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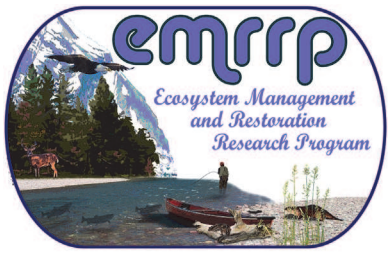

Retrospective Evaluation of Corps Aquatic Ecosystem Restoration Projects Protocol Part 1: Project Overview

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PURPOSE: Despite substantial national investments in aquatic ecosystem restoration, there is little or no quantitative monitoring of ecological response, and little or no basis upon which to assess project and program success. Moreover, few national databases have been developed for ecosystem restoration projects. Monitoring and assessment efforts within the US Army Corps of Engineers ("the Corps") largely reflect this pattern. Better data and information are needed by the Corps and others to ensure that restoration investments maximize environmental benefits to the Nation.

This report describes the methods and protocol used to develop and evaluate a database of ecosystem restoration projects completed by the Corps. Specific objectives are to evaluate (1) the benefits realized relative to objectives, and (2) the performance of selected restoration techniques and practices with respect to stated objectives as well as to independent ecological criteria. The authors also wish to identify lessons learned and noteworthy projects or practices that can improve the performance and outcomes of future projects or practices. Results will have applications beyond the Corps to practitioners nationwide.

Part 1 of this report summarizes (1) results of a workshop conducted during October 2009 to help formulate and refine the focus and direction of the present study; (2) methods used to develop the database; and (3) questions that ongoing analyses will address in subsequent reports. Part 2 details the database content and development guidelines as well as the protocols used for district review of the database.

Several key issues were addressed in the workshop. Key issues include ascertaining what information and knowledge can be gained; determining the critical questions to ask and the evaluation criteria to be used; managing project stratification, practical limitations and constraints, and reviewer qualifications and calibration; identifying which projects to include and which are notable and innovative projects; and factoring in reporting considerations.

General methods and detailed guidelines for development of the database have been prepared and are reported in Parts 1 and 2 of this report, respectively. Calibration exercises are being performed to ensure a consistent approach to database entry and interpretation across multiple reviewers. District project managers are being contacted to review data input by ERDC personnel. They are also being asked to provide supplemental information, where appropriate, and to complete an independent assessment of project performance.

The authors have identified 260 Corps restoration projects for inclusion in the database, including projects funded under eight different authorities. Documentation has been received on 229 of these, which comprise investments of nearly $809M. Data have been entered for 217 projects so far. A web-based version of the database will be developed during FY2013.

The structure of the database allows for a number of analyses. Based on data examined to date, restoration projects completed by the Corps are geographically and ecologically diverse, with just under one-third falling into each of the following size categories: <100 acres, 101-1,000 acres, and 1,001 to 10,000 acres. Fewer than 10% are larger than 10,000 acres. Preliminary analyses are not presented here, but confirm that most Corps restoration projects lack quantitative monitoring by which to evaluate project success. However, for those projects that have been evaluated, most are at least partially successful based on project objectives. Very few projects fail, and most yield some significant environmental benefit. A comprehensive set of analyses will be completed during FY2013, and are described in this document.

INTRODUCTION

Background. Various reviews of the state of science and practice for aquatic ecosystem restoration have repeatedly identified two common weaknesses: little or no quantitative monitoring of physical and biotic response, and little or no basis upon which to assess project and program success. For example, in the most comprehensive review of completed river restoration projects to date, Bernhardt and co-workers (2005) found that only 20% of over 37,000 projects had stated goals, and only 10% had any form of monitoring or assessment.[1] Among these, disconnects between stated goals and monitoring were typical, and few monitoring programs were designed to evaluate consequences.

Unfortunately, few national databases have been developed for ecosystem restoration projects, the study by Bernhardt et al. (2005) being a notable exception. Although numerous stream restoration databases do exist (Jenkinson et al. 2006), published evaluations of these data are sparse. Another significant effort is the National Estuary Restoration Initiative (NERI), which incorporates information on estuary restoration activities conducted by several federal agencies across the country.[2] Also, Coastal restoration in Louisiana conducted by the Corps, National Oceanographic and Atmospheric Agency (NOAA), Natural Resource Conservation Service (NRCS), and Environmental Protection Agency (EPA) under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) are cataloged on-line with numerous fact sheets, monitoring plans and related reports that may contribute to a meta-analysis.[3]

While the Corps has spent more than $400M per year in its ecosystem restoration program and has made substantial investments in restoration projects over the past 20 years, monitoring and assessment efforts within the Corps largely reflect the patterns noted above. Despite some useful early attempts to compile information on restoration projects completed by the Corps (Muncy et al. 1996, Muncy 2000), there has been no systematic analysis of project outcomes and performance of

[1] See also National River Restoration Science Synthesis or NRRSS [*http://nrrss.nbii.gov/*]
[2] *https://neri.noaa.gov/neri/index.htm*
[3] *http://www.lacoast.gov/cwppra*; 40 of 174 projects involve USACE

specific techniques and practices.[1] Post-implementation monitoring and assessment that have occurred are limited in scope and have been applied with little guidance or coordination.[2] These realities constrain the ability of the Corps to evaluate and improve its ecosystem restoration program. Although widely recognized — historically — this shortcoming has not been addressed due to the significant resource requirement and the daunting nature of the effort. Clearly, better documentation of restoration outcomes is needed to identify areas where improvement is necessary, make ecosystem restoration investments informed by the best science, and maximize environmental benefits to the Nation (Lamont 2007).

