



**State of Louisiana**

**Coastal Protection and Restoration Authority  
of Louisiana**

## **Monitoring Plan**

for

**Cameron-Creole Watershed Grand  
Bayou Marsh Creation (CS-54)**

State Project Number CS-54  
Priority Project List 20

September 2013  
(revised July 2016)



Prepared by:

Mike Miller  
Coastal Protection and Restoration Authority of Louisiana  
Lafayette Regional Office  
Abdalla Hall, Suite 201-H  
635 Cajundome Blvd  
Lafayette, LA 70506

The Coastal Protection and Restoration Authority of Louisiana (CPRA) and the U.S. Fish and Wildlife Service (USFWS) agree to carry out the terms of this Monitoring Plan (hereinafter referred to as the “Plan”) of the accepted, completed project features in accordance with the Cost Sharing Agreement. The CSA will be included in the Operations and Maintenance (O&M) Plan, along with the construction completion report, the project permits, and the O&M budget. The Monitoring Plan and the O&M Plan will be available on the CPRA Document Referencing System (<https://lacoast.gov/new/Projects/List.aspx>).

The project features covered by this plan are inclusive of and are identified as the Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) Project. The intention of the provisions of this Plan is to monitor the project using standardized data collection techniques and to analyze that data to determine whether the project is achieving the anticipated benefits. Reports will be generated and recommendations made to adaptively manage the project.

The Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) project was a candidate on the Project Priority List (PPL) 20 of the CWPPRA program. It was selected as one of 5 projects from a group of 60-80 projects for Phase I Funding authorization for Engineering and Design. In January 2011, USFWS entered into a cost-share agreement with The Coastal Protection and Restoration Authority (CPRA) to create a design which will work with other existing projects to return this area to a healthier marsh environment.

## **1. PROJECT DESCRIPTION, PURPOSE, GOALS and FEATURES**

### **Description:**

The Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) project is located within the Cameron Creole Watershed project area, in Region 4 of the Calcasieu-Sabine Basin, Cameron Parish, 6 miles northeast from Cameron, LA, on the Cameron Prairie NWR and Miami Corporation property north of Grand Bayou. The marsh creation project is divided into two marsh creation cells which are located on the Miami Corporation and Cameron Prairie NWR properties. The cells will be referred to as the Northern Cell and the Southern Cell. The Northern Cell is located on Miami Corporation Property and is bordered by North Prong Bayou to the east and to the south by the Ducks Unlimited Terracing Project. The Southern Cell lies on the Cameron Prairie National Wildlife Refuge property and is bordered by North Prong Bayou to the east and Grand Bayou to the south. The Northern Cell encompasses an area of 219 acres and the Southern Cell covers an estimated 398 acres (Figure 1).

The Cameron-Creole Watershed Project was first implemented in 1989 to combat the degradation of the local marshes from saltwater intrusion due to large tidal exchange and hurricane scouring. Additionally, a 19 mile long levee was constructed along the eastern shoreline of Calcasieu Lake. Other aspects of the project include five water control structures, five culverts and four stoplog structures, which provide water regulation between Calcasieu Lake and the Watershed. To the north along the GIWW, eight

flapgate structures were installed to introduce freshwater to offset the increased salinity in the Watershed ( Lacoast. n.d.)

