

Deepwater Horizon NRDA Monitoring Plan  
Phase I Early Restoration:

Lake Hermitage Marsh Creation –  
NRDA Early Restoration Project

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## 1.0 Introduction

The Louisiana Natural Resource Trustees (Trustees) developed this monitoring plan (Plan) for the Lake Hermitage Marsh Creation – Natural Resource Damage Assessment (NRDA) Early Restoration Project (Project). This Project is included as a Phase I Deepwater Horizon early restoration project and is intended to compensate the public for injury to brackish marsh habitat in the Barataria Hydrologic Basin (Deepwater Horizon Natural Resource Trustees, 2012). The purpose of this plan is to describe monitoring activities that will be conducted to evaluate and document restoration effectiveness, including performance criteria for determining the success of restoration or need for interim corrective action (15 CFR 990.55(b)(1)(vii)). This Plan will be implemented by the Coastal Restoration and Protection Authority of Louisiana (CPRA) in coordination with the Louisiana co-trustees and may be modified over time based on the management needs for the Project.

### 1.1 Project Overview

The Project involves the creation of marsh within a project footprint known as the “Lake Hermitage Marsh Creation (BA-0042) Project” developed for and funded through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Program. This Project substitutes approximately 104 acres of created brackish marsh habitat for approximately 5-6 acres of earthen terraces that would otherwise have been constructed within the CWPPRA project boundary.

The Lake Hermitage Marsh Creation – NRDA Early Restoration Project is located within the Barataria Hydrologic Basin in Plaquemines Parish, Louisiana, to the west of the community of Pointe a la Hache, and northwest of the community of Magnolia (Figure 1). This basin was identified as a priority area for coastal restoration, and has been the focus of extensive study and project design and implementation.

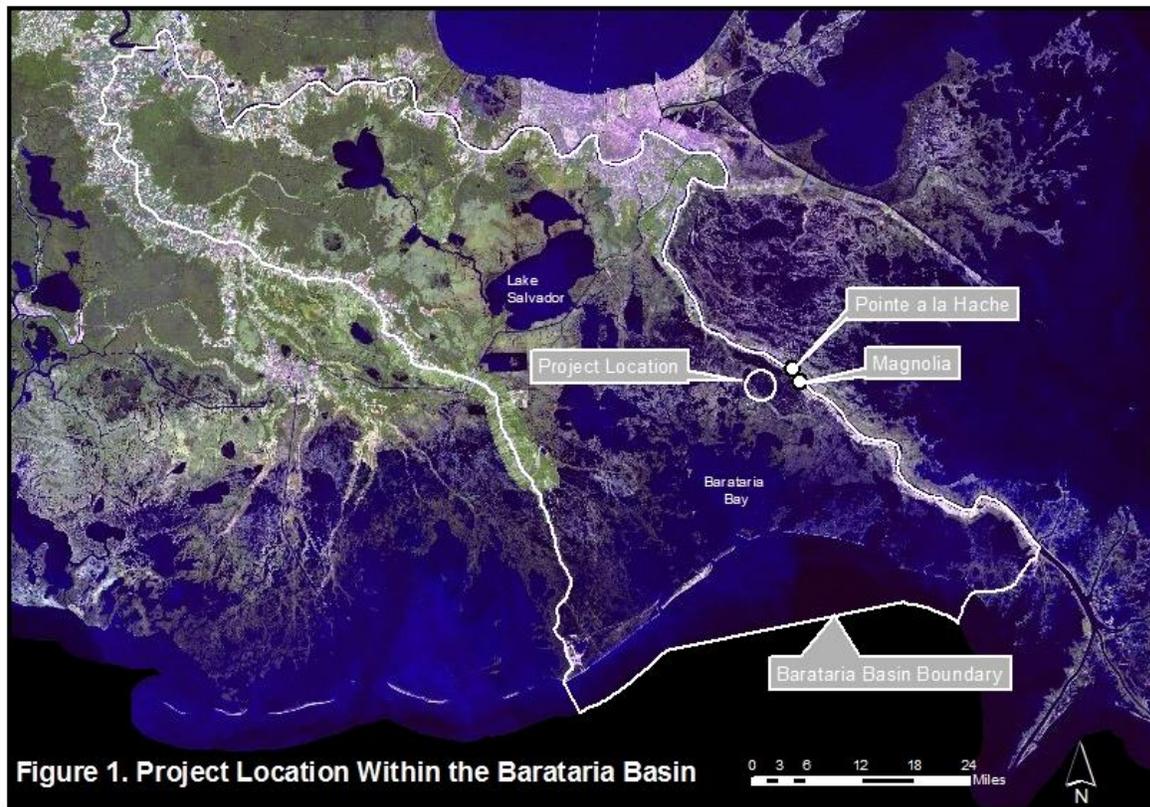
The Project is designed to create an additional 104 acres of brackish marsh habitat in lieu of the earthen terraces included in the final design of the base BA-0042 CWPPRA project. Marsh areas will be constructed entirely within the BA-0042 CWPPRA project’s terrace boundary (Figure 2). Sediment will be hydraulically dredged from a borrow area in the Mississippi River, and pumped via pipeline to create new marsh habitat in the Project area (Figure 3). Over time, natural dewatering and compaction of dredged sediments should result in elevations within the intertidal range which would be conducive to the establishment of emergent marsh. The 104-acre fill area will be planted with native marsh vegetation (*Spartina* spp.) to accelerate benefits to be realized from this Project.

