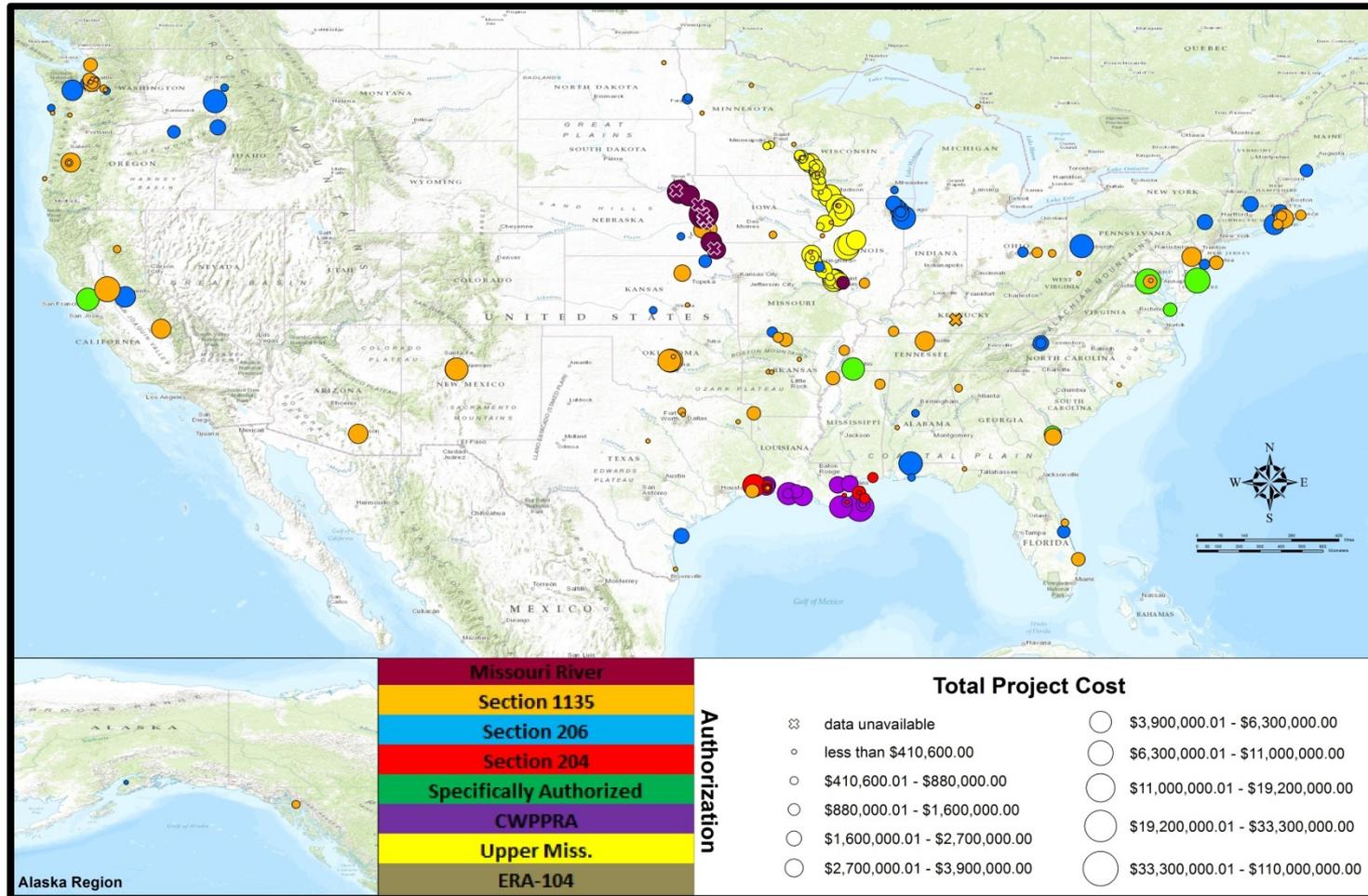


# Retrospective Evaluation of Completed Corps Aquatic Ecosystem Restoration Projects



David Price, Craig Fischenich, Erynn Maynard, Justin Gardner

# Objectives



## Environmental Benefits/Outcomes

- What are the environmental benefits of Corps projects?
- Are projects meeting stated objectives?
- Are we adequately capturing ecological outcomes?