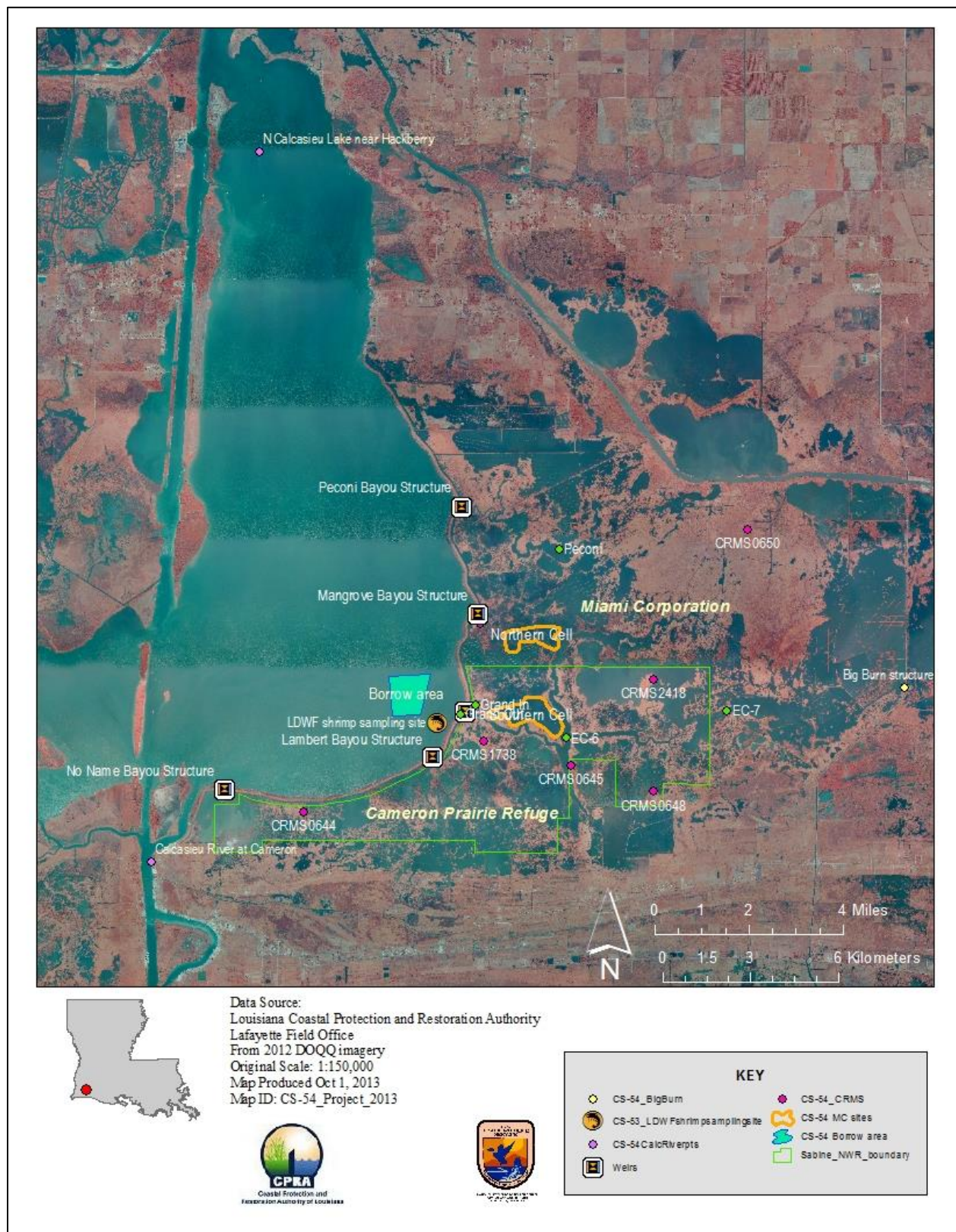
Extended periods of inundation of high saline water from Calcasieu Lake and wind induced scour from Hurricanes Rita and Ike are the main causes of vegetation loss within the Watershed. Extended periods of inundation of high saline water from Calcasieu Lake and wind induced scour from Hurricanes Rita and Ike are the main causes of vegetation loss within the Watershed. This, combined with the local subsidence of the area, increased tidal exchange, and disruption of hydrologic processes by oil and gas activities has caused a conversion of marsh to open water.

**Purpose:**

Approximately 14,390 acres (32%) of the Cameron-Creole Watershed Project (CCWP) marshes were lost to open water from 1932 to 1990 (USFWS CWPPRA Project Fact Sheet) at an average loss rate of 248 acres/year (0.55 percent/year). due to subsidence and saltwater intrusion from the Calcasieu Ship Channel. The CCWP was implemented by the NRCS in 1989 to reduce saltwater intrusion and stimulate restoration through re-vegetation. Hurricanes Rita and Ike in 2005 and 2008 breached the watershed levee scouring the marsh and allowing higher Calcasieu Lake salinities to enter the watershed causing exponential land loss. The Calcasieu-Sabine Basin lost 28 square miles (17,920 acres) (4.4%) as a result of Hurricane Rita (Barras et al. 2006). Land loss is estimated to be 1.33 %/year based on USGS data from 1985 to 2009 within the extended project boundary.