### 1.2 Restoration Objectives and Performance Criteria

The goal of the Project is to restore brackish marsh habitat within Barataria Bay that contributes to making the environment and the public whole for brackish marsh injuries in Louisiana caused by the Deepwater Horizon Oil Spill. The following restoration objectives and performance criteria are provided to facilitate evaluation of Project performance. Measurement against performance criteria will determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)).

#### Objectives

- 1) Create brackish marsh habitat
- 2) Promote establishment of native brackish marsh vegetation

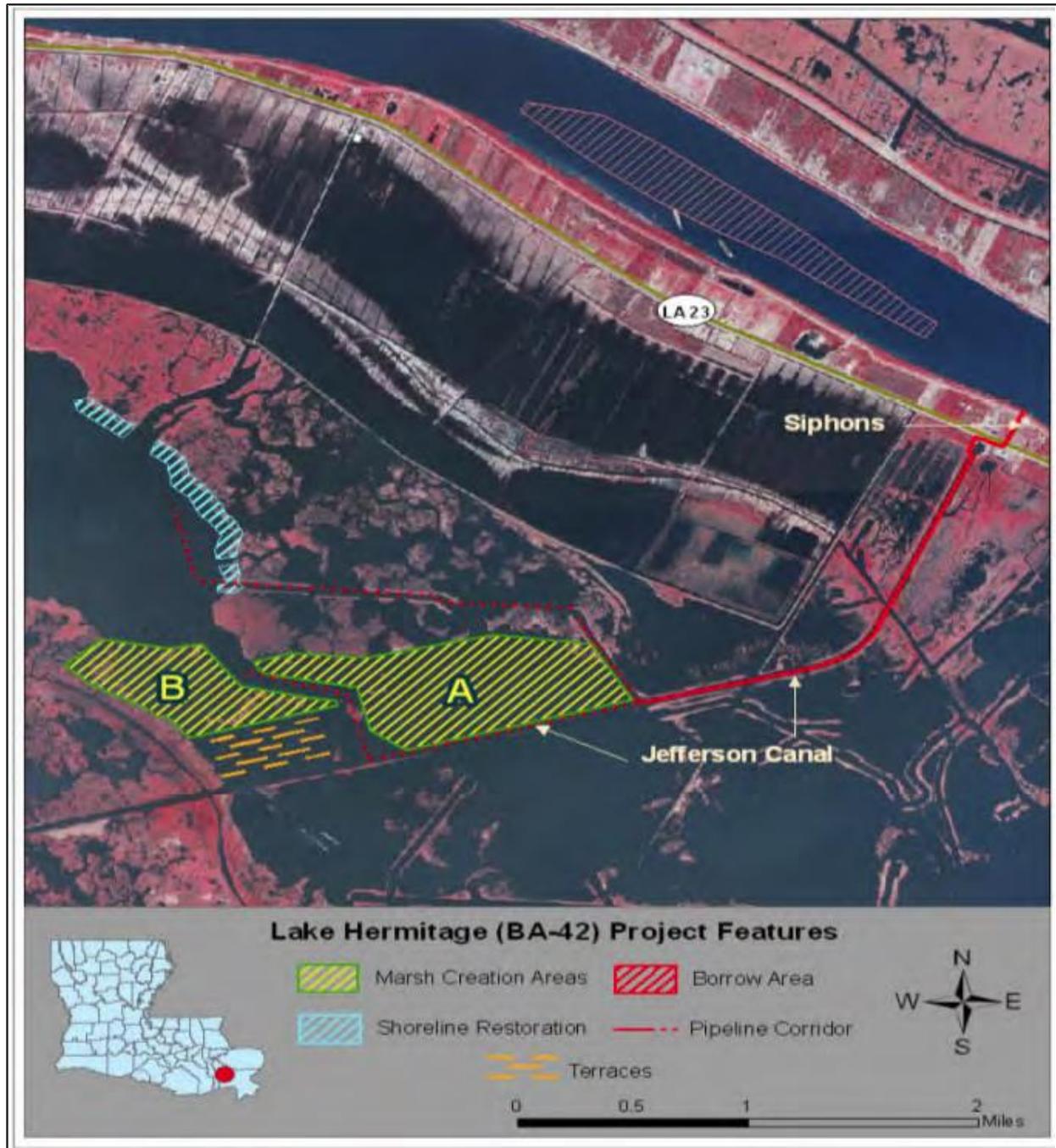


**Figure 1.** Lake Hermitage Marsh Creation – NRDA Early Restoration Project location within the Barataria Basin

### Performance Criteria

- 1) Spatial Extent (acres): Spatial extent of the marsh creation area is approximately 104 acres after construction is complete and equal to or greater than 70 acres at Year 5 (at current trajectory, Year 5 is expected to be summer/fall 2020; see Section 3.0 for details regarding timeline).
- 2) Elevation: Elevations within the marsh creation area are between approximately +1.5 and +2.0 feet NAVD 88 (North American Vertical Datum of 1988) after platform construction is complete (this is the target elevation range based on the values in the initial bid package for BA-0042 CWPPRA project).
- 3) Survival of Plantings: Plant survival is equal to or greater than 50% approximately 90-180 days after vegetation is planted.
- 4) Vegetation Cover of Plantings: Live vegetative cover is equal to or greater than 66% at Year 5<sup>1</sup>.
- 5) Invasive Species: Invasive species cover (e.g., alligator weed, *Alternanthera philoxeroides*) is less than 5% within the marsh creation area at Year 5 (target invasive species cover is based on the minimal presence of invasive species at brackish marsh CRMS sites).

<sup>1</sup> This is the minimum mean percent vegetative cover for brackish marsh at a nearby Coast-Wide Reference Monitoring System (CRMS) site (CRMS0263) for years 2007 through 2013.



**Figure 2.** Lake Hermitage Marsh Creation CWPPRA project (BA-0042) design before the NRDA Project was substituted for the terrace field (terrace field shown in orange south of Marsh Creation Area B)