## Monitoring

- How much monitoring is being done?
- How effective is monitoring in evaluating project success?

## Performance

- How do individual restoration features/techniques perform?
- What are our strengths; areas for improvement?



Allin's Cove  
(New England District)

# Approach



**Activity 1:** Review Data and Information from Analogous Programs

**Activity 2:** Engage Academic, Interagency & District Partners

**Activity 3:** Formulate Database Structure

**Activity 4:** Compile Info on Completed  
Corps Projects, including District Review

**Activity 5:** Data Summary, Synthesis & Analysis

**Activity 6:** Technology Transfer

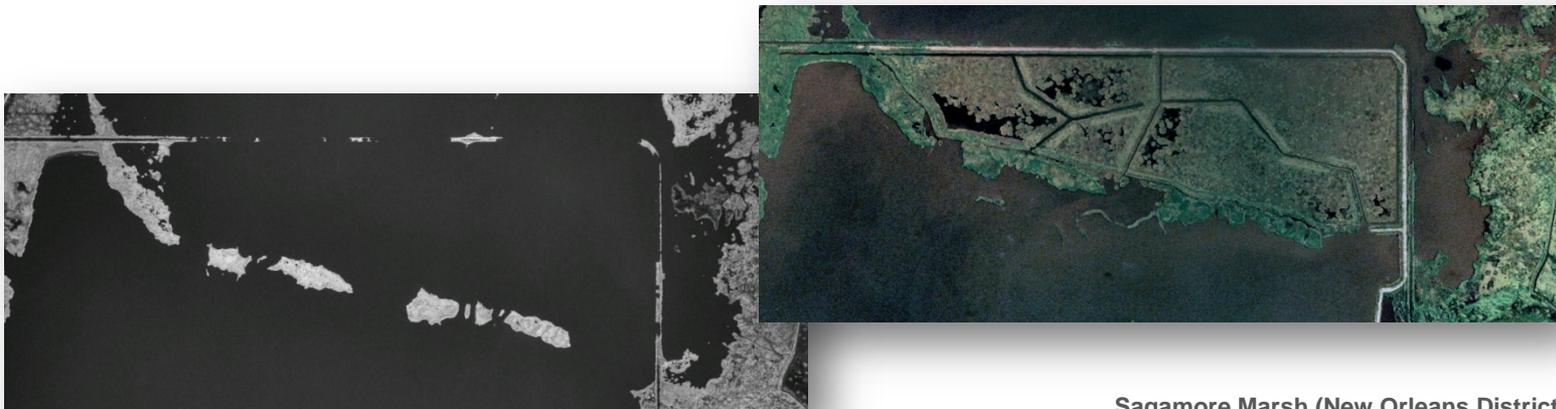


Codiga Farms (Seattle District)

# Products



- TN: Part 1 – Project Overview
- TN: Part 2 – Database Content and Data Entry Guidelines
- TR: Retrospective Evaluation of Corps Aquatic Ecosystem Restoration Projects
- Web Database



Sagamore Marsh (New Orleans District)

# Data Summary



- **Background**
- Planning
- Implementation
- Monitoring & Success



Spring Lake Peninsula  
(St. Paul District)

# Projects by Ecosystem Type



Ecosystem Type	Percent (Number) of Projects	Normalized Percent
Riverine	60% (130)	42%
Non-tidal Wetland	28% (60)	19%
Reservoir/Lake	27% (59)	19%
Estuarine	16% (34)	11%
Tidal Wetland	11% (24)	8%
Upland	1% (2)	1%