The purpose of the project is to create sustainable emergent marsh through the use of dredged sediments from a disposal site within Calcasieu Lake. The benefits provided by the project include the re-creation of degraded wetlands that provide important wetland habitat for marine organisms and the enhancement of storm protection for inland areas. In order to meet the project goals of a marsh elevation that is comparable to the marsh elevation of near-by healthy marsh, CRMS 0650 was utilized as the target marsh elevation (Figure 1). CRMS 0650 is the closest area to the project site that can be considered healthy marsh that was near a water level station. The elevation of the marsh located in this vicinity of CRMS 0650 is +1.08 ft. NAVD88. Using this elevation, the design for the marsh creation area site including settlement curves was constructed so as to result in an elevation as close to this value as possible. A target marsh elevation of +1.1 ft NAVD 88 was used to determine fill volumes for the cells. Additionally, the Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) project will work in conjunction with other projects in the area to reduce salt water intrusion, tidal exchange, and erosion within the Cameron-Creole Watershed.





**Figure 1.** Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) project features.

**Goals:**

The specific project goals are:

1. Construct an emergent marsh that is 80% vegetated and contains 175 acres of land in the southern cell and 318 acres in the northern cell.
2. Construct a marsh that settles to the height predicted by the established settlement curves within the southern and northern cells and maintains an elevation of 1.1 ft NAVD88 at the end of the project life. The southern cell is predicted to settle to 1.91 ft at FY1, 1.39 ft at FY3, 1.22 ft at FY5 and 1.13 ft at FY10. The northern cell is predicted to settle to 1.80 ft at FY1, 1.37 ft at FY3, 1.24 ft at FY 5 and 1.15 ft at FY10.
3. Construct a marsh that is flooded between 20% and 60% of the year and maintains water levels between 2" above and 6" below the marsh surface after settlement.

**Features:**

The projects purpose is to restore and nourish hurricane scoured marsh in the Cameron Prairie National Wildlife Refuge and adjacent brackish marshes of the Cameron Creole Watershed. The Project goals include constructing an emergent marsh that is 80 percent vegetated, settles to a height of 1.1 ft at the end of project life and is flooded 20 to 60 percent of the year. Approximately 5.7 million cubic yards of dredging material are available from a borrow site proposed in Calcasieu Lake. The dredge material will be placed into two marsh creation cells north of Grand Bayou and west of North Prong Bayou, to restore 609 acres and nourish approximately seven acres of brackish marsh. The borrow site was designed to avoid and minimize impacts to oyster reefs and other sensitive aquatic habitat. Tidal creeks will be constructed prior to placement of dredge material, retention levees will be gapped and/or degraded to support estuarine fisheries access and to achieve a functional marsh. The project would result in approximately 534 net acres of brackish marsh over the 20-year project life.

## 2. ITEMS REQUIRING MONITORING

The Coastwide Reference Monitoring System (CRMS) - Wetlands is a network of 392 monitoring sites distributed throughout the coastal zone of Louisiana. Hydrographic, vertical accretion, elevation change, vegetation, soils, and aerial photography data are collected at each CRMS site. Although no CRMS monitoring stations are located in the CS-54 project area, there are seven CRMS stations and four operation sondes located within the watershed which can be used to determine project effectiveness (figure 1).

The following monitoring strategies will provide the information necessary to evaluate the specific goals of restoring/creating approximately 617 acres and nourish approximately 25 acres of emergent marsh.