Information on Corps ecosystem restoration projects is highly decentralized. Nonetheless, the Corps' aquatic ecosystem restoration program is known to be diverse. It encompasses a wide range of habitats and ecosystem types, geographic locations, landscape size and scale, engineering features, and funding levels. Muncy et al. (1996) reported on 52 Corps restoration projects from 16 different districts and divisions. They described a wide range of management measures, engineering features, and associated costs. Muncy (2000) reported on 28 completed Section 1135 studies from 21 Corps districts, including a wide array of geophysical settings — lake, pond, chute, river, stream, cape, bay, salt marsh, island, wetland, harbor and seagrass. Only half of these 28 included a monitoring plan. A review of completed Corps restoration and mitigation studies conducted by Feather and Capan (1995) observed a general lack of clear association among project environmental significance, objectives, and measurable outputs in 10 projects selected for their case study review.

Database standards and protocols have not been formally established for Corps or other agencies' ecosystem restoration projects. The features of Muncy's (2000) database are illustrated in Appendix A, and the Corps is currently beta-testing a comprehensive database of current restoration projects that will be expanded over time to include previously completed projects.[3] Jenkinson et al. (2006) suggested a minimum standard dataset for such databases to include the following:

- Project location, dates & contacts
- Project description/abstract
- Project costs and funding sources
- Goals and objectives
- Explicit success criteria & benefits/outputs anticipated
- Planning models
- Major engineering & design features and specific restoration measures
- Monitoring, metrics and reference base used
- Project constraints
- Notable innovations & lessons learned
- Applications of adaptive management

[1] USACE Environmental Statement of Need (SON) 2007-ER-1, Ecosystem Restoration –Lessons Learned, (*https://wwwel.wes.army.mil/cwenv/son/son.cfm?CoP=Env&Option=View&Id=1*)

[2] Note that many projects are turned over to local sponsors for monitoring, operation and maintenance.

[3] Tazik, D.2009. Personal communication with Ellen Cummings. October 20. Dallas, TX.

The human dimension may be an important consideration in evaluating the success of ecosystem restoration and management. For example, successful river restoration projects often had strong community involvement and an advisory committee (Bernhardt et al. 2007, Palmer et al. 2007). It is possible that a higher level of interest and accountability helped to drive such projects toward success. Also, Lamont (2007) reported that partnerships were critical to the success of seven recently constructed Corps projects. As such, it may be important to obtain information on roles, contributions, and views of cost-share sponsors, and other partners and stakeholders that participate in Corps restoration projects.

Objectives. The present study was initiated to assess the physical and ecological outcomes of a variety of completed Corps aquatic ecosystem restoration projects. Specific objectives were to evaluate (1) the benefits realized relative to intended objectives, and (2) the performance of selected restoration techniques and practices applied in wetland, coastal/estuary, and riverine/stream systems with respect to stated objectives and independent ecological criteria. The authors also aimed to identify lessons learned and noteworthy projects that can help improve the performance and outcomes of future projects.

Approach. The following activities were accomplished in order to meet these objectives:

1) ***Compilation of Corps Ecosystem Restoration Projects:*** Compile information about completed Corps ecosystem restoration projects, including — but not limited to — information about objectives and outcomes/benefits anticipated, techniques and practices employed, and extent of and availability of post-implementation monitoring and assessment data. This will serve as a basis for assessing what the Corps has completed to date, the status of post-implementation monitoring and assessment, and the extent to which data and information are available to document outcomes and lessons learned. This information can be utilized to select specific projects for more detailed evaluation.

2) ***Identify and Evaluate Utility of External Databases:*** Identify and access external databases, including National River Restoration Science Synthesis, National Estuaries Restoration Inventory, and other analogous programs. Evaluate the applicability of these databases to research project objectives. Explore opportunities to leverage efforts with other agencies and organizations attempting to accomplish similar objectives.

3) ***Scientific and Field Advisory Group:*** Establish an advisory group, including representatives from academia, government agencies, nongovernmental organizations, and Corps restoration practitioners. This group will help establish the measures and assessment protocols that can be feasibly applied to evaluate project outcomes and success of selected techniques and practices.

4) ***Project Evaluations:*** Conduct an analysis of restoration techniques, practices, and benefits associated with ecosystem restoration projects completed by the Corps. To the extent practicable, we will consider implications of the results to improve Corps project planning and design and identify critical project success criteria and monitoring parameters. The depth, breadth, and focus of this analysis depend on availability of data from Corps projects.

5) ***Review of Innovative and Successful Corps Ecosystem Restoration Projects:*** Compile information about successful application of innovative techniques and practices and about projects that particularly illustrate successful use of common or inexpensive approaches. This will include information on the technique, project name, location, brief description, contact/project manager, and citation/URL for further information. If warranted, and depending upon follow-on funding, the authors may wish to prepare more detailed case study reports on some of these.