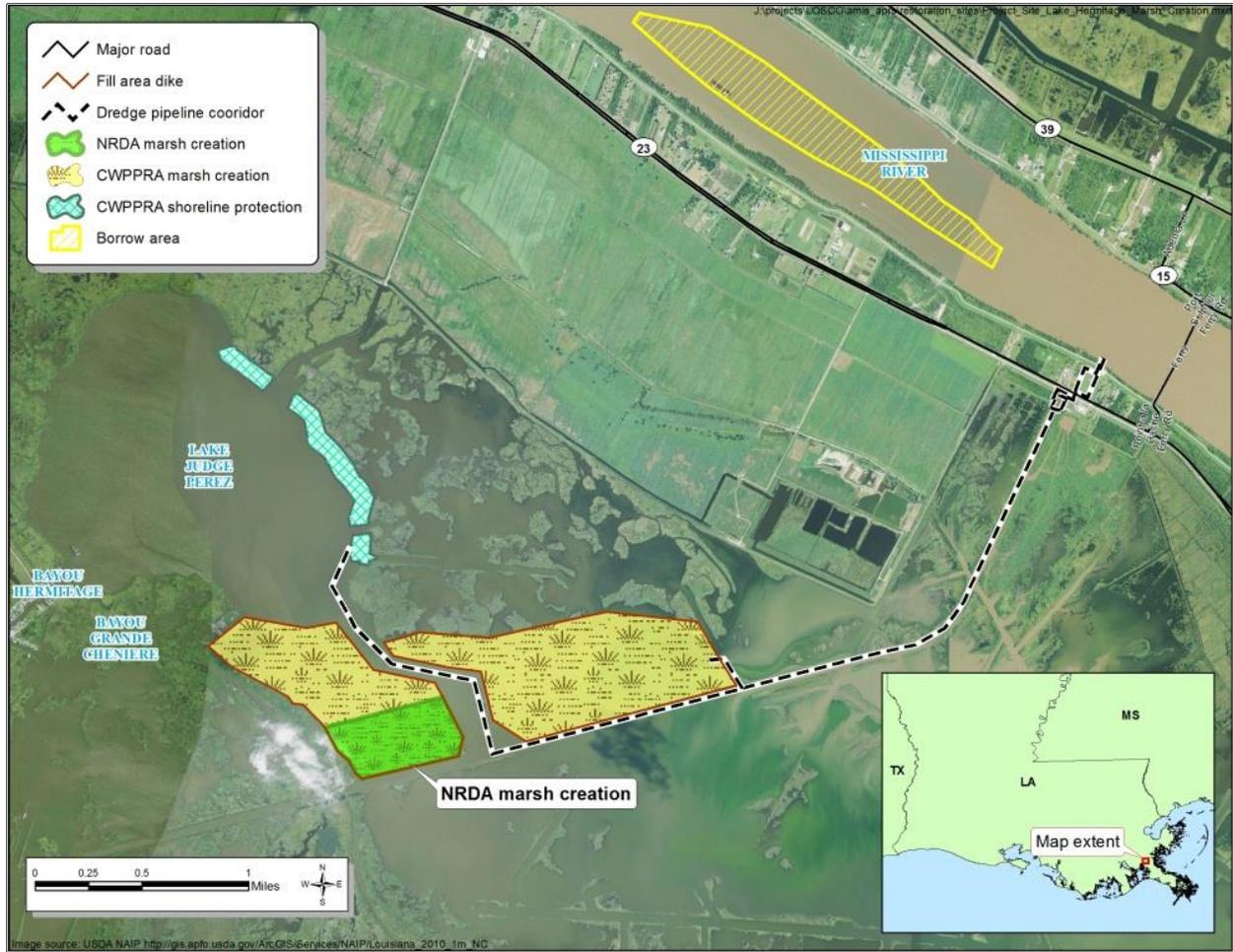


Figure 3. Lake Hermitage Marsh Creation showing NRDA Project component that replaces terrace field.

**Conceptual Model**

Table 1 provides a conceptual model of the relationship between the restoration actions and goal of the Project.

**Table 1.** Conceptual Model for Lake Hermitage Marsh Creation – NRDA Early Restoration Project

Restoration Actions	As-Built	Interim	Restoration Goal
<ul style="list-style-type: none"> <li>Place hydraulically dredged sediments along existing subtidal areas to create a marsh platform</li> <li>Plant native marsh vegetation</li> </ul>	<ul style="list-style-type: none"> <li>≥104 acres of marsh platform is present</li> <li>Marsh plants are present</li> </ul>	<ul style="list-style-type: none"> <li>Fill sediments compact and dewater</li> <li>Marsh vegetation community becomes established</li> </ul>	<ul style="list-style-type: none"> <li>Brackish marsh habitat is restored and provides ecological services that contribute to making the environment and the public whole for Spill-related injuries to these habitats</li> </ul>

## 2.0 Performance Monitoring

Successful implementation of the Project will be measured by assessing the performance of the restored brackish marsh habitat. Performance will be evaluated using both qualitative and quantitative measures related to the Project goals and objectives. Performance monitoring is organized by restoration objective, with each objective having one or more monitoring parameters. Each parameter provides information on the monitoring methods, timing and frequency, sample size, sampling sites, performance criteria, and potential corrective actions.

The CPRA currently maintains a monitoring program that provides ecological data and research to support the planning, design, construction, evaluation, and adaptive management of Louisiana's wetland restoration projects (Folse et al. 2012). This Coast-wide Reference Monitoring System – *Wetlands* (CRMS) was developed and implemented to improve the monitoring program's effectiveness in evaluating individual restoration projects, as well as the combined effects of multiple projects, by providing a network of reference sites where data are collected on a regular basis (Steyer et al. 2003). To the extent possible, the monitoring methodologies used for the Project will be consistent with the methodologies described in Folse et al. (2012).