# Projects by Authority



<b>Congressional Authority</b>	<b>Percent (Number) of Projects</b>
Section 1135 - WRDA 1986, as amended	39% (84)
Upper Mississippi River Restoration (UMMR)-EMP	22% (47)
Section 206 - WRDA 1996, as amended	20% (43)
Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA)	6% (14)
Missouri River Recovery Program (MRRP)	6% (13)
Section 204 – WRDA 1992, as amended	5% (10)
Specific Authorization	2% (5)
Estuary Restoration Act of 2000, as amended	<1% (1)

# Authority and Ecosystem Type



Authority (Percent of Projects)		Ecosystem Type					
		Riverine	Nontidal Wetland	Reservoir /Lake	Estuarine	Tidal Wetland	Upland
All Projects	217	60%	28%	27%	16%	11%	1%
Section 1135	(39%)	54%	19%	43%	19%	10%	1%
Upper Mississippi River Restoration – EMP	(22%)	89%	38%	23%	0%	0%	0%
Section 206	(20%)	60%	26%	26%	12%	0%	2%
Coastal Wetlands Planning, Protection and Restoration Act	(6%)	7%	50%	7%	21%	64%	0%
Missouri River Recovery Program	(6%)	100%	38%	0%	0%	0%	0%

<b>Authority</b>	<b>Percent of All</b>	<b>Division</b>	<b>Percent (Number)</b>
Section 1135	39%	Northwestern	26% (22)
		Mississippi Valley	19% (16)
		Southwestern	18% (15)
		North Atlantic	11% (9)
		South Atlantic	11% (9)
		Great Lakes and Ohio River	8% (7)
		South Pacific	6% (5)
		Pacific Ocean	1% (1)
Upper Mississippi River Restoration-EMP	22%	Mississippi Valley	100% (47)
Section 206	20%	Great Lakes and Ohio River	26% (11)
		Northwestern	26% (11)
		North Atlantic	14% (6)
		Southwestern	12% (5)
		Mississippi Valley	9% (4)
		South Atlantic	9% (4)
		Pacific Ocean	2% (1)
South Pacific	2% (1)		
CWPPRA	6%	Mississippi Valley	100% (14)
Missouri River Recovery Program	6%	Northwestern	100% (13)
Section 204	5%	Mississippi Valley	80% (8)
		South Atlantic	10% (1)
		Southwestern	10% (1)
Specific Authorization	2%	North Atlantic	40% (2)
		Mississippi Valley	20% (1)
		South Atlantic	20% (1)
		South Pacific	20% (1)
ERA 2000	<1%	Great Lakes and Ohio River	100% (1)

# Projects by Size Class



Size Class (acres)	Percent (Number) Projects
$\leq 100$	37% (81)
101-1,000	35% (76)
1,001-10,000	24% (51)
$> 10,001$	4% (9)
All projects	217