Scope. This study focuses on aquatic ecosystem restoration projects constructed by the Corps during the past 20 years. This includes projects completed under the Continuing Authorities Program (i.e., CAP sections 204, 206, and 1135); projects specifically authorized under Water Resources and Development Acts; and other congressionally authorized projects, including large restoration programs, such as Upper Mississippi River Restoration Program, Comprehensive Everglades Restoration Program (CERP), Missouri River Recovery, Estuary Restoration Act (ERA), Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and Puget Sound.

This report documents progress made on this project as of October 2012. **Part 1** presents a project overview, including results of a project planning workshop, methods being used to manage database development, and progress made in acquiring restoration project planning reports and related environmental documentation. **Part 2** provides considerable detail on the database content, guidelines for data entry, and protocols for district review.

Benefits. Completion of this work will allow the Corps to (1) document best practices and lessons learned; (2) provide a catalog of innovative and successful projects; (3) improve Corps planning and design; (4) identify useful success metrics and monitoring parameters; and (5) help formulate programmatic benefits assessment. Although the intended audience is the Corps of Engineers, results will have applications beyond the Corps to practitioners nationwide. The Corps' knowledge base will be shared, including dissemination of much local knowledge (e.g., via case studies) that may have applications to others in the region, as well as to those in similar circumstances in other regions.[1]

WORKSHOP SUMMARY: A workshop was held in Dallas, Texas during 20-21 October 2009 with a group of academic, interagency, and Corps district experts to help formulate and refine the focus and direction of the Retrospective Study. Participants are listed in Appendix B. The workshop was intended to assist in identifying a suite of performance measures and assessment protocols deemed most appropriate to carry this effort forward. The key points listed here are followed by further explanation below.

Key Points

- The key question is whether the Corps' restoration program has benefitted the environment; if it has, to what extent? What are the environmental outputs and outcomes? What monitoring is being done? What are we learning?

[1] Via web postings, webinars, conference presentations, regional technology transfer meetings, etc.

- Evaluate project outcomes not only against project objectives but also by the extent to which ecological function is achieved. Also, evaluate project planning, documentation, and monitoring.
- Stratify the evaluation to ensure a balance of habitat types, restoration techniques, and geography in the analysis. Select appropriate ecosystem functions or services to provide a program-level accounting.
- The database will provide only so much information. Plan to interview project managers to supplement data available in reports, and to delve into greater detail on a selected subsample of projects.
- Carefully consider the qualification of reviewers and establish calibration protocols to ensure consistency across multiple reviewers.
- Not all projects will qualify as "ecosystem restoration" per se; decide what to include and what not to include.
- Be sure to highlight particularly noteworthy and successful projects.
- In the end, report on how well the Corps is doing; what the Corps does especially well; and factors critical to project success.

Information and Knowledge to Be Gained. A number of essential questions need to be answered to provide more details on the bullets above. Most importantly, have the projects implemented by the Corps had a positive effect on the environment? What information will have the greatest benefit to the Corps as the primary target; and then to the broader community of practice? Clearly, the questions that can be asked and answered will, in no small measure, depend on the data and information available. Three critical questions posed by workshop participants follow:

1) *What are the environmental outputs and outcomes from Corps aquatic ecosystem restoration projects?* To address this question, it is necessary to prepare a standard list of metrics and performance measures for evaluating projects that allows comparability across project types and geographical regions. Is there a standard set of core ecological functions that can help frame these metrics that would, in turn, permit documentation of positive environmental outputs and outcomes from Corps restoration projects?

2) *What is the Corps doing in terms of ecosystem restoration monitoring?* Absent project monitoring, it will be difficult, if not impossible, to evaluate the outputs and outcomes of Corps restoration projects. The intent here should be to learn enough to replicate success and minimize limitations to future success. Specifically, what does the Corps do well, and where and why is success limited? It will also be useful to see whether and how well Corps planners structure project objectives and hypotheses in order to learn how to improve in the future – i.e., knowledge gained that informs future benefit.

3) *Do project design and monitoring plans support effective learning?* It will be important to evaluate the type and quality of monitoring that has been and is being done. Is it designed to support effective learning? Are some monitoring measures and strategies more effective than others? What are the significant obstacles? If the required level of data and information is unavailable in report form, it will be necessary to survey project managers directly. There are many practitioners who are undoubtedly learning from practical experience whether or not

there is formal monitoring and adaptive management. The most valuable aspect of this may lie in identifying particularly innovative and noteworthy case studies.

Evaluation Criteria. Evaluate project outcomes relative to stated project objectives as well as ecological baselines, which may or may not be captured in project objectives. While project success could be interpreted either way, an ecological baseline is required as it relates most directly to generally held notions of ecosystem restoration, and the Corps' definition in particular.[1] See, for example, criteria endorsed by the Society for Ecological Restoration (SER; *www.ser.org*). Clearly, some projects simply cannot satisfy all relevant ecological criteria. Does this make them a failure? Consideration should also be given to whether the project provided a measurable improvement over a previously degraded condition. If a project met all of the SER criteria, it would be an exceptional project. It may not be necessary to set a bar *per se*, but simply to report on the degree to which the project met the selected attributes. Given that Corps restoration has evolved over time, it may be appropriate and useful to stratify projects temporally to evaluate trends in the quality of Corps efforts and results over time.

In addition to information on ecological outcomes, it may be useful to evaluate how well the processes of project planning, documentation, and monitoring were performed. As examples, was the specific technique used effective; and what does a good monitoring plan look like? Another approach is to look at *predictors* of success: was there a watershed plan; were reference sites or conditions used; was there an envisioned image for the project, etc.? (e.g., Palmer et al. 2005).

Stratification. The goal of stratification is to ensure a balance of habitat types, restoration techniques, and geography in the analysis. Also, there may be specific types of ecosystem functions or services that the Corps may want to focus on to provide a program-level accounting regardless of individual project goals and objectives. Does the Corps tend to do better on big projects or small ones, are they better in some ecosystems than others, and are they better with some techniques than others? Stratification can be on the basis of restoration technique or practice, habitat/ecosystem type, project authorization, geographic location and scale, for example.

Practical Limitations and Constraints. There are limitations to what can be learned from a database. Additional work will be required to capture local contingencies, useful details, and knowledge gained. Also, the availability and accessibility of important data and information will almost certainly be limiting. In the absence of robust monitoring data, project success may not be fully evaluated. It may be necessary to conduct systematic, standardized, and unbiased interviews to capture more subtle information.

Any survey instrument or interviews should be designed to elicit objective, unbiased information. The approach could be two-tiered: (1) acquire basic comparable information for all projects supplemented; and (2) conduct more in-depth surveys of a subset based on appropriate stratification factors to ensure representation. As an example, NRRSS reported on all 37,099 projects and interviewed project managers of a stratified sample of 350 projects. A third tier

[1] The purpose of the Corps' program is to "restore significant ecosystem function, structure, and dynamic processes that have been degraded. Ecosystem restoration efforts will involve a comprehensive examination of the problems contributing to the system degradation, and the development of alternative means for their solution." (ER 1165-2-501)

could include selected case studies of a smaller representative subsample – see Noteworthy and Innovative Projects below. (e.g., Alexander and Allan 2006, 2007; and Bernhardt et al. 2007).

Reviewer Qualifications. The evaluation should be designed to allow someone without specific regional expertise to make a fair and honest appraisal without biases. Reviewers should maintain a national perspective that accommodates regional differences. Systems they work on should align with their particular area of expertise – e.g., a coastal ecologist should not evaluate stream projects. Reviewers should be detail oriented.

Calibration. Given that multiple people will be involved, plan to go through a series of calibration exercises and maintain frequent contact and communication.[1] Use a standard reference project for calibration, and standardize definitions and interpretations. Initially, target a selected subset of districts in order to refine the methodology and protocols. The idea is to start small before moving to a larger scale. The projects selected for calibration should be diverse enough to represent a range of issues and conditions.

Which Projects to Include. Not all projects funded by the Corps would necessarily be considered ecosystem restoration. It may not be useful to evaluate, for example, waterfront developments and city park improvements. Beach nourishment and bank stabilization absent ecological restoration objectives may be inappropriate as well. Questions might also be raised where restoration targets are ecologically out of place, such as establishment of cold-water fishery below a dam in an otherwise warm water system. It will not be possible to completely illuminate these outliers until a substantial amount of information is in hand to identify them.

Innovative and Noteworthy Projects. Ask each district to identify two to three projects that could be examined in more depth. There are at least two approaches to this: (1) engage a separate team to work specifically on lessons learned; or (2) conduct as a follow-on activity utilizing those involved in the review process. The group in the latter approach will have developed a depth of knowledge upon which to execute more effective case studies.

Reporting Considerations. There are at least two levels of analyses. First, how well is the Corps doing overall? What are the outcomes of Corps aquatic ecosystem restoration projects? Second, what is the Corps most effective at? What are our strengths; where do we excel; and what ought we to do better? It is also important to assess whether (1) the methods selected were appropriate and properly applied; (2) critical criteria and factors of success were sufficiently addressed in project planning, design and implementation; and (3) projects were engineered to the right level or are over-designed due to risk aversion.

DATABASE DEVELOPMENT METHODS

Methodology for Requesting, Receiving, and Cataloging Projects and Project Reports. Requests for project information and documentation were sent to District contacts and project managers. Requests included the project name, authorization, and report types identified from a variety of sources such as, HQUSACE CAP Program management data, Muncy et al. 1996, Muncy 2000, and various USACE District website searches. Projects initially requested were

[1] NRRSS went through 15 rounds of calibration

authorized under Continuing Authorities Program (CAP - 204, 206 and 1135); WRDA Stand-Alone, Upper Mississippi River Restoration – Environmental Management Plan (UMRS-EMP); and Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). Report documentation types initially identified included Environmental Assessments, Definite Project Reports, Operations and Maintenance Manuals, Project Fact Sheets, and Maps. Project managers and District contacts sent back reports in a variety of ways, including emailing PDF documents, mailing hard copies to be scanned, and sending virtual copies of reports through FTP sites. As documents were received they were cataloged using a series of acronyms created specifically for this retrospective database project. A detailed description of the acronym system can be found in Appendix C. Additionally, a series of Excel workbooks were created to track the projects requested and received by District, Division, and Authorization type. A separate workbook was created to catalog all reports received for each project.