- A. **Water Level** - Water level (ft)) readings will be recorded hourly at seven CRMS sites within the vicinity of the southern and northern cells. Additionally when available, data from five operation sondes utilized for the CS-04a project will be used to aid in determining if project goals are met (Figure 2). Water level readings will be used to determine the frequency, depth, and duration of flooding in each cell relative to the marsh elevation determined by the fill area surveys. These will be used to assess the goal of maintaining water between 2" above and 6" below marsh and percent time flooded between 20% and 60% of the year.
- B. **Emergent Vegetation** - To document the condition of the emergent vegetation in the project area over the life of the project, vegetation will be monitored at 16 sampling stations using a modified Braun Blanquet sampling method as outlined in Steyer et al. (1995). Stations will be established uniformly across the created marsh and the location of the stations will be such that they coincide with at least some of the elevation transects. Sixteen stations with replicate plots will be established within the dredged areas (Figure 3). Percent cover, dominant plant heights, and species composition will be documented in 2m x 2m sampling plots marked with 2 corner poles to allow for revisiting the sites over time. Vegetation data from the seven CRMS sites within the watershed will be used as reference stations to compare species composition over time. Vegetation will be monitored postconstruction in FY3, FY5, FY10 and at a later date if deemed necessary.
- C. **Aerial Photography** - In order to evaluate land/water ratios in the fill areas, land/water data will be obtained from digital imagery with 1-meter resolution. The photography will be georectified using standard operating procedures described in Steyer et al. (1995, revised 2000), and land/water ratios will be determined. Aerial photography will be captured using CRMS coastwide flights in FY0 (preconstruction) and postconstruction when coastwide imagery becomes available near FY1, FY5 and at a later date if deemed necessary.
- D. **Borrow Area Surveys** – To determine fill rates within the borrow area, bathymetric and topographic surveys in the Calcasieu Lake borrow area will be



performed along the same transects as the As-Built surveys. Survey transects shall be spaced 1000 feet apart, perpendicular to the longitudinal centerline, and extend 250 feet past each side of the cut. Position, elevation, and water depth will be recorded every 50 feet along each transect (Figure 4). All bathymetric surveys must be corrected for tidal fluctuations and wave action to the NAVD88 vertical datum. All surveys shall be performed to CPRA standards. Borrow area surveys will be performed postconstruction in FY1, FY3, FY5 and at a later date if deemed necessary.

- E. **Fill Area Surveys** - Bathymetric and topographic surveys in the northern and southern cells will be performed along every other transect as the As-Built surveys. Survey transects shall be spaced 1000 feet apart, perpendicular to the longitudinal centerline, and extend 200 feet past each side of the containment levee (Figure 3). Position, elevation, and water depth will be recorded every 50 feet along each transect. All bathymetric surveys must be corrected for tidal fluctuations and wave action to the NAVD88 vertical datum. All surveys shall be performed to CPRA standards. Fill area surveys will be performed postconstruction in FY1 (if accessible), FY3, FY5, FY10 and at a later date if deemed necessary. To monitor the settlement of the underlying soils, six settlement plates will be placed in the marsh creation areas during construction at locations where geotechnical soil borings were collected pre-construction (Figure 5). Settlement plates shall be resurveyed at years FY1 (if accessible), FY3, FY5, and at a later date if deemed necessary.

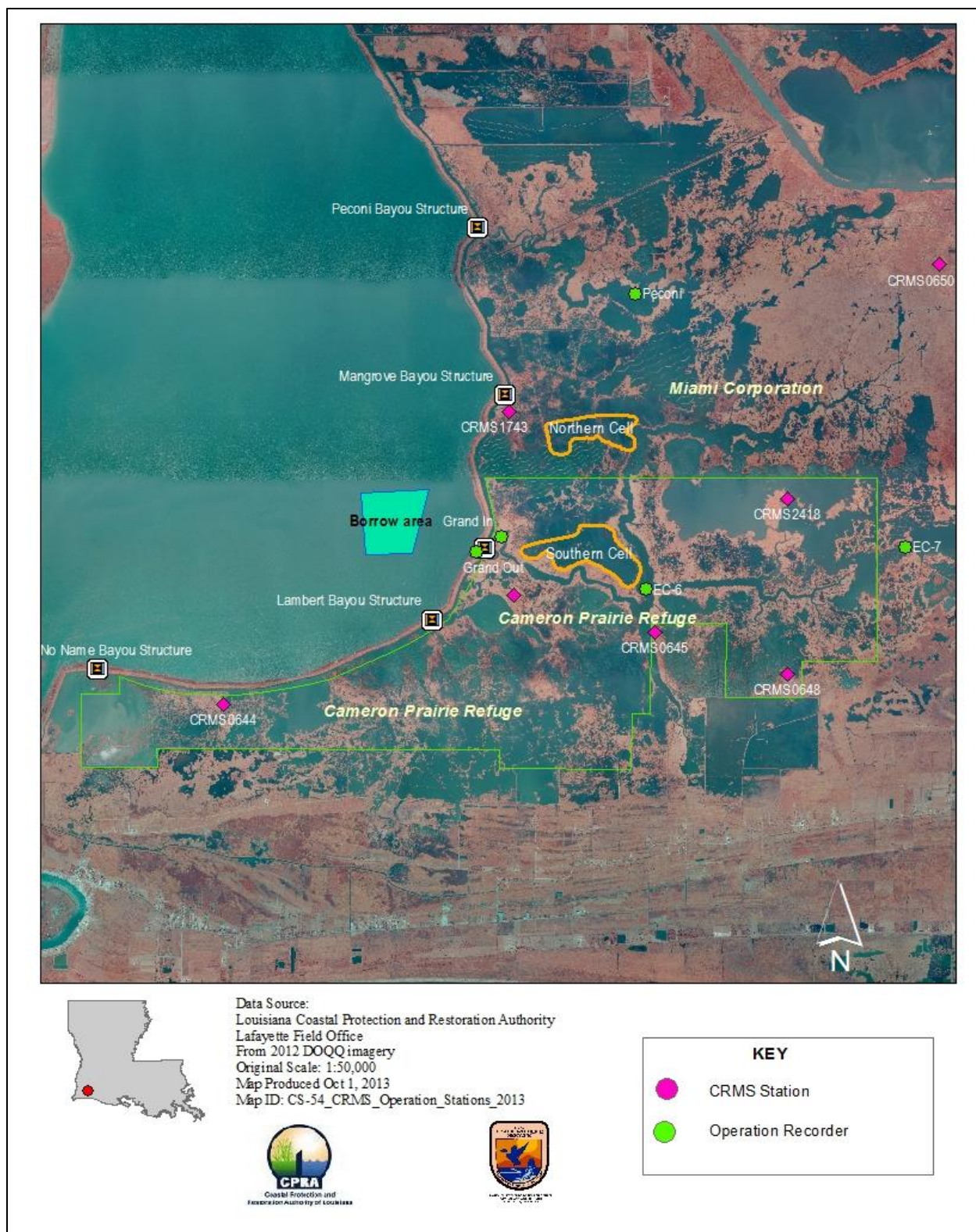
- F. **Dissolved Oxygen / Hypoxia Monitoring** - To identify potentially hypoxic conditions within the dredge areas, gauges that record dissolved oxygen (DO), salinity and temperature will be set in the Calcasieu Lake borrow areas. A gauge will be set in the deepest portion of the borrow area, approximately 2 ft. off of the bottom, and a second gauge acting as a control will be set approximately 0.25 to 0.50 miles outside of the borrow area. The gauges will be deployed by jetting a length of pipe into the bottom substrate until stable. The probe will then be attached to the pipe approximately 2 feet above the bottom. The location of the gauge deployments will be based on results of the geophysical investigation (CB&I; BMM 2013). Gauges will be continuously monitored over a period of four months (June to September). Site visits will be conducted once per month for data download and maintenance. Instrumentation will be maintained in good working order over the period deployed. During deployment, each maintenance event and retrieval, vertical profiles will be taken for temperature, salinity and dissolved oxygen (DO) at each deployment site. Vertical profile data will be collected at one foot intervals in waters shallower than 20 feet. At both the dredge area and at the control sample site, sampling for vertical profiles will be conducted before 10:00 a.m. or after 8:00 p.m. to ensure that incident sunlight

does not influence the expected minimum local DO concentrations. Dissolved oxygen monitoring will be conducted at FY1, FY3 and FY5 if deemed necessary due to sedimentation fill within the borrow area.

Supplemental data from the seven CRMS sites will also be available and can be used to assess trends and changes in the watershed. Those data include hourly salinity, annual vegetation, rates of elevation change, vertical accretion, and shallow subsidence as well as soil composition and aerial photography analysis. Supplemental data will be used in OM&M Reports as needed.

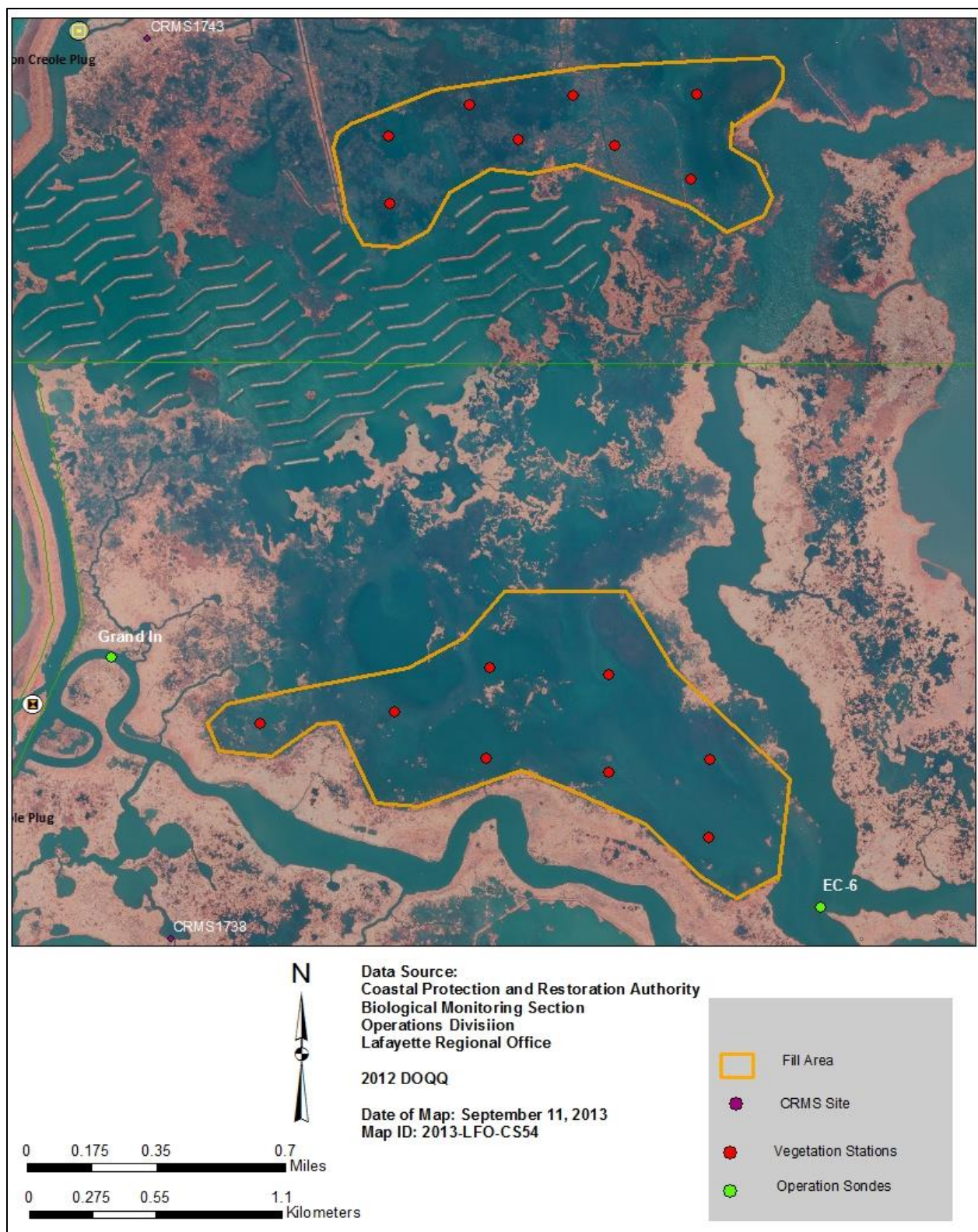
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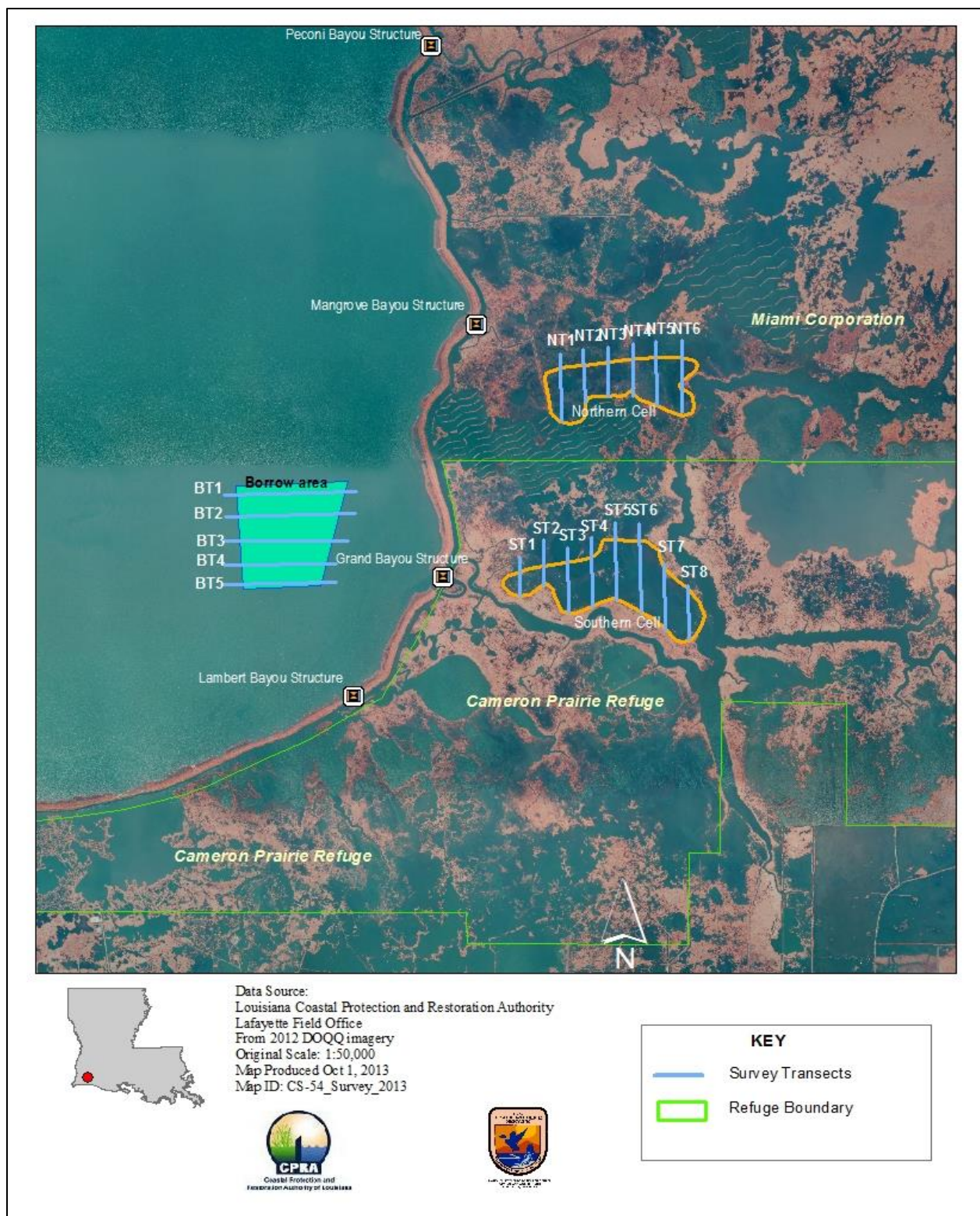
**Figure 2.** Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) CRMS and Operation recorder locations.





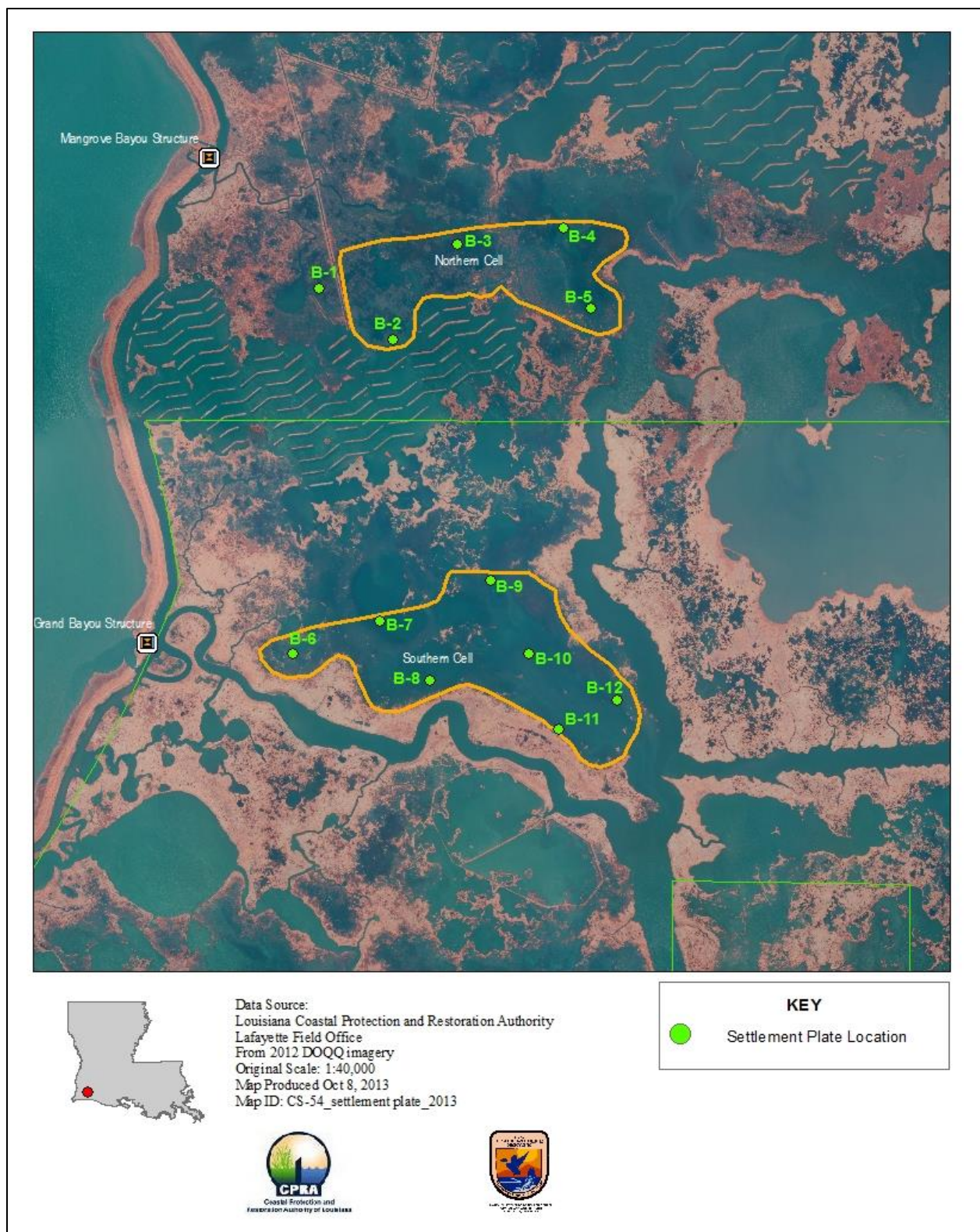
**Figure 3.** Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) emergent vegetation monitoring stations.





**Figure 4.** Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) Borrow and Fill area survey transects.





**Figure 5.** Cameron-Creole Watershed Grand Bayou Marsh Creation (CS-54) settlement plate locations.

### 3. **MONITORING BUDGET**

The cost associated with project-specific monitoring variables for the twenty (20) year project life is \$668,229 as outlined in Attachment 1 of this plan.

### 4. **RESPONSIBILITIES**

#### A. CPRA will:

1. Coordinate and oversee all scientific data collection.
2. Ensure that all data goes through quality control procedures and is entered into the public database.
3. Analyze the data and report on the status of the project after data collection events. Should the data indicate that the project is not meeting the goals and objectives, adaptive management recommendations will be made to improve the response.
4. Review the monitoring plan and budget annually with the USFWS to determine that the data being collected adequately evaluates the project.

#### B. USFWS will:

1. Review the monitoring plan and budget annually with the CPRA to determine that the data being collected adequately evaluates the project.



## REFERENCES

- CB&I. 2013. Louisiana Borrow Area Management and Monitoring; Shaw Environmental and Infrastructure, Baton Rouge, LA. 29 pp.
- Coastal Protection and Restoration Authority of Louisiana. