

APPENDIX C

Monitoring and Adaptive Management Plan

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August 2009 guidance from USACE headquarters, implementing Section 2039 of WRDA 2007, requires that ecosystem restoration projects include plans for monitoring success and adaptively managing ecosystem restoration projects.

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure, that when conducting a feasibility study for a project (or component of a project) under the U.S. Army Corps of Engineers (USACE) ecosystem restoration mission, that the recommended project includes a monitoring plan to measure the success of the ecosystem restoration.

AUTHORITY

Section 2039 of WRDA 2007 Monitoring Ecosystem Restoration

- a) *"In General - In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration."*
- b) Monitoring Plan - The monitoring plan shall:
 - 1) Include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and
 - 2) Specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.
- c) Cost Share - For a period of 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

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Purpose of Monitoring

Monitoring of an ecosystem restoration project provides information with which to gauge the success of the restoration. Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining the achievement of ecological success, and determining the necessity of adaptive management to attain project benefits.

Purpose of Adaptive Management

The USACE implementation guidance for Section 2039 also directs the development of a contingency plan (an adaptive management plan) for all ecosystem restoration projects. Adaptive management is intended to increase the ability to make timely responses based on new information from monitoring to maximize the objectives of the restoration effort. An adaptive management plan considers the planned restoration activities and establishes a framework for evaluation of the ecosystem performance; and it identifies uncertainties that will be addressed through monitoring. As monitoring data is collected and assessed, the management plan guides the decision to a) continue the restoration plan without modification, or b) to modify the restoration plan.

The monitoring and adaptive management plan (MAMP) was developed in accordance with the following guidance:

- a. USACE. 31 August 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration.
- b. USACE. 22 April 2000. ER 1105-2-100, Planning, Planning Guidance Notebook.
- c. USACE. 01 May 2003. EC 1105-2-404. Planning Civil Work Projects under the Environmental Operating Principles.

OBJECTIVES AND SCOPE

The objective of the project is to restore the ecological structure and function of the Resacas in the vicinity of the City of Brownsville, Texas (Project). The objective includes the importance of the Resaca habitats for the unique and diverse flora and fauna dependent on these ecosystems and the importance of connectivity to the surrounding high value habitat. Monitoring and, if necessary, adaptive management, would occur for a period of 10 years as evidence for successful establishment of the project prior to the project being turned over to the non-federal sponsor for operation and maintenance. The Brownsville Public Utilities Board (BPUB) and USACE personnel would conduct monitoring efforts.

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The scope of monitoring and adaptive management was developed for the project's restoration objectives. Monitoring and adaptive management cost and duration were based on the recommended plan, Alternative 5. This plan is based on currently available data and information. Uncertainties remain regarding the exact project features, monitoring elements, and adaptive management opportunities. Components of the monitoring and adaptive management plan, including costs, were estimated using a similar ecosystem restoration project in south Texas as a model. Uncertainties would be addressed during preconstruction engineering and design of the recommended plan. A more detailed monitoring and adaptive management plan, including cost breakdown, would be included in the design documentation report (DDR).

This feasibility level MAMP identifies and describes the monitoring and adaptive management activities proposed for the project and estimates their cost and duration.

MANAGEMENT AND RESTORATION ACTIONS

The project delivery team conducted a thorough plan formulation process to identify potential management measures and restoration actions that address the project objective. The team considered, evaluated, and screened all alternatives to produce a final array of alternatives. Ultimately, the team identified one plan, Alternative 5, as the National Ecosystem Restoration plan and recommended it for implementation. Alternative 5 would restore aquatic and terrestrial complexes as self-regulating, functioning systems in Resaca de la Guerra and Resaca del Rancho Viejo. In total, the plan would restore 899 acres of aquatic and riparian habitat along the Resaca de la Guerra and Resaca del Rancho Viejo in 46 separate areas. About 681 acres of terrestrial riparian habitat would be cleared of invasive species of plants and native species would be replanted. An implementation plan would restore about 218 acres of aquatic habitat through the removal of sediment, by shaping banks, and by planting 57 acres with aquatic and emergent vegetation (Figure C-1).

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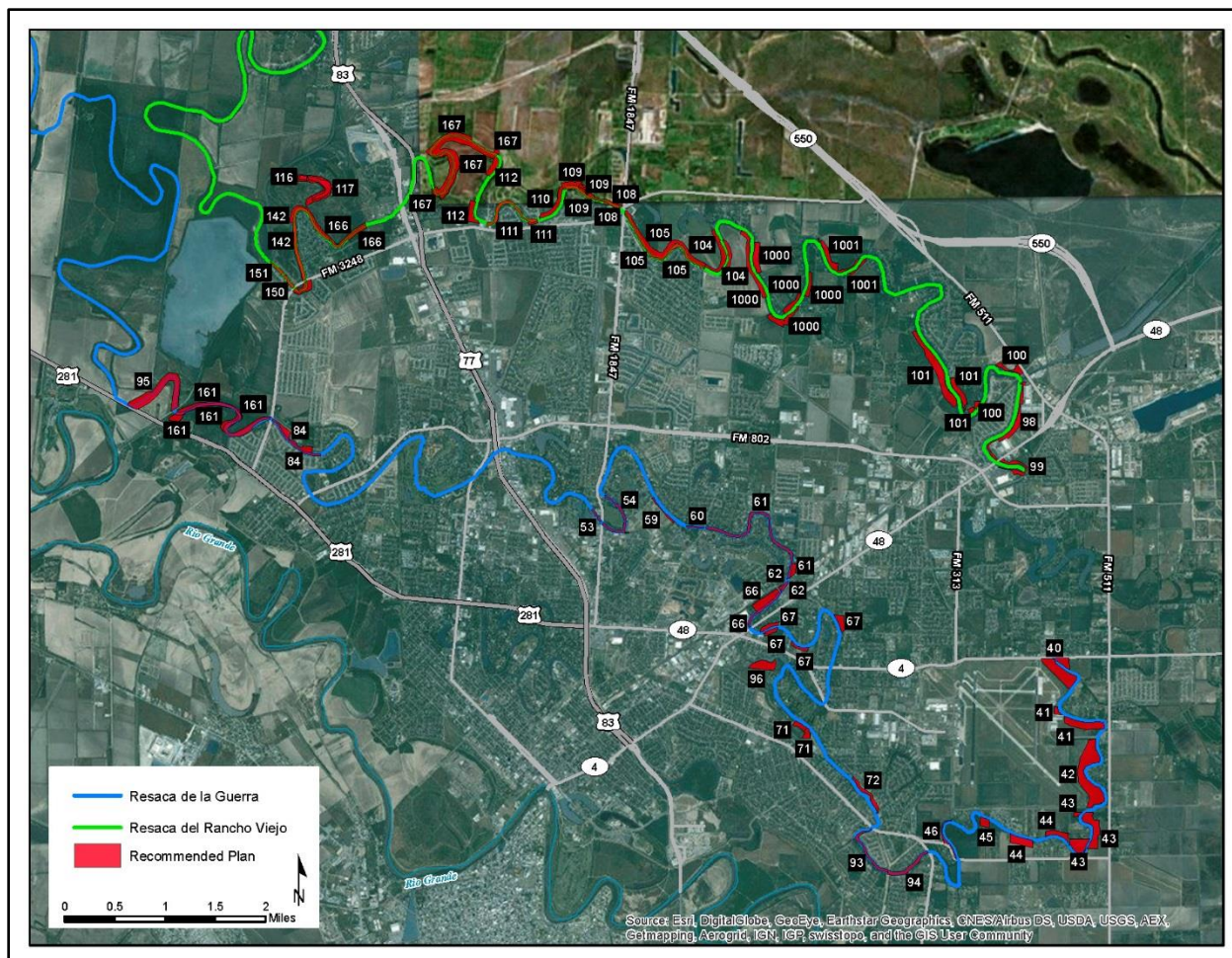


Figure C-1: View of Areas Included in the Recommended Plan

The recommended plan includes the following ecosystem restoration components, all or some of which would be implemented on 46 restoration areas on Resaca del Rancho Viejo and Resaca de la Guerra:

- 218 acres of dredging to restore resaca depths to a minimum average of six feet in depth;
- 31 miles of bank sculpting to restore the 1V:10H to 1V:15H bank slopes along the resaca shoreline;
- 681 acres of riparian planting to replace or augment existing vegetation within the riparian habitats of the resaca;
- 57 acres of emergent planting along the shallow aquatic habitats paralleling the newly sculpted shoreline; and
- 681 acres of invasive species management

The Drawings section at the end of the main report provides additional figures of each Resaca.

IMPLEMENTATION

Monitoring would be initiated before construction, would continue during construction, and would continue for up to ten years after the completion of construction of each restored area. A monitoring and adaptive management team (MAMT) composed of the USACE and the BPUB staff would conduct the data acquisition. The MAMP would be implemented in a phased approach as each separable element in the project is constructed. Monitoring and adaptive management would be initiated at the end of the construction of each restoration area, and a ten-year clock for each separable element would start at that time.

Monitoring would focus on evaluating project success and guiding adaptive management actions by determining if the project has met performance standards (Table C-1). Validation monitoring would involve various degrees of monitoring with quantitative metrics aimed at verifying that restoration objectives have been achieved for biological resources. Effectiveness monitoring would be implemented to confirm that project construction elements perform as desired. Monitoring would be carried out until the project has been determined to be successful. Monitoring would occur for up to 10 years or less depending on when success criteria are met. Monitoring objectives have been tied to original baseline measurements that were performed during site characterization field visits. Adaptive management measures would be considered upon first instance or indication of failure to meet a performance standard. Metrics and specific adaptive management triggers would be further developed during preconstruction engineering and design.

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Table C-1: Modeling Criteria, Performance Standards, and Adaptive Management

Measurement	Performance Standard	Adaptive Management
Aquatic Vegetation	80 percent plant establishment	Replacement of dead vegetation; modify plant species composition or location within the restoration area; modify propagation method, allowing natural succession of native vegetation; remedial planting/seeding; amending soil; modify irrigation, herbicide application, biological control; mechanical control of invasive species
Woody Vegetation	80 percent plant establishment	
Herbaceous Vegetation	50 percent canopy cover	
Species Diversity	75 percent of reference site	
Non-native Vegetation	Less than 25 percent canopy cover of non-native species with no area greater than 0.25 acres in size with greater than 25 percent non-native species	Chemical, biological, or mechanical control
Invasive Species	Less than 25 percent canopy cover of invasive species with no area greater than 0.25 acres in size with greater than 25-percent invasive species	
Bank Slope	90 percent of modified slopes less than 1:10	Regrade slope, identify and mitigate erosion source, utilize green armoring techniques
Resaca Depth	Average depth 4-6 feet	Re-dredge, identify and mitigate erosion source

Vegetation

Baseline metrics to quantify vegetation parameters of the restoration were compiled during initial site assessments throughout the study area. Vegetation metrics include species composition, percent canopy cover for each species, percent over story canopy cover, and percent aquatic vegetation canopy cover. These measurements would allow the MAMT to assess the performance standards. Any planted material that has died within the warranty period would be replaced. Post warranty period, the adaptive management plan would include the replacement of the plants, modification of the propagation method, and/or allow natural selection to augment the habitat. Restoration of the aquatic and riparian vegetation would be considered successful when the site meets the species diversity associated with the target vegetation association and when the site is generally vegetated with 80 percent success of plantings for aquatic and woody species with an herbaceous canopy cover of at least 50 percent. Adaptive management could include remedial planting/seeding, modifying species composition, modifying propagation method, amending soil, and/or modifying irrigation to ensure successful establishment the vegetation.

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The percent canopy cover of non-native and invasive species should be less than 25 percent at each restoration site. On an annual basis, or more frequently if needed, areas greater than or equal to 0.25 acres in size that have more than the 25 percent areal cover of non-native or invasive vegetation would be treated per the Operations and Maintenance Manual for the project which would be developed during PED. Typically, methods include chemical and mechanical management of non-native and invasive species.

Interim monitoring targets for the herbaceous component of the riparian plantings is 75 to 80 percent herbaceous cover in two years. After two years, herbaceous plantings would decrease proportionately with the increase in shrub vegetation. Adaptive management would be initiated if the percent cover has not reached these criteria in two years and/or when the control of invasive herbaceous species is not achieved.

The establishment of shrub species should be evaluated annually to ensure viability of seedlings. The establishment of volunteer shrubs, consistent with the proposed vegetation community being established, would be evaluated on an annual basis during the monitoring period to ensure the correct species composition of the restoration area is maintained. Adaptive management would be initiated in areas that fail to establish the density of shrubs with the percent species composition designed for the restoration area.

Resaca Shoreline and Depth

The resiliency of the Resaca ecosystems is dependent on the hydraulic influences of the Resaca on the adjacent habitats. The proposed dredging and bank sculpting address these hydraulic influences on the habitats. Restoration would be considered successful when 90 percent of the modified slopes are less than 1V:10H and when the average depth of each Resaca restoration area is greater than 6 feet.

REPORTING

The Project is expected to be constructed as a phased project over a period of sixteen years. Evaluation of the success would be assessed annually until all performance standards are met for each phase of the study. Site assessment would be conducted annually by the MAMT and an annual report would be submitted to the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, and USACE by January 30 following each monitoring year for up to ten years after the last phase is constructed.

Permanent locations for photographic documentation would be established to provide a visual record of habitat development over time. The locations of photo points would be

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identified in the pre-construction monitoring report. Photographs taken at each photo point would be included in monitoring reports.

MONITORING AND ADAPTIVE MANAGEMENT COSTS

Costs to be incurred during preconstruction engineering and design and construction phases would include preparation of the detailed monitoring and adaptive management plan. Cost calculations for post-construction monitoring are displayed for a ten-year monitoring period for each construction phase.

A centralized data management system would be used for storage, analysis, and reporting. All data collection activities would follow consistent and standardized processes established in the detailed monitoring and adaptive management plan.

Cost estimates include monitoring equipment, photo point establishment, data collection, quality assurance/quality control, data analysis, assessment, and reporting for the proposed monitoring elements (Table C–2). Unless noted, preconstruction monitoring costs would begin at the onset of preconstruction engineering and design of the first construction phase. Monitoring would be budgeted as construction costs.

Table C–2: Preliminary Cost Estimates

Category	Activities	PED Set-up & Data Acquisition	Construction	10-year Post Construction	Total
Monitoring: Planning and Management	Monitoring workgroup, drafting detailed monitoring plan, working with PDT on performance measures	\$25,000			\$25,000
Monitoring: Data Collection	Data collection		\$50,000	\$450,000	\$500,000
Data Analysis	Assessment of monitoring data and performance standards		\$25,000	\$75,000	\$100,000
Adaptive Management Program	Detailed adaptive management plan and program	\$25,000			\$25,000
	Establishment of adaptive management program			\$600,000	\$600,000
Database Management	Database development, management, and maintenance		\$10,000	\$30,000	\$40,000
Total		\$50,000	\$85,000	\$1,155,000	\$1,290,000