Methodology of Database Development and Formulation. Beginning with the framework from the 2009 workshop (summarized above), an initial set of database headings was adopted. Those headings were further defined by investigating and reviewing previously constructed databases, most notably NOAA-NERI and NRRSS. An initial database was formulated and sent to members of the 2009 workshop for review and comment. This series of reviews and additions to the existing framework led to the database consisting of 21 Sections and 107 data fields. Each data field was then classified by data entry type, which included drop-down selections, text box entries, tables, and Yes/No questions.

Upon construction of the initial version of the retrospective database, 10 projects were selected to be entered. The documents provided for each project were read and reviewed to complete the applicable fields in the database. Data entry of the initial 10 projects was followed by a series of reviews and revisions to the database reports created for each project. During that review process, the database was modified and refined to include pertinent information identified while entering data gathered from the initial projects. This led to the development of database guidelines, which are included as Part 2 of this report.

The guidelines document was developed to (1) describe the procedures for entering and reviewing project specific information; (2) explain different components; (3) outline datasets and data fields; and (4) document the development process of the database.

ERDC data entry personnel were being calibrated based on a standard set of 10 projects to ensure consistent data entry across reviewers. After the initial calibration, periodic calibration exercises have taken place periodically over the duration of the project.

Methodology for District Review of Entered Projects. The database includes a "District Project Review" section in which District project managers are to (1) complete a quality check on ERDC-entered data; (2) provide supplementary project information as appropriate; and (3) evaluate the success of their projects based on ecological criteria modified in accordance with the Society of Ecological Restoration's *Attributes of Restored Ecosystems*.[1] A standard protocol is followed whereby each district is presented with background on the retrospective research effort's specific instructions for reviewing project data, access to all available documentation on

[1] http://www.ser.org/content/ecological_restoration_primer.asp

the projects to be reviewed, and an Excel spreadsheet template for completion of the review. Details on the protocol are presented in Part 2 of this progress report. After initial emails were sent with the instructions, SharePoint link, and project information according to the District Review protocols, follow-up emails were sent to District POCs and Project Managers. Additionally, phone call follow-ups were conducted with contacted District POCs and Project Managers to facilitate the review process. These phone calls consisted of explaining the District Review process and a "talk through" of one or two projects as examples. Emails and phone calls are continuing on an ongoing basis to attempt to complete as many District Reviews as possible.

DATABASE DEVELOPMENT STATUS

A total of 260 ecosystem restoration projects have been completed by the Corps and its partners under the several authorities listed in Table 1. These are sorted by Division in Table 2. They represent expenditures of nearly $809M with a median cost of approximately $1.28M per project. The authors have completed data entry for 217 projects as of October 2012. The status of projects with respect to the on-going review process is illustrated in Table 3. Of the 217 projects entered, 214 have been reviewed internally by at least one principle investigator; 112 are under review by district personnel; and 100 have been reviewed by the district. Figure 1 is a map of the geographic distribution, illustrating the location of various completed Corps ecosystem restoration projects with accompanying Congressional Authority and cost data for each of the included projects.

TECHNOLOGY TRANSFER

Accomplished Technology Transfer Activities. The project information was presented at a poster session at the National Conference on Ecosystem Restoration in August 2011. A poster was also presented at the Joint Corps/TNC meeting in November 2011. An oral presentation was delivered at the Mid-Atlantic Stream Restoration Conference in November 2011.

Table 1. Summary of Completed Projects

AUTHORIZATION	CATALOGUED PROJECTS	TOTAL PROJECTS	REPORTS RECEIVED	MEDIAN PROJECT COSTS	MEAN PROJECT COSTS	TOTAL PROJECT COSTS
WRDA Section 204	10	11	26	$809,000.00	$1,644,642.00	$18,091,062.00
WRDA Section 206	43	46	163	$1,073,000.00	$2,284,054.24	$105,066,495.00
WRDA Section 1135	89	99	323	$703,000.00	$1,830,316.54	$181,201,337.00
CWPPRA	14	14	142	$3,130,000.00	$5,491,428.57	$76,880,000.00
ERA-104	1	3	2	$359,500.00	$569,266.67	$1,707,800.00
UPPER MISS	52	52	245	$2,336,500.00	$3,825,239.31	$198,912,444.00
MISSOURI RIVER	13	27	19	ND	ND	ND
Specifically Authorized	7	8	43	$12,735,972.50	$28,334,980.63	$226,679,845.00
TOTALS	229	260	963	$1,281,184.00	$3,470,124.39	$808,538,983.00

Table 2. Summary of Division Projects Reported by Authorization

USACE Division	WRDA 204	WRDA 206	WRDA 1135	WRDA Stand Alone	CWPPRA	ERA-104	UPPER MISS	MISSOURI RIVER	TOTALS
LRD	0	11 of 11	7 of 9	0	0	1 of 1	0	0	19 of 21
MVD	8 of 9	4 of 5	19 of 19	1 of 1	14 of 14	0	52 of 52	0	98 of 100
NAD	0	6 of 6	9 of 9	3 of 3	0	0 of 1	0	0	18 of 19
NWD	0	11 of 11	24 of 25	0	0	0	0	13 of 27	48 of 63
POD	0	1 of 1	1 of 1	0	0	0	0	0	2 of 2
SAD	1 of 1	4 of 4	8 of 11	1 of 1	0	0 of 1	0	0	14 of 18
SPD	0	1 of 3	6 of 10	2 of 3	0	0	0	0	9 of 16
SWD	1 of 1	5 of 5	15 of 15	0	0	0	0	0	21 of 21
TOTALS	10 of 11	43 of 46	89 of 99	7 of 8	14 of 14	1 of 3	52 of 52	13 of 27	229 of 260

Table 3. Status of Data Entry by Division*

DIVISION	Total Projects	Cataloged Projects	Data Entry Completed	Internal Review Completed	External Review In Progress	External Review Completed
LRD	21	19	19	19	11	7
MVD	100	98	88	86	14	72
NAD	19	18	17	17	3	14
NWD	63	48	47	47	41	6
POD	2	2	2	2	2	0
SAD	18	14	14	14	14	0
SPD	16	9	9	8	6	1
SWD	21	21	21	21	21	0
TOTAL	260	229	217	214	112	100

* Includes WRDA-204, WRDA-206, WRDA-1135, Specifically authorized projects, Upper Mississippi River, Estuary Restoration Act, Missouri River, and Coastal Wetlands Planning, Protection and Restoration; Does not include Comprehensive Everglades, Puget Sound, and Columbia River

Future Technology Transfer Activities. The project data incorporated into the Retrospective Database will be compiled into an online version of the database, which is currently under development. Major features of the web-based version are presented in Appendix D of this report. The website will provide various search options, display a variety of project data, and include a library of project documentation. The beta-version of the website was available for review at the end of December 2012. An ensuing technical report, *Evaluation of Corps Ecosystem Restoration Techniques and Practices*, will provide data stratification analyses of the database. One such stratification could include breakdowns of the top environmental resource issues, restoration intents, and restoration practices employed by district and ecosystem type. This will illustrate any potential regional variation in Corps restoration specialties and bridge potential gaps between similar ecosystems from different regions. Another subsequent technical report, *Compilation of Innovative Corps Ecosystem Restoration Projects*, will address notable projects with innovative features or projects that provide lessons learned to be applied to future projects. Completed projects

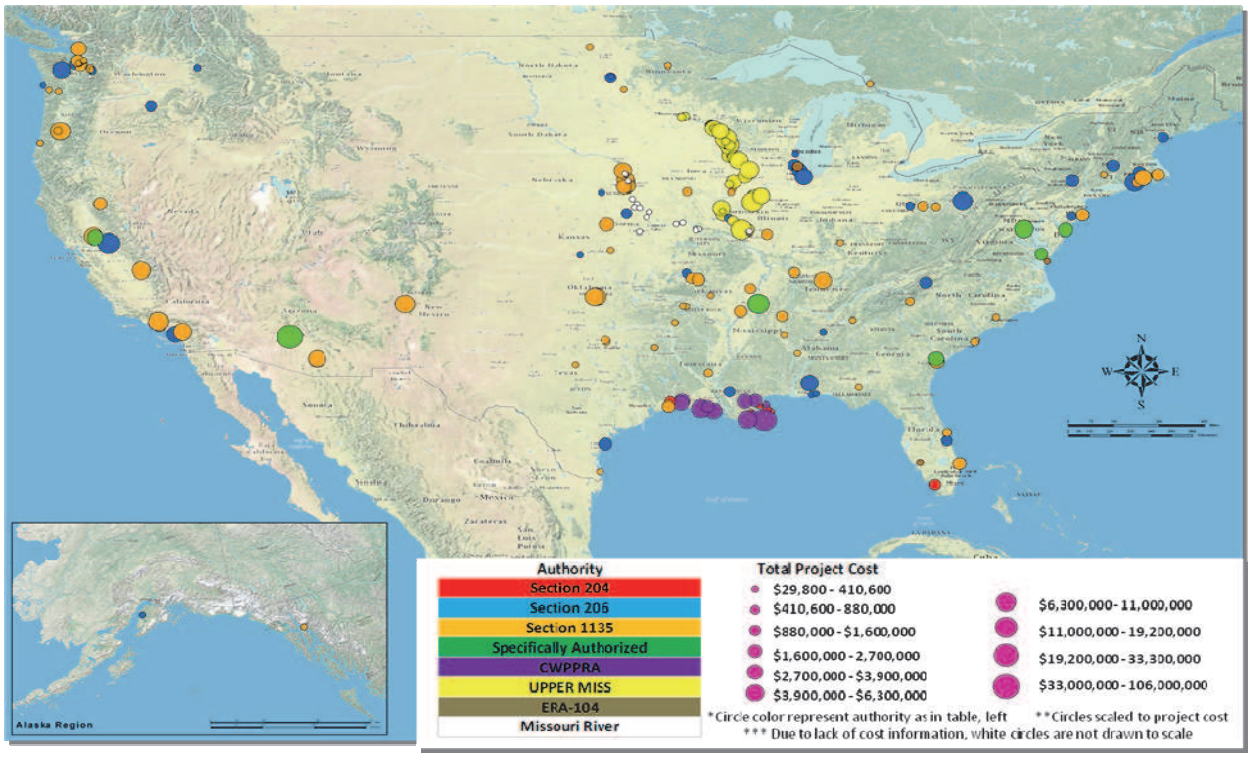

Figure 1. Geographic Distribution of Corps Ecosystem Restoration Projects Across the United Stated. Projects are color coded by Congressional Authority; balloon size is correlated with total project cost. (Note project cost data were not available for Missouri River Projects (white) at the time this map was developed.)

with innovative features or lessons learned have been identified by Corps project managers and through analyzing project documentation. An additional product of the Retrospective Database Project is a journal publication to address the success of aquatic ecosystem restoration projects, "Evaluating the Success of Aquatic Ecosystem Restoration Projects." This journal publication will provide ecosystem restoration practitioners outside of the Corps with a glimpse at the success of the Corps Ecosystem Restoration Program. These products are anticipated to be completed during the first half of FY-2013.

PROSPECTIVE ANALYSES: In addition to the database itself being a useful tool for restoration practitioners and planners, the compiled data will allow us to explore patterns in Corps restoration projects that can improve the Corps Ecosystem Restoration Program. Fulfilling a major objective of this project, the benefits realized can be explored relative to the intended objectives and anticipated benefits. Other questions asked in the Workshop's Key Points can be addressed directly with database content as well as by using some of the following compilations and exploratory analyses. With the large quantity of information gathered, a vast combination of analyses stratifying the data in a multitude of ways will be possible. The basic breakdowns of cost and size for all restoration projects will be available for the first time. Additionally, the breakdown of cost and size by district, authority, ecosystem, restoration features used, and any other category of interest from the database can be done. A breakdown of the top Environmental Resource Issues, Restoration Intents, and Restoration Practices Employed by district (also by ecosystem) will

illustrate any potential regional variation in Corps restoration specialties, allowing for a bridge in the gap that may occur between similar ecosystems on, for instance, opposite coasts or for riverine projects that occur throughout the nation. A basic breakdown of Restoration Intent across all projects would elucidate the most common intents for completed Corps restoration projects. For each Restoration Intent, was the project successful in achieving the goals/success criteria as determined from the project documentation? This would help to explore what intents the Corps most successfully carries out. The previous analyses/questions could be revisited with the top Restoration Practices Employed in place of Restoration Intent. This would focus more on actual techniques/engineering features used no matter what the intent of the technique. This type of analysis could also be done for each ecosystem, for each authority, and for a total summary of all the projects; each answering slightly different questions. It may be useful to explore whether the focus of restoration projects has shifted over time by looking at the most common Restoration Intents (also Restoration Practices Employed) over five- or ten-year periods through history. Depending on the patterns seen over time, it may be of interest to see whether the average cost for particular Restoration Intents or Practices Employed has shifted over time with their use. Ecosystem type can be stratified by Restoration Intent, Environmental Resource Issues, or Restoration Practices Employed to determine whether the Corps is focusing on the same problems, and methods to fix those problems, for certain ecosystems. Are there any patterns to cost-share (non-profit, state, local government) for different districts and for different authorities or over time? What is the average project cost by authority? Do certain authorities tend to employ specific Restoration Intents or Restoration Practices Employed? What is the success by Authority? Is the presence of a documented Monitoring Plan related to success, related to authority, and/or related to District? The information compiled in this database will allow us to answer these questions. As the data are analyzed further, additional relevant questions will arise and be attended to, in turn improving our understanding of this program and enabling us to increase the effectiveness of the Corps Ecosystem Restoration Program as a whole.

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This technical note was prepared by Justin Gardner, Erynn Maynard, David Price, and Craig Fischenich, EL. The study was conducted as an activity of the Ecosystem Management and Restoration Research Program (EMRRP). For additional information on EMRRP, please consult http://el.erdc.usace.army.mil/emrrp/emrrp.html or contact the Program Manager, Glenn Rhett, at Glenn.G.Rhett@erdc.usace.army.mil. This technical note should be cited as follows:

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Appendix A. Fact Sheet Headings for Section 1135 Studies (from Muncy 2000)

Project
State
Corps District
Project Modified and Authorized Purpose
Congressional District
Location
County
USGS Topographic Map(s)
Nearest City or Town
Watershed
Resource Problem
Objective/ Goals
Description of Proposed Modification
Significant Design Changes
Future with Project Condition
Concerns/ Issues
Coastal America Project
Contribute to Goals of the North American Waterfowl Management Plan
Benefit Endangered Species
Cost Sharing Sponsor
Views of the Sponsor
Other Contributing and Supporting Agencies
Corps Project Manager
Monitoring Plan
Benefits/ Outputs
Cost of the Project before Final Accounting
Schedule of Project Site Visits
Level of Certainty that Project is Trending toward Desired Goals
Lessons Learned and Assistance Desired
Recreation Uses
Available Photographs

Appendix B. List of Workshop Participants

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Courtney Chambers	ERDC, Environmental Laboratory
Jock Conyngham	ERDC, Environmental Laboratory
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Julie Marcy	ERDC, Environmental Laboratory
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David Price	ERDC, Environmental Laboratory
Richard Starr	US Fish and Wildlife Service, Chesapeake Bay Field Office
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Dave Tipple	USACE, Jacksonville District
Peter Wilcock	Johns Hopkins University
Chuck Wilson	USACE, Wilmington District

Appendix C: Retrospective Ecological Restoration Project – File Naming Conventions, Abbreviations, and Citation Standards

PROJECT LABELING:

District (DIS)-Project Authorization-Project Title (Name)

PROJECT REPORTS LABELING:

District (DIS)-Project Authorization-Project Title (Name)-Report Type-Section Number (when documents are too large)-Year (as applicable see below)

PROJECT AUTHORIZATIONS ABBREVIATIONS:

WRDA Sec. 204: **204**
WRDA Sec. 206: **206**
WRDA Sec. 1135: **1135**
Missouri River Restoration Program: **MRR**
Coastal Wetlands Planning, Protection and Restoration Act: **CWPPRA**
Upper Mississippi River Restoration: **UMRR**
Chesapeake Bay Restoration: **CBR**
Lower Columbia River Restoration: **LCRR**
Upper Columbia River Restoration: **UCRR**
Comprehensive Everglades Restoration Program: **CERP**
Puget Sound Near-Shore: **PSNS**
Puget Sound and Adjacent Waterways: **PSAW**
Estuary Restoration Act: **ERA**
Specific Authorization: **SA**

REPORT TYPES:

Project Fact Sheet: **PFS**
Project Map: **MAP**
Executive Summary: **ES**
Problem Appraisal Report: **PAR-YYYY**
Feasibility Study: **FS-YYYY**
Feasibility Study Appendices: **FSA-YYYY**
Feasibility Report: **FR-YYYY**
Preliminary Restoration Plan: **PRP-YYYY**
Basis of Design: **BOD-YYYY**
Definite Project Report: **DPR-YYYY**
Definite Project Report Appendices: **DPRA-YYYY**
Environmental Assessment: **EA-YYYY**
Environmental Assessment Appendices: **EAA-YYYY**
Environmental Impact Statement: **EIS-YYYY**
Environmental Impact Statement Appendices: **EISA-YYYY**

Ecological Restoration Report: **ERR-YYYY**
Ecological Restoration Report Appendices: **ERRA-YYYY**
General Design Memorandum: **GDM-YYYY**
Reconnaissance Report: **RR-YYYY**
Restoration Study: **RS-YYYY**
Project Completion Report: **PCR-YYYY**
Project Cooperation Agreement: **PCA-YYYY**
Project Modification Report: **PMR-YYYY**
Project Modification Report Appendices: **PMRA-YYYY**
FONSI: **FONSI**
Monitoring Plan: **MP-YYYY**
Operations and Maintenance Manual: **OM-YYYY**
Operations and Maintenance Manual Appendices: **OMA-YYYY**
Monitoring Report: **MR-YYYY**
Progress Report: **PR-YYYY**
Annual Inspection Report: **AIR-YYYY**
Adaptive Management Report: **AMR-YYYY**
Performance Evaluation Report: **PER-YYYY**
Letter: **LTR-YYYY**
As Built Drawings: **As-Builts**
Other: **OTR-Description**

CITATIONS:

Technical Reports (Non-ERDC):

1. Sewerage Commission of the City of Milwaukee. 1971. *Evaluation of conditioning and dewatering sewage sludge by freezing.* Washington, DC: US Department of Commerce.
2. Brown, G. N., K. B. Kirwan, G. J. Englehardt, and J. R. DeWolfe. 1993. *Mechanical freeze/thaw conditioning of water works residuals pilot study.* Project report to Municipal Water and Wastewater Treatment Electrotechnology Committee. Miami: Electric Power Research Institute.
3. Brown, J. R., and G. T. Egglestone. 1989. *Ballistic properties of composite materials for personnel protection.* MRL-TR-89-6. Victoria, Australia: Materials Research Laboratory.

Website:

1. Green, M. P. 1995. A history of learning institutions. *http://www.ccs.neu.edu/home/distancelearning.html*

APPENDIX D: Initial Concepts for a Web-Based Version of the Retrospective Database

HOME

Introductory paragraph

- Go to Search
- Go to Maps

ABOUT

- Background
- Status of the Database
- How to Add a Project or Provide Additional Information on an Existing Project
- Links

SEARCH FOR PROJECTS (Some of this will be available on every page)

Basic Search Advanced Search

- Location → go to map view (view by Corps District)
- Ecosystem Type
- Congressional Authority
- Restoration Intent
- Restoration Practice
- Partners

Advanced Search: Develop a list of possible criteria to choose from: project name, state, county, region, Congressional district, ecosystem type, specific habitat type, restoration intent, restoration technique, level of success, monitoring category, benefit category, partners, etc. Each should allow for multiple picks.

Note: Include an option for keyword searchers

MAPS (This will be tied in with Google Maps)

National Map

- Location by Congressional Authority
- Number of Projects by State
- Number of Projects by Corps District
- Number of Projects by Congressional District
- Acres of Projects by State
- Acres of Projects by Corps District
- Acres of Projects by Congressional District

Regional Maps: showing locations and with a link to summary information for each region

- Corps Districts
- Congressional Districts
- State

- Watershed/HUC

  Summary Information by designated region:

  - Total number of projects
  - Total acres restored
  - Number of projects by Ecosystem Type
  - Acres restored by Ecosystem Type
  - More to be determined