### Objective #1: Create brackish marsh habitat

#### ➤ Parameter 1: Spatial Extent (acres) of marsh creation area

##### Methods:

1. Collect topographic survey data using RTK GPS (Real Time Kinematic Global Positioning System) methodology and/or another equivalent method;
2. Acquire high-resolution, near-vertical, orthorectified aerial imagery;
3. Collect spatial measurements using hand-held GPS (**optional**);
4. Quantify spatial extent of the marsh area using the collected information and best available science and methods.

##### Timing and Frequency:

- **Method 1: As-built topographic survey (once).** Topographic surveys will be acquired shortly after fill placement is completed and serve as a data set for determining spatial extent of the created marsh area.
- **Method 2: Aerial imagery (at least twice).** Aerial imagery will be acquired after fill placement is completed and once again in Year 5. The data will assist in the quantification of spatial extent of the created marsh area.
- **Method 3: GPS Surveys (optional).** Continuous spatial measurements may be collected along the perimeter of the created marsh area to assist in the delineation and quantification of spatial extent, if needed. This method is optional.

##### Sample Size:

- **Method 1: As-built topographic survey.** Construction contractor will survey marsh creation areas during and after construction and perform operational corrections to achieve the required spatial extent (acres).

- **Method 2: Aerial imagery.** The spatial resolution of imagery will likely not exceed 1 meter pixel size.
- **Method 3: GPS Surveys (optional):** Continuous spatial measurement

Site: Lake Hermitage NRDA Restoration site

Performance Criterion:

Spatial extent of the marsh creation area is approximately 104 acres after construction is complete and equal to or greater than 70 acres at Year 5.

Potential Corrective Actions: Plant vegetation

➤ **Parameter 2: Elevation of marsh creation area**

Method: Collect topographic survey data using RTK GPS methodology and/or another equivalent method.

Timing and Frequency:

**As-built topographic survey (once).** Topographic surveys will be acquired shortly after fill placement is completed and serve as a data set for determining elevation of the created marsh area.

Sample Size: Construction contractor will survey elevations across the created marsh area and perform operational corrections to achieve the target elevation range of 1.5 to 2.0 feet NAVD 88.

Site: Lake Hermitage NRDA Restoration site

Performance Criterion:

Elevations within the marsh creation area are between approximately +1.5 and +2.0 feet NAVD 88 (North American Vertical Datum of 1988) after platform construction is complete.

Potential Corrective Actions:

Adding sediment and/or re-grading

**Objective #2: Promote establishment of native brackish marsh vegetation**

➤ **Parameter 1: Survival of Plantings (% survival)**

Method: Count live and dead plants within the planted areas to determine if the planted vegetation is surviving. In the event that natural colonization of vegetation occurs in the vicinity of the plantings making it difficult to distinguish between planted vegetation and natural recruitment, a survival measurement will not be collected at that sampling location.

Timing and Frequency:

**As-built plant survival survey (once).** Survival of plantings will be measured approximately 90 – 180 days after vegetation is planted.

Sample Size: Sampling plots in planted areas.

Site: Lake Hermitage NRDA Restoration site

Performance Criterion:

Survival of vegetative plantings is equal or greater than 50% approximately 90 - 180 days after vegetation is planted.

Potential Corrective Actions: Replant vegetation.

➤ **Parameter 2: Vegetative Cover**

Method: Five transects will be established within the Project site, with 10 vegetation stations randomly located along each transect, for a total of 50 vegetation stations. Plots will be established at each station and marked with corner poles to allow for revisiting over time. Vegetation species composition, percent live cover, and height will be determined using methods described in Folse et al. (2012), within the 50 vegetation stations described above.

Timing and Frequency:

**As-built vegetative cover survey (once).** Vegetation cover will be measured approximately 90 – 180 days after vegetation is planted (currently anticipated for spring 2015).

**Post Construction vegetative cover survey (twice).** Vegetation cover will be measured during the fall of Years 3 and 5.

Sample Size: Fifty randomly selected vegetation stations will be established across the Project site and sampling will be conducted at each station.

Site: Lake Hermitage NRDA Restoration site

Performance Criterion: Live vegetative cover of native brackish marsh species (Lester et al., 2005) is equal to or greater than 66% within the marsh creation area at Year 5.

Potential Corrective Actions:

Plant additional vegetation, add fertilizer, and/or continue to monitor.