# Authority and Size

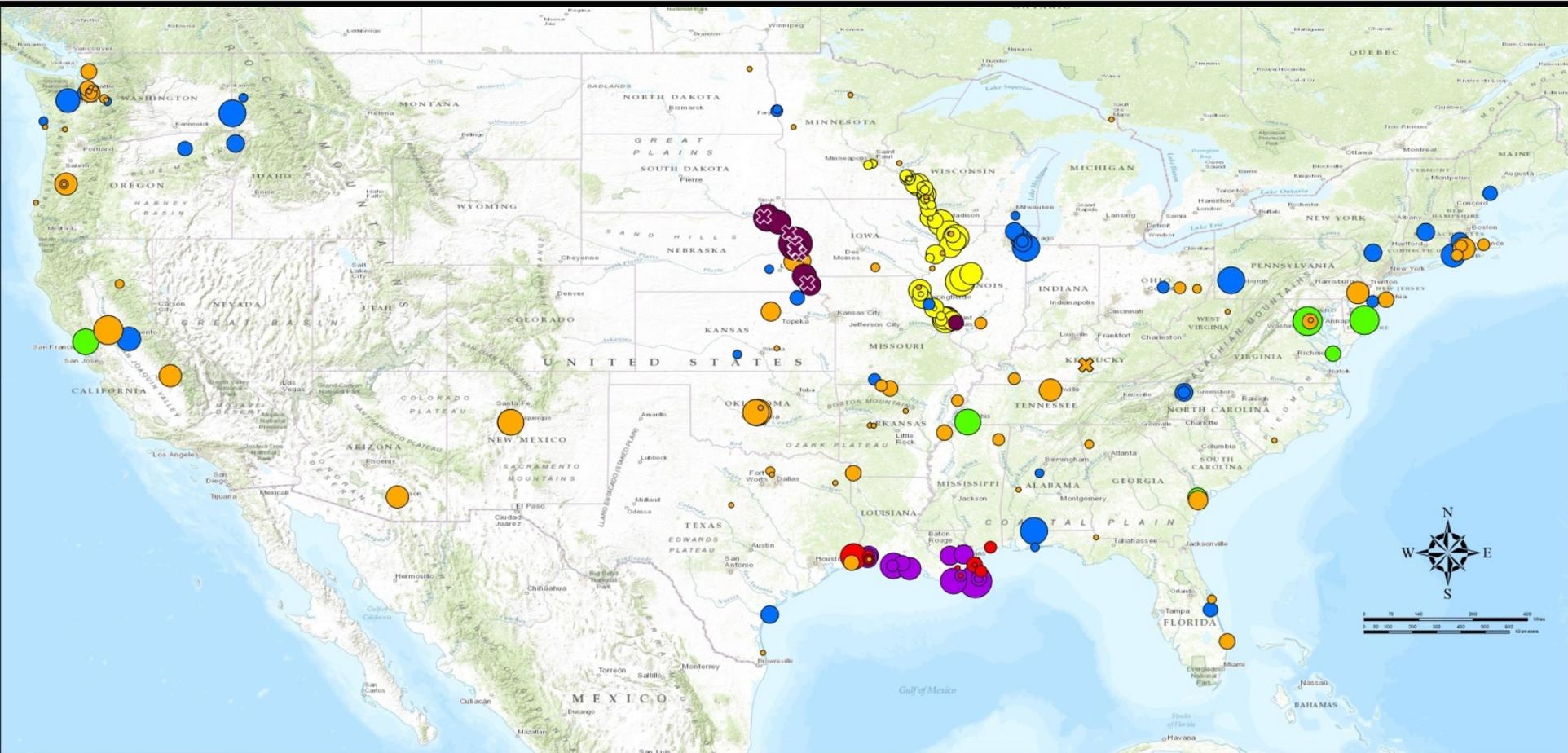


Authority (Percent of Projects)		Size Class (acres)			
		<100	101-1,000	1,001-10,000	>10,000
All Projects	217	37%	35%	24%	4%
Section 1135	(39%)	45%	35%	17%	4%
Upper Mississippi River Restoration-EMP	(22%)	13%	40%	43%	4%
Section 206	(20%)	60%	23%	14%	2%
Coastal Wetlands Planning, Protection, and Restoration Act	(6%)	21%	29%	43%	7%
Missouri River Recovery Program	(6%)	23%	62%	15%	0%
Section 204	(5%)	40%	40%	20%	0%
Specific Authorization	(2%)	0%	40%	20%	40%
ERA 2000	(<1%)	0%	100%	0%	0%

# Cost by Size Class



Size Class (acres)	Percent (Number) Projects	Average Cost	Standard Deviation
<100	36% (71)	\$1,351,443	\$1,794,706
101-1,000	36% (71)	\$2,896,264	\$3,614,480
1,001-10,000	26% (51)	\$3,708,666	\$3,624,376
>10,001	4% (7)	\$9,712,100	\$11,439,371
All projects	200	\$2,793,570	\$4,042,525



Alaska Region

Missouri River	Authorization
Section 1135	
Section 206	
Section 204	
Specifically Authorized	
CWPPRA	
Upper Miss.	
ERA-104	

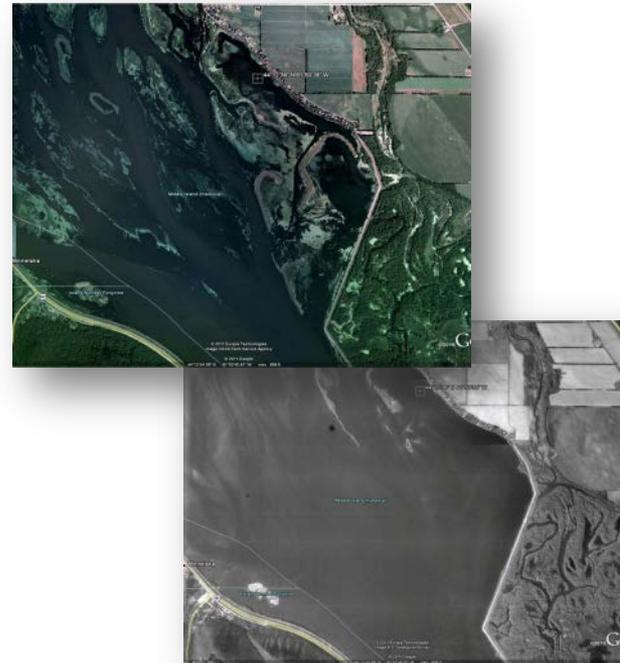
### Total Project Cost

⊗	data unavailable	○	\$3,900,000.01 - \$6,300,000.00
◦	less than \$410,600.00	○	\$6,300,000.01 - \$11,000,000.00
○	\$410,600.01 - \$880,000.00	○	\$11,000,000.01 - \$19,200,000.00
○	\$880,000.01 - \$1,600,000.00	○	\$19,200,000.01 - \$33,300,000.00
○	\$1,600,000.01 - \$2,700,000.00	○	\$33,300,000.01 - \$110,000,000.00
○	\$2,700,000.01 - \$3,900,000.00		

# Data Summary



- Background
- **Planning**
- Implementation
- Monitoring & Success



Spring Lake Peninsula  
(St. Paul District)

# Project Sponsors & Partners



Sponsor Type	Percent (Number)
State	52% (133)
Local	22% (57)
Federal	14% (35)
NGO	5% (14)
Other	4% (11)
Private	2% (4)
Academic	1% (2)
Tribal	<1% (1)

Partner Type	Percent (Number)
Federal	39% (333)
State	36% (308)
Local	9% (77)
NGO	7% (59)
Academic	3% (24)
Tribal	2% (18)
Private	2% (18)
Citizen Groups	2% (18)
Other	1% (5)

# Environmental Resource Issues



Environmental Resource Issues	Percent (Number) of Projects
ALL (217 projects with a mean of 2.9 ERI's per project)	(636)
Habitat Loss and Fragmentation	82% (179)
Sediment Management	32% (70)
Water Quality	26% (56)
Erosion	24% (53)
Fish & Wildlife Populations/Communities	23% (49)
Native Plant Communities	18% (40)
Environmental Flows	18% (39)
Land Loss	14% (31)
Threatened & Endangered Species	13% (29)
Fish Passage	12% (26)
Recreation	7% (15)
Invasive Species	6% (13)
Other (Specify)	5% (10)
Tidal Exchange	4% (8)
Biodiversity	3% (6)
Contaminant Material	2% (5)
Storm Water	2% (5)
Acid Mine Drainage	1% (2)

# Restoration Intents



Restoration Intents	Percent (Number) of Projects
ALL (217 projects with a mean of 1.8 RI's per project)	(399)
Aquatic Habitat Improvement	66% (144)
Water Quality Management	21% (46)
Aquatic or Wetland Plant Management	17% (36)
Bank/Shoreline Stabilization	12% (27)
Floodplain/Tidal/Backwater Reconnection	12% (25)
Fish Passage	11% (23)
Flow Modification	10% (21)
Channel Reconfiguration	9% (20)
Land Creation/Restoration	9% (19)
Riparian/Shoreline Management	7% (16)
Beneficial Uses of Dredged Material	6% (13)
Dam Removal/Retrofit	3% (7)
Fish and Wildlife Management	1% (2)

# Use of Planning Models



Planning Model	Percent (Number of Projects)
Hydraulic Model	25% (47)
Habitat Suitability Index (multiple species)	24% (46)
Hydrologic Model	12% (23)
Habitat Suitability Index (single species)	12% (22)
Wetland Value Assessment	4% (7)
Habitat Evaluation Procedure model	3% (5)
Wildlife Habitat Appraisal Guide	3% (5)
Diving Duck Migration Habitat Model	2% (3)
Habitat Quality Index	1% (2)
Sediment Model	1% (2)
Aquatic Habitat Appraisal Guide	1% (2)
Water Quality Model	1% (2)
Other models with a single representative	13% (25)

# Planning Model Use by Size



Size Class (Percent of All Projects)		Percent (Number) of Projects with Planning Model(s)
< 100 acres	(37%)	38% (30)
101-1,000 acres	(35%)	60% (46)
1,001-10,000 acres	(24%)	73% (37)
> 10,001 acres	(4%)	78% (7)

# Planning Model Use and Authority

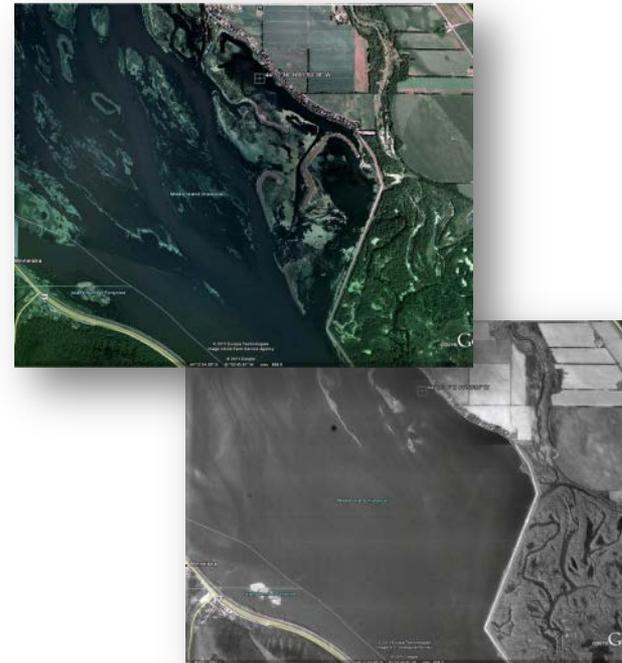


Authority (Percent of All Projects)		Percent of Projects with Planning Model(s) within Authority (Number)
Section 1135	(39%)	54% (45)
Upper Mississippi River Restoration-EMP	(22%)	72% (34)
Section 206	(20%)	44% (19)
CWPPRA	(6%)	64% (9)
Missouri River Recovery Program	(6%)	46% (6)
Section 204	(5%)	30% (3)
Specific Authorization	(2%)	80% (4)
ERA 2000	(<1%)	100% (1)

