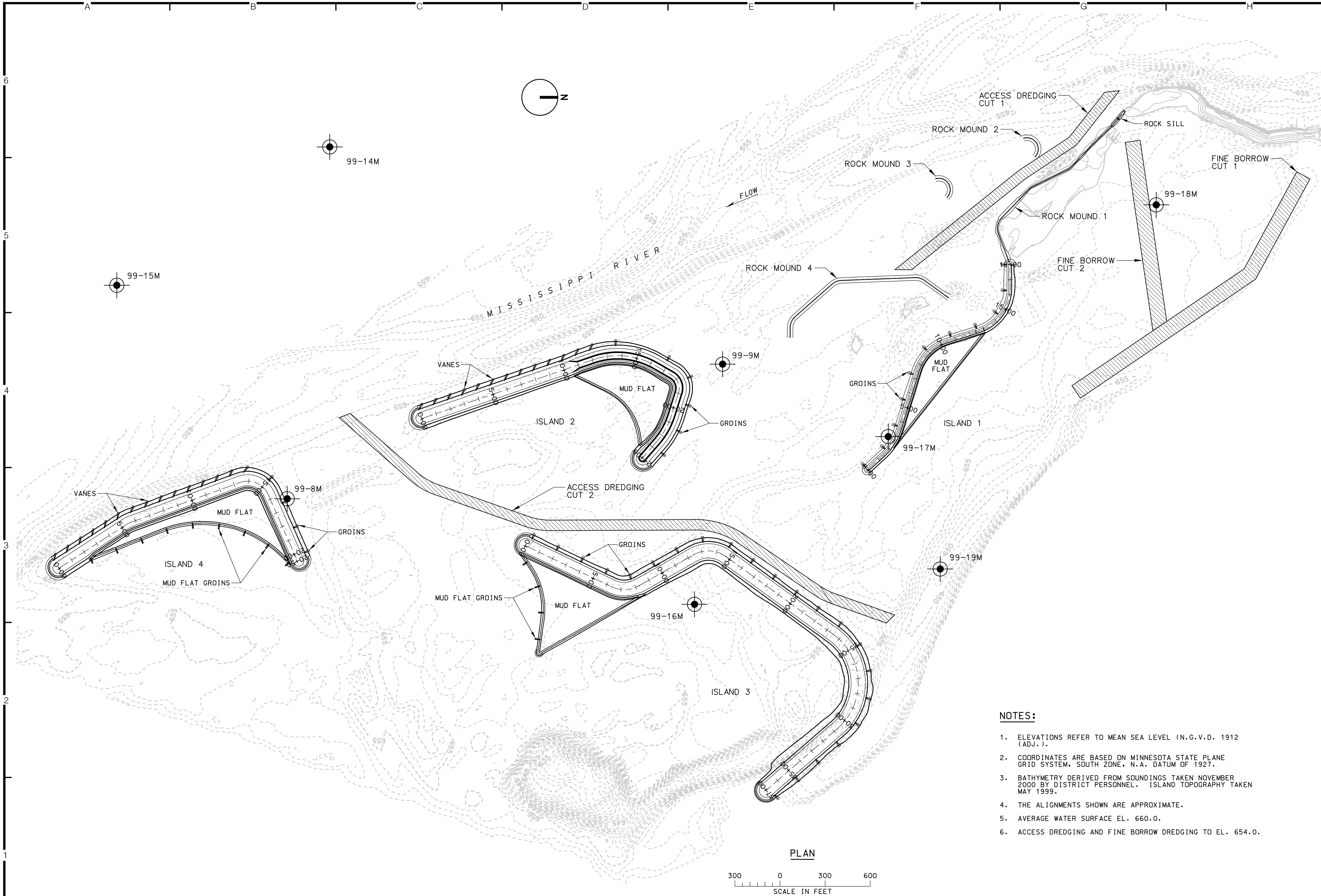
Figure 5.1

LOCK & DAM NO. 5 OPERATING CURVES



Upper Mississippi River
Nine-Foot Navigation Channel
Lock & Dam No. 5
Operating Curves
(Historical Data 1972-2001)
U.S. Army Corps of Engineers
St. Paul District - St Paul, MN

Figure 5.2



NOTES:

1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 (ADJ.).
2. COORDINATES ARE BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.
3. BATHYMETRY DERIVED FROM SOUNDINGS TAKEN NOVEMBER 2000 BY DISTRICT PERSONNEL. ISLAND TOPOGRAPHY TAKEN MAY 1999.
4. THE ALIGNMENTS SHOWN ARE APPROXIMATE.
5. AVERAGE WATER SURFACE EL. 660.0.
6. ACCESS DREDGING AND FINE BORROW DREDGING TO EL. 654.0.

PLAN

300 0 300 600
SCALE IN FEET

US Army Corps of Engineers
St. Paul District

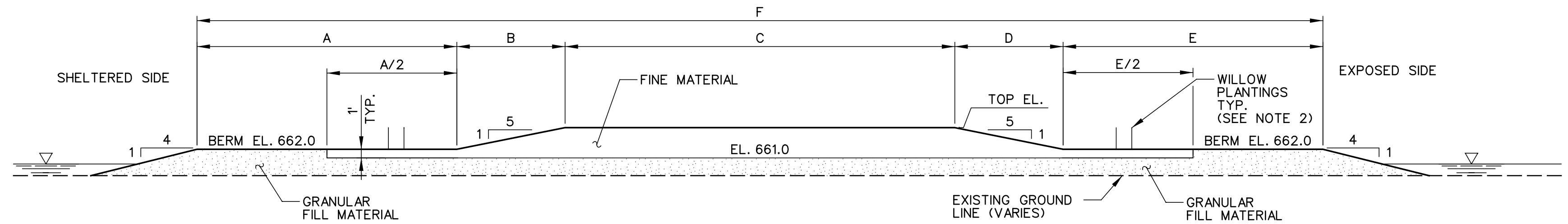
Symbol	Description	Date	Appr.

DESIGNED: LKT/JJF
CHECKED: TMG
DRAWN: LKT
DESIGNED: KLL
CHECKED: JSH
ED-D
ED-H
SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: M5RC10401.DGN
SOL. NO.:
AE APPROVING OFFICIAL:

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
SITE LAYOUT

DRAWING NUMBER:
PLATE 10
SHT OF



NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

SECTION

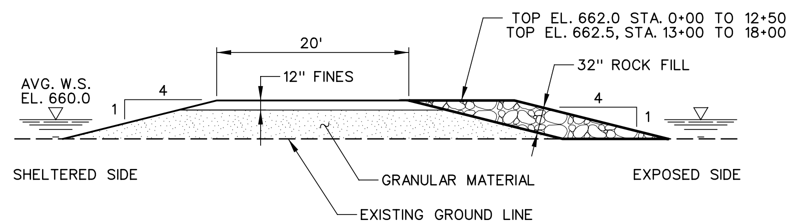
ISLANDS 2, 3 & 4

SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

ISLAND DIMENSIONS (FEET)

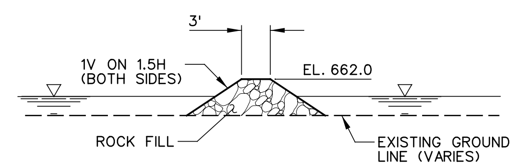
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND 2 STA. 0+00 TO 10+50	45	0	40	0	30	115	662.0
ISLAND 2 STA. 11+00 TO 23+00	45	5	40	5	20	115	663.0
ISLAND 2 STA. 23+50 TO 24+00	45	5	40	5	30	125	663.0
ISLAND 3 STA. 0+00 TO 7+75	30	0	65	0	30	125	662.0
ISLAND 3 STA. 8+25 TO 37+00	30	0	65	0	20	115	662.0
ISLAND 4 STA. 0+00 TO 2+00	45	0	40	0	30	115	662.0
ISLAND 4 STA. 2+50 TO 18+50	45	0	40	0	20	105	662.0



TYPICAL SECTION

ISLAND 1

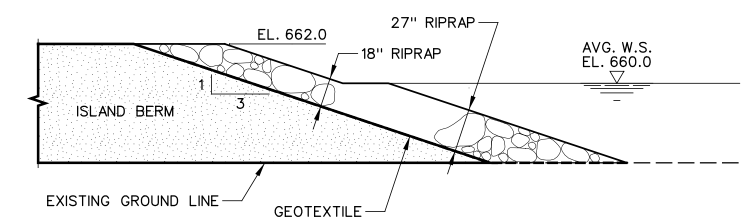
SCALE: 1" = 10'-0"



TYPICAL SECTION

ROCK MOUND ISLAND PROTECTION

SCALE: 1" = 10'-0"



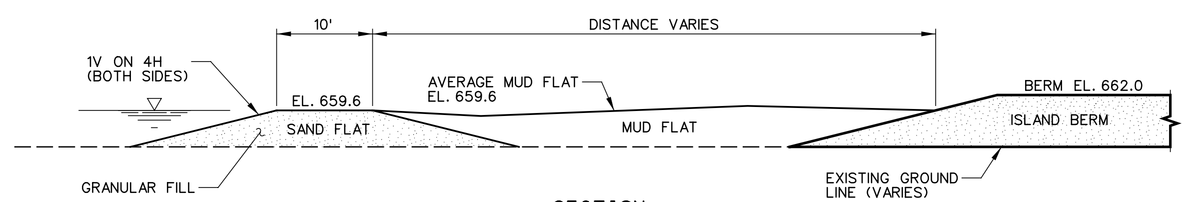
1. RIPRAP REQUIRED TO TOP OF ISLANDS 2, 3 & 4 AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL

ISLAND RIPRAP END PROTECTION

SCALE: 1" = 5'-0"

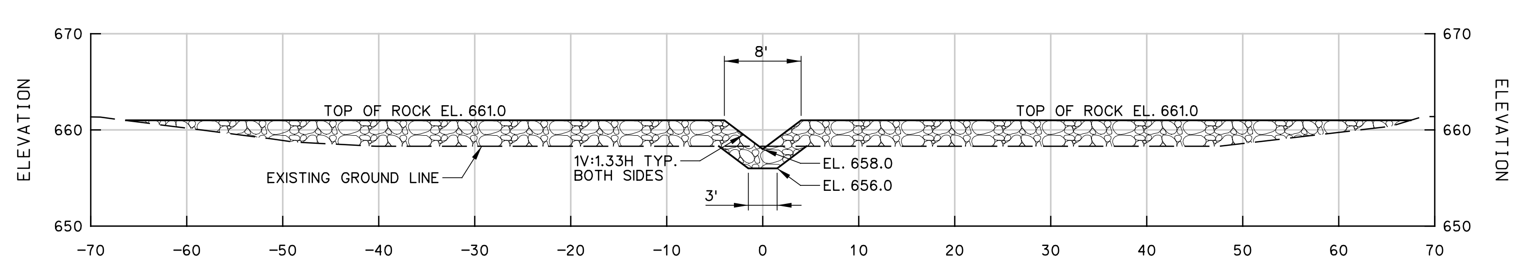
5 0 5 10
SCALE IN FEET



SECTION

TYPICAL MUD/SAND FLAT

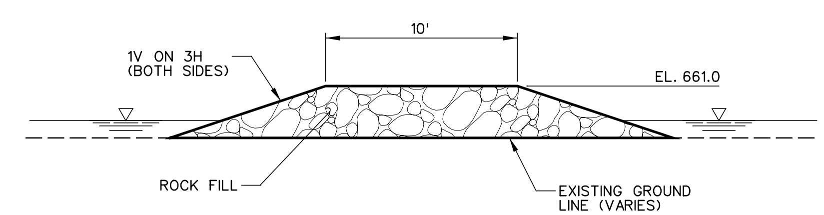
SCALE: 1" = 10'-0"



LONGITUDINAL SECTION

ROCK SILL

SCALE: 1" = 10'-0"



TYPICAL CROSS SECTION

ROCK SILL

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: ED-D | CHECKED: | DRAWN: | DESIGNED: | CHECKED: ED-H

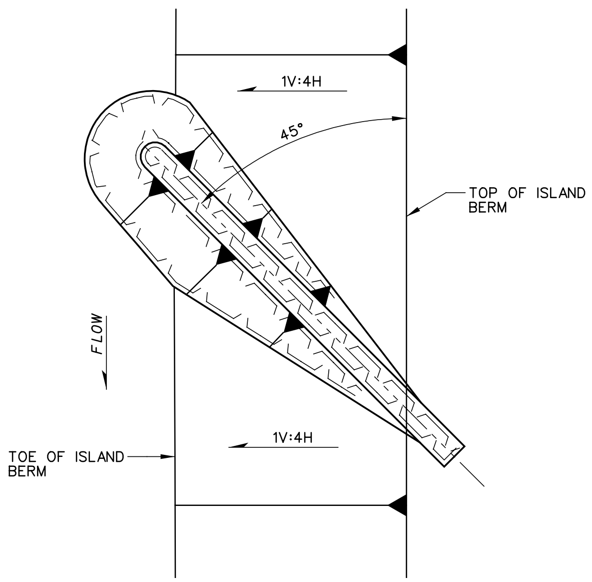
SCALE: AS SHOWN | DATE: APR 2002 | CADD FILE NAME: m0rc30402.DGN | SOL. NO.: | AE APPROVING OFFICIAL:

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
ISLAND
TYPICAL SECTIONS & DETAILS

DRAWING NUMBER:
PLATE 11

SHT OF



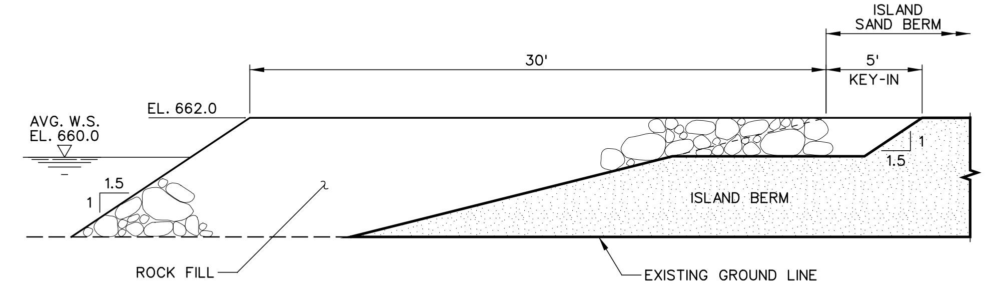
PLAN

TYPICAL ROCK VANE

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



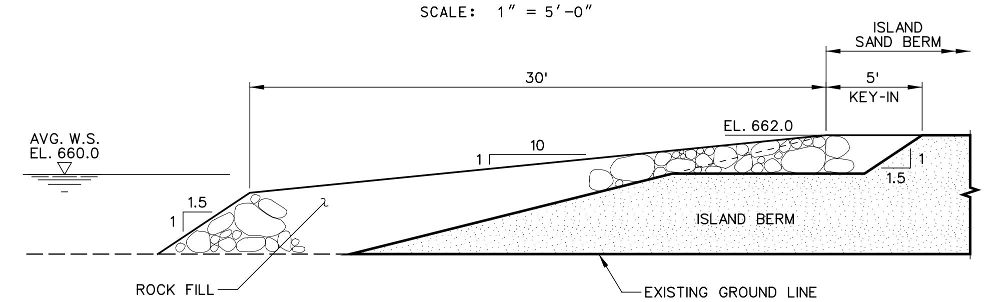
NOTES:

1. TOP OF MUD FLAT GROINS AT EL. 659.6.
2. ROCK GROINS SHALL BE PLACED PERPENDICULAR TO THE ISLAND.

LONGITUDINAL SECTION

ROCK GROIN

SCALE: 1" = 5'-0"



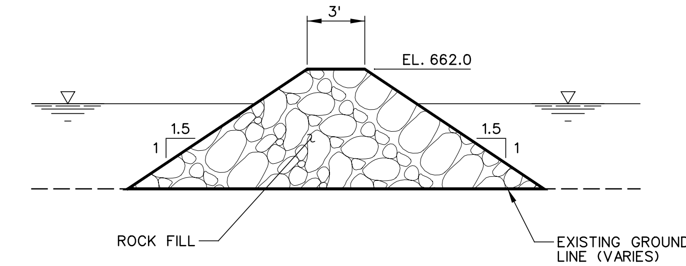
LONGITUDINAL SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

5 0 5 10

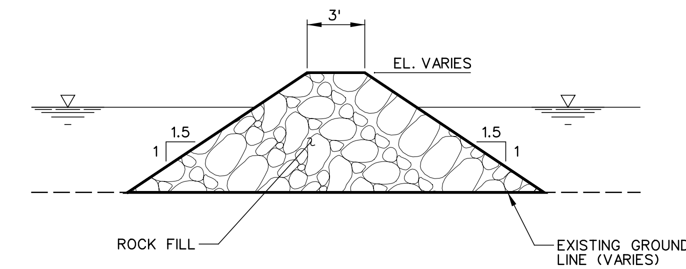
SCALE IN FEET



CROSS SECTION

TYPICAL ISLAND ROCK GROIN

SCALE: 1" = 5'-0"



CROSS SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: ED-D
CHECKED:
DRAWN:
DESIGNED: ED-H
CHECKED:

SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: MSRC3043.DGN
SOL. NO:
AE APPROVING OFFICIAL:

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

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
GROIN & VANE DETAILS

DRAWING NUMBER:
PLATE 12

SHT OF

Geotechnical Appendix

Attachment 6

TABLE OF CONTENTS

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
SPRING LAKE, UPPER MISSISSIPPI RIVER
BUFFALO COUNTY, WISCONSIN
ATTACHMENT NO. 6
GEOTECHNICAL DESIGN

1. GENERAL:

Geologic information for the Spring Lake HREP was obtained from the following sources: The Physical Geography of Wisconsin, by Lawrence Martin, Wisconsin Geological and Natural History Survey; USGS Hydrologic Atlas HA-548 (1975); The Geology and Underground Waters of Southern Minnesota (Thiel, 1944, pp 433-438, University of Minn. Press); Wisconsin Geologic and Natural History Bulletin No. XXXVI; and from Corps of Engineers soil borings.

2. PHYSIOGRAPHY

3. The Spring Lake Island, Habitat Rehabilitation, and Enhancement Project (HREP) is located in the Mississippi River between river miles 741 and 742. Along this portion of its course, the Mississippi River Valley is located in the Central Lowlands Physiographic Province of the United States. This province may be further subdivided into the Western Uplands Physiographic Region of Wisconsin. Approximately 3/4 of the Wisconsin Western Uplands, and most of the Southeast Minnesota Uplands, were not overridden by glacial ice during the Wisconsin Stage of the Pleistocene Epoch and is known as the Driftless Area. Topographic features of the Driftless Area today are thought to reflect conditions as they were over much of Wisconsin prior to glaciation.

4. The uplands region adjacent to the river has been dissected into a system of ridges and valleys with practically no broad upland areas remaining. Buffalo County in Wisconsin and Winona County in Minnesota are dominated by this ridge and valley topography. The steep sided valleys are known locally as coulees. Numerous tributary rivers and streams dissect the uplands on both sides of the river and continue to contribute sediment to the Mississippi River Basin.

5. The Mississippi River lies in a broad, bedrock gorge or trench. The gorge is a U-shaped feature with steep-sided limestone bluffs rising 400 to 500 feet above river level on either side. A well -developed, broad alluvial terrace parallels the river on the Wisconsin side, with a less prominent terrace paralleling the river on the Minnesota side. In the vicinity of Spring Lake, the gorge is between 3 to 6 miles wide. The river gradient averages about 2 inches per mile during normal flow conditions. The Spring Lake area was once a part of an extensive Mississippi River floodplain complex consisting of side channels, meanders, and sloughs that typify low gradient conditions.

6. GENERAL GEOLOGY:

Although the Mississippi River gorge probably existed as far back 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 the Pleistocene Epoch. During this period, the Mississippi gorge was filled with glacial outwash sand and gravel deposits. After deposition of the outwash sediments, Glacial River Warren carried large volumes of meltwater from the southward outflow of glacial Lake Agassiz and eroded the outwash deposits while simultaneously scouring and deepening the bedrock valley. As the flow of Glacial River Warren diminished, the deeply eroded gorge filled with up to 200 feet of Quaternary fluvial material. The large supply of sediment from the Mississippi headwaters and its tributary streams, coupled with a diminished supply of water 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 the Locks and Dams during the 1930's flooded the area and inundated the river valley and obscured the braided stream characteristics. Away from the navigation channel, lacustrine sediments now form a relatively thin, stratified, veneer of organic sediments, clays, silts, and sands over most of the present river bottom.

7. Over most of the upland areas there is a thin deposit of glacial drift and loam with scattered pebbles and boulders. Wind-blown silt, or loess, extends down the slopes of the main valleys nearly to the streams. Loess deposits on the uplands and on the valley slopes can reach a thickness of up to 15 feet, but are typically much less.

8. Natural springs emerge at numerous points along the base of the cliffs and along deeply incised stream valleys bordering the river. Most are thought to issue from upland formations, and their discharges are generally small.

9. Exposures of bedrock can be seen along the Mississippi River bluffs. Ordovician Period Dolomite of the Prairie du Chien Formation caps the bluffs and ridges. Below the Prairie du Chien Formation, the bluffs consist of the following Cambrian rock formations, in descending order: Jordan Sandstone, St. Lawrence Siltstone and Dolomite, and the Franconia Glauconitic Sandstone. Below the terraces along the river is the Dresbach Formation, which is composed of the Ironton and Galesville Sandstone, Eau Claire Sandstone, and the Mt. Simon Sandstone.

10. The Mississippi gorge is entrenched into the Dresbach Formation. This unit is a marine-deposited quartz sandstone. The sandstone is relatively easy to erode, and it accounts for the wide, U-shaped geometry of the bedrock gorge. A Precambrian red clastic group, the Hinkley Sandstone, lies below the Dresbach Formation. The Hinkley Sandstone rests on an undifferentiated Precambrian crystalline rock formation that is assumed to be thousands of feet thick.

11. Textural analyses of soil samples and drill cuttings from borings at Lock and Dam 5 and

from Spring Lake confirmed the absence of glacial drift in the ancestral gorge. The Quaternary material above the bedrock surface in the river valley is typical fluvial clays, silts, and sands with occasional fine gravel. Twelve borings taken in 1999 in Spring Lake confirmed that an abundance of poorly sorted loose sands with minor amounts of organic-rich sandy clays and silts underlie the project area. Several borings indicated that discontinuous soft clay layers exist between one and five feet below the lake bottom. Clay layer thickness varied from one boring location to another. The cohesive sediments discovered in these borings were similar in composition and are possibly a remnant of the floodplain that existed prior to the construction of the Mississippi River Lock and Dam system.

12. The structural geology of this portion of the Mississippi gorge has not been determined in detail. Regionally, the sedimentary rocks dip gently and thicken to the southwest, conforming to the Precambrian basement rocks. Solution weathering in the Dolomite is common. Stress relief joints that tend to parallel the trend of the Mississippi gorge can be observed in rocks along the river bluffs. The region is considered structurally stable and without tectonic disturbances of regional or local magnitude.
.

13. GENERAL GEOTECHNICAL DESIGN:

The Geotechnical Design philosophy used for Environmental Management Program (EMP) projects is different than that used for flood control projects. The acceptable level of risk is higher for EMP's because their design purpose is to create animal habitat, and their alignments can be easily adjusted. Whereas, flood control projects protect lives and property and alignments are often difficult to change. For these reasons, stability and settlement analyses were completed using an average of parameters obtained at other Upper Mississippi River valley construction sites. If the factor-of-safety is above 1.3, it is assumed to be stable. If failures do occur, the alignment of the islands can be easily changed during construction.

14. SELECTED PLAN SUMMARY:

An approximate layout of the selected plan is shown on Plate 6-1. Generally, the project side slopes are 4H to 5H:1V for islands and 1.5H:1V for rock groins and vanes. Erosion protection includes: rock groins along the sides of islands subjected to wave action, rock vanes along islands next to the slough that runs along the main-channel side of the project, and rock mounds. The table below lists the lengths of the various features of the selected plan with its geotechnical aspect(s).

Feature	Volume (CY)	Geotechnical Part
Islands	211,000 Sand 67,000 Random/Fines	Clean sand base with fine material on top
Rock for overflow sections/groins/mounds	13,000	Rock gradation Side slope

15. SUBSURFACE INVESTIGATIONS:

The St. Paul District obtained a total of 12 borings for the Spring Lake Islands project. The locations for the borings are shown on Plate 6-1 with the logs shown on Plates 6-2 and 6-3. The borings were taken near the proposed islands as they were aligned in 1999, and in areas where it was thought sand might be found. They don't have a generalized stratigraphy. The table below shows for each boring how thick the top layer of soft to very soft of fine-grained soil is:

Boring No.	99-9M	99-10M	99-11M	99-12M	99-16M
Soft Layer Thickness, ft. (m.)	1.0 (0.3)	0.8 (0.2)	1.0 (0.3)	6.8 (2.1)	1.5 (0.5)

Boring No.	99-17M	99-18M	99-19M
Soft Layer Thickness, ft. (m.)	2.0 (0.6)	4.6 (1.4)	10+ (3+)

The testing results on the samples taken from this subsurface investigation were as follows:

Testing Summary		
Type of Test	Number of Tests Completed	Results
Percent passing the no. 200 sieve	6	Range 6.5% to 30.6%

16. SLOPE STABILITY:

A slope stability analysis using EM 1110-2-1913 was only completed for Case I (end of construction conditions), because this is the only case that applies. Much of the islands length is only 6 feet high and much of the stratigraphy has a thin layer of fine material above sand. However, the islands are up to 8 feet high in some areas and in these areas the clay layer thickness cannot be determined from the borings. For these reasons, a stability analysis was completed for one island cross section which is typical for all the islands. The stability plate is on Plate 6-4, with the input data for UTEXAS 4 on Plate 6-5. UTEXAS 4 is a general-purpose computer program used for limit equilibrium slope stability computations. No shear strength testing was completed for the Spring Lake Islands project. Instead, an average of the shear strength found at other Upper Mississippi River projects was used. As the table below shows, the average End-of-Construction (EOC) strengths minus one standard deviation for other EMP projects is 240 psf, which was rounded down to 200 psf. The section was stable assuming a shear-strength of 200 psf with a computed factor-of-safety equal to 1.36. In the locations where the shear strengths are below 170 psf the factor-of-safety of the critical section will be below the 1.3 required. In these locations, the island side-slopes may fail during construction. This will necessitate adjustments to the alignment of the island, which may mean greater quantities of fill.

EOC Strengths for EMP Projects

Project Name	Type Project	Number of	Sample	Type of Test	p (tsf)	q (tsf)
AMBROUGH SLOUGH						
	EMP	1998 - 1 MU	1	Q	0.91	0.41
				average q - stdev		
CAPOLI SLOUGH						
	EMP	1999 - 1 MU	2	Q	0.73	0.23
	EMP	1999 - 1 MU	2	Q	1.25	0.25
	EMP	1999 - 1 MU	2	Q	2.25	0.25
	EMP	1999 - 3 MU	1	Q	0.83	0.33
	EMP	1999 - 3 MU	1	Q	1.39	0.39
	EMP	1999 - 3 MU	1	Q	2.44	0.44
				average q - stdev		**0.23**
CONWAY LAKE						
	EMP	2001 - 3 MU	1	Q	0.56	0.31
	EMP	2001 - 3 MU	1	Q	0.87	0.37
	EMP	2001 - 3 MU	1	Q	1.35	0.35
	EMP	2001 - 6 MU	1	UNCONFINED	0.14	0.14
				average q - stdev		**0.19**
POOL 8						
	EMP	1987 - 3 MU	1	Q	0.67	0.17
	EMP	1987 - 3 MU	1	Q	1.17	0.17
	EMP	1987 - 3 MU	1	Q	2.21	0.21
	EMP	1987 - 4 MU	2	Q	0.64	0.14
	EMP	1987 - 4 MU	2	Q	1.34	0.34
	EMP	1987 - 4 MU	2	Q	2.29	0.29
	EMP	1987 - 4 MU	4	Q	0.82	0.32
	EMP	1987 - 4 MU	4	Q	1.34	0.34
	EMP	1987 - 4 MU	4	Q	2.42	0.42
	EMP	1987 - 5 MU	1	Q	0.55	0.05
	EMP	1987 - 5 MU	1	Q	1.06	0.06
	EMP	1987 - 5 MU	1	Q	2.05	0.05

Project Name Type Project Number of Sample Type of Test p (tsf) q (tsf)

POOL 8						
	EMP	1995 - 40 MU	1	UNCONFINED	0.37	0.37
	EMP	2000 - 52 MU	1	Q	0.51	0.26
	EMP	2000 - 52 MU	1	Q	0.72	0.22
	EMP	2000 - 52 MU	1	Q	1.29	0.29
	EMP	2000 - 62 MU	1	UNCONFINED	0.44	0.44
	EMP	2000 - 66 MU	1	UNCONFINED	0.37	0.37
					average q - stdev	**0.13**
TREMPEALEAU NWR						
	EMP	1991 - 7 MU	1	Q	1.37	0.87
	EMP	1991 - 7 MU	1	Q	2.34	0.34
	EMP	1993 - 18 MU	1	Q	0.61	0.11
	EMP	1993 - 18 MU	1	Q	1.14	0.14
	EMP	1993 - 18 MU	1	Q	2.22	0.22
	EMP	1993 - 21 MU	1	Q	0.60	0.10
	EMP	1993 - 21 MU	1	Q	1.14	0.14
	EMP	1993 - 21 MU	1	Q	2.19	0.19
	EMP	1993 - 22 MU	1	UNCONFINED	0.12	0.12
	EMP	1993 - 22 MU	3	Q	0.66	0.16
	EMP	1993 - 22 MU	3	Q	1.19	0.19
	EMP	1993 - 22 MU	3	Q	2.23	0.23
					average q - stdev	**0.02**
					Overall average q - stdev	**0.12**

17. SETTLEMENT AND DISPLACEMENT:

The potential settlement of the islands was estimated using the CONSOL computer program. CONSOL calculates the amount and the time rate of consolidation for one-dimensional drainage conditions in horizontally layered soil masses. The time rate of consolidation is calculated using an implicit finite difference procedure. The proposed islands will be placed in locations where islands have existed in the past, according to surveys taken before the locks and dams were built. The parameters $C_c = 0.3$, $e_0 = 0.9$, and OCR= 1.2, were used. These are averages of testing done for other EMP projects in backwaters of the Upper Mississippi River valley. Soil stratigraphy from boring no. 99-19M was used as the worst case boring with the thickest clay layer. A summary of the input and results of the CONSOL run is shown on Plate 6-6 with the most-likely long-term settlement of 0.6 feet computed. A Taylor's series reliability analysis, according to J. M. Duncan[(1)] ,was completed and is shown on Plate 6-7. The results of the analysis were that there is a 20% chance of an ultimate settlement of 0.77 ft. and that there is a 5% chance of less then 0.3-ft. of settlement. EMP projects are different then other construction projects in that it is important that the constructed islands are not higher then designed. If the islands were overbuilt for settlement but remained high, they would be overtopped less frequently, which would provide less flood plain habitat. Also, experience has shown that islands constructed in the Upper Mississippi River Valley do not appear to settle as much as calculations show. This is possibly due to calculations over estimating settlement and/or due to some settlement occurring during construction. For this reason, and because the computed settlement was so small, the islands will not be overbuilt. The displacement of the rock and sand was assumed to be 0.5 ft.

18. MATERIAL SOURCES:

All the borrow area locations are shown in the main report. Sand was found at the channel bottom in the area of Belvidere Slough near borings nos. 99-14M and 99-15M. However, subsequent surveys have shown that this area contains a major mussel resource, therefore it will not be used as a borrow site. The soils within the backwater being protected could be suitable for sand borrow if some means were used to separate the sand from the fines or if water quality standards were relaxed. Borings nos. 99-18M and 99-19M appear suitable for fines borrow. The delineation of any borrow sites near the dam, will be kept at least 100 feet away from the toe of Dam No. 5.

19. CONSTRUCTIBILITY:

This project proposes constructing islands by hydraulically placing dredged sand to an elevation that is 0.5 ft above the water surface. This will be followed with constructing the rest of the island out of random fill and fines. This construction technique has been used for other similar EMP projects without problems.

20. ROCK GRADATION:

Both rockfill and riprap are available locally. Numerous dolomite quarries have been developed in the Prairie du Chien Formation adjacent to the Mississippi River valley. Acceptable quality rock for this project is available within a 10-mile radius of Spring Lake. The calculation of the minimum weight of the 50 percent-less-than-by-weight rocks for the rockfill is explained in the Hydraulic Appendix. The selected gradation is shown on Plate 6-8 and in the table below:

Table: Rock Gradation

Percent Less-than-by-Weight:	Maximum, lbs. (kg.):	Minimum, lbs. (kg.):
100	300 (136)	100 (45)
50	120 (54)	40 (18)
15	25 (12)	8 (4)

21. FUTURE WORK:

No additional borings or tests will be done to define the subsurface stratigraphy on this project. However, the work for plans and specifications may include borings and testing to better define the limits of borrow sites. Additionally, plans and specifications work will include designating specific quarries, further defining riprap placement, input to the specifications, and review of the contract documents.

Bibliography

1. **Duncan, J. M.** (1999). *Factors of Safety and Reliability in Geotechnical Engineering*, American Society of Engineers

2. **Martin, Lawrence**. *The Physical Geography of Wisconsin*, Wisconsin Geological and Natural History Survey, (1932)

3. **Young, H. L., and R. G. Borman,** *Water Resources of Wisconsin – Trempealeau-Black River Basing*, U.S.G.S Hydrologic Investigations Atlas (1973)

SPRING LAKE ISLANDS: BORING LOCATIONS

Legend

- BORINGS PLANNED FOR P & S
- BORINGS DONE FOR DPR

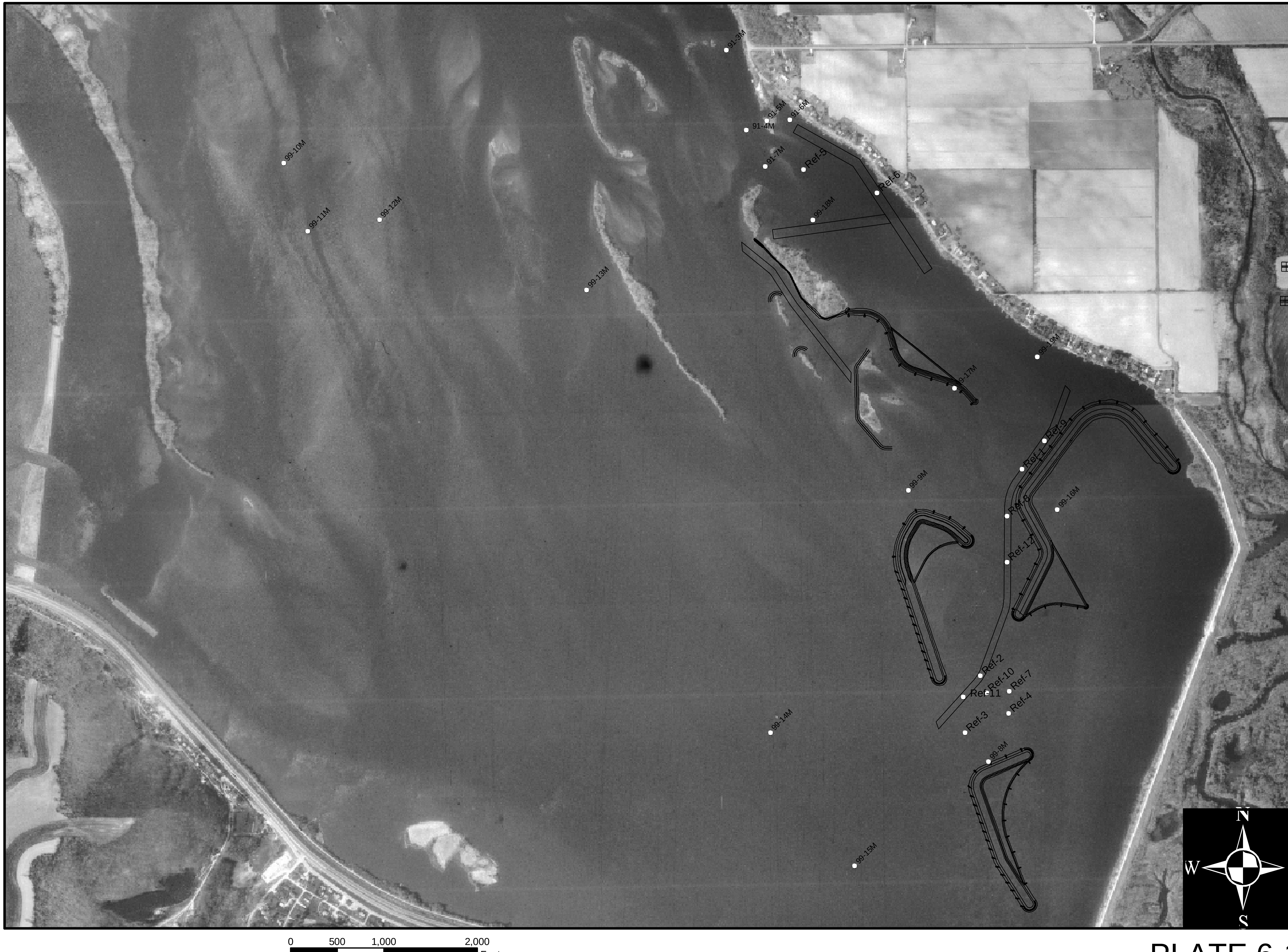
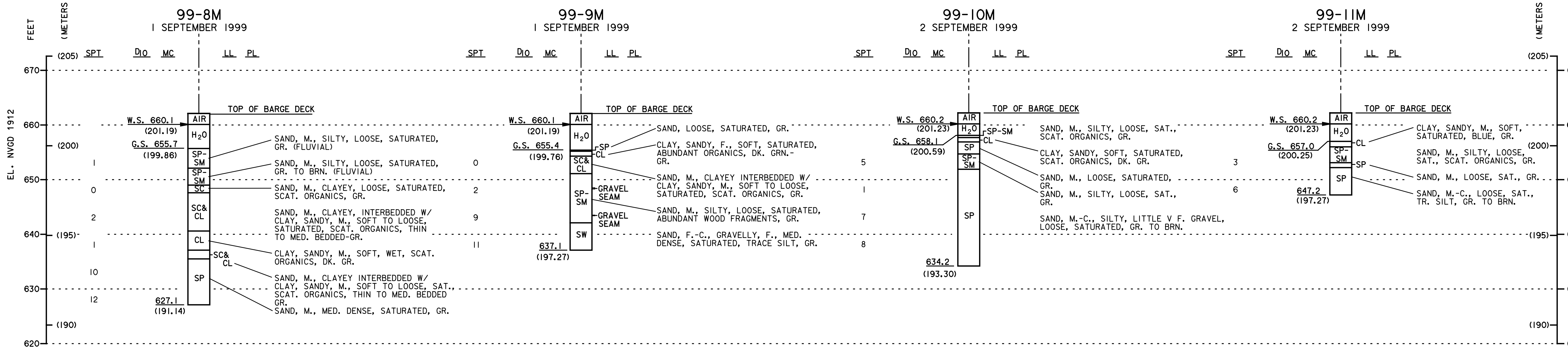


PLATE 6-1

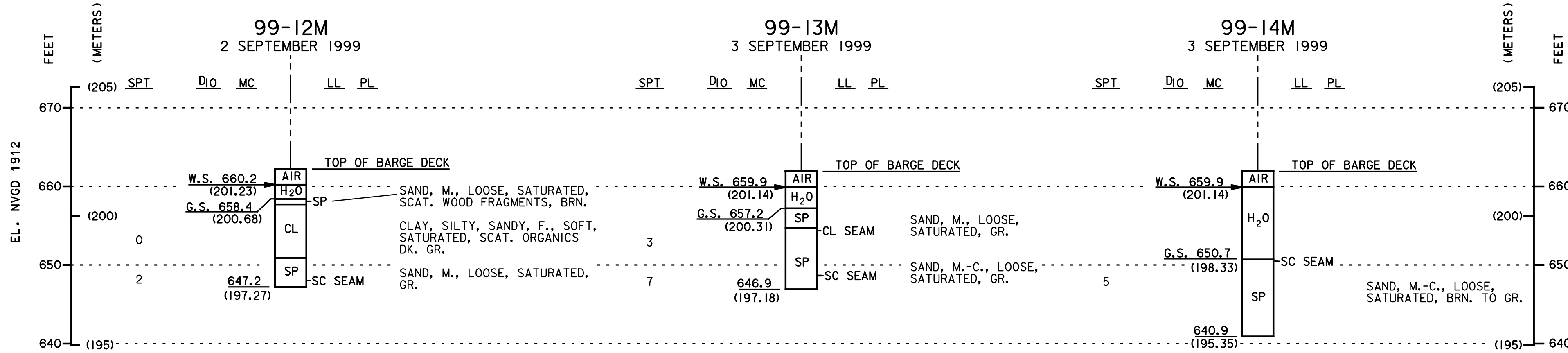


NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 646.9', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. ALL CASING REMOVED. BORING ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 647.1', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. ALL CASING REMOVED. BORING ALLOWING TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. HEAVING SANDS BELOW EL. 636.2'.
4. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.



NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 643.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

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 1⅜" 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. RQD: ROCK QUALITY DESIGNATION (RQD) IS SHOWN TO THE LEFT OF THE PERCENT RECOVERY COLUMN. ROD IS THE PERCENT RECOVERY CONSISTING OF UNBROKEN PIECES LONGER THAN 4".

7. % RECOVERY: PERCENT CORE RECOVERY IS SHOWN TO THE LEFT OF THE BORING STAFF. PERCENT RECOVERY IS LENGTH OF CORE RECOVERED/LENGTH OF CORE CUT X 100. UNLESS SPECIFIED OTHERWISE, ALL CORE IS 4" DIAMETER.

8. ELEVATIONS REFERENCED TO N.G.V.D. 1912 ADJ.

9 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 (651) 290-5599.

CONVERSION NOTES

TO CONVERT FEET TO METERS, MULTIPLY FEET BY 0.3048 = METERS.

TO CONVERT INCHES TO MILLIMETERS, MULTIPLY INCHES BY 25.4 = MILLIMETERS

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
W.S. 1026.7	WATER SURFACE ELEVATION ON DAY 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
700.1	ELEVATION AT BOTTOM OF BORING
(238.56)	ELEVATION IN METERS

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

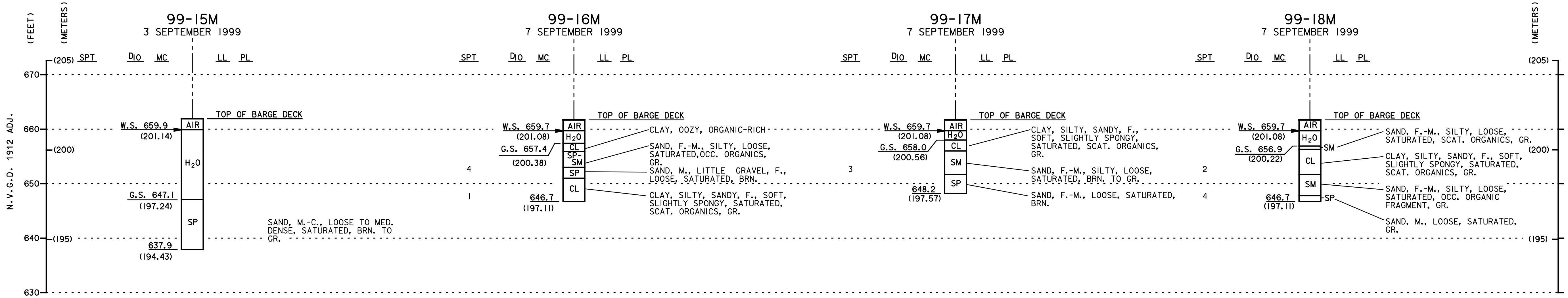
DESIGNED: KSN
CHECKED: JJF/KSN
DRAWN: GRS
DESIGNED:
CHECKED:
SCALE: AS SHOWN
DATE: DEC. 1999
CADD FILE NAME: spb12i0002.dgn
SOL. NO.: DACW37-93-B-0044
AE APPROVING OFFICIAL:

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

REFERENCE DRAWING
POOL #5 SPRING LAKE ISLANDS
GEOLOGICAL DATA
LEGEND, GENERAL NOTES & BORING LOGS: 99-8M, 99-9M, 99-10M 99-11M, 99-12M, 99-13M & 99-14M

DRAWING NUMBER:
PLATE 6-2

SHT 1 OF 2



NOTES (99-15M)

1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 642.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-16M)

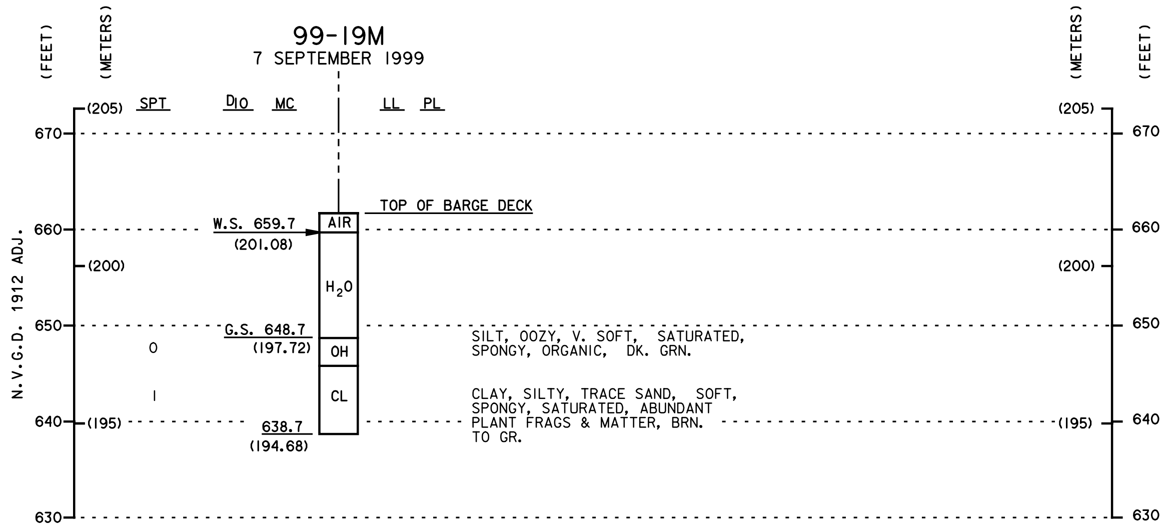
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-17M)

1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 651.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-18M)

1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.



NOTES

1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 641.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

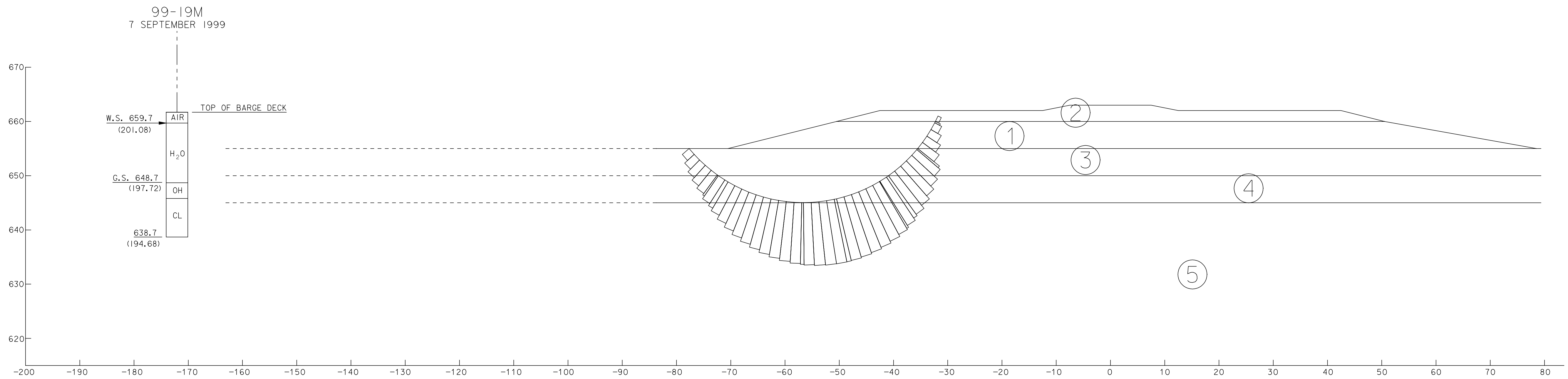
DESIGNED: KSN
CHECKED: JJF/KSN
DRAWN: GRS
DESIGNED:
CHECKED:
SCALE: AS SHOWN
DATE: DEC. 1999
CADD FILE NAME: spb1210003.dgn
SOL. NO.: DACW37-93-B-0044
AE APPROVING OFFICIAL:
ED-D ED-H

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

POOL #5
REFERENCE DRAWING
SPRING LAKE ISLANDS
GEOLOGICAL DATA
BORING LOGS; 99-15M, 99-16M, 99-17M, 99-18M & 99-19M

DRAWING NUMBER:
PLATE 6-3
SHT 2 OF 2

SOIL NO.	DESCRIPTION	UNIT WEIGHT (psf) MOIST	UNIT WEIGHT (psf) SATURATED	ESTIMATED Q-STRENGTHS c (psf)	ESTIMATED Q-STRENGTHS PHI (DEGREES)	CRITICAL CIRCULAR FAILURE CENTER COORDINATES X	CRITICAL CIRCULAR FAILURE CENTER COORDINATES Y	RADIUS	FACTOR OF SAFETY
1	SAT. SAND FILL		120	0	28	-56.6	672.3	27.26	1.36
2	SAND FILL	115		0	28				
3	OH		110	150	0				
4	CL		90	200	0				
5	SP		120	0	25				



NOTES:
1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN FEET.
2. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.)

US Army Corps of Engineers
St. Paul District

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

SPRING LAKE EMP - DPR
ISLAND STABILITY ANALYSIS

DRAWING NUMBER:
PLATE 6-4

HEADING
Spring Lake Islands EMP

Levee top= 663

GRAPHICS
PROFILE LINES

1	1	Embankment fill saturated
100.00	655.00	
120.00	660.00	
221.00	660.00	
249.00	655.00	
2	2	Embankment fill moist
120.00	660.00	
128.00	662.00	
158.00	662.00	
163.00	663.00	
178.00	663.00	
183.00	662.00	
213.00	662.00	
221.00	660.00	
3	3	Foundation soil (CH)
-50.00	655.00	
100.00	655.00	
252.00	655.00	
255.00	654.00	
265.00	654.00	
268.00	655.00	
418.00	655.00	
4	4	Foundation soil (MH)
-50.00	650.00	
418.00	650.00	
5	5	Foundation soil (SP)
-50.00	645.00	
418.00	645.00	

MATERIAL PROPERTIES
1 Embankment fill saturated
120
C
0.00 28
0
2 Embankment fill moist
115
C
0.00 28
0
3 Foundation soil (CH)
100
C
150.00 0
0
4 Foundation soil (MH)
100
C
200.00 0
0
5 Foundation soil (SP)
100
C
0.00 25
0

ANALYSIS/COMPUTATION DATA
Circular Search 1
114.00 675.00 0.10 550.00
POINT
114.00 635.00
ITErations
100
CRACK
1 DEPTH
WATER
1 DEPTH
SIDE
1
PROCEDURE
SPENCER

COMPUTE

top_el		c_q
655	OH	150.00
650	CL	200.00
645	SP	0.00

```
UTEXAS4 - Version: 1.0.0.1 - Latest Revision: 4/15/99
Licensed for use by: Joel Face, U. S. Army Corps of Engineers
Time and date of run: Thu Nov 15 15:07:28 2001
Input file: C:\...\My Documents\spring\utex\springNOsp2.prn

                         Spring Lake Islands EMP

                         Levee top=   663

TABLE NO. 33
*********************************************
* 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *
*********************************************
X Coordinate of Center . . . . . . . . . . . . .  113.90
Y Coordinate of Center . . . . . . . . . . . . .  672.30
Radius . . . . . . . . . . . . . . . . . . . . .  27.26
Factor of Safety . . . . . . . . . . . . . . . . 1.357
Side Force Inclination/Lambda  . . . . . . . . . 5.34
Number of Circles Tried  . . . . . . . . . . . .  255
Number of Circles F Calculated for . . . . . . .  255
Time Required for Search (seconds) . . . . . . .  1.7
```

```
CONSOL -- 1-D CONSOLIDATION ANALYSIS--------------------
|                                                      |
|                  --  VERSION 2.0  --                 |
|                                                      |
|    VIRGINIA TECH DEPARTMENT OF CIVIL ENGINEERING     |
|                                                      |
--------------------------------------------------------
```

DATE: 10-30-2001
INPUT FILE: springoc.dat
OUTPUT FILE: springoc.OUT
PLOT FILE: springoc.PLT

TITLE: Settlement of Spring Lake Islands

**** C O N T R O L   D A T A ****

NUMBER OF COMPRESSIBLE UNITS	7
NUMBER OF SOIL LAYERS	10
NUMBER OF DIFFERENT SOILS	2
ELEVATION OF THE GROUND SURFACE	655.00
ELEVATION OF THE TOP OF THE COMPRESSIBLE SOIL MASS ..	655.00
GROUND WATER ELEVATION	660.00
UNIT WEIGHT OF WATER	62.40
MST. UT. WT. OF SOIL BTWN. GS & COMP. SOIL MASS	.00
SAT. UT. WT. OF SOIL BTWN. GS & COMP. SOIL MASS	.00

**** U N I T   B O U N D A R Y   D A T A ****

UNIT NUMBER	TOP BOUNDARY	BOTTOM BOUNDARY	DRAINAGE CONDITION
1	1	3	2
2	3	4	2
3	4	5	2
4	7	7	2
5	8	8	2
6	9	9	2
7	10	10	2

**** S O I L   P R O P E R T Y   D A T A ****

SOIL TYPE	UNIT WEIGHT	VOID RATIO	Cc	Ccs	Cv	Cvs
1	111.00	.90	.30	.03	1.00	200.00
2	125.00	1.50	.00	.00	10.00	200.00

**** S U B L A Y E R   D A T A ****

LAYER	CENTER ELEV	BOTTOM ELEV	THICK	OVERBN PRESSURE	PRECONS PRESSURE	SOIL TYPE
1	654.50	654.00	1.00	24.30	24.30	1
2	653.75	653.50	.50	60.75	60.75	1
3	653.00	652.50	1.00	104.20	104.20	2
4	652.00	651.50	1.00	166.80	166.80	2
5	651.00	650.50	1.00	229.40	229.40	2
6	650.00	649.50	1.00	292.00	292.00	2
7	649.00	648.50	1.00	354.60	354.60	2
8	647.00	645.50	3.00	458.80	458.80	1
9	644.00	642.50	3.00	604.60	604.60	1
10	638.75	635.00	7.50	912.25	912.25	2

**** NUMBER OF LOADCASES TO BE ANALYSED: 1

**** L O A D C A S E : 1 ****
**** I N F I N I T E   S T R I P   F I L L ****

TIME INTERVALS: .00 .02 .10 .50 1.00 2.00
4.00 10.00 20.00 30.00 40.00

OLD FILL ELEVATION 655.00
NEW FILL ELEVATION 663.00
CHANGE IN FILL THICKNESS 8.00
MOIST UNIT WEIGHT OF FILL 120.00
SATURATED UNIT WEIGHT OF FILL 125.00
STRIP LOAD WIDTH 100.00
SETTLEMENT LOCATION FROM CENTERLINE ... .00
BUOYANCY EFFECT OPTION 1

LAYER	THICK.	VOID RATIO	INITIAL PRESSURE	PRECONS. PRESSURE	FINAL PRESSURE	ULT. SETTL.
1	1.00	.90	24.30	24.30	697.30	.23
2	.50	.90	60.75	60.75	733.74	.09
3	1.00	1.50	104.20	104.20	777.18	.00
4	1.00	1.50	166.80	166.80	839.74	.00
5	1.00	1.50	229.40	229.40	902.25	.00
6	1.00	1.50	292.00	292.00	964.72	.00
7	1.00	1.50	354.60	354.60	1027.11	.00
8	3.00	.90	458.80	458.80	1130.66	.19
9	3.00	.90	604.60	604.60	1274.72	.15
10	7.50	1.50	912.25	912.25	1576.56	.00

ULTIMATE SETTLEMENT WITHOUT CORRECTION FOR BUOYANCY : .67

FOR THIS LOAD CASE TIME	SETTLEMENT	ACCUMULATED TIME	SETTLEMENT	SURFACE ELEVATION
.01	.53	.01	.53	662.47
.02	.53	.02	.53	662.47
.10	.55	.10	.55	662.45
.50	.58	.50	.58	662.42
1.00	.59	1.00	.59	662.41
2.00	.59	2.00	.59	662.41
4.00	.59	4.00	.59	662.41
10.00	.59	10.00	.59	662.41
20.00	.59	20.00	.59	662.41
30.00	.59	30.00	.59	662.41
40.00	.59	40.00	.59	662.41

**** C O M P L E T E   T I M E   S E T T L E M E N T   R E C O R D ****

TIME	SETTLEMENT
.01	.53
.02	.53
.10	.55
.50	.58
1.00	.59
2.00	.59
4.00	.59
10.00	.59
20.00	.59
30.00	.59
40.00	.59

Taylor's Series Reliability: for Spring Lake Islands Settlement

1.) Determine most-likely-value (mlv) settlement = S_{mlv}

Using a CSETT settlement analysis with the following guesses at parameters:

$ocr := 1.2$ $\quad C_c := .3$ $\quad C_r := .03$ $\quad C_v := 1 \cdot \frac{ft^2}{yr}$ $\quad e := .9$

$d_c := 6.0 \cdot ft$ $\quad S_{mlv} := .57 \cdot ft$

2.) Estimate standard deviations of parameters that involve uncertainty.

Over Consolidation Ratio (ocr):

Highest Conceivable Value $HCV := 2$

Lowest Conceivable Value $LCV := 1$

$$\sigma_{ocr} := \frac{HCV - LCV}{6} \qquad \sigma_{ocr} = 0.2$$

Compression Index (C_c):

Highest Conceivable Value $HCV := 1.3$

Lowest Conceivable Value $LCV := .1$

$$\sigma_{Cc} := \frac{HCV - LCV}{6} \qquad \sigma_{Cc} = 0.2$$

These extreme values were obtained from TR 3-604 "Eng. Properties...", 1962, Fig. 25.

Recompression Index (C_r):

Highest Conceivable Value $HCV := .1$

Lowest Conceivable Value $LCV := .01$

$$\sigma_{Cr} := \frac{HCV - LCV}{6} \qquad \sigma_{Cr} = 0.015$$

These extreme values were obtained from NAVFAC DM-7.1 "Soil Mechanics", Table 6.

Void Ratio (e):

Highest Conceivable Value $HCV := 2.4$

Lowest Conceivable Value $LCV := .5$

$$\sigma_e := \frac{HCV - LCV}{6} \qquad \sigma_e = 0.32$$

Depth of Clay layer (d_c):

Highest Conceivable Value $HCV := 20 \cdot ft$

Lowest Conceivable Value $LCV := 3 \cdot ft$

$$\sigma_{dc} := \frac{HCV - LCV}{6} \qquad \sigma_{dc} = 2.8\,ft$$

3.) Compute Coefficient of Variation (COV):

Over Consolidation Ratio (ocr):

$S_{ocrp} := .55 \cdot ft$

$S_{ocrm} := .59 \cdot ft$

$\Delta S_{ocr} := S_{ocrm} - S_{ocrp}$ $\Delta S_{ocr} = 0.04\ ft$

Compression Index (C_c):

$S_{Ccp} := .76 \cdot ft$

$S_{Ccm} := .37 \cdot ft$

$\Delta S_{Cc} := S_{Ccp} - S_{Ccm}$ $\Delta S_{Cc} = 0.39\ ft$

Recompression Index (C_r):

$S_{Crp} := .6 \cdot ft$

$S_{Crm} := .6 \cdot ft$

$\Delta S_{Cr} := S_{Crp} - S_{Crm}$ $\Delta S_{Cr} = 0\ ft$

Void Ratio (e):

$S_{ep} := .5 \cdot ft$

$S_{em} := .69 \cdot ft$

$\Delta S_e := S_{em} - S_{ep}$ $\Delta S_e = 0.19\ ft$

Depth of Clay layer (d_c):

$S_{dcp} := .92 \cdot ft$

$S_{dcm} := .5 \cdot ft$

$\Delta S_{dc} := S_{dcp} - S_{dcm}$ $\Delta S_{dc} = 0.42\ ft$

4.) Compute Coefficient of Variation (COV) (continued):

$$\sigma_S := \left[\left(\frac{\Delta S_{ocr}}{2}\right)^2 + \left(\frac{\Delta S_{Cc}}{2}\right)^2 + \left(\frac{\Delta S_{Cr}}{2}\right)^2 + \left(\frac{\Delta S_{e}}{2}\right)^2 + \left(\frac{\Delta S_{dc}}{2}\right)^2\right]^{.5}$$

$$\sigma_S = 0.303\,\text{ft}$$

$$COV := \frac{\sigma_S}{S_{mlv}} \cdot 100$$

$$COV = 53.1\%$$

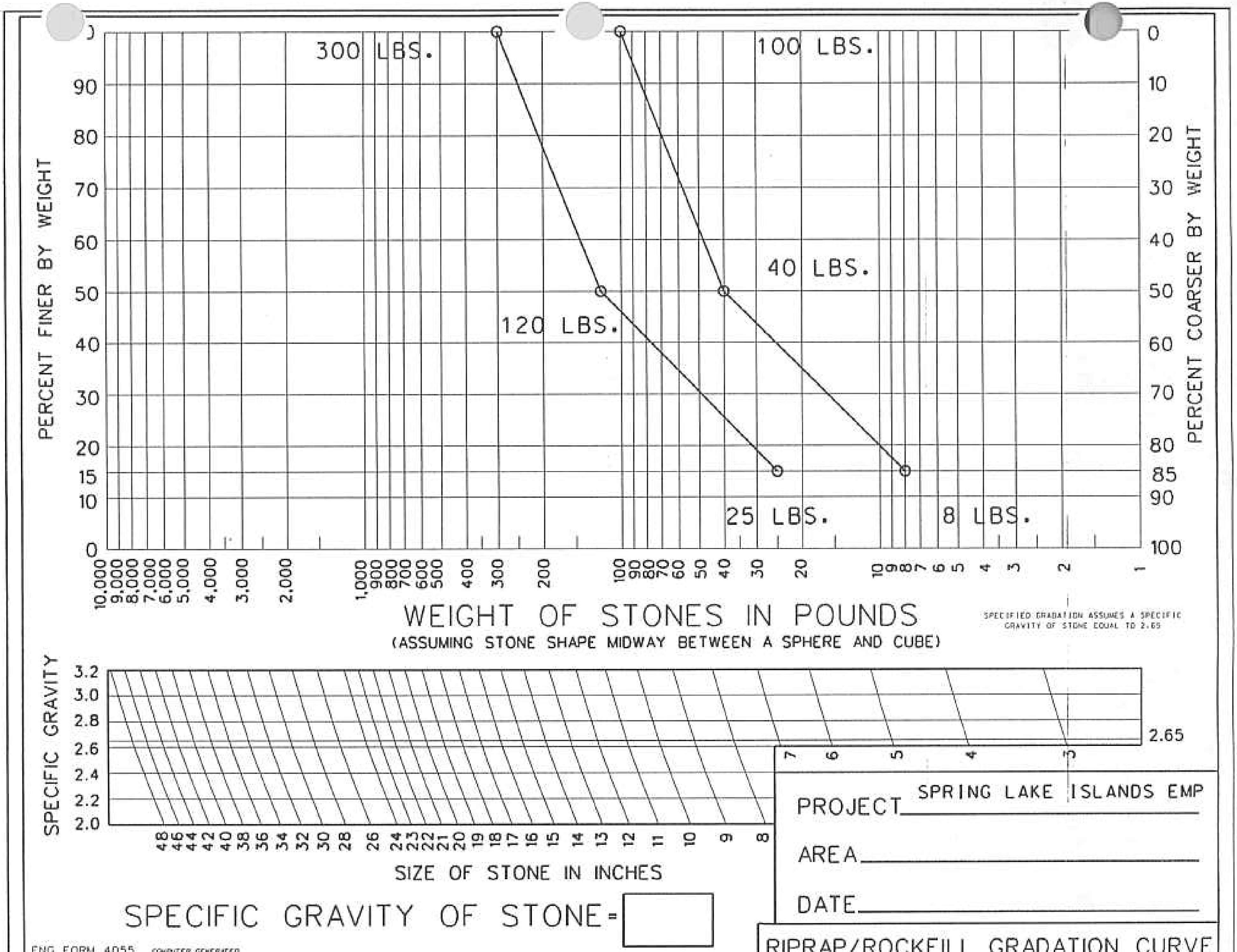
5.) Compute Possible Settlement (PS):

Settlement ratio (SR) with a chance of occurrence of 20% and a $COV = 53.1$ % is $SR := 1.344$. This yields a PS of the following:

$PS := SR \cdot S_{mlv}$ $\quad PS = 0.77\,\text{ft}$

6.) Compute risk of Small Settlement (SS):

With a $COV = 53.1$ % and $SS := 0.5 \cdot \text{ft}$ there is a 50% chance of the SS occurring. which means that there is a 50% chance of getting less than .5 ft. of settlement



300 LBS.
100 LBS.
40 LBS.
120 LBS.
25 LBS.
8 LBS.
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
WEIGHT OF STONES IN POUNDS
(ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE)
SPECIFIED GRADATION ASSUMES A SPECIFIC GRAVITY OF STONE EQUAL TO 2.65
SPECIFIC GRAVITY
2.65
SIZE OF STONE IN INCHES
SPECIFIC GRAVITY OF STONE =
PROJECT SPRING LAKE ISLANDS EMP
AREA
DATE
RIPRAP/ROCKFILL GRADATION CURVE
ENG FORM 4055

Memorandum of Agreement

Attachment 7

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
SPRING LAKE ISLAND PROJECT
BUFFALO 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 **Spring Lake Islands** 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 **Spring Lake Islands 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 **Spring Lake Islands 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 5** of the Mississippi River. **The project consists of constructing islands, rock sills and protection for existing islands. Dredging would occur in Spring Lake to improve habitat conditions for the backwater fish community.**

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 and protecting existing islands from additional erosion.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction: **Construction of the project consists of islands, rock sill and rock mounds. Islands would be constructed using sand and fine sediments dredged from within Spring Lake. Rock would be placed on the existing and new islands for stabilization. Islands would be seeded and planted with willows and trees for stabilization and habitat purposes.**

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 **Spring Lake Island project** as described in the **Supplemental Definite Project Report/Environmental Assessment, Spring Lake Island Habitat Rehabilitation and Enhancement Projects, dated May 2003**, 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 **Supplemental Definite Project Report/Environmental Assessment entitled "Spring Lake Island Habitat Rehabilitation and Enhancement Project," dated May 2003,** 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	THE U.S. FISH AND WILDLIFE SERVICE
BY: __________________________	BY: __________________________
(signature)	(signature)
ROBERT L. BALL	WILLIAM F. HARTWIG
Colonel, Corps of Engineers	Regional Director
St. Paul District	U.S. Fish and Wildlife Service
DATE: ____________________	DATE: ____________________

Coordination/Cooorespondence

Attachment 8

The draft Definite Project Report/Environmental Assessment or Executive Summary/Notice of Availability (*) was sent to the following agencies, interests, media, and libraries. In addition, the Executive Summary/Notice of Availability was sent to all private citizens on the project mailing list.

Congressional
Sen. Mark Dayton (Twin Cities Office)
Sen. Russell Feingold (La Crosse Office)
Sen. Herbert Kohl (Madison Office)
Sen. Norm Coleman (St. Paul Office)
Rep. Ron Kind (La Crosse Office)
Rep. Gil Gutknecht (Rochester Office)
Rep John Kline (Burnsville Office)

Federal
Environmental Protection Agency – Region V Administrator
Department of Transportation - Region V Administrator
U.S. Coast Guard – St. Paul Office
U.S. Geological Survey – St. Paul and Madison Offices
U.S. Geological Survey – Upper Midwest Environmental Sciences Center
National Park Service – Midwest Regional and St. Paul Offices
National Resource Conservation Service – St. Paul and Madison Offices
Advisory Council on Historic Preservation
U.S. Fish and Wildlife Service (Hartwig, Hultman, Drieslein, Wege, Thiel, Dobrovolny)

State of Wisconsin

Department of Natural Resources (Hassett, G. Benjamin, Janvrin, Marron, Brecka, M. Anderson, R. Benjamin)
Department of Transportation
State Historic Preservation Office

State of Minnesota

Department of Natural Resources (Merriam, Balcom, Sc. Johnson, St. Johnson, Denz, Dieterman)
Minnesota Pollution Control Agency (Carrigan, Mader, Senjen)
Department of Transportation
State Historic Preservation Office
Water and Soil Resource Board

State of Iowa

Department of Natural Resources (Szcodronski)

Local Government

Alma, Wisconsin
Buffalo City, Wisconsin
Buffalo County, Wisconsin
Cochrane, Wisconsin
Fountain City, Wisconsin
Kellogg, Minnesota
Wabasha County, Minnesota

Interest Groups

American Rivers
Audubon Society
Ducks Unlimited
Gopher State Sportsmen Club
Lewiston Sportsmen Club
McKnight Foundation
Mississippi River Regional Planning Commission
Nature Conservancy
Mississippi River Citizen Commission
Upper Mississippi Waterways Association
Associated Sportsmen Club
Badger State Sportsmen Club
Izaak Walton League
La Crosse County Conservation Alliance
MARC 2000
Mississippi Sportsmen Club
Mississippi River Revival
Sierra Club
Upper Miss. R. Conservation Committee

Media/Libraries

Courier Press*
Lake City Graphic*
Winona Daily News*
Cochrane Recorder*
La Crosse Tribune*
Arcadia News Leader*
Galesville Republican*

KAGE Radio (Winona)*
WIZM Radio (La Crosse)*
WKBT TV (La Crosse)*
WLSU Radio (La Crosse)*
KQAL Radio (Winona)*
WKBH Radio (La Crosse)*
WLAX-TV (La Crosse)*
WXOW TV (La Crosse)*

Alma Public Library
Red Wing Public Library
La Crosse County Library
Wabasha Public Library
Galesville Public Library
La Crescent Public Library
La Crosse Public Library
Winona Public Library

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

REPLY TO
ATTENTION OF

March 11, 2003

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

SUBJECT: Spring Lake Islands Habitat Rehabilitation and Enhancement Project, Buffalo County, Wisconsin (SHSW # 90-0162 and 02-1174/BF)

Mr. Sherman Banker
Compliance Archaeologist
Division of Historic Preservation
State Historical Society of Wisconsin
816 State Street
Madison, Wisconsin 53706-1482

Dear Mr. Banker:

The following is in response to your letter of November 18, 2002, concerning the St. Paul District, U.S. Army Corps of Engineers (Corps) assessment that there are no historic properties within the area of potential effect of the above referenced project. Specifically, your office has noted that submerged resources (e.g., shipwrecks and other historic structures) were not discussed and that there is a possibility that submerged archaeological sites may be affected. Your office recommends a soil coring or other investigations be conducted. Below you will find additional cultural resource information for the project and the Corps' proposed course of action.

Most of the Spring Lake Habitat Rehabilitation and Enhancement Project area is situated over areas that, prior to inundation from construction of Lock and Dam 5 during the late 1930s, consisted of floodplain, back channels, and wetlands. It is unlikely that submerged resources in the form of shipwrecks exist in the project area. Further, a literature review indicates that no shipwrecks, or other historic structures, are identified or known to have existed within the project area. Specifically, the northern access channel will be excavated over an area that prior to inundation was along the course of a narrow back channel, well away from the main river channel and Pomme de Terre Slough. The areas selected for fine borrow were previously a wetland. Therefore, the Corps believes that no submerged resources or other historic structures will be affected by the proposed project in these areas.

The southern proposed access channel will transect areas that prior to inundation consisted of back channels, wetlands, a small lake, and general floodplain that would have been seasonally dry. As there is a potential for archaeological sites, now inundated, to exist within portions of the area proposed for this channel, a soil coring program will be conducted along the footprint of the proposed channel in the spring of 2003. Any cultural resources sites identified in the project construction limits will be evaluated for eligibility to the National Register of Historic Places. Potential project impacts to eligible properties will be mitigated prior to construction, if said impacts cannot be avoided.

Please contact Mr. Bradley Perkl, Corps archaeologist, at 651-290-5370 with any questions.

Sincerely,

For Terry J. Birkenstock
Chief, Environmental and Economic
Analysis Branch

WISCONSIN
hi story
WISCONSIN HISTORICAL SOCIETY

Headquarters Building
816 State Street
Madison, WI 53706-1482
608-264-6400

November 18, 2002

Mr. Bradley Perkl
U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul MN 55101-1638

SHSW#: 02-1174/BF
RE: Spring Lake Islands Habitat Rehabilitation & Enhancement

Dear Mr. Perkl:

We have reviewed the above referenced project as required for compliance with Section 106 of the National Historic Preservation Act and 36 CFR Part 800: Protection of Historic Properties, the regulations of the Advisory Council on Historic Preservation governing the Section 106 review process.

We do not concur with your assessment that there are no historic properties within the area of potential effect of the proposed undertaking. The submittal does not discuss what was done to identify any submerged resources in the proposed project area such as shipwrecks or other submerged historic structures. There is also a possibility that there are submerged prehistoric archeological sites in the project area. Some type of soil coring or other investigations are needed to determine if there are submerged in situ archeological features in the project area.

If you have any questions concerning these matters, please call me at (608) 264-6507.

Sincerely,

Sherman Banker
Office of Preservation Planning

Responses to Wisconsin DNR Comments

Comment #1
3.2.1 - Winter discharge - Average Jan-Feb river flows are closer to 15,000 cfs based on the USGS gage at Winona.

Response: Flows between October and February were used to calculate winter discharges.

Comment #2
3.2.1 - Spring Lake Velocity - There is substantially more data than what was referenced here (i.e. Lucchesi and Benjamin, 1988), some of which was paid for by the USCOE. 1988 was low flow and not representative of an average winter. Monitoring conducted in 1992, 1995 and 2001 show winter inflow velocities to Spring Lake approach 0.3 to 0.5 ft/s. Backwater velocities exceeding 0.1 ft/s have been found in Spring Lake and influence mixing and winter thermal stratification. Some of the more recent studies are referenced elsewhere in the DPR. The Wisconsin DNR has done water quality monitoring in Spring Lake during 1988, 1992, 1995 and 2001. Copies of these reports or summaries are enclosed. We recommend providing a summary of this more recent information in this section and elsewhere in the DPR. The 1995 and 2001 monitoring would be most appropriate for use since they represent conditions in Spring Lake after the peninsula was reconstructed. These 2 years should be he basis for most of the discussion on current conditions, not the studies which are 20+ years old.

Response: Concur. Report will be revised to include winter water velocity information from 1995 and 2001.

Comment #3
3.3 - TSS concentrations in Spring Lake - Where is the reference for this data? We believe there are data available (Site 18?) - from the Weaver Bottoms Resource Analysis Plan/Reports.

Response: Concur. Report will be revised to include the above TSS data.

Comment #4
3.3 - Depth-stratified sediment contaminant data have been collected on May 21, 1991 by the USCOE and WDNR. The elevated chromium levels reported in Table 404-1 in Attachment 3 for record #3 in 1991 is incorrect. The value is 11 ug/g not 57 based on a July 25, 1991 Letter from Robert Whiting which included the results from Pace Lab.

Response: The report included with the referenced letter does list the value as 57 and not 11. However, this value seems unusually high in relation to values listed in

the report for chromium and other contaminants for the same area. It is possible that this value is listed in error, which will be discussed in this section.

Comment #5

3.3 – Add to the discussion that an area called Spring Lake existed prior to impoundment.

Response: Concur. Will add language.

Comment #6

3.4 - Winter WQ data. The majority of Spring Lake is not protected from flows. Therefore the winter water temperatures are close to 0.0 degrees C for over 80% of the area. In general, the high inflows result in colder water being introduced with typical temperatures around 0.35. Spatial sampling during the winter of 1995 showed an average surface water temperature of 0.3 and average bottom temperature of 0.4. The majority of Spring Lake is also influenced by velocity, with an average surface velocity in unprotected areas of 2.2 cm/second. There has been substantial information collected that is not referenced in this section of the DPR.

Response: Concur. See response to Comment 2 above. Section will be revised to include more pertinent information.

Comment #7

3.5 – A comparison of 1989 and 2001 vegetation coverage should be made in this section. The comparison will show a dramatic decline in percent coverage of aquatic vegetation in that time period. The observation of Wisconsin DNR staff is that a drastic decline in aquatic vegetation occurred in 1990 and aquatic vegetation remained sparse in the project area throughout the 1990's. A slight increase in aquatic vegetation was observed in 2000 and 2001.

Response: Concur. Section will be revised to include more pertinent information.

Comment #8

3.6.1 - The Wisconsin Department of Natural Resources conducted netting and electrofishing surveys of the Spring Lake fishery during the late-80s and mid-90s. Thirty-six species were sampled during the fall of 1987 and the spring of 1988 (Lucchesi and Benjamin 1989). During these surveys, the dominant species were bluegill (31.3% of the total catch), black crappie (12.9%), common carp (10.0%) and yellow perch (7.5%). During the fall of 1995 and the spring of 1996, thirty-one species were sampled (Brian Brecka, Wisconsin DNR, Alma, personal communication). Dominating the catch were freshwater drum (17.3%), white bass (17.3%), black crappie (16.5%) and gizzard shad (13.1%). Comparing the two sampling periods, panfish species (bluegill, black crappie and yellow perch) were a higher percent of the catch during the 80s (51.4%) than during the 90s (18.6%). This significant difference is likely due to differences in the aquatic vegetation along with other factors. Lucchesi and Benjamin (1989) reported large beds *of*

aquatic macrophytes in the upper reaches of Spring Lake. They also warned that high flow rates and increased sedimentation due to a breached peninsula might further degrade this habitat. Although the peninsula was replaced in 1995, losses of vegetation and depth occurred and will not likely return without physical improvements.
We recommend replacing the present last paragraph in this section with the one above.

Response: Concur. The above paragraph will be slightly revised and used to replace the last paragraph in this section.

Comment #9
3.7 – An important point which is missing in this section of the report is the reason for an increase in island acreage from 1994-1998 due to the construction of the peninsula. This needs to be added. Also, a map showing a comparison of 1975, 1989 and 2001 vegetation coverage would be very informative. The present wording leads the reader to believe that all 570 acres surveyed by LTRMP in 2001 was vegetated. No mention is made of the percent of area which was open water. Add percent of open water to the discussion and comparison of vegetation in the same area in 1975, 1989 and 2001.

Response: Concur. Section will be revised as recommended.

Comment #10
4.1 - Since closure at the upper end, current velocities in Spring Lake are not greater than 0.1 meters/s (0.3 ft/s) during the winter. Velocities exceeding 0.1 m/s were found near the inflows prior to 1995.

Response: The text will be revised to include velocity data and the statement regarding winter fishery habitat being limited by velocities greater than 0.1 m/sec will be removed because it is too general. It will be replaced with a reference to the velocity requirements of bluegill (greater than 3 cm/s is severely limiting and 0 cm/s is ideal strictly from a velocity perspective).

Comment #11
4.2 – The flow into Spring Lake continued to increase past 1977 due to continued erosion of the peninsula and other islands. This is supported by the information provided in sections 4.2.1.

Response: Concur. Section will be revised to reflect this change.

Comment #12
4.2.1 – Plates 4 and 5 should be referenced in this section. The reason for the "increase" in island acreage should be included in this section. The reason for the increase was the construction of the peninsula. Furthermore, plate 5 clearly indicates that island loss has

continued in the project area. Several of the original island masses were smaller or gone when looking at size and location from 1994-1998.

Response: Concur. Section will be revised as recommended.

Comment #13

4.3 – The loss of islands is also a factor contributing to turbidity increase due to resuspension and changes in aquatic plant beds. Please add to discussion in last 2 paragraphs on page 4-3.

Response: Concur. Discussion will be revised as recommended.

Comment #14

4.3 - FYI - Korschgen's (and others) light penetration/TSS relationship for Pool 8 has been published in Aquatic Botany 58 (1997) 1-9. What are the turbidity levels in Spring Lake, and how do they compare with other parts of the UMR? We suspect that the values for this portion of Pool 5 are low compared to other UMR pools (i.e. due to the influence of Lake Pepin and no major inflows on the east side of Pool 5).

Response: Concur. Section will be revised to include available turbidity data.

Comment #15

5.2 – Goal A: Spring lake does not presently support a popular fishery. We recommend replacing the justification for this goal with the following discussion:

The Spring Lake fishery traditionally supported backwater species such as bluegill, black crappie, yellow perch and largemouth bass. It is not uncommon to find local anglers that recollect an extremely popular winter fishery that received pressure from more than one hundred ice shanties. This quality winter fishery occurred as late as the mid-80s. However, fishery declines appeared to occur due to increased flow, decreased depth and loss of aquatic vegetation. Recent winters have brought only a few anglers to Spring Lake. Management goals for Spring Lake are to maintain year-round backwater fishery habitat and prevent future degradation of the aquatic plant community.

Response: Concur. Section will be revised as recommended.

Comment #16

5.2 -- Objective A1 D. We recommend modifying the following objectives to include a depth criteria for meeting the objective of water velocity. Suggested modification is: Mid-depth current velocity <0.3 cm/sec over 80 % of the area.

Response: Concur. Objective will be modified as recommended.

Comment #17

5.2 – General comment: It would be more appropriate to look at the joint occurrence of temperature, DO and velocity for setting/specifying "minimal" centrachid habitat conditions. Based on Wisconsin DNR monitoring of the Lake Onalaska Dredge Cut, we have proposed DO > 3 mg/L, Temp > 1C and velocity < 1 cm/s. These things can be tweaked somewhat but we believe this approach provides a better way to assess winter conditions since they are based on actual measurements. For example it is not likely/common to have DO > 5 and Temp > 2 C during mid-winter conditions due to thermal stratification and reduced photosynthetic activity under ice and snow cover. Perhaps this type of discussion may be appropriate to add in a later section of the DPR (i.e. 7.5.1.1).

Response: It would be more appropriate to look at the joint occurrence of variables for setting minimal habitat conditions. However, the number of combinations of factors this could lead to makes the approach impractical for the purpose here. However, some discussion reflecting this will be added to section 7.5.1.1.

Comment #18

7.0 – Islands have also been constructed in Pools 9 and 10. These should be added to the discussion.

Response: Concur. The discussion will be modified as recommended.

Comment #19

7.0 - The benefits of increasing the depth in the project area as borrow for the islands was not included in any of the analysis. This feature will definitely improve habitat conditions in several of the alternatives. We recommend that the analysis be done with inclusion of the benefits of the dredge cuts **or** the discussion be modified to clearly indicate that the benefits of the islands was not included in any of the analysis with 1 or 2 examples of how including consideration of the dredge cuts increases the habitat value of areas in the Spring Lake.

Response: Concur. The discussion will be modified as recommended.

Comment #20

7.4.1.1 – And the Habitat Evaluation Appendix – Alternative 6, which evaluates the construction of island 3, should include an increase in winter water temperature and reduction of velocities for the area of Spring Lake protected by island 3. We estimate that the winter water temperature will increase to approximately 1.5 degrees C on average and velocities will be undetectable throughout much of the protected area.

Response: The evaluation of Alternative 6 does include an increase in winter water temperature and a reduction in velocities in the area protected by island 3. The evaluation assumes that the island would protect 20 acres of habitat deeper than 4 feet, and within the protected area temperature and velocity would approach optimal values.

Comment #21
7.4.1.1 b – Island 3 will be a major location for the disposal of dredged material. Therefore, the HEP analysis, or discussion, should include credit for the increase of deep water in the upper portions of the project area.

Response: Concur. Included additional discussion will be revised as recommended.

Comment #22
7.6.1 – Add mention that alternative evaluation did not include the benefits of dredging in the project area. The dredging in the upper portion of the project area is considered critical to us for meeting the biological objective of improving backwater fishery habitat. Also, the discussion for Alternative 6 should include the benefits it would provide for the upper portions of the project area if it is built and the borrow was obtained from the areas indicated on Plate 9.

Response: Concur. Included additional discussion as noted above.

Add a reference to Plate 9 at the end of this section.

Response: Concur. Reference added.

Comment #23
8.1.1 - Deposition of fines and sand (bedload) are both concerns we have for the area. Based on the island configuration in the interior, we doubt that adequate velocities will be present to "flush" accumulated fine materials during flood events. We are concerned that additional bedload may enter the area if the sills are not high enough. Please review the hydraulic analysis to determine if higher sill elevations may be appropriate if reduction of bedload entering the area may be a greater concern.

Response: Two main criteria are used to determine sill height: 1. Water surface elevation associated with a 1.5–2 year flood, and 2.Top elevation of the adjacent natural landmass. In this instance, the top elevation of natural features was determined to be the governing criteria. Rock sills are designed to overtop first in a flooding event. During initial overtopping, the potential for erosion is the highest because head differential and velocity are at their greatest. If the top elevation of the rock sill is higher than the surrounding landmass, the water will be directed

over the natural features, causing erosion. Due to this, sill elevation should not be raised.

Additionally, given the distance of Spring Lake from a sediment source and frequency of overtopping, sedimentation should not be a problem.

Comment #24

8.1.2 – Some of the rock mounds may function similar to the seed islands in Pool 8. The discussion should include mention of the potential secondary benefit of accumulating material over time.

Response: Concur. Included additional discussion as noted above.

Comment #25

8.1.3.2 and 8.1.3.3 - We recommend adding trees (ash, maple, river birch) as plantings to these islands in addition to the grass/forb mix.

Response: Concur.

Comment #26

8.1.5 - Construction Restrictions - It is likely that lower TSS limits would be required based on the demonstration that lower limits are achievable. Further, restrictions would be placed on sand borrow sources to ensure the base of islands are constructed with minimal fines (i.e. P200 < 10%).

Response: Concur.

Comment #27

Item a. We do not concur that waterfowl migration season is a restriction on construction. Spring Lake is not part of a waterfowl hunting closed area, which is where this restriction is sometimes applied. Remove this restriction.

Response: Concur. Restriction has been removed.

Comment #28

It is likely that portions of some islands may be constructed mechanically. This option should be added to c and d.

Response: Concur. Included additional discussion as noted above.

Comment #29
Item e should include mention that the upper dredge cuts will be mandatory for the purpose of meeting one of the primary goals, which is improving over-wintering habitat for backwater fish species.

Response: Concur. Included additional discussion as noted above.

Comment #30
8.4.1 – A cost comparison of obtaining sand borrow from the main channel and the disposal sites was done during project planning. A discussion of the increased cost of obtaining the material from these locations should be included in the DPR.

Response: Concur. Included additional discussion in cost comparison.

Comment #31
8.4.1 - Proposed borrow source for sand material. Have there been adequate borings collected between islands 2 and 4 to show that suitable material is available? We believe sand is readily available adjacent to the deep hole located in the area downstream of island 3. This was the site for sand borrow used for the construction of the lock and dam 5 dike. Additional borings for the area may also be included in the planning and as built drawings for lock and dam 5 dike. If so, these should be referenced in this section and included in the DPR geotech appendix.

Response: Concur. The geotechnical engineer has scheduled additional borings.

Comment #32
Table 8-4 – Remove reference to no work during the waterfowl season.

Response: Concur. Reference removed.

Comment #33
Page 10-2 – There is no 2001 photo on plate 13. Remove reference to 2001 photo.

Response: Concur. Reference removed.

Comment #34
Pages 12-1 and Page 12-2, Table 12-1 - This table references NPS (EMTC) which no longer exists.

Response: Concur. Changed NBS to USGS and EMTC to UMESC.

Comment #35

Plate 11 - Mud/Sand flat x-section - The top elevation is lower than Pool 5 control pool elevation by 0.4 ft. We assume this is the proposed elevation once the berm has stabilized. We recommend that the planned x-section dimension of this berm during the construction phase also be included.

Response: See Hydraulic Appendix page 5 of 12 for mudflat design.

Comment #36

404(b)(1) B. page 4 - Water Circulation - We would not expect winter DO to increase in Spring Lake as a result of this project. Instead, winter DOs would be expected to decrease due to increased thermal stratification and increased hydraulic retention time (greater SOD). Decreasing the hydraulic retention time may lead to greater phytoplankton concentrations at times. Increased growths of submersed aquatic vegetation will also contribute to increased summer DO/temperature stratification and greater opportunities for filamentous algae and floating-leafed vegetation (i.e. Lemna) development. This vegetation will have a strong influence on circulation, mixing and reaeration.

Response: Concur. Statement will be revised to indicate a decrease in DO.

Comment #37

404(b)(1) C. page 5 - Turbidity - Summer turbidity levels would decrease noticeably if 80% SAV coverage is realized as a result of reduced sediment resuspension and increased hydraulic retention time.

Response: It is possible that turbidity levels would decrease noticeably. However, due to many confounding factors such as increased algal growth caused by increased retention time and decreased suspended solids, it is difficult to predict the significance of the decrease in turbidity.

Comment #38

404(b)(1) page 7 - Table 404-1. The chromium value reported for record #3 collected in 1991 needs to be changed as indicated above. The PCB listing is for Aroclors 1016 but should include Aroclors 1221 to 1260.

Response: The chromium value is not in error – see response to comment number 4. Text in 404 will be revised as stated in response to comment number 4. The PCB listing is for total PCBs; 1016 was listed in error. Table will be revised to include Aroclors 1006 – 1260.

Comment #39

Hydrodynamics - page 5-4 - Pool 8 should be changed to Pool 5 (first sentence).

Response: This has been fixed in the appendix.

Comment #40

Hydrodynamics - page 5-5 - Table 5-4. What about winter measurements? These have been made by the WDNR at the inlets in the mid to early 1990s. I believe this information has been provided to Jon Hendrickson and Dan Wilcox in the past.

Response: Concur. Included additional data as noted above.

Comment #41

We recommend that a discussion on the impacts of the earthen dike culverts at Dam 5 be included. We didn't see any discussion in the main body of the report concerning the expected influence these culverts have in controlling current velocities, DO and temperature in the project area, especially during winter conditions. It may be desirable to reduce the winter flows through these culverts to optimize winter habitat conditions in Spring Lake as well as Fountain City Bay. We noticed that this is covered in the Hydraulics sections. This information should be discussed in the main portion of the report as well with potential options identified.

Response: A culvert is located in the dike of the southeastern border of Spring Lake. The culvert conveys approximately 300cfs from Spring Lake into the Whitman Wildlife area. The culvert will pull water through the deep hole in southern Spring Lake. In order to establish an over-wintering habitat in this area, the flows through the culvert may have to be regulated in the winter. Once the project features are in place, this area will require monitoring to determine the appropriate culvert regulation.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN DEPT. OF NATURAL RESOURCES

Scott McCallum, Governor
Darrell Bazzell, Secretary
Scott A. Humrickhouse, Regional Director

La Crosse Service Center
State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

October 30, 2002

Mr. Tom Novak, Project Manager
U.S. Army Corps of Engineers, St. Paul District
Army Corps of Engineers Centre
190 fifth St. East
St. Paul, MN 55101-1638

Dear Mr. Novak:

We have completed review of the draft Definite Project Report/Environmental Assessment for Spring Lake Islands Habitat Rehabilitation and Enhancement Project, dated September 2002. We concur with the recommended plan. Many of our comments focus on omissions of information regarding the present physical and biological conditions of the project area. Reports and summaries of water quality conditions in Spring Lake are referenced in our comments below and enclosed for your information

3.2.1 - Winter discharge - Average Jan-Feb river flows are closer to 15,000 cfs based on the USGS gage at Winona.

3.2.1 - Spring Lake Velocity - There is substantially more data than what was referenced here (i.e. Lucchesi and Benjamin, 1988), some of which was paid for by the USCOE. 1988 was low flow and not representative of an average winter. Monitoring conducted in 1992, 1995 and 2001 show winter inflow velocities to Spring Lake approach 0.3 to 0.5 ft/s. Backwater velocities exceeding 0.1 ft/s have been found in Spring Lake and influence mixing and winter thermal stratification. Some of the more recent studies are referenced elsewhere in the DPR. The Wisconsin DNR has done water quality monitoring in Spring Lake during 1988, 1992, 1995 and 2001. Copies of these reports or summaries are enclosed. We recommend providing a summary of this more recent information in this section and elsewhere in the DPR. The 1995 and 2001 monitoring would be most appropriate for use since they represent conditions in Spring Lake after the peninsula was reconstructed. These 2 years should be he basis for most of the discussion on current conditions, not the studies which are 20+ years old.

3.3 - TSS concentrations in Spring Lake - Where is the reference for this data? We believe there are data available (Site 18?) - from the Weaver Bottoms Resource Analysis Plan/Reports.

3.3 - Depth-stratified sediment contaminant data have been collected on May 21, 1991 by the USCOE and WDNR. The elevated chromium levels reported in Table 404-1 in Attachment 3 for record #3 in 1991 is incorrect. The value is 11 ug/g not 57 based on a July 25, 1991 Letter from Robert Whiting which included the results from Pace Lab.

3.3 – Add to the discussion that an area called Spring Lake existed prior to impoundment.

3.4 - Winter WQ data. The majority of Spring Lake is not protected from flows. Therefore the winter water temperatures are close to 0.0 degrees C for over 80% of the area. In general, the high inflows result in colder water being introduced with typical temperatures around 0.35. Spatial sampling during the winter of 1995 showed an average surface water temperature of 0.3 and average bottom temperature of 0.4. The majority of Spring Lake is also influenced by velocity, with an average surface velocity in unprotected areas of 2.2 cm/second. There has been substantial information collected that is not referenced in this section of the DPR.

3.5 – A comparison of 1989 and 2001 vegetation coverage should be made in this section. The comparison will show a dramatic decline in percent coverage of aquatic vegetation in that time period. The observation of Wisconsin DNR staff is that a drastic decline in aquatic vegetation occurred in 1990 and aquatic vegetation remained sparse in the project area throughout the 1990's. A slight increase in aquatic vegetation was observed in 2000 and 2001.

3.6.1 - The Wisconsin Department of Natural Resources conducted netting and electrofishing surveys of the Spring Lake fishery during the late-80s and mid-90s. Thirty-six species were sampled during the fall of 1987 and the spring of 1988 (Lucchesi and Benjamin 1989). During these surveys, the dominant species were bluegill (31.3% of the total catch), black crappie (12.9%), common carp (10.0%) and yellow perch (7.5%). During the fall of 1995 and the spring of 1996, thirty-one species were sampled (Brian Brecka, Wisconsin DNR, Alma, personal communication). Dominating the catch were freshwater drum (17.3%), white bass (17.3%), black crappie (16.5%) and gizzard shad (13.1%). Comparing the two sampling periods, panfish species (bluegill, black crappie and yellow perch) were a higher percent of the catch during the 80s (51.4%) than during the 90s (18.6%). This significant difference is likely due to differences in the aquatic vegetation along with other factors. Lucchesi and Benjamin (1989) reported large beds of aquatic macrophytes in the upper reaches of Spring Lake. They also warned that high flow rates and increased sedimentation due to a breached peninsula might further degrade this habitat. Although the peninsula was replaced in 1995, losses of vegetation and depth occurred and will not likely return without physical improvements.

We recommend replacing the present last paragraph in this section with the one above.

3.7 – An important point which is missing in this section of the report is the reason for an increase in island acreage from 1994-1998 due to the construction of the peninsula. This needs to be added. Also, a map showing a comparison of 1975, 1989 and 2001 vegetation coverage would be very informative. The present wording leads the reader to believe that all 570 acres surveyed by LTRMP in 2001 was vegetated. No mention is made of the percent of area which was open water. Add percent of open water to the discussion and comparison of vegetation in the same area in 1975, 1989 and 2001.

4.1 - Since closure at the upper end, current velocities in Spring Lake are not greater than 0.1 meters/s (0.3 ft/s) during the winter. Velocities exceeding 0.1 m/s were found near the inflows prior to 1995.

4.2 – The flow into Spring Lake continued to increase past 1977 due to continued erosion of the peninsula and other islands. This is supported by the information provided in sections 4.2.1

4.2.1 – Plates 4 and 5 should be referenced in this section. The reason for the "increase" in island acreage should be included in this section. The reason for the increase was the construction of the peninsula. Furthermore, plate 5 clearly indicates that island loss has continued in the project area. Several of the original island masses were smaller or gone when looking at size and location from 1994-1998.

4.3 – The loss of islands is also a factor contributing to turbidity increase due to resuspension and changes in aquatic plant beds. Please add to discussion in last 2 paragraphs on page 4-3.

4.3 - FYI - Korschgen's (and others) light penetration/TSS relationship for Pool 8 has been published in Aquatic Botany 58 (1997) 1-9. What are the turbidity levels in Spring Lake, and how do they compare with other parts of the UMR? We suspect that the values for this portion of Pool 5 are low compared to other UMR pools (i.e. due to the influence of Lake Pepin and no major inflows on the east side of Pool 5).

5.2 – Goal A: Spring lake does not presently support a popular fishery. We recommend replacing the justification for this goal with the following discussion:

The Spring Lake fishery traditionally supported backwater species such as bluegill, black crappie, yellow perch and largemouth bass. It is not uncommon to find local anglers that recollect an extremely popular winter fishery that received pressure from more than one hundred ice shanties. This quality winter fishery occurred as late as the mid-80s. However, fishery declines appeared to occur due to increased flow, decreased depth and loss of aquatic vegetation. Recent winters have brought only a few anglers to Spring Lake. Management goals for Spring Lake are to maintain year-round backwater fishery habitat and prevent future degradation of the aquatic plant community.

5.2 -- Objective A1 D. We recommend modifying the following objectives to include a depth criteria for meeting the objective of water velocity. Suggested modification is: Mid-depth current velocity <0.3 cm/sec over 80 % of the area.

5.2 – General comment: It would be more appropriate to look at the joint occurrence of temperature, DO and velocity for setting/specifying "minimal" centrachid habitat conditions. Based on Wisconsin DNR monitoring of the Lake Onalaska Dredge Cut, we have proposed DO > 3 mg/L, Temp > 1C and velocity < 1 cm/s. These things can be tweaked somewhat but we believe this approach provides a better way to assess winter conditions since they are based on actual measurements. For example it is not likely/common to have DO > 5 and Temp > 2 C during mid-winter conditions due to thermal stratification and reduced photosynthetic activity under ice and snow cover. Perhaps this type of discussion may be appropriate to add in a later section of the DPR (i.e. 7.5.1.1).

7.0 – Islands have also been constructed in Pools 9 and 10. These should be added to the discussion.

7.0 - The benefits of increasing the depth in the project area as borrow for the islands was not included in any of the analysis. This feature will definitely improve habitat conditions in several of the alternatives. We recommend that the analysis be done with inclusion of the benefits of the dredge cuts <u>or</u> the discussion be modified to clearly indicate that the benefits of the islands was not included in any of the analysis with 1 or 2 examples of how including consideration of the dredge cuts increases the habitat value of areas in the Spring Lake.

7.4.1.1 – And the Habitat Evaluation Appendix – Alternative 6, which evaluates the construction of island 3, should include an increase in winter water temperature and reduction of velocities for the area of Spring Lake protected by island 3. We estimate that the winter water temperature will increase to approximately 1.5 degrees C on average and velocities will be undetectable throughout much of the protected area.

7.4.1.1 b – Island 3 will be a major locations for the disposal of dredged material. Therefore, the HEP analysis, or discussion, should include credit for the increase of deep water in the upper portions of the project area.

7.6.1 – Add mention that alternative evaluation did not include the benefits of dredging in the project area. The dredging in the upper portion of the project area is considered critical to us for meeting the biological objective of improving backwater fishery habitat. Also, the discussion for Alternative 6 should include the benefits it would provide for the upper portions of the project area if it is built and the borrow was obtained from the areas indicated on Plate 9.

Add a reference to Plate 9 at the end of this section.

8.1.1 - Deposition of fines and sand (bedload) are both concerns we have for the area. Based on the island configuration in the interior, we doubt that adequate velocities will be present to "flush" accumulated fine materials during flood events. We are concerned that additional bedload may enter the area if the sills are not high enough. Please review the hydraulic analysis to determine if higher sill elevations may be appropriate if reduction of bedload entering the area may be a greater concern.

8.1.2 – Some of the rock mounds may function similar to the seed islands in Pool 8. The discussion should include mention of the potential secondary benefit of accumulating material over time.

8.1.3.2 and 8.1.3.3 - We recommend adding trees (ash, maple, river birch) as plantings to these islands in addition to the grass/forb mix.

8.1.5 - Construction Restrictions - It is likely that lower TSS limits would be required based on the demonstration that lower limits are achievable. Further, restrictions would be placed on sand borrow sources to ensure the base of islands are constructed with minimal fines (i.e. P200 < 10%).

Item a. We do not concur that waterfowl migration season is a restriction on construction. Spring Lake is not part of a waterfowl hunting closed area, which is where this restriction is sometimes applied. Remove this restriction.

It is likely that portions of some islands may be constructed mechanically. This option should be added to c and d.

Item e should include mention that the upper dredge cuts will be mandatory for the purpose of meeting one of the primary goals, which is improving over-wintering habitat for backwater fish species.

8.4.1 – A cost comparison of obtaining sand borrow from the main channel and the disposal sites was done during project planning. A discussion of the increased cost of obtaining the material from these locations should be included in the DPR.

8.4.1 - Proposed borrow source for sand material. Have there been adequate borings collected between islands 2 and 4 to show that suitable material is available? We believe sand is readily available adjacent to the deep hole located in the area downstream of island 3. This was the site for sand borrow used for the construction of the lock and dam 5 dike. Additional borings for the area may also be included in the planning and as built drawings for lock and dam 5 dike. If so, these should be referenced in this section and included in the DPR geotech appendix.

Table 8-4 – Remove reference to no work during the waterfowl season.

Page 10-2 – The is no 2001 photo on plate 13. Remove reference to 2001 photo.

Pages 12-1 and Page 12-2, Table 12-1 - This table references NPS (EMTC) which no longer exists.

Plate 11 - Mud/Sand flat x-section - The top elevation is lower than Pool 5 control pool elevation by 0.4 ft. We assume this is the proposed elevation once the berm has stabilized. We recommend that the planned x-section dimension of this berm during the construction phase also be included.

404(b)(1) B. page 4 - Water Circulation - We would not expect winter DO to increase in Spring Lake as a result of this project. Instead, winter DOs would be expected to decrease due to increased thermal stratification and increased hydraulic retention time (greater SOD). Decreasing the hydraulic retention time may lead to greater phytoplankton concentrations at times. Increased growths of submersed aquatic vegetation will also contribute to increased summer DO/temperature stratification and greater opportunities for filamentous algae and floating-leafed vegetation (i.e. Lemna) development. This vegetation will have a strong influence on circulation, mixing and reaeration.

404(b)(1) C. page 5 - Turbidity - Summer turbidity levels would decrease noticeably if 80% SAV coverage is realized as a result of reduced sediment resuspension and increased hydraulic retention time.

404(b)(1) page 7 - Table 404-1. The chromium value reported for record #3 collected in 1991 needs to be changed as indicated above. The PCB listing is for Aroclors 1016 but should include Aroclors 1221 to 1260.

Hydrodynamics - page 5-4 - Pool 8 should be changed to Pool 5 (first sentence).

Hydrodynamics - page 5-5 - Table 5-4. What about winter measurements? These have been made by the WDNR at the inlets in the mid to early 1990s. I believe this information has been provide to Jon Hendrickson and Dan Wilcox in the past.

We recommend that a discussion on the impacts of the earthen dike culverts at Dam 5 be included. We didn't see any discussion in the main body of the report concerning the expected influence these culverts have in controlling current velocities, DO and temperature in the project area, especially during winter conditions. It may be desirable to reduce the winter flows through these culverts to optimize winter habitat conditions in Spring Lake as well as Fountain City Bay. We noticed that this is covered in the Hydraulics sections. This information should be discussed in the main portion of the report as well with potential options identified.

We look forward to the completion of the Spring Lake DPR and construction of the project. Please contact Jeff Janvrin at the above address, phone 608-785-9005, or e-mail Jeff.Janvrin@dnr.state.wi.us, if you have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Scot Johnson, MNDNR, with enclosures
Bob Drieslein, USFWS
Gary Wege, USFWS

PM-A/Novak

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

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management 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 for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (3 copies)

Copy Furnished:
Brian Brecka (1 copy)

Responses to Minnesota DNR Comments

Our review of the draft DPR suggests to us that the monitoring information presented within the text of the document does not adequately support the proposed HREP. Moreover, many of the HREP objectives are quantitative while the characterization of the project area's current conditions is very generalized and dependent on old monitoring data.

The following examples illustrate the lack of monitoring data to support the need for Objective A1:

"Objective A1: Create and/or enhance overwintering (November – March) habitat for Centrarchids meeting the following criteria:

A. A minimum of three discrete areas.
B. A minimum of 20 acres per area.
C. Dissolved Oxygen levels $\geq$5 mg/l.
D. Current Velocity< 0.3 cm/sec over 80% of the area."

Comment #1

DPR Page 3-3 "A detailed analysis of riverbed elevation changes in the Spring Lake area cannot be made because of a lack of accurate and complete hydrographic surveys over time."

The 2001 Flood was the second largest flood on record. The 2001 Flood had the potential to scour and deposit large amounts of sand in the project area. To support the need for Objective A1A "A minimum of three discrete areas." and Objective A1B "A minimum of 20 acres per area", a survey should be completed to determine the current bathymetric conditions within the project area.

Response: The 2001 high water event did have the potential to scour and deposit sand within the project area. However, given the distance of Spring Lake from a sediment source, the changes are likely small in scale. To determine the current conditions, a more detailed survey can be taken during the plans and specifications stage.

Comment #2

DPR Page 3-1 "Current velocities are usually low throughout Spring Lake. Velocities measured under the ice were generally less than 0.1 ft/sec (Lucchesi and Benjamin, 1988)."

Response: While current velocities are generally low throughout Spring Lake, they are too high to support the goal of a winter fishery. The objective velocity to provide over-wintering habitat was established as 0.3cm/sec (0.01ft/sec).

Comment #3

DPR Page 3-4 "During winter, areas within Spring Lake that are protected from current tend to be warmed by the river bottom, perhaps from an influx of groundwater, to temperatures up to several degrees warmer than the near-freezing water in the flowing channels. Winter warm temperatures under the ice are quite stable…"

If Spring Lake water is warm and stable in areas protected from current, the Objective A1D calling for "current velocity < 3 cm/sec over 80% of the area" may already have been met for the project area. Are there more recent flow velocity data sets available for winter ice conditions that show a problem throughout the project area? Are there water temperature maps or profiles available for winter ice conditions in the project area?

Response: While it is unclear in the quoted text, it is not implied that most of Spring Lake is protected from current. It should have been stated that these conditions currently exist in a relatively small area behind the repaired peninsula. However, there are more recent data that show high current velocities do exist in most of Spring Lake. This information will be included in the DPR to support the project objectives.

Comment #4

DPR Page 3-4 "Dissolved oxygen in Spring Lake is normally above the 5-mg/l concentrations necessary to sustain most forms of aquatic life."

Objective A1C, Dissolved Oxygen levels $\geq$ 5mg/l, appears to have been met already. However, the data cited is 14 years old and from a different part of Pool 5. If this objective is not already met under the current environmental conditions, more recent data from the Spring Lake Area should be referenced or collected.

Response: More recent data are available, however, these data show that this objective is being met in Spring Lake. It is often the case that in areas with high flows that winter DO will be above 5 mg/l and will even approach saturation. This objective was included because in projects such as this when current velocities, and consequently, water exchanged rates are decreased, DO levels will also decrease. Without this objective it would be likely that a project would be developed that would actually have a negative impact on winter fisheries by creating habitat with ideal flow velocities but no DO. Clarification for this objective will be added to the report.

Comment #5

DPR Page 3-5 "No population estimates of fish in Spring Lake are available. Average standing stock of bluegill in backwater lakes, sloughs, and side channels of the UMR pools is 21.2 kg/hectare (Pitlow 1987). Standing stock of largemouth bass from the same set of samples averaged 5.5 kg/hectare. Populations of blue gill and bass in Spring Lake may be somewhat higher than these figures because of the protected backwater character of the area."

If the Spring Lake blue gill and bass populations are somewhat higher than the average because of the protected backwater character of the area, what is the justification for Objective A1? Does more recent monitoring data document a problem in the area?

Response: The above narrative from the report should have stated, that "Populations of bluegill and bass in Spring Lake may have been similar to these figures when it was a protected backwater prior to island erosion". There are no population estimates available for Spring Lake. However, this section will be revised to include the limited data that is available that shows a probable decline in the populations of backwater fishes in Spring Lake.

In our opinion, an analysis of some of the additional proposed project objectives would likely provide similar results. The documentation within the DPR text simply does not justify the project in many cases. If there are better data sets or observations that can be referenced and documented within the text, this project would have a much better chance at being endorsed and/or approved. If the stated objectives remain as quantitative as they are now, a large amount of pre-project field data must be collected to characterize the project area and justify the project. A similar level of post-project monitoring would be needed to document the benefits of the project.

Problem Identification Section

Statements within the Problem Identification Section are not always supported by the monitoring data referenced within the text of the document. For example:

Comment #6
DPR Page 4-1"Existing habitat conditions in Spring Lake are deficient in meeting management goals."

The monitoring data provided in the DPR suggests that conditions in Spring Lake may already meet Objective A1's criteria.

Response: Text will be revised to clarify current Spring Lake conditions.

Comment #7
DPR Page 4-1 "Wildlife habitat includes the open water areas, submergent vegetation, emergent vegetation and the islands. The primary wildlife habitat deficiency is the increasing lack of aquatic vegetation to wave action."

Yet the vegetation information provided in DPR Page 3-4 states: " ...The emergent vegetation beds in the Lost Island-Belvidere Slough area are evenly distributed throughout, although Spring Lake had a higher coverage than the other areas surveyed

(Nielsen et al. 1978). Emergent species found in Spring Lake during this study were water lily, arrowhead, narrow-leaf arrowhead, burreed, cattail, and lotus. A total of 15 species of submergent aquatic plants were also identified within Spring Lake in the study including coontail, wild celery, river pondweed, curly-leaf pondweed, waterweed, and water star grass…" and

Response: More recent vegetation data will be incorporated into the DPR and the text will be reviewed and revised to show the current trend in the loss of vegetation coverage and diversity.

Comment #8
DPR Page 3-7 states, "Interspersion of shallow open water, submergent and emergent aquatic plant beds has not been quantified; however, it appears good."

To support the statement that there is an increasing lack of aquatic vegetation, more recent data should be presented to show/quantify the decline.

Concur. More recent data from the Wisconsin DNR has been included.

Comment #9
The 2001 LTRMP Land Cover/Land Use Assessment in the Coordination/Correspondence Attachment 8 states: "Despite the later date all submersed and emergent vegetation appeared vigorous and health because of the warmer than usual weather and excellent water quality."

Figure 1 shows a visual comparison of a 1984 true color photograph to a 2001 infrared photograph – but does not provide a numeric comparison of aquatic vegetation acreages. Table 1 only shows acreages for 2001. Figure 2 in this assessment illustrates a diverse and widespread distribution of aquatic plants in the Spring Lake Habitat Project. Again, where are the monitoring results that show the decline in aquatic plant beds?

Response: Simple aquatic plant coverage is not the only criterion that should be applied to plant bed quality. Aquatic plant diversity should also be considered. An analysis and discussion showing changes in plant bed diversity and coverage will be included in the report.

Comment #10
Section 4.2 Historically Documented Changes in Habitat - "A reduction in the fisheries output and aquatic plant bed area has been observed."

Where are the data sets or who observed these changes and how were they documented over time?

Response: The Paragraph has been revised as follows, "Flow into Spring Lake increased because the peninsula forming the head of the lake was breached

during the period from 1964 to 1977. The loss of barrier islands, the breach in the peninsula, and the decline of aquatic vegetation changed flow conditions and wave action in the lake. Although quantitative data on declines in use by waterfowl and other wildlife are not available, local resource managers believe that the lake has a much greater potential for habitat use than currently exists. This reasoning is based on the fact that the area was more heavily used by fish and wildlife in the past and the physical changes are producing habitat conditions that are not as conducive to their use."

Comment #11

Section 4.2.1 "The loss of barrier islands in Spring Lake is well documented".

Also documented, in Table 4-1 Island Loss in the Spring Lake Area, is an increase in island area from 1994 to 1998 . The 1998 acreage is actually greater than what was present in 1989. This could be interpreted at an indication the Spring Lake area has actually turned the corner and is now entering a period of aggradation that is resulting in the natural development of new islands. More discussion is needed here.

Response: The completion of the upper peninsula breach closure project in 1995 did help stabilize the upper portion of Spring Lake. However, erosion of the lower barrier island chain has continued. Wind and wave action have been identified as the principal cause of erosion. The predominant wind directions in the Spring Lake project area are northwesterly and southeasterly, with a wind fetch of 6,000 feet. These conditions allow a wave height up to 1 foot. Continued barrier island loss, caused by these conditions, will not be halted unless the wind fetch is disrupted.

Comment #12

Section 4.3.1 "The turbidity observed in Spring Lake may be the result of several factors, including the resuspension of fine substrates by wind-induced turbulence, the importation of suspended solids via the breach in the peninsula, the growth of planktonic algae, and feeding of rough fish."

There are no turbidity observations or measurements provided in the text of the DPR to show that there is a turbidity problem let alone the identification of a main cause of the problem.

Response: Concur. Report will be revised to include the TSS data. See Wisconsin Comment/Response No. 3.

Comment #13

In the Coordination/Correspondence Attachment 8, a 1998 technical memo from Pat Foley states: "Since TSS in Spring Lake is already low, it is doubtful that it can be reduced further… To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed."

On what Total Suspended Solids (TSS), turbidity or other data was a decision made to build islands?

Response: Concur. Report will be revised to include the TSS data. See Wisconsin Comment/Response #3.

Comment #14

DPR 4.3 Factors Influencing Habitat Change – This section completely misses the point that the area has been permanently inundated by 9-Foot Channel Project. This section should explain the environmental impacts occurring with the Spring Lake area in the context of the navigation reservoir impoundment.

Response: In addition to previous paragraphs, i.e. Section 4.2.3, the following paragraph has been added to 4.3. Construction of L/D 5 submerged the natural levees and floodplain in the lower end of Pool 5 resulting in continuous flow of water and sediment through the floodplain for all conditions. The higher parts of the natural levee became islands. Submergence caused changes in vegetation communities resulting in decreased floodplain resistance and increased floodplain conveyance with time. For river flows near and well above bank full, the majority of the conveyance is now in the floodplain in the lower pool 5. This has decreased the hydraulic slope in the pools and subsequently the fluvial processes of erosion and deposition in channels.

Comment #15

DPR 4.4 Estimated Future Habitat Types and Conditions – There are plans being developed to change how water levels are managed in Pool 5 and therefore it is likely that the water regime will change. The potential changes and benefits of a water level drawdown should be explained in detail within this section. Natural island formation is occurring rapidly just upstream of the Spring Lake area. The potential for islands to form and be stabilized in conjunction with the development of additional emergent plant beds associated with water level drawdowns should be explained as a possible alternative to the selected plan. The future habitat conditions discussion should be tempered by this potential development.

Response: The presence of emergent beds and deposition of sediment related to a drawdown will help stabilize the landmass in Spring Lake. However, the distance of Spring Lake from a significant sediment source will prevent rapid natural island formation. The repairs completed on the upper peninsula have cut off sediment from Belvidere Slough, which fed the area in the late 80s and early 90s. Additionally, natural reestablishment of the barrier chain will be hindered by the presence of wave action. Wind driven wave action has been identified as the primary cause of erosion.

The magnitude, timing, and frequency of drawdowns are insufficient to cause rapid changes in river planform in lower pool 5. If there is a response of natural levee or island growth, it will be years before there is a significant change in planform. In the mean time the Spring Lake Island project will provide improved and desired habitat conditions. In addition, the longevity of emergent plant beds created by future water level management in pool 5 will be increased by the Spring Lake project. These two forms of river restoration (hydrologic as in water level management, and planform as in island construction) compliment each other and must be done in parallel.

Comment #16

DPR 8-11 The Corps' Operation and Maintenance staff at Fountain City are still receptive to discussing the possible use of Lost Island sand in the Spring Lake project.

Response: See Wisconsin DNR Comment #30 and COE response. In addition, we've had continued discussion with Steve Tapp, Dan Krumholz (Channel Maintenance) and Gary Palesh (Pool 5 Drawdown Initial Report) and there are still no cost savings to either the EMP or O&M Channel Maintenance Program to do the above.

Comment #17

DPR 8-12 The schedule is not consistent with the text as far as when construction is planned to begin.

Response: Concur. Schedule has been revised.

Comment #18

DPR 12-1 Pool 5 is not considered a key pool by the LTRM program. The Lake City LTRMP Field Station has recently completed some water quality, fish and vegetation monitoring in Pool 5 as the LTRM Program sought to expand its monitoring coverage to include pools adjacent to the key pools. With the current level of funding in the appropriation bill, it is doubtful that any LTRMP monitoring will be done in Pool 5 in 2003. However, in our opinion, HREP funds could be used by the Corps to support future LTRMP monitoring activities that are deemed necessary for proper evaluation of HREPs.

Response: Concur. The entire paragraph has been deleted.

Comment #19

Table 12-1 This table needs to be updated to reflect the correct names of the federal agencies involved in the proposed evaluation.

Response: Concur. Table 12-1 has been revised.

Comment #20

Figures 7, 7.1 and 9 These figures need better titles on the plates to differentiate old proposed plans from the selected plan.

Response: Concur. Titles have been revised.

Comment #21

Geotechnical Appendix – Attachment 8 The statement that the area was not glaciated during the Pleistocene is wrong. The geology section should be updated using more current references.

Response: Concur. The sentence was reworded to say "Approximately 3/4 of the Wisconsin Western Uplands, and most of the Southeast Minnesota Uplands, were not overridden by glacial ice during the Wisconsin Stage of the Pleistocene Epoch and is known as the Driftless Area."

Comment #22

The DNR's MRT believes that until the necessary monitoring data is included in the DPR to support the project, a request for endorsement or approval of the Spring Lake HREP project should be deferred. We have been in contact with the WDNR and apparently they have additional water quality and fisheries monitoring data that will help support the proposed project. LTRM submerged vegetation data is available for the Spring Lake area for 2001 when approximately 100 random sites were sampled by Lake City and Onlalska Field Stations. In addition, the Lake City Field Station sampled approximately 30 sites in 2002.

Response: Additional data has been supplied by the Wisconsin DNR has been incorporated into the report.

Minnesota Department of Natural Resources

DNR Waters
1801 South Oak Street
Lake City, Minnesota 55041

651/345-5601

October 21, 2002

Mr. Tom Novak, Project Manager
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Novak:

Re: draft Spring Lake HREP Definite Project Report (DPR) and Environmental Assessment (EA)

Representatives from the Department of Natural Resources' (DNR) Mississippi River Landscape Team (MRT) have completed their review of the draft Definite Project Report and Environmental Assessment for the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) dated September 10, 2002. The DNR's MRT is an inter-disciplinary team comprised of field and central office professional staff that work with Upper Mississippi River programs and projects. The MRT would like to take this opportunity to recognize and thank the Corps staff for their efforts in the development of the draft DPR.

The intent of our comments today are to provide the Corps with constructive input into the HREP planning process that will result in a planning document that can be endorsed by the River Resources Forum, approved by Mississippi Valley Division and result in a wise expenditure of federal taxpayers monies to improve fish and wildlife habitat in the Spring Lake project area.

Our review of the draft DPR suggests to us that the monitoring information presented within the text of the document does not adequately support the proposed HREP. Moreover, many of the HREP objectives are quantitative while the characterization of the project area's current conditions is generalized and dependent on old monitoring data.

The following examples illustrate the lack of monitoring data to support the need for Objective A1:

"Objective A1: Create and/or enhance overwintering (November – March) habitat for Centrarchids meeting the following criteria:

A. A minimum of three discrete areas.
B. A minimum of 20 acres per area.
C. Dissolved Oxygen levels $\geq$ 5 mg/l.
D. Current Velocity< 0.3 cm/sec over 80% of the area."

DPR Page 3-3 *"A detailed analysis of riverbed elevation changes in the Spring Lake area cannot be made because of a lack of accurate and complete hydrographic surveys overtime."*

The 2001 Flood was the second largest flood on record. The 2001 Flood had the potential to scour and deposit large amounts of sand in the project area. To support the need for Objective A1A "A minimum of three discrete areas." and Objective A1B "A minimum of 20 acres per area", a survey should be completed to determine the current bathymetric conditions within the project area. A comparison of bathymetric surveys before and after the 2001 Flood can be used to illustrate trends in the project area.

DPR Page 3-1 *"Current velocities are usually low throughout Spring Lake. Velocities measured under the ice were generally less than 0.1 ft/sec (Lucchesi and Benjamin, 1988)."*

DPR Page 3-4 *"During winter, areas within Spring Lake that are protected from current tend to be warmed by the river bottom, perhaps from an influx of groundwater, to temperatures up to several degrees warmer than the near-freezing water in the flowing channels. Winter warm temperatures under the ice are quite stable..."*

If Spring Lake water is warm and stable in areas protected from current, the Objective A1D calling for "current velocity < 3 cm/sec over 80% of the area" may already have been met for the project area. Are there more recent flow velocity data sets available for winter ice conditions that show a problem throughout the project area? Are there water temperature maps or profiles available for winter ice conditions in the project area?

DPR Page 3-4 *"Dissolved oxygen in Spring Lake is normally above the 5-mg/l concentrations necessary to sustain most forms of aquatic life."*

Objective A1C, Dissolved Oxygen levels ≥ 5mg/l, appears to have been met already. However, the data cited is 14 years old and from a different part of Pool 5. If this objective is not already met under the current environmental conditions, more recent data from the Spring Lake Area should be referenced or collected.

DPR Page 3-5 *"No population estimates of fish in Spring Lake are available. Average standing stock of bluegill in backwater lakes, sloughs, and side channels of the UMR pools is 21.2 kg/hectare (Pitlow 1987). Standing stock of largemouth bass from the same set of samples averaged 5.5 kg/hectare. Populations of blue gill and bass in Spring Lake may be somewhat higher than these figures because of the protected backwater character of the area."*

If the Spring Lake blue gill and bass populations are somewhat higher than the average because of the protected backwater character of the area, what is the justification for Objective A1? Does more recent monitoring data document a problem in the area?

In our opinion, an analysis of other proposed project objectives would likely provide similar results. The documentation within the DPR text simply does not justify the project in many cases. If there are better data sets or observations that can be referenced and documented within the text, this project would have a much better chance at being endorsed and/or approved. If the stated objectives remain as quantitative as they are now, a large amount of pre-project field data should be collected to characterize the project area and justify the project. A similar level of post-project monitoring may be needed to document the benefits of the project.

Problem Identification Section

Statements within the Problem Identification Section are not always supported by the monitoring data referenced within the text of the document. For example:

DPR Page 4-1 "*Existing habitat conditions in Spring Lake are deficient in meeting management goals.*"

The monitoring data provided in the DPR suggests that conditions in Spring Lake may already meet Objective A1's criteria.

DPR Page 4-1 "*Wildlife habitat includes the open water areas, submergent vegetation, emergent vegetation and the islands. The primary wildlife habitat deficiency is the increasing lack of aquatic vegetation to wave action.*"

Yet the vegetation information provided in DPR Page 3-4 states: " ...*The emergent vegetation beds in the Lost Island-Belvidere Slough area are evenly distributed throughout, although Spring Lake had a higher coverage than the other areas surveyed (Nielsen et al. 1978). Emergent species found in Spring Lake during this study were water lily, arrowhead, narrow-leaf arrowhead, burreed, cattail, and lotus. A total of 15 species of submergent aquatic plants were also identified within Spring Lake in the study including coontail, wild celery, river pondweed, curly-leaf pondweed, waterweed, and water star grass...*" **and**

DPR Page 3-7 states, "*Interspersion of shallow open water, submergent and emergent aquatic plant beds has not been quantified; however, it appears good.*"

To support the statement that there is an increasing lack of aquatic vegetation, more recent data should be presented to show/quantify the decline.

The 2001 LTRMP Land Cover/Land Use Assessment in the Coordination/Correspondence Attachment 8 states: "*Despite the later date all submersed and emergent vegetation appeared vigorous and healthy because of the warmer than usual weather and excellent water quality.*"

Figure 1 shows a visual comparison of a 1984 true color photograph to a 2001 infrared photograph – but does not provide a numeric comparison of aquatic vegetation acreages. Table 1 only shows acreages for 2001. Figure 2 in this assessment illustrates a diverse and widespread distribution of aquatic plants in the Spring Lake Habitat Project. Again, where are the monitoring results that show the decline in aquatic plant beds?

Section 4.2 Historically Documented Changes in Habitat - *"A reduction in the fisheries output and aquatic plant bed area has been observed."*

Where are the data sets or who observed these changes and how were they documented over time?

Section 4.2.1 *"The loss of barrier islands in Spring Lake is well documented".*

While the loss of islands since the 1930s is clearly illustrated, also documented in Table 4-1 Island Loss in the Spring Lake Area is an increase in island area from 1994 to 1998. The 1998 acreage is actually greater than what was present in 1989. This could be interpreted at an indication the Spring Lake area has actually turned the corner and is now entering a period of aggradation that is resulting in the natural development of new islands. More discussion is needed here.

Section 4.3.1 *"The turbidity observed in Spring Lake may be the result of several factors, including the resuspension of fine substrates by wind-induced turbulence, the importation of suspended solids via the breach in the peninsula, the growth of planktonic algae, and feeding of rough fish."*

There are no turbidity observations or measurements provided in the text of the DPR to show that there is a turbidity problem let alone the identification of a main cause of the problem.

In the Coordination/Correspondence Attachment 8, a 1998 technical memo from Pat Foley states: *"Since TSS in Spring Lake is already low, it is doubtful that it can be reduced further... To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed."*

On what Total Suspended Solids (TSS), turbidity or other data was a decision made to build islands?

Other Comments

DPR 4.3 Factors Influencing Habitat Change – This section completely misses the point that the area has been permanently inundated by 9-Foot Channel Project. This section should explain the environmental impacts occurring with the Spring Lake area in the context of the navigation reservoir impoundment.

DPR 4.4 Estimated Future Habitat Types and Conditions – There are plans being developed to change how water levels are managed in Pool 5 and therefore it is likely that the water regime will change. The potential changes and benefits of a water level drawdown should be explained in detail within this section. Natural island formation is occurring rapidly just upstream of the Spring Lake area. The potential for islands to form and be stabilized in conjunction with the development of additional emergent plant beds associated with water level drawdowns should be examined as a possible alternative to the selected plan. The future habitat conditions discussion should be tempered by this potential development.

DPR 8-11 The Corps' Operation and Maintenance staff in Fountain City are still receptive to discussing the possible use of Lost Island Containment Site sand in the Spring Lake project.

DPR 8-12 The schedule is not consistent with the text as far as when construction is planned to begin.

DPR 12-1 Pool 5 is not considered a key pool by the LTRM program. The Lake City LTRMP Field Station has recently completed some water quality, fish and vegetation monitoring in Pool 5 as the LTRM Program sought to expand its monitoring coverage to include pools adjacent to the key pools. With the current level of funding in the appropriation bill, it is doubtful that any LTRMP monitoring will be done in Pool 5 in 2003. However, in our opinion, HREP funds could be used by the Corps to support future LTRMP monitoring activities that are deemed necessary for proper evaluation of HREPs.

Table 12-1 This table needs to be updated to reflect the correct names of the federal agencies involved in the proposed evaluation.

Figures 7, 7.1 and 9 These figures need better titles on the plates to differentiate old proposed plans from the selected plan.

Geotechnical Appendix – Attachment 8 The statement that the area was not glaciated during the Pleistocene is wrong. The geology section should be updated using more current references.

The DNR's MRT believes that until the necessary monitoring data is included in the DPR to support the project, a request for endorsement or approval of the Spring Lake HREP project should be deferred. We have been in contact with the WDNR and apparently they have additional water quality and fisheries monitoring data that will help support the proposed project. LTRM submerged vegetation data is available for the Spring Lake area for 2001 when approximately 100 random sites were sampled by Lake City and Onlaska Field Stations. In addition, the Lake City Field Station sampled approximately 30 sites in 2002.

Thank you for the opportunity to comment on the draft DPR and EA. It is our hope that the Corps and other partners will give our comments due consideration before moving ahead with project planning activities. Please give me a call if you would like to discuss or to set up a meeting to go over our comments. I can be contacted at the address and phone number listed above.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jeff Janvrin, WDNR, LaCrosse
Bob Drieslein, USFWS, Winona
Steve Johnson, MDNR, St. Paul
Dave Leuthe, MDNR, New Ulm
Tim Schlagenhaft, MDNR, Rochester
Dan Dieterman, MDNR, Lake City
Kevin Staufer, MDNR, Lake City

PM A/Novak

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

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management Division

Mr. Scot Johnson
Habitat Projects Coordinator
Minnesota Department of Natural Resources
1801 South Oak Street
Lake City, Minnesota 55041

Dear Mr. Johnson:

Enclosed for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (2 copies)

Copy Furnished:
Steve Johnson (2 copies)

Responses to USFWS Comments

Comment #1

1. On the second page of the Executive Summary of the Report, it is stated that project construction is scheduled to begin in 2003 and be completed in 2004. Is the reference here to fiscal years? The schedule shown on page 15-1 indicates that construction would begin in 2004 and be completed in 2005. Which statement is correct?

Response: Concur. Schedule has been corrected.

Comment #2

2. Under Section 3.62, first paragraph, the second sentence should be revised to read, "Common species include the coot and a variety of waterfowl including the mallard, blue-winged teal and woodduck".

I would also suggest deleting the words, "large numbers of" from the third sentence in that paragraph.

Response: Concur. Text will be revised as suggested.

Comment #3

3. Objective B1,E. on page 5-8 states that 10-20 waterfowl loafing sites will be provided at scattered locations throughout the study area. There are no details on this and there is no mention made of it in the Cost Estimate Appendix. We strongly support this objective but think clarification is needed. Placement of trees along the shoreline such as was done on Polander Island complex could meet the requirements here.

Response: Concur. Cost Estimate will be corrected. Details will be added during Plans and Specifications.

Comment #4

4. Under Section 8.1.3. Islands, the Service would suggest that some limited plantings of native shrubs and trees be made. This would enhance plant diversity of the islands and if care is taken to specify locally available nursery stock, the cost may not exceed that of planting native grasses and forbs on the same site. The Service would be willing to provide the labor for tree and shrub plantings if that is desired to help keep project costs down.

Response: Concur. See response to Wisconsin DNR comment #25.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River National Wildlife and Fish Refuge
51 E. Fourth Street - Room 101
Winona, Minnesota 55987

IN REPLY REFER TO:

September 23, 2002

Mr. Tom Novak, Project Manager
Department of the Army
St. Paul District Corps of Engineers
Army Corps of Engineers Center
190 Fifth St. East
St. Paul, MN 55101-1638

Dear Mr. Novak:

Thank you for the opportunity to review the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project.

Based on our review of the draft report, we have a number of comments and questions which follow:

1. On the second page of the Executive Summary of the Report, it is stated that project construction is scheduled to begin in 2003 and be completed in 2004. Is the reference here to fiscal years? The schedule shown on page 15-1 indicates that construction would begin in 2004 and be completed in 2005. Which statement is correct?

2. Under Section 3.62, first paragraph, the second sentence should be revised to read, "Common species include the coot and a variety of waterfowl including the mallard, blue-winged teal and woodduck."

   I would also suggest deleting the words, "large numbers of" from the third sentence in that paragraph.

3. Objective BI, E. on page 5-8 states that 10-20 waterfowl loafing sites will be provided at scattered locations throughout the study area. There are no details on this and there is no mention made of it in the Cost Estimate Appendix. We strongly support this objective but think clarification is needed. Placement of trees along the shoreline such as was done on the Polander Island complex could meet the requirement here.

4. Under Section 8.1.3. Islands, the Service would suggest that some limited plantings of native shrubs and trees be made. This would enhance plant diversity of the islands and if care is taken to specify locally available nursery stock, the cost may not exceed that of planting native grasses and forbs on the same site. The Service would be willing to provide the labor for tree and shrub plantings if that is desired to help keep project costs down.

Aside from the comments/questions noted above, the Fish and Wildlife Service concurs with the recommended plan for the Spring Lake Islands HREP and we encourage the Corps of Engineers to move forward and maintain the momentum of this project as it moves closer to implementation.

We look forward to working with you and representatives of Wisconsin and Minnesota natural resource agencies on this project in the future.

Sincerely,

James Nissen
Acting Complex Manager

cc: Tim Schlagenhaft, MN DNR
Jeff Janvrin, WI DNR
Gary Wege, USFWS, Bloomington, MN
Jon Kauffeld, USFWS, Twin Cities, MN

PM-A/Novak

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

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management Division

Mr. Bob Drieslein
Refuge District Manager
U.S. Fish and Wildlife Service
51 East Fourth Street
Winona, Minnesota 55987

Dear Mr. Drieslein:

Enclosed for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the Wisconsin and Minnesota Departments of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (6 copies)

Novak, Tom MVP-PM-A

From: Sullivan, John F (DNR - LaCrosse) [SulliJ@mail01.dnr.state.wi.us]
Sent: Thursday, March 07, 2002 1:43 PM
To: Jeff Janvrin (E-mail); Clark, Steven J MVP
Subject: RE: Spring Lake HREP - Sediment Evaluation

Steve-

I think the sediment monitoring that was done for the Spring Lake Closure provides adequate information to assess the next phase. So I don't believe we need additional bulk chemical data to evaluate the proposed dredge cut. I am assuming that you will be preparing a 404(b)(1) evaluation for this project. The historic sediment data for Pool 5 should be adequate to assess the sediment contamination potential. As far as I know, the most recent data for lower Pool 5 is a surface composite sample collected as part of a post-flood evaluation effort in 1994 (i.e. Sullivan & Moody 1996). A copy of this should be in your District's library.

> ----------
> From: Clark, Steven J
> MVP[SMTP:Steven.J.Clark@mvp02.usace.army.mil]
> Sent: Wednesday, March 06, 2002 2:26 PM
> To: Jeff Janvrin (E-mail); John Sullivan (E-mail)
>
> <<File: rock island design.jpg>>
> Jeff and John - here is a jpeg of the design. Keep in mind that we are
> not certain where we are dredging for access and borrow (it looks now like
> we may expand the "big hole" for borrow). John - does this general area
> of pool 5 have a history of "excessive" contamination (do you have any
> major concerns)?
>
> <<rock island design.jpg>>
>
>

PUBLIC MEETING NOTICE

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Since 1987, 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, has been investigating measures for fish and wildlife habitat restoration within Spring Lake. Spring Lake is an area of approximately 500 acres located in pool 5 of the Upper Mississippi River just above the Lock and Dam 5 dike adjacent to Buffalo City, Wisconsin. The study has been conducted under the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

Date: **February 25, 2002**

Time: **6:30 p.m. – 8:30 p.m.**

Location: **Buffalo City Community Room**
245 East 10th Street
Buffalo City, Wisconsin

Preliminary studies have been essentially completed and a draft report is being prepared recommending a number of measures to restore and enhance fish and wildlife habitat within the study area. These include:

- Construction of islands and rock features to provide protection from wind, waves, and flow.
- Construction of a channel for construction contractor and public access.
- Construction of mud/sandflats for waterfowl habitat and excess material placement.
- Dredging in the upper part of Spring Lake to provide topsoil for islands and to provide depth for fish habitat.

The purpose of the public meeting is to discuss the recommended habitat restoration features and provide the public an opportunity to provide comment on the recommended plan.

If there are any questions concerning the public meeting, please contact Tom Novak, Project Manager, at (651) 290-5524 or at tom.novak@.usace.army.mil.

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS

Date 25 FEB 2002

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 (optional)
Gene Smith	1355 S. River Rd	
Barb Smith	1355 So River Rd	
Jan Moe	1353 So " "	/
Burt Moe	" " "	
Tom Murray	S2935A Indian Creek Rd.	
Dick Gordon	S2935 Indian Creek Rd.	
Brian Bjarke	1368 South River Rd.	
STEVE BURMEISTER	165 W 9th ST	
CLIFFORD BURMEISTER	281 W 12th St.	
NICK SERSOGKO	473 W. 26TH	
Brett LADUKE	340 W 18st	
GAYLE LEWIS	S2322 CTY RD OO COCHRANE, WI.	
CHAD KUSIDOWSKI	376 N. BELVIDERE BUFFALO CITY	
Matt Forest	127 W 6th St Buffalo City FOUNTAIN CITY	
RON WOZNEY	S2922A INDIAN CR RD	
Ray Mueller	S1946 Prairie St F.C.	
ROBERT SIEKER	530 S MAIN FC	
Dale O. Hoch	S2028 Hickory Alma	
[illegible]	S2608 Alma	
Nancy Sagan	1305 So River BC.	
Larry Ross	P.O. BOX 10 Ft. City WI. 54629	

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS

Date 25 FEB 2002

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 (optional)
JACK HILT	1400 S. RIVER RD	SELF
GARY ROBINSON	96 E 1ST ST. Buffalo City	SELF
JOHN FANDREY	1372 S. RIVER Rd. Buff City	SELF
GENE GLOMSKI	81 3RD St B. City	SELF
Ray Spreeman	64 W 3rd St B. City	SELF
Phil Braun	1303 S. River Rd BCY	Self
H R Goeldner	280 State Road 35 N ALMA WI 54610	—
Jack Scherer	Cochrane 54622	—
Dan Wiki Wicka	Buffalo City 54622	City of Buffalo City
Dan Liethe	Cochrane 54622	Self
Ron Cisewski	Fountain City 54629	Self
BARRY AUER	BUFFALO CITY 54622	"
Patti Stinson	1394 S River Rd Buf City	Self
Bill Seivers	↓ ↓	"
Bun Burmaster	Buffalo City	Self
Brian Michaels	88 W 12th St Buffalo City	Self.
Tony L Boggs	1725 S RIVER RD	SELF
Warren Rivette	S2394 CTH 60	Self.
Bruce McFarlin	164 W 24th	Buffalo City
David Fratan[illegible]	1329 S. River Rd	" "
Ken Kaufahy	S River Rd	" "

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS

Date 25 FEB 2002

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 (optional)
Luann Rinn	181 W. 7th Buffalo City	Self.
Jim Pearson	1335 S River Rd	Self -
Dave Becker	1025 N. Front St. Buffalo	Self
Joan Weaver	1382 S. River Rd. Buffalo	self
Eugene Weaver	1382 S. River Rd. Buffalo	Self
[illegible]	RR#1 Box 37 Kellogg Mn 55945	Self
Joel Malanaphy	1384 S River Rd Buff City	self
Karl Hoffmann	645 S. River Rd.	
Joan Schnabel	Box 5 Fountain City WI	self / the river
SUSAN KELLER	1325 S. RIVER Rd. BUFFALO CITY	SELF
Jeff Falk	BOX 5 FTN CITY	Self
Ed ANNINK	450 W 24 Buffalo	Self
Deb Bartel	Clerk of Buffalo City	City
MARK PREVOST	S2401 N. HERMAN Buffalo City	self - W.W.A.
Sandy Michaels	88 W. 12th st. B.C.	B+S Express
John Weaver	1103 S. River Rd. B C	
Frank Kuhlman	1111 S. 2nd St. Alma.	Self
Keith Braunreiter	1225 Mississippi St La Crosse WI 54601	Self Wisconsin Waterfowl association

Novak, Tom MVP-PM-A

From: Sullivan, John F (DNR - LaCrosse) [SulliJ@mail01.dnr.state.wi.us]
Sent: Thursday, February 14, 2002 3:27 PM
Clark, Steven J MVP
Cc: Janvrin, Jeff A
Subject: RE: Pool 5 Spring Lake

Interestingly, I just talked with Jeff about this project. Your map is different that the one Jeff had. His showed more islands.

Anyway, I suggested to Jeff that the upper cut might be better - more head and greater mixing into the upper end of the project. However, we sure don't want a lot of flow through here, otherwise we will defeat the purpose of the upper dredge cuts. Right now, I am think about 10 cfs during winter conditions! I don't have a serious problem with bringing it in the lower cut, but we would probably want to see more flow here say 30-50 cfs. I don't think we need both cuts. Don't worry about providing oxygen flows everywhere. The fish can handle these gradients. Further, algae can play a major role even with out flows in some years with little snow (like this one!).

> ----------
> From: Clark, Steven J
> MVP[SMTP:Steven.J.Clark@mvp02.usace.army.mil]
> Sent: Thursday, February 14, 2002 2:57 PM
> To: John Sullivan (E-mail)
> Subject: Pool 5 Spring Lake
>
> <<File: spring lake notches.jpg>>
> John - I could use your opinion on an aspect of the Spring Lake HREP
> design we are working on. The attached image shows the current plan on a
> DOQ of the area. We are looking at a number of features, mostly islands.
> The upper end of the lake is of interest as over wintering habitat for
> centrarchids (as you probably know). We are proposing to protect the
> existing peninsula, construct a sill or dike in a hole in the peninsula
> (labeled notch 1), construct a rock dike/island structure off the bottom
> of the peninsula (shown as a red-checked reverse S) with a notch (notch
> 2), and dredging in the upper end for fine material. The area behind the
> island and peninsula is being protected for over wintering habitat but we
> must provide a minimum flow into the area for DO. I was always under the
> impression that we were going to introduce flow at notch 1. However, Jeff
> Janvrin now wants to introduce flow at notch 2. I believe he realizes
> that the upper end of the lake will go anoxic during late winter, but he
> says he is OK with that and what they are trying to accomplish is a
> gradient of conditions. I am afraid that if we only introduce flow
> through notch 2 too much of the upper end of the lake will go anoxic too
> soon and we would be defeating the purpose. Please take a look at it and
> let me know what you think, or call me so we can discuss it. Thanks.
>
> <<spring lake notches.jpg>>
> Steven J. Clark
> Fisheries Biologist
> U.S. Army Corps of Engineers, St. Paul District
> 190 5th Street East
> St. Paul, MN 55101-1638 USA
> Phone: (651) 290-5278
> Fax: (651) 290-5258
> steven.j.clark@mvp02.usace.army.mil
>

Novak, Tom MVP-PM-A

From: Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
nt: Thursday, February 01, 2001 1:52 PM
: 'Novak, Tom'
ubject: FW: Winter Survey at Spring Lake and Fountain City Bay area

```
fyi

> ----------
> From:     Sullivan, John F (DNR - LaCrosse)
> Sent:     Thursday, February 01, 2001 1:44 PM
> To:       Janvrin, Jeff A; Benjamin, Ron; 'Hendrickson, Jon'
> Cc:       Brecka, Brian J.
> Subject:  Winter Survey at Spring Lake and Fountain City Bay area
>
> Brian Brecka and I conducted a water quality survey of Spring Lake and
> Fountain City Bay yesterday (Jan 31, 2001).  This document is a quick
> summary FYI.
>
> Spring Lake
>
> A huge area of open water exists in the area north and west of spring
> Lake.  To our dismay, both the upper cut (new opening) and the lower cut
> to spring lake were open and flowing into Spring Lake.  We tried to gage
> the upper cut (about 50 ft wide), but it was too deep for wading.  Based
> on a few velocity measurements and an estimated x-sectional area of 100 sq
> ft, I would estimate the upper cut flow at 25 cfs.  The inflow had a DO of
> 13 mg/L and temperature of 0.6 C.
>
  Surface (1.5-2 ft depth) DOs in Spring lake were very good (around 12.5-13
  ng/L) with cold water (0.2 C).  Bottom DOs were a few tenths lower than
  surface measurements but had "warmer" water (0.6 - 0.9 C), even in the
> deep areas (10-11 ft) in lower Spring Lake.  Surface  and mid-depth
> velocities ranged from 0.06 to 0.12 ft/s with higher velocities noted
> below the lower cut. Obviously, the large volume of flow into this area
> has negatively influenced centrarchid habitat.
>
> Fountain City Bay
>
> Since we were not able to gage the inflows at Spring Lake, I suggested to
> Brian that we make a few measurements in the FCB area.
>
> Our first site was mid-channel off the upper boat landing (Merrick State
> Park) in Fountain City Bay.  DO and Temperature were essentially uniform
> top to bottom (11 ft) with measurements of about 11 mg/L and 0.0 C.  The
> surface and mid-depth velocity was about 0.2 ft/s.  As observed in the
> past, the high velocities isothermal conditions are due to the Spring Lake
> culvert and Waumandee Creek.
>
> Next, Brian took me to his secret fishing spots in the FCB backwaters to
> the west of the park.  Surface or mid-depth DOs were good (about 10 mg/L)
> with temperatures of about 0.7 C.  One site (Duck Pond) had a surface (1.5
> ft) DO of 10.3  and bottom (3.5 ft) DO of 1.2 mg/L in 3.5 ft of water with
> temperatures of 0.4 and 2.4 C, respectively.
>
> Next Week
>
> Due to higher winds and colder weather, I am rescheduling the Stoddard
  survey for next week.  I may also attempt to get a second survey of Long
  ake.
-
>
> John F. Sullivan
```

Novak, Tom MVP-PM-A

From: Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
Sent: Thursday, February 01, 2001 1:52 PM
To: 'Novak, Tom'
Subject: FW: Winter Survey at Spring Lake and Fountain City Bay area

fyi

> ----------
> From: Sullivan, John F (DNR - LaCrosse)
> Sent: Thursday, February 01, 2001 1:44 PM
> To: Janvrin, Jeff A; Benjamin, Ron; 'Hendrickson, Jon'
> Cc: Brecka, Brian J.
> Subject: Winter Survey at Spring Lake and Fountain City Bay area
>
> Brian Brecka and I conducted a water quality survey of Spring Lake and
> Fountain City Bay yesterday (Jan 31, 2001). This document is a quick
> summary FYI.
>
> Spring Lake
>
> A huge area of open water exists in the area north and west of spring
> Lake. To our dismay, both the upper cut (new opening) and the lower cut
> to spring lake were open and flowing into Spring Lake. We tried to gage
> the upper cut (about 50 ft wide), but it was too deep for wading. Based
> on a few velocity measurements and an estimated x-sectional area of 100 sq
> ft, I would estimate the upper cut flow at 25 cfs. The inflow had a DO of
> 13 mg/L and temperature of 0.6 C.
>
> Surface (1.5-2 ft depth) DOs in Spring lake were very good (around 12.5-13
> mg/L) with cold water (0.2 C). Bottom DOs were a few tenths lower than
> surface measurements but had "warmer" water (0.6 - 0.9 C), even in the
> deep areas (10-11 ft) in lower Spring Lake. Surface and mid-depth
> velocities ranged from 0.06 to 0.12 ft/s with higher velocities noted
> below the lower cut. Obviously, the large volume of flow into this area
> has negatively influenced centrarchid habitat.
>
> Fountain City Bay
>
> Since we were not able to gage the inflows at Spring Lake, I suggested to
> Brian that we make a few measurements in the FCB area.
>
> Our first site was mid-channel off the upper boat landing (Merrick State
> Park) in Fountain City Bay. DO and Temperature were essentially uniform
> top to bottom (11 ft) with measurements of about 11 mg/L and 0.0 C. The
> surface and mid-depth velocity was about 0.2 ft/s. As observed in the
> past, the high velocities isothermal conditions are due to the Spring Lake
> culvert and Waumandee Creek.
>
> Next, Brian took me to his secret fishing spots in the FCB backwaters to
> the west of the park. Surface or mid-depth DOs were good (about 10 mg/L)
> with temperatures of about 0.7 C. One site (Duck Pond) had a surface (1.5
> ft) DO of 10.3 and bottom (3.5 ft) DO of 1.2 mg/L in 3.5 ft of water with
> temperatures of 0.4 and 2.4 C, respectively.
>
> Next Week
>
> Due to higher winds and colder weather, I am rescheduling the Stoddard
> survey for next week. I may also attempt to get a second survey of Long
> Lake.
>
>

Spring Lake Islands
Interagency Meeting No. 3
January 30, 2002
0930 hrs- 1230 hrs
USFWS - Winona

AGENDA

1. Purpose of the Meeting

    - The purpose of the meeting is (1) discuss proposed project features, HEP evaluation, comparison of design features base on the December package (2) discuss and come to an agreement on proposed project features.

2. Project Features – December 01 Plan

    - Alternatives/Options
    - Proposed Alternative (Corps Jan 02 Plan)
    - Recommendations

3. Schedule –

    - Public Meeting date
    - Solicitation/Award -
        - Constraints - no new starts in FY 03
        - Opportunities – Pool Plans/Water Level Management

Spring Lake
30 January 2002

Tom Novak	COE	651-290-5524
Gary Wege	FWS	612/725-3548 ext 207
Pam Thiel	FWS	608-783-8431
Brian Brecka	WDNR	608-685-6221
KARI LAYMAN	COE	651-290-5424
Steve Clark	CoE	651-290-5278
Eric Nelson	FWS	507/494-6234
JEFF JANVRIN	WDNR	608/785-9005
Job Drieslein	USFWS	507-494-6229
Michelle Marron	WDNR	608-685-6221
Patrick Short	WDNR	608 326 8818
DAN DIETERMAN	MNDNR	651 345 3365
Scot Johnson	MDNR	651 345-5601
KEITH BESEKE	US FWS	507-452-4232
MARK ANDERSEN	WDNR	608-785-9994
Ron Benjamin	WDNR	" 785-9012

Novak, Tom MVP-PM-A

From:	Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
nt:	Thursday, November 30, 2000 10:04 AM
.	Benjamin, Ron; 'Beseke, Keith'; Brecka, Brian J.; 'Drieslein, Bob'; 'Novak, Tom'; 'Schlagenhaft, Tim'
Cc:	Benjamin, Gretchen L; 'Davis, Mike'; 'Johnson, Scot'; Sullivan, John F (DNR - LaCrosse); Wetzel, John F
Subject:	Spring Lake Islands Proposal

Spring Lake Island HREP new g ...

Attached are the goals, objectives, criteria and a proposed feature map for Spring Lake Islands HREP. This was prepared based on comments from the last meeting and a follow-up meeting with Brian Brecka, Jeff Janvrin and Bob Drieslein. In other words, everyone still needs to look at it and provided comments.

Tom, please forward this to COE staff working on the project, since I did not have all of their emails.

<<Spring Lake Island HREP new g and o.doc>>

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

Wisconsin Department of Natural Resources
ate Office Building, Room 104
50 Mormon Coulee Road
La Crosse, WI 54601
phone: 608-785-9005
fax: 608-785-9990
janvrj@dnr.state.wi.us

Spring Lake Island HREP,
Pool 5, Upper Mississippi River
Goals, Objectives, Criteria and Features

<u>Introduction</u>: Spring Lake is an area of approximately 300 acres located just above the Lock and Dam 5 dike adjacent to Buffalo City, Wisconsin. Historically the area had a diversity of habitats which included: wooded terrestrial islands, emergent wetlands, smaller flowing sloughs, submersed plant communities and open water which was devoid of vegetation due to depth. The "deepest" areas in the complex are Spring Lake proper, which is adjacent to the shoreline, and the area which was dredged to obtain material for construction of the dike. Before the islands eroded away, much of the area served as an overwintering site for centrarchids. It is likely that Spring Lake was also dominated by a centrarchid community before impoundment due to its depth and lack of flow.

The area was selected as a site for an Environmental Management Program Habitat Rehabilitation and Enhancement Project in 1987 with the final Definite Project Report (DPR) completed in August 1991. The DPR recommended the construction of Spring Lake Peninsula to reduce sedimentation and flow into the Spring Lake complex and also recommended the construction of islands to replace historic islands which had eroded and further improve habitat for fish and wildlife species. Due to financial constraints, only the Peninsula was constructed in 1992 and the design of the proposed island complex was not detailed. The agencies are now in the process of developing a Supplemental DPR to initiate construction of the islands proposed and justified in the 1991 DPR.

The 1991 DPR for Spring Lake included a series of goals and objectives for the project area along with criteria to ensure the quality of the habitat created would be suitable for a multitude of target species. These goals and objectives focused on improving habitat conditions for riverine and backwater fish species with an emphasis on overwintering habitat for centrarchids and wildlife habitat improvements for waterfowl (diver and dabblers) migratory habitat, wading birds and aquatic mammals (furbearers).

The goals, objectives and criteria were reviewed by the agencies for the supplemental DPR. Based on this review, the agencies determined that the general goals and objectives were still accurate, however, experience with other HREPs, and monitoring of completed projects, has resulted in a revision of some objectives, criteria and proposed features and addition of goals aimed at restoring specific habitat types not addressed in the 1991 DPR. These habitat types include: sand/mud habitat for turtles and waterbirds, mussel habitat in the flowing channels, and optimization of connectivity of various habitat types.

The main 1991 objective which has changed is "Decrease water flows from entering Spring Lake." During the development of the 1991 DPR the focus was on reducing discharge into the complex as much as possible. Experience with and monitoring of completed projects shows that "fighting" the discharge into an area can cause operation and maintenance problems. Additionally, water discharge into the Spring Lake area is partially related to the water control structure located in the dike which provides flow to the Whitman Wildlife area backwaters in Pool 5A. This structure "pulls" water into the Spring Lake complex and must be accounted for when proposing features for the Spring Lake Islands HREP. Therefore the agencies are proposing that rather than reduce the discharge into the complex, it is more desirable from a maintenance and habitat diversity standpoint to maintain discharges into Spring Lake by "routing" the flow through reestablishment of historic channels by employing specific project features.

The planning team also noted that no reference to a time frame of "Maintain" conditions was presented. Therefore, some of the objectives were changed to reference a specific time frame based on historical data which can be used as a guide to envision the desired habitat conditions.

Revised Goals, Objectives and Criteria:

The following objective was revised to reflect the desire to diversify flow distribution within the complex rather than strictly control discharge into the project area:

- ~~Decrease~~ Optimize the distribution of water flows ~~from~~ entering Spring Lake

The following objective was added to address habitat types not specifically mentioned in the 1991 DPR:

- Increase the aerial coverage of sand/mud habitat

Criteria/features for the objectives in the 1991 DPR and those listed above are as follows *(species/guilds to be benefited are present in parentheses and italics).*

Optimize the distribution of water flows entering Spring Lake *(invertebrates, migratory and brood rearing habitat for waterfowl and shorebirds, spawning habitat for backwater fish species, turtle habitat, riverine species, freshwater mussels)*

- Reestablish inlets and flowing channels which existed in the 1951 photo coverages
- Provide for multiple no flow habitats

Increase the extent of water greater than 3 feet deep sheltered from river current in proximity to macrophyte beds, and with adequate dissolved oxygen for centrarchid habitat *(centrarchids and associated backwater fish and wildlife species)*

OVERWINTERING HABITAT -- A minimum of 3 discrete areas with a minimum size of 20 acres per site which meet the following:

- Current velocity <0.3 cm/sec over 80 % of the area
- Water temps 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
- Dissolved oxygen ≥ 5 ppm
- Water depths >4 feet over >40% of the wintering area and > 7 feet over 15% of the area**
- Connected to adjacent flowing water habitats**

** (The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat which would always result in summer fish kills.)

SUMMER HABITAT -- A minimum of 3 discrete areas with a minimum size of 20 acres per site which meet the following:

- Dissolved oxygen ≥ 5 ppm
- Aquatic vegetation cover in the range of 25-50%
- Water depths >4 feet over >40% of the wintering area and > 7 feet over 15% of the area**
- Connected to adjacent flowing water habitats**

** (The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat which would always result in summer fish kills.)

SPAWNING, REARING AND JUVENILE HABITAT -- To be met in a minimum of 3 areas of 5 acres each with the following criteria:

- Dissolved oxygen levels $\geq$ 5 ppm
- Current velocity < 0.5 cm/sec
- Aquatic Vegetation cover of approximately 80%
- Substrates of sand and/or gravel available for spawning

Increase then maintain the aerial extent, interspersion, density and species composition of macrophyte beds *(waterfowl, shorebirds, wading birds, backwater and riverine fish, turtles)*

- Provide $\geq$ 75 acres with physical attributes conducive to the establishment and maintenance of emergent vegetation. Criteria to be met include:
  Water depths less than 2 feet
  Protected from dominant wind fetches
  Current velocities generally less than 0.5 feet per second
- Provide $\geq$ 125 acres with the physical attributes conducive to the establishment and maintenance of submersed vegetation. Criteria to be met include:
  Water depth less than 4 feet
  Protected from dominant wind fetches

Increase the length of shoreline and area of islands *(invertebrates, waterfowl, shorebirds/wading birds, backwater fish species, turtle habitat, riverine fish species, freshwater mussels, terrestrial plant and animal species)*
The construction of islands will be an integral part of meeting many of the other objectives. Following are additional criteria to be considered during island design:

- Islands should be located in locations and configurations comparable to the natural island that previously existing the study area.
- A mix of high and low elevation islands
- Minimize the use of rock
- slopes of 10:1 outward for 30 feet
- Create dynamic shorelines with transition zones (see sand/mud objective)
- Locate islands to induce the maintenance of channels and reduce flows into 3 centrarchid habitat areas
- Islands should be located in shallow water to reduce costs and increase stability
- Existing islands should be incorporated into restored islands for aesthetics
- Position so shoreline stabilization is in shallow water
- Position to minimize access dredging
- Position islands to have the greatest effect on hydraulic and sediment regimes.

Reestablish then maintain an interspersion of flowing channel habitat *(riverine species, freshwater mussels)*

- Reestablish inlets and channels which existed in the 1951 photo coverages
- Continuous flowing channels bordered by islands
- Areas of scour, eddies and varying velocities
- Variety of substrates (sand, silt, clay gravel, cobble, wood, etc.)
- Connected to other channels
- Variety of water depths

Increase the aerial coverage of sand/mud habitat *(shorebirds, wading birds, loafing waterfowl, turtles, homo sapians)*

- Create sand/mudflats in at least 3 locations which are 2-4 acres in size
- Water depths of 0-0.25 feet during normal summer conditions
- Sand/mudflats located in proximity to islands
- Enhance the micro-topography within expanses of sand/mudflats.

Decrease suspended solids concentrations (increase photic zone by .25 meters) *(aquatic vegetation)*

- Construct islands to reduce wave resuspension of bottom sediments
- Construct islands to create areas free from flow.

Other items to consider in design of the project:

1. Provide loafing sites for turtles and waterfowl in protected areas through the installation of "tree drops" at several locations in Spring Lake.
2. Enhance approximately 200 acres for migratory waterfowl habitat with approximately 50 acres in areas away from main boat traffic route. (This seems most appropriate for the lower 1/3 of the area, those areas south of islands A and B. Islands C and D will also offer some areas buffered from boat disturbance in the main travel routes.)
3. Enhance mussel habitat where appropriate based on substrate, water velocities, and depth. The following criteria can be used:

Velocities: Mid-depth velocities 0.6-1.5 ft/sec during normal flow, mid-depth velocities of $\geq$2.5 ft/sec during bank full conditions

Depth: 3-6 feet

Substrate: "River Washed" or rounded rock with the following gradations:

Sieve Size	Percent by Weight Passing
2 inch	95-100
1 inch	80-95
0.5 inch	50-80
0.25	0-50

The substrate should be located in an area that has some transport of sand which will allow "filling" of the spaces between the washed rock without burying the rock. Additionally, larger rock (riprap size) should be scattered throughout the mussel habitat area to allow for variation in substrate distribution due to changes in velocities around the rocks.

Host Considerations: The channel where the mussel habitat is constructed must be continuous and maintain a depth of at least 6 feet. This is to ensure that mussel hosts will have access to the mussel habitat at all river stages (even if 2-3 feet drawdowns are implemented for Pool 8 in the future). *(Note to Gary: What will be the maximum drawdown in the 3 west vicinity given a drawdown of 3 feet at the dam? This is important since we would not want to leave these mussels high and dry during a drawdown or limit host access.)*

Notes on some features presented in draft plan prepared by USFWS and WDNR. The following proposed feature map using a July 31, 1951, aerial photo as a base. Actual location of features will be dependent on bathymetry surveys.

Islands

A1 -- A lower island which has the primary purposes of defining channel habitat and providing conditions suitable for the establishment/maintenance of aquatic vegetation beds within Spring Lake.

A2 -- Lower than A1 to provide for a better mix of topographic relief in the area. This island would preferably be frequently flooded in spring and fall. This will make the terrestrial habitat available for fish to feed and spawn and provide food resources for migratory waterbirds.

B -- A lower island which has the primary purposes of defining channel habitat and providing conditions suitable for the establishment/maintenance of aquatic vegetation beds within Spring Lake.

C -- A medium elevation island in the complex to define channel habitats, improve environmental conditions for aquatic vegetation and improve the channel habitat in Belvidere Slough.

D1, D2, D3, and D4 -- These would be medium elevation islands to create one and maybe two overwintering sites for centrarchids. The complex will also improve channel habitat between the C and D complexes and the D and E complexes. The islands will also improve environmental conditions for aquatic vegetation. A small rock sill(s) could be placed at locations along the island if it is deemed necessary to "equalize" water levels within the Spring Lake complex and perhaps "flush" out flocculant sediment which will likely settle in this area over time.

E1 and E2 -- Island E2 would create overwintering habitat in the northern section of Spring Lake and E2 would create it in Spring Lake proper. These islands will create areas of low/no velocities and also increase winter water temperatures in these 2 water bodies. The islands will also improve channel habitat conditions in the interior of the Spring Lake Complex. A sill may be needed somewhere along island E2 to alleviate hydraulic pressure and reduce O&M costs. Island E1 would be at an elevations comparable to the Spring Lake Peninsula. The elevation for Island E2 should be such that the island is not overtopped October-March more than 1 out of 10 years.

F1 and F2 -- These Islands will improve aquatic vegetation beds adjacent to a flowing channel, help define and improve the quality of flowing channel habitats and both sides, and will also provide wave protection for E1 and the existing island north of E1, thereby reducing the amount of protection needed in IP5. This island chain should incorporate the existing remnant islands in there layout/design. The elevation should be the only slightly higher than the D island complex. a low rock sill (S2) should be included in the F island chain. Recommended elevation is the 2-3 year flood event.

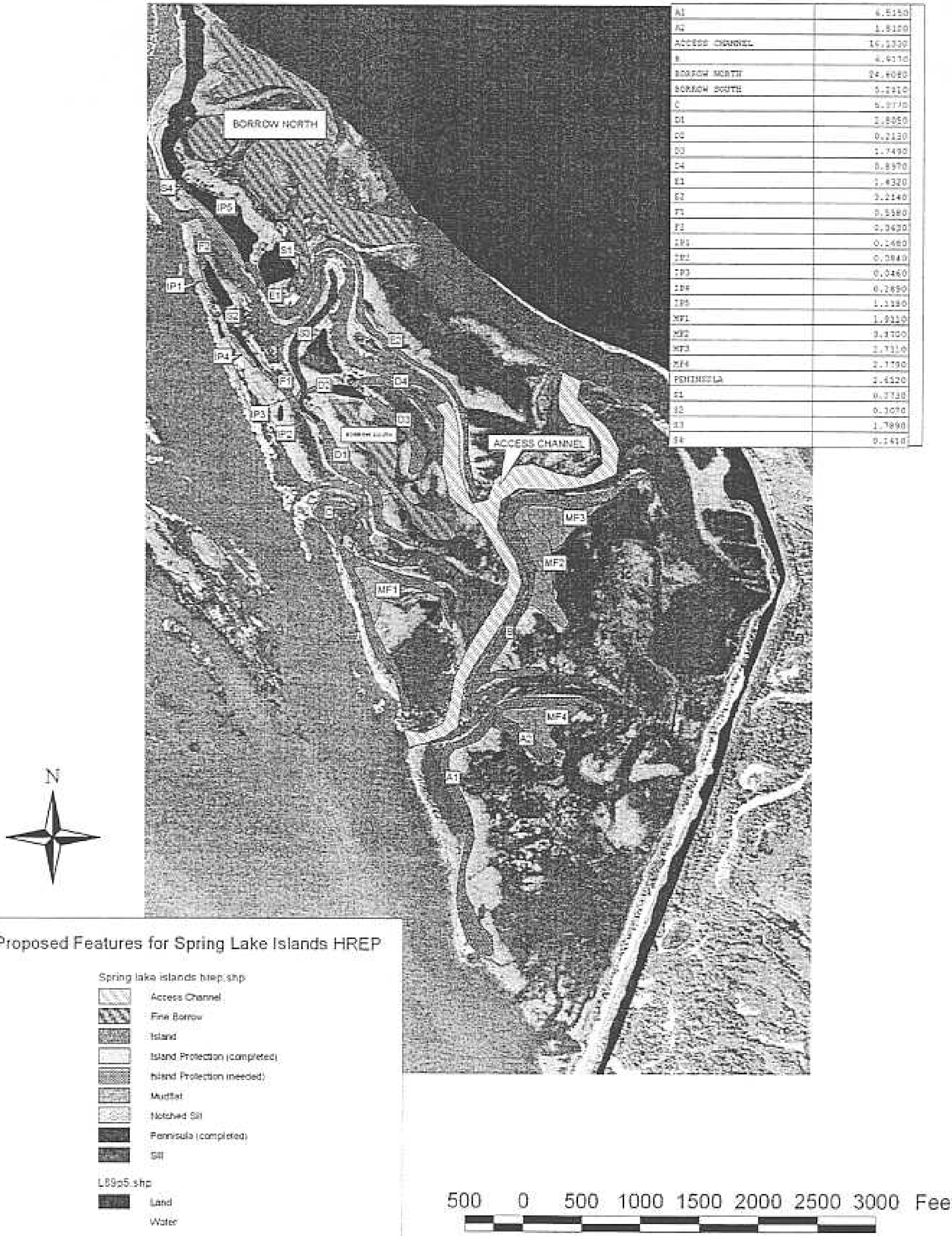
Rock Sills

S1 -- A notched rock sill that would be designed to pass 10 cfs during winter conditions.

S2 -- See description for islands F1 and F2.

S3 -- This rock sill, in combination with the existing channel between proposed islands F and E1 and rock sill S2, will serve as hydraulic pressure relief for the upper end of the Spring Lake complex. The sill should be designed to meet this purpose while at the same time enhancing/maintaining the existing channel.

Label	Sum_Acres
A1	6.5150
A2	1.8100
ACCESS CHANNEL	16.1320
B	4.9170
BORROW NORTH	24.6080
BORROW SOUTH	3.2810
C	5.2770
D1	2.8050
D2	0.2130
D3	1.7490
D4	0.8970
E1	1.4320
E2	3.2140
F1	0.5580
F2	0.3420
IP1	0.1680
IP2	0.2840
IP3	0.0460
IP4	0.2850
IP5	1.1380
MF1	1.9310
MF2	3.3700
MF3	2.7310
MF4	2.7790
PENINSULA	2.6120
S1	0.2730
S2	0.3070
S3	1.7890
S4	0.1410



Proposed Features for Spring Lake Islands HREP

Spring lake islands hrep.shp

- Access Channel
- Fine Borrow
- Island
- Island Protection (completed)
- Island Protection (needed)
- Mudflat
- Notched Sill
- Pennisula (completed)
- Sill

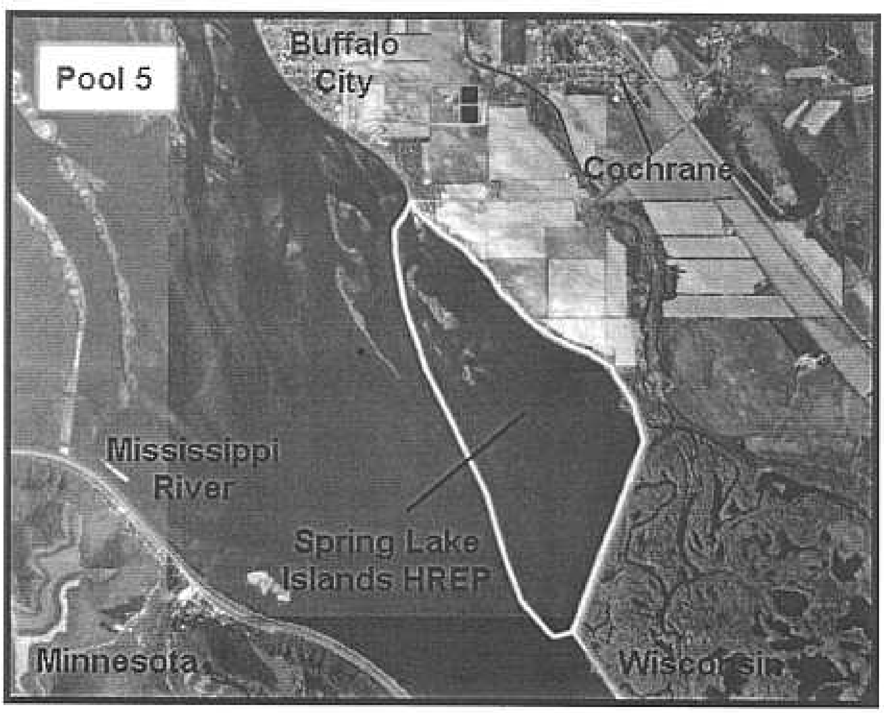
L89p5.shp

- Land
- Water

Spring Lake Habitat Project – Pool 5
2001 Land Cover/Land Use Assessment

Resource problem:

Natural islands along the west side of Spring Lake have eroded and many have disappeared since the creation of Pool 5. Previously, these islands protected Spring Lake from the direct effects of the main Mississippi River channel area and reduced wind fetch and associated wave action. This island loss has degraded the shallow water fish and wildlife habitat in the lake because of higher turbidity levels and undesirable conditions for the establishment of aquatic plant beds. The fish and wildlife habitat in Spring Lake had been of high quality because of the diversity present and the physically protected nature of the area. Quiet, protected areas are valuable for fish and wildlife such as largemouth bass, bluegill, wading birds, muskrat, and dabbling ducks. Aquatic plant beds provide a valuable food source for fish and migrating birds.



Project outputs:

The project would slow the continued degradation of about 200 acres of valuable backwater fish and wildlife habitat by permitting Spring Lake to be maintained as a protected, shallow backwater wetland with the proper conditions for high productivity of both fish and wildlife. More than two-thirds of the lake would be directly affected by the project. If suitable material can be dredged from Spring Lake for island fill, it would also provide additional fish habitat.

HABITAT INVENTORY:

On September 25, 2001, color infrared aerial photography of the Spring Lake Islands study area site was collected at a scale of ~1:9,600. This date was later in the growing season than planned but weather and other factors prevented earlier photo acquisition. Despite the later date all submersed and emergent vegetation appeared vigorous and healthy because of warmer than usual weather and excellent water quality. The photo scale was larger than originally intended (1:15,000) due to concurrent collection with another project requiring large-scale photography. Aerial photographs were ground truthed for plant verification and interpreted with the LTRMP 31-Class scheme that assesses vegetation based on the species dominance and approximate hydrology (see Appendix A). Interpreted aerial photo overlays were referenced to the earth in UTM Zone 15, NAD27 through the use of digital orthophoto quarter-quads. Photo interpretation and the final vegetation coverage were each checked using Upper Midwest Environmental Sciences Center's standard quality control/quality assurance protocols.

The table below summarizes the aquatic habitat contained within the HREP study area. Each of these categories is described further in Appendix A. Figure 1 shows the decline of aquatic habitat in Spring Lake since 1984. The location and relative distribution of these classes are shown in Figure 2.

Table 1. Frequency of occurrence and acreage of aquatic vegetation classes in the Spring Lake HREP study area.

UMR_CLASS	FREQ	ACRES
Deep Marsh Perennial	7	1.2
Developed	1	7.8
Floodplain Forest	17	14.7
Levee	3	3.1
Open Water	2	376.5
Rooted Floating Aquatics	17	34.6
Salix Community	3	2.7
Shallow Marsh Perennial	12	5.2
Submerged Aquatic Vegetation	39	124.1
Wet Meadow	1	0.4
Wet Meadow Shrub	4	2.4
	106	572.7

Figure 1. Aquatic vegetation changes in the Spring Lake, 1984-2001

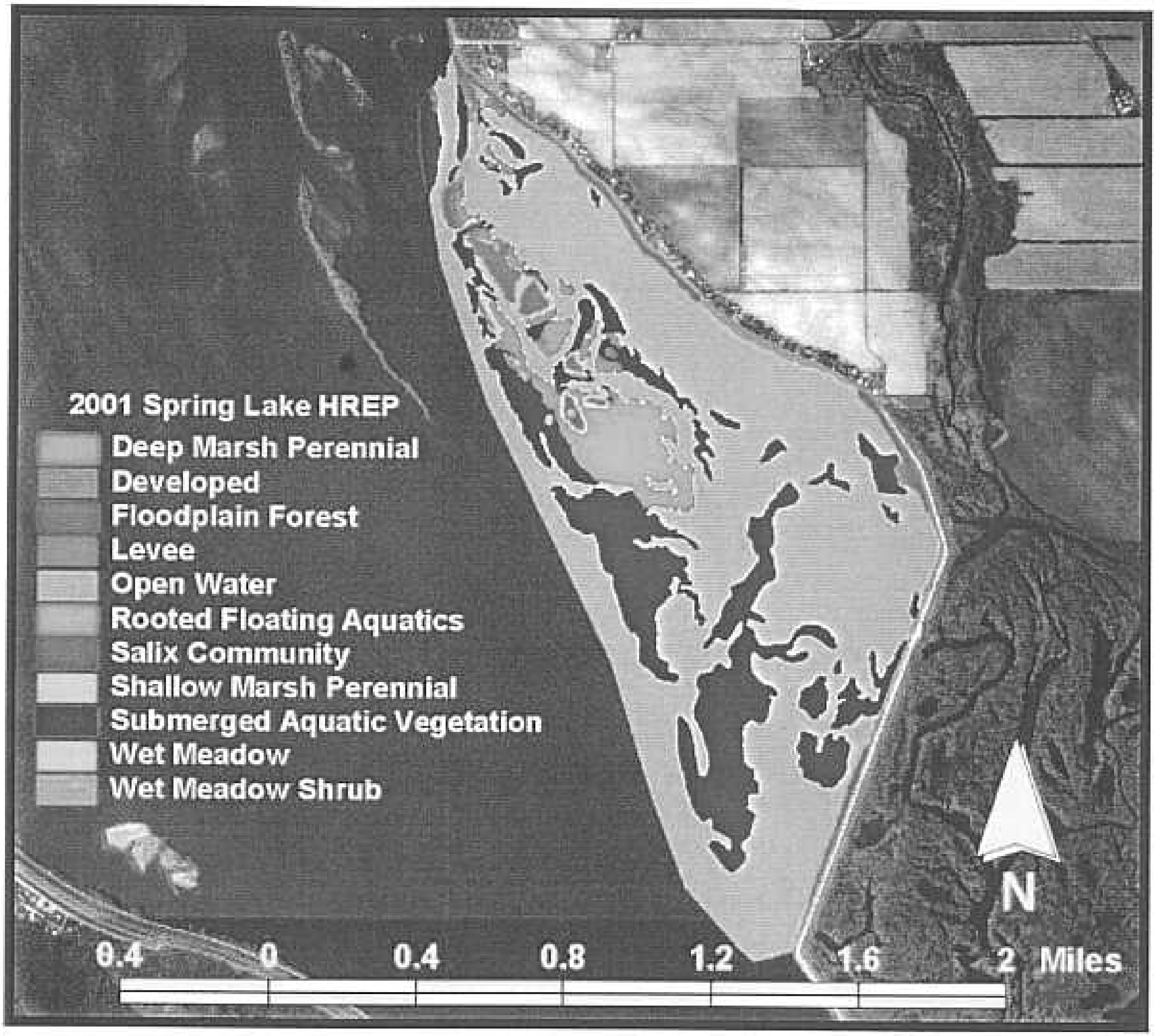


Figure 2. Distribution of aquatic vegetation in Spring Lake Habitat Project, Pool 5 of the Upper Mississippi River.

APPENDIX A

LTRMP 31-Class Vegetation System

UMR_CODE	UMR_CLASS	UMR_CLASS_DESCRIPTION	HYDRO_DESCRIPTION
AG	Agriculture	All obviously cultivated fields. This category may include transitional fallow fields that show evidence of tilling.	Infrequently Flooded Non-Forest
CN	Conifers	All natural or semi-natural evergreen communities. Typically Pine, but occasionally Cedar.	Infrequently Flooded Forest
DMA	Deep Marsh Annual	Dominated by Wild Rice, but may include floating-leaf species, submergents, or deep marsh perennials.	Semipermanently Flooded Non-Forest
DMP	Deep Marsh Perennial	Persistent emergents that prefer lots of water. Dominated by Arrowhead, Bur-reed, and Cattail and may include Pickerelweed, Giant Reed Grass, and Bulrush.	Semipermanently Flooded Non-Forest
DMS	Deep Marsh Shrub	Shrubby vegetation >25%, dominated by Buttonbush and Water Willow, frequently growing in standing water. May include RFA, SV, and deep marsh perennials.	Semipermanently Flooded Shrubs
DV	Developed	Areas that are predominantly artificial in nature such as cities/towns, large farmsteads, and industrial complexes.	Infrequently Flooded Non-Forest
FF	Floodplain Forest	Softwood forests growing on saturated soils near the main channel and in floodplain backwaters. These forest are predominantly Silver Maple, but also include Elm, Cottonwood, Black Willow, and River Birch.	Seasonally Flooded Forest
GR	Grassland	Drier upland grass or grass/forb fields. May include fallow fields, sand prairies, and shrubby vegetation < 25%.	Infrequently Flooded Non-Forest
LF	Lowland Forest	Lowland Forest - More common on southern reaches of the UMRS. These forests grow along the river banks on sites that are drier than FF sites. Typical species include many Hickories, Pecan, River Birch.	Temporarily Flooded Forest
LV	Levee	All continuous dikes or embankments designed for flood protection. More common on southern reaches of the UMRS and typically covered with mixed grass and forbs.	Infrequently Flooded Non-Forest
MUD	Mud	Exposed, non-vegetated mudflats. May occur near the main channel or in backwaters.	Seasonally Flooded Non-Forest
NPC	No Photo Coverage	Gaps in photo coverage. May include areas obscured by clouds or shadows.	No Photo Coverage
OW	Open Water	All non-vegetated open bodies of water.	Permanently Flooded Non-Forest
PC	Populus Community	Predominantly Cottonwood (>50%) but may include willow and other floodplain forest species.	Seasonally Flooded Forest
PN	Plantation	All commercially-grown evergreen plantations, large nurseries, and orchards. Typically will be Red or White Pine.	Infrequently Flooded Forest
PS	Pasture	All grass fields used for the production of livestock.	Infrequently Flooded Non-Forest
RD	Roadside Grass/Forbs	Grass/forb-covered right-of-ways along side of roads, highways, and railroads.	Infrequently Flooded Non-Forest
RFA	Rooted Floating Aquatics	Typically Lotus and Lily, but may include Water Shield and Water Primrose. Frequently grows with submergent vegetation when RFA density is < 90%.	Permanently Flooded Non-Forest
SB	Sand Bar	Exposed sand bars typically found in and near the main channel, and often associated with wing dams and islands.	Temporarily Flooded Non-Forest

SC	Salix Community	Predominantly Willow (>50%) but may include Cottonwood and other floodplain forest species.	Seasonally Flooded Forest
SD	Sand Dunes/Spoil	Sand spoil banks, beaches, and other sparsely-vegetated sandy areas.	Infrequently Flooded Non-Forest
SM	Sedge Meadow	Dominated by mixed Sedges but may include perennial emergents and moist soil grass/forbs.	Temporarily Flooded Non-Forest
SMA	Shallow Marsh Annual	Typically Wild Millet and Beggarsticks and other annual species that favor mudflats and shallow basins.	Seasonally Flooded Non-Forest
SMP	Shallow Marsh Perennial	The transition zone between deep marsh and wet meadow that is dominated by Bulrush, and to a lesser extent Cattail, Arrowhead, Bur-reed, Giant Reed Grass, Smartweed, and other moist soil species.	Seasonally Flooded Non-Forest
SMS	Shallow Marsh Shrub	Mixed shrubs >25%, but typically Sandbar Willow growing near the main channel and in backwaters along with mixed emergents, grasses, and forbs.	Seasonally Flooded Shrubs
SS	Shrub/Scrub	Shrubby vegetation > 25% on drier soils with a mixed grass/forb understory.	Infrequently Flooded Shrubs
SV	Submerged Aquatic Vegetation	All submersed aquatic vegetation.	Permanently Flooded Non-Forest
UF	Upland Forest	Forests growing at the edge or out of the UMRS floodplain. Species include Red/White Oak, Hickories, Elm, and other deciduous trees.	Infrequently Flooded Forest
WM	Wet Meadow	Dominated by moist soil grasses such as Reed Canary Grass and Rice Cutgrass. Also includes Loosestrife, Smartweed, and small inclusions of other mixed emergents, grasses, and forbs.	Saturated Soil Non-Forest
WMS	Wet Meadow Shrub	Mixed shrubby vegetation > 25%, typically Alder, Elder, False Indigo, Dogwood and/or Willow with a sedge/grass/forb understory.	Temporarily Flooded Shrubs
WS	Wooded Swamp	Most common in southern reaches of UMRS. Includes Bald Cypress, Water Tupelo, Sourgum, and Black Ash.	Semipermanently Flooded Forest

Spring Lake Islands HREP
Interagency Coordination Meeting
October 30, 2000
0930 hrs – 1500 hrs
Fountain City Service Base Conference Room

AGENDA

1. Introductions

2. Purpose of Meeting

   - The purpose of the meeting is (1) brief individuals previously not involved in the project, (2) discuss problems/objectives to see if they're still valid, (3) discuss alternative solutions to date and (4) visit the site.

3. Habitat Problems

   - Review problem identification in the DPR.

4. Habitat Project Objectives – General and Specific

   - Review Objectives in the DPR

5. Data what's new, what's old, what's needed

   - Geotechnical - Soil Borings
   - Hydraulics Analysis
   - Environmental

6. Other issues

7. Where do we go from here (summary)

8. Lunch

9. Site Visit

CEMVP-PM-A 30 October 2000

MEMORANDUM FOR RECORD

SUBJECT: Spring Lake Islands HREP

A kickoff meeting to discuss the above product was held on 30 October 2000,at 0920 hrs in the Fountain City Service Base conference room. The discussion items are summarized below. Attendees included:

Tom Novak	Pam Thiel	Brian Brecka
Kari Layman	Bob Dreslein	Jeff Janvrin
Jeff Stanek	Gary Wege	
Joel Face	Keith Beseke	
Steve Clark		

1. Specific Objectives - focus on upper part for centrarcid habit. Also, past public meetings the consensus was maintain the channel and bring back the islands.
   - Include Bob/Jeff's objectives here.
   - One
   - Two
   - Three
   - Public Access

2. Geotechnical issues

   - Dike 5 borrow area data
   -

3. Hydraulic issues

   - Data
   -

4. Environmental issues

   - Mussel survey

5. Action Items

   - Bathymetry
   - Public Meeting

Tom Novak

CEMVP-PE-H (1110-2-1403)

23 June 1998
Schneider/ms/5576

MEMORANDUM FOR Don Powell and Pete Fasbender, PE-M

Subject: Information Needs to complete H&H design of Spring Lake Islands HREP

1. Based on previous meeting notes, project goals include: protecting lake from effects of main channel, reduce wind fetch, reduce wave action, lower turbidity levels, establish aquatic plant beds, reduce bed load sediment, and create deeper holes in Spring Lake. Our thoughts and information needs for these goals are as follows:

Protecting Lake from Effects of Main Channel: We are assuming that this means reduce inflows to Spring Lake. The hydraulic residence times for Spring Lake before and after construction of the Spring Lake Peninsula project are shown in Table 1. Residence times for Peterson Lake and Stoddard Bay are also shown for comparison. To develop a hydraulic design for the Spring Lake project, a desired future hydraulic residence time must be established.

Table 1. Hydraulic residence times for three similar size backwaters on the Upper Mississippi River. A low flow river discharge of 20,000 cfs was used for these calculations.

	Preproject		Postproject	
Site	Discharge (cms)	Residence Time (Days)	Discharge (cms)	Residence Time (Days)
Spring Lake	11.3	2.3	3.5	6.1
Peterson Lake	29.0	1.2	9.3	3.6
Stoddard Bay	60.9	0.4	1.4	16.4

Reduce Wind Fetch and Wave Action: Attachment 1, shows three wind direction figures from the recently completed Weaver Bottoms Report. The predominant wind directions at Lock and Dam 5 are NW and SE. Since the major axis of Spring Lake is aligned in a NW-SE direction, and since the wind fetch in along this axis exceeds 6,000 feet, obviously wave action is a factor affecting conditions in Spring Lake. Given the orientation of Spring Lake and the predominant wind directions, the only way to effectively reduce wave action would be to build an island across Spring Lake at a location approximately 4,000 feet downstream of the head of the lake. To complete a hydraulic design for the Spring Lake project, a decision must be made regarding whether an island across Spring Lake is needed.

Lower Turbidity Levels: Attachement 2, shows suspended sediment concentrations in Spring Lake based on monitoring that was done for the Weaver Bottoms project. The preproject and postproject time periods on these two plots refer to the Weaver Bottoms project, not the Spring

Lake Peninsula project. All of this data was obtained prior to construction of the Spring Lake Peninsula project. Suspended sediment concentrations in Spring Lake are relatively low, averaging 10 and 18 mg/ L for pre- and postproject conditions respectively. In addition, a best fit relationship for this data, would have a negative slope (ie. TSS decreases with increasing discharge). This type of relationship occurs in backwaters where wave action is a factor, and is further evidence that wave action affects conditions in Spring Lake. Since, TSS in Spring Lake is already low, it is doubtful that it can be reduced further. Since, wave action appears to be a primary factor affecting TSS, an island constructed in Spring Lake would be the only effective way to reduce TSS. To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed.

Establish aquatic plant beds: To complete the hydraulic design for this project, additional information must be provided on what project features will help establish aquatic plant beds.

Reduce bed load sediment: Bed load sediment was being transported into Spring Lake through the breach at the upstream end of the Lake. The Spring Lake Peninsula project eliminated this source of bed load sediment into Spring Lake. It is unknown whether the downstream openings are a significant source of bed load sediment.

Create deeper holes in Spring Lake: Sediment from within Spring Lake, may be a source of construction material for project features. However, creating deep holes will be a waste of time unless the proper hydraulic and water quality conditions are established. To complete the hydraulic design, these conditions must be established, and the location of backwater dredging must be established.

2. Please provide the information requested above, desired winter hydraulic residence time and whether an island is needed across Spring Lake, to Michelle Schneider. Hydraulics is unable to proceed on the subject project without the requested information. Please contact Michelle Schneider with any questions you may have at extension 5576.

PATRICK M. FOLEY
Chief, Hydraulic Section

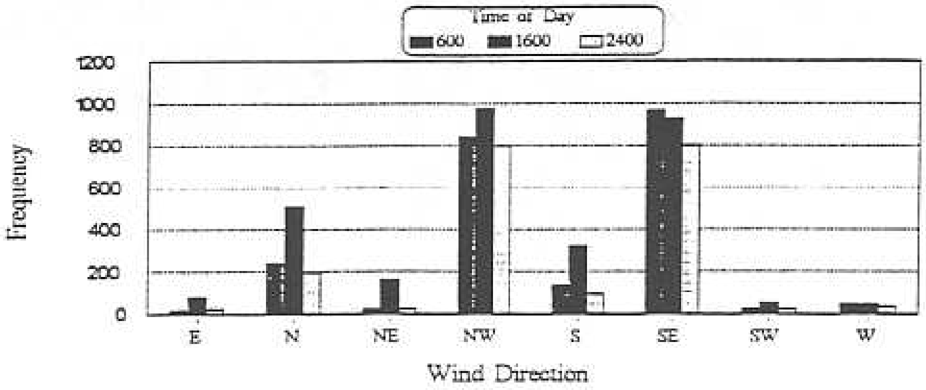


Figure 7. Frequency of wind directions (n=7359) occurring at 0600, 1600 and 2400 hrs., 1987-97, Lock and Dam 5, Upper Mississippi River.

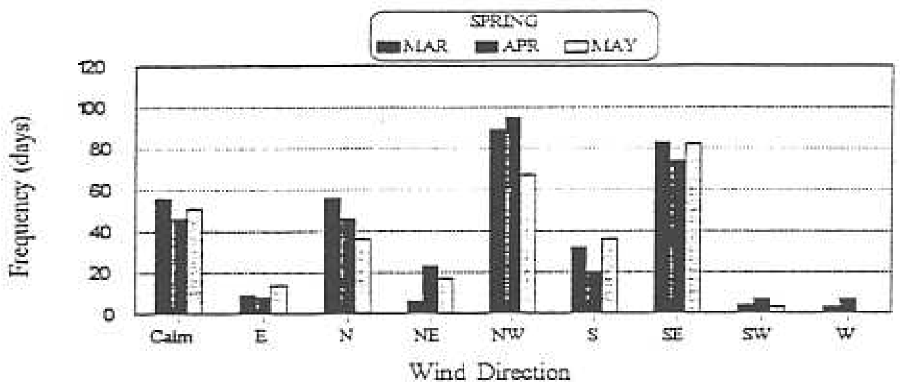


Figure 8. Frequency (days) of wind direction at 1600hrs, during spring months, 1987-97, Lock and Dam 5, Upper Mississippi River.

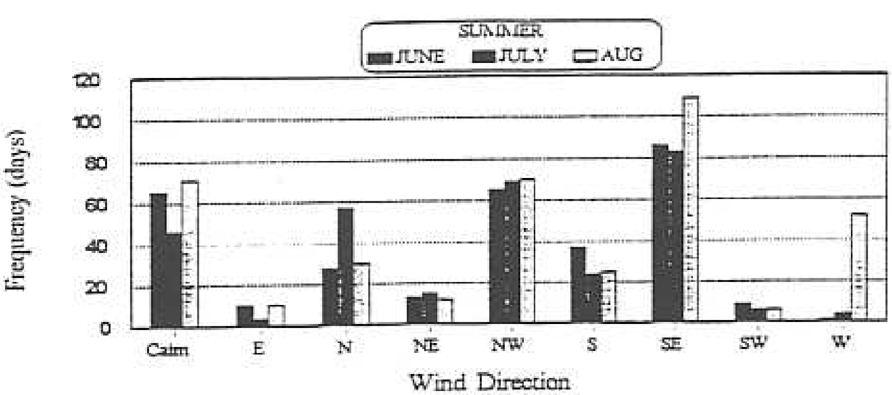
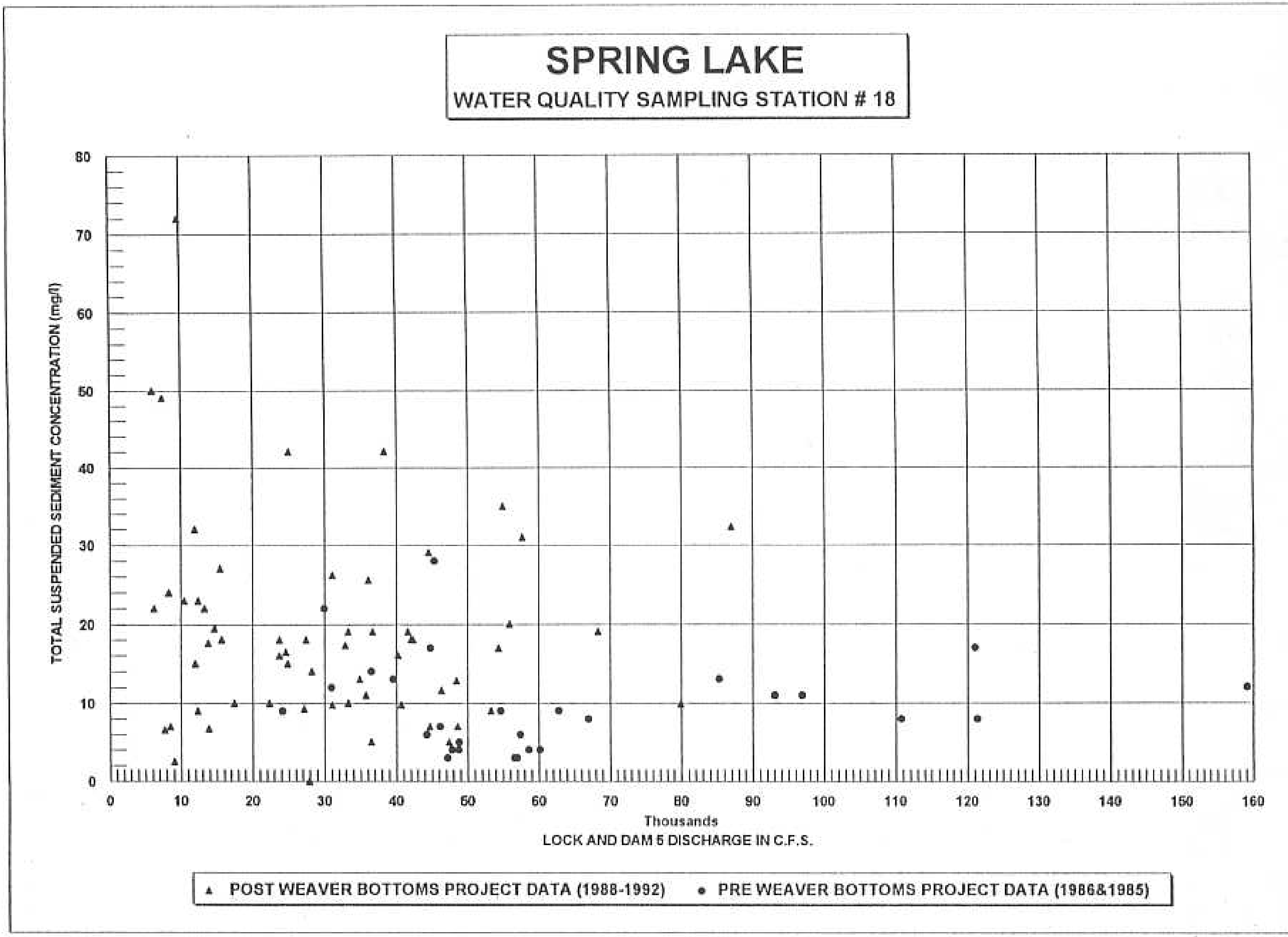


Figure 9. Frequency (days) of wind direction at 1600hrs, by summer months, 1987-97, Lock and Dam 5, Upper Mississippi River.

Attachment 1



Attachment 2