➤ **Parameter 3: Invasive Species Cover**

Method: Five transects will be established within the Project site, with 10 vegetation stations randomly located along each transect, for a total of 50 vegetation stations. Plots will be established at each station and marked with corner poles to allow for revisiting over time.

Timing and Frequency:

**Post Construction vegetative cover survey (twice).** Invasive species cover will be measured approximately 3 years and 5 years following the as-built vegetation cover survey.

Sample Size: Fifty vegetation stations will be established across the Project site and samples will be taken at each station.

Site: Lake Hermitage NRDA Restoration site

Performance Criterion:

Invasive species (e.g., alligator weed, *Alternanthera philoxeroides*) cover will be less than 5% within the marsh creation area at Year 5.

Potential Corrective Actions: Removal of invasive species, and/or continue to monitor

### 3.0 Monitoring Schedule

Table 2 summarizes the anticipated NRDA performance monitoring activities that will be conducted at the Project site. The table is based on a timeline in which planting occurs in the spring of 2015 (approximately 1 ¼ years after platform construction was completed in January 2014) and the survival measurement occurs in the fall of 2015. If plantings are completed successfully in 2015, project construction would be complete and the post-construction performance monitoring phase would commence. If plantings are not completed in spring of 2015, or if the plantings fail to meet the performance criterion for survival in the fall of 2015, the timeline would need to be adjusted accordingly. In the event of a failure to meet the survival criterion, a Corrective Action Plan may be developed, which may include a revised timeline for monitoring.

**Table 2.** Monitoring schedule for the Lake Hermitage Marsh Creation – NRDA Early Restoration Project

Monitoring Activity	Construction		Post-Construction				
	2014	2015	2016 (Year 1)	2017 (Year 2)	2018 (Year 3)	2019 (Year 4)	2020 (Year 5)
Topographic survey	X						
Aerial photography	X				O		X
Planting survival survey		X					
Vegetation survey		O			O		X

X = Indicates monitoring time points that correspond to set standards/performance criteria.  
 O = Indicates monitoring time points that do not correspond to set standards/performance criteria. Data will be used in evaluating the need for mid-course corrections.

### 3.1 Additional Monitoring Efforts in the Vicinity of the Project

Because the Project is being implemented in conjunction with the BA-0042 CWPPRA project, monitoring data collected for the CWPPRA project may be used in evaluating Project performance. There are also two CRMS reference sites within 3 miles of the NRDA Project site that can serve as reference sites for the NRDA Project (Figure 4).

Table 3 presents a summary of the scheduled monitoring near the NRDA Project site that is anticipated to occur either through the CWPPRA project (BA-0042) or the ongoing CRMS monitoring for nearby reference sites (also funded through the CWPPRA program).



**Figure 4.** Project location and CRMS Wetland sites

## 4.0 Reporting and Data Requirements

This section describes the process the Trustees will follow to document, validate and report field data collected for the purposes of performance monitoring. The reporting and data requirements described herein are intended to:

- Maximize the quality, utility, and integrity of monitoring data
- Organize, track, locate, and access monitoring data over the long-term
- Share finalized monitoring data with the public in a consistent and comprehensible format

### 4.1 Field Data Documentation

The majority of data collected during this Project will be field observations and/or measurement of environmental conditions (e.g., spatial extent, elevation, water quality), species identification, and coverage of plants on the created marsh. To the extent possible, all environmental and biological data generated during monitoring activities will be documented using standardized CPRA field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets will be drafted by CPRA prior to conducting any Project monitoring activities.

**Table 3.** Anticipated additional monitoring efforts near the NRDA Project. Timeline indicates the expected number of occurrences of each monitoring activity, but may not correspond exactly to the post-construction years indicated.

		Construction		Post-Construction				
		2014	2015	2016	2017	2018	2019	2020
Funding Source	Monitoring Activities							
CWPPRA BA-42 project	Land / Water Analysis <sup>1</sup>						X	
	Topographic Survey					X		X
CRMS-Wetlands reference monitoring sites	Hydrology <sup>2</sup>	X	X	X	X	X	X	X
	Vegetation <sup>3</sup>	X	X	X	X	X	X	X
	RSET / Accretion <sup>4</sup>	X	X	X	X	X	X	X
	Soil <sup>5</sup>							
	Aerial Photography <sup>6</sup>		X			X		
	Elevation Surveying <sup>7</sup>	X						

<sup>1</sup> - The CWPPRA project (BA-0042) is currently budgeted for 3 land / water analyses. The second land / water analysis will occur either in 2022 or 2027. The actual year of analysis will be an adaptive management decision by the CWPPRA project (BA-0042) team.