# Data Summary

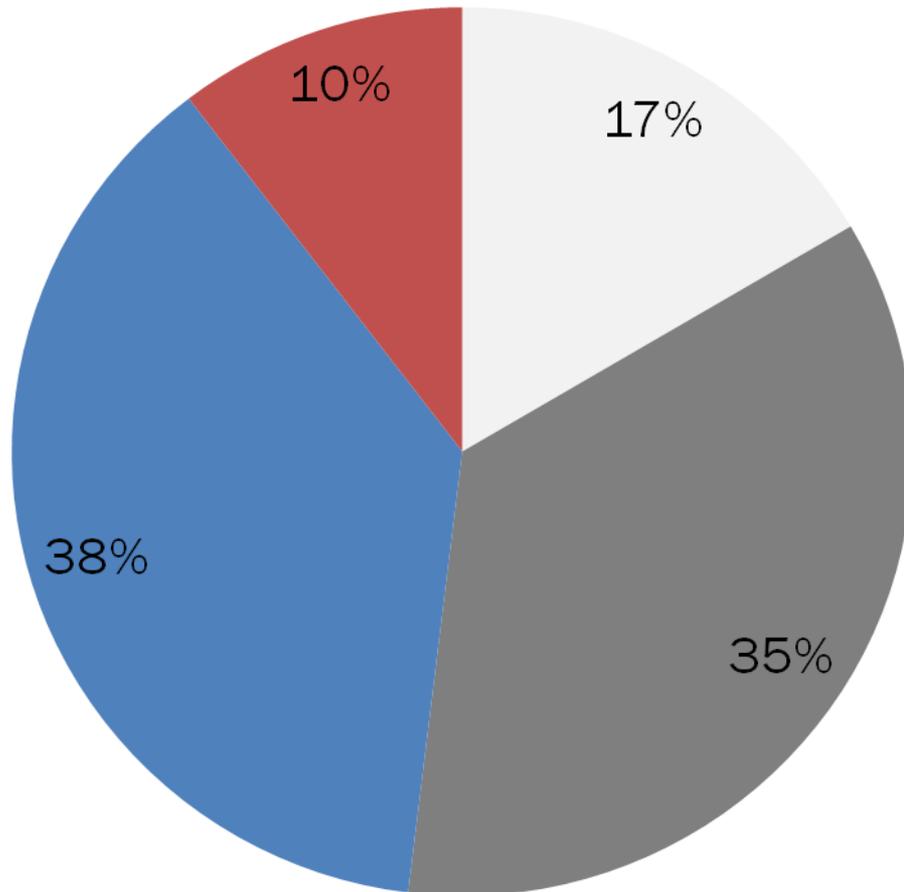


- Background
- Planning
- **Implementation**
- Monitoring & Success



Spring Lake Peninsula  
(St. Paul District)

# Implementation



- No documentation at all
- No post-construction documentation
- Implemented as planned and designed
- Not implemented as planned and designed

# Restoration Practices Employed

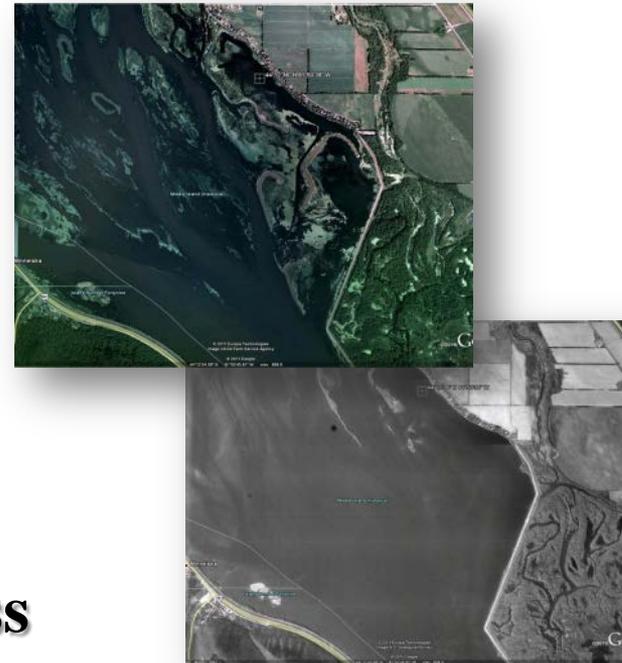


Restoration Practices Employed	Percent (Number of Projects)
ALL (217 projects with a mean of 3.7 RPE's per project)	(855)
Dredging and excavation	47% (102)
Native plantings and revegetation - terrestrial	33% (72)
Channel creation/restoration/stabilization	29% (64)
Dike and levee breaching/construction/removal	29% (64)
Habitat development and improvement	29% (64)
Water control structure installation/modification	29% (63)
Shore and erosion control structures	27% (58)
Placement of dredged material	22% (47)
Native plantings and revegetation - aquatic	18% (39)
Culvert addition/modification/removal	15% (32)
Weir construction/modification/removal	11% (23)
Fish/aquatic species passage or barrier installation/modification/removal	10% (21)

# Data Summary



- Background
- Planning
- Implementation
- **Monitoring & Success**



Spring Lake Peninsula  
(St. Paul District)

# Monitoring



Monitoring Plan?	Percent (Number) of Projects	Monitoring Report?	Percent (Number) of Projects	Monitoring Data?	Percent (Number) of Projects
No	51% (110)	Yes	11% (12)	Yes	50% (6)
				No	50% (6)
		No	89% (98)	Yes	0% (0)
				No	100% (98)
Yes	49% (107)	Yes	40% (43)	Yes	95% (41)
				No	5% (2)
		No	60% (64)	Yes	0% (0)
				No	100% (64)

# Success



Success Achieved?	Percent (Number) of Projects
Yes	15% (32)
Partially	15% (32)
No	1% (2)
ND	70% (151)

# Success



Attribute	Mean Score (1-5)
Characteristic assemblage of species, including indigenous species to extent practicable	3.8
All functional groups present for continued development along appropriate trajectory	4.0
Physical environment capable of sustaining reproducing populations of species necessary for community maintenance	4.0
Normal function for stage of ecological development, recognizing that character and functions may/should change with time	3.6
Suitably integrated into the landscape	3.9
Potential threats from surrounding landscape removed	2.8
Sufficiently resilient to endure normal periodic stress	3.9
Self-sustaining	3.1

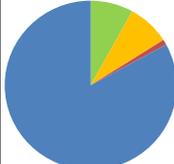
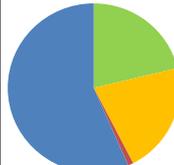
# Success and Model Use



Percent (Number) of Projects		Was the project successful as determined from source project documentation?				
		Yes	Partially	No	ND	
Planning Model Used	54% (118)	17%	15%	0%	68%	
No Planning Model Used	46% (99)	12%	14%	2%	72%	

# Success and Monitoring



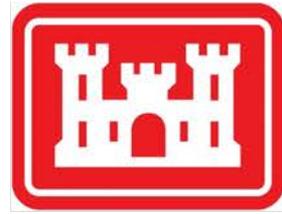
Monitoring Plan?	Percent (Number) of Projects	Was the project successful as determined from source project documentation?				
		Yes	Partially	No	ND	
No	51% (110)	8% (9)	8% (9)	1% (1)	83% (91)	
Yes	49% (107)	21% (23)	21% (23)	1% (1)	56% (60)	

# Monitoring and Authority



Authority (Percent of All Projects)		Percent of Projects with a Monitoring Plan (Number)
Section 1135	(39%)	41% (34)
Upper Mississippi River Restoration-EMP	(22%)	89% (42)
Section 206	(20%)	23% (10)
Coastal Wetlands Planning, Protection, and Restoration Act	(6%)	86% (12)
Missouri River Recovery Program	(6%)	38% (5)
Section 204	(5%)	0% (0)
Specific Authorization	(2%)	60% (3)
ERA 2000	(<1%)	100% (1)

# Accomplishments



Corps projects included in the Retrospective Investigation can be found online at the project website:

<http://cw-environment.usace.army.mil/retro/index.cfm>

**ERDC Website Demo: Corps Aquatic  
Ecosystem Restoration Projects**

# Capability to Corps



Corps planners and practitioners now have access to a wealth of completed project information and summaries to produce robust cost-effective designs and better predict long-term consequences of various restoration actions. Given the breadth of Corps' restoration projects, this study provides strategies to improve project success and promotes the Corps' reputation as an innovator in ecosystem science and a leader in mid-scale and large restoration projects.



Boyer Chute (Omaha District)