<sup>2</sup> - Hydrology consists of collecting hourly water temperature, salinity, and depth of water above sensor which is then post-processed to an elevation datum (NAVD, 88 Feet).

<sup>3</sup> - Vegetation consists of using 10 randomly selected 2x2 meter square plots where the entire plot is analyzed for species specific percent live cover Dominant species height measurements and height of vegetation layers are also collected. No productivity samples (destructive sampling) are collected. Data are collected from August through September. See Folse et al. (2012).

<sup>4</sup> - RSET stands for Rod Surface Elevation Table which measures the marsh surface movement. Accretion measurements are conducted using feldspar markers and cryogenic coring. Data are collected twice per year: spring and fall. See Folse et al. (2012).

<sup>5</sup> - Soil cores are collected and divided into specific intervals to measure for percent organic matter content and bulk density. Coring was conducted in June, 2008.. See Folse et al. (2012).

<sup>6</sup> - Aerial Photography is collected in partnership with USGS. It is currently scheduled for 3 year intervals.

<sup>7</sup> - Elevation surveying was conducted at the time of site establishment to survey for the top of the RSET, marsh elevation, and the continuous hydrography station. All CRMS sites were re-surveyed in 2014. Frequency is based on budget constraints. Sites may be surveyed when required due to damages that occur with the RSET and hydrography stations.

The Project-specific datasheets will be submitted to the Trustees by CPRA for review prior to use. The Trustees must submit their approval or disapproval of the datasheets within five (5) calendar days of receipt.

CPRA will lead collection of field data, in collaboration with the co-trustees. All tangible forms of field data will be reviewed by CPRA for completeness and accuracy before being finalized. Original hardcopy datasheets and notebooks and any photo microSD cards will be retained by CPRA in a secure location in accordance with agency and litigation-hold requirements.

#### **4.2 Field Data Transcription, Validation, and Analysis**

All field datasheets and notebook entries will be scanned to PDF files and will be archived along with the hardcopy datasheets. Electronic data files should be named with the date on which the file was created. Where possible, a ReadMe file should be included that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into Excel spreadsheets (or similar digital format) for required data analysis. After transcription of the data, a second person not associated with data transcription will perform a 100% check of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and will make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. After any and all identified errors are addressed, data are considered to be QA/QC'd. When the data transcription process is complete, electronic datasets can be used for data analysis. Analyses will be conducted by the Trustees to determine if the Project has met the performance criteria.

#### **4.3 Document and Sample Retention Requirements**

Hardcopy and electronic documents generated during data collection will be retained by CPRA and the Louisiana Oil Spill Coordinator's Office (LOSCO). Preservation includes retaining and not altering any such thing as to its form, content, or manner of filing.

The NRDA monitoring plan for this Project does not include removing any physical samples from the marsh sample sites. However, if any samples are taken, as stipulated in the *June 24, 2011 U.S. District Court, Eastern District of Louisiana Pretrial Order No. 37 Relating to the United States' and Natural Resource Trustees' Testing of Samples*, these samples collected from the field and subsequently analyzed for this Project will be retained. Project sample retention policies will apply to all samples collected and removed from the marsh sampling sites during Project monitoring activities. This primarily includes above or below-ground biomass or sediment samples that are removed from sampling sites to be analyzed after the sampling event concludes. At a minimum, samples will be labeled with the sample site name, replicate number, and date collected.

#### **4.4 Data and Document Transfers**

Data and document transfers between the Trustees will be conducted throughout the course of this Project. Transfer of electronic files will be accomplished via email and secure FTP.

#### **4.5 Reporting Schedule**

The Trustees will produce a Final Construction Report at the end of construction and a monitoring progress report after the Year 3 sampling event (see Table 2 in Section 3.0). A comprehensive monitoring report will be produced after the Year 5 sampling is completed. If corrective actions are necessary, the Trustees will develop a Corrective Action Plan and provide a schedule of performance monitoring and reporting. All reports will contain monitoring data that have been validated and have undergone final quality control checks.

### **5.0 References**

Deepwater Horizon Natural Resource Trustees. 2012. Deepwater Horizon Oil Spill Phase I Early Restoration Plan and Environmental Assessment. Available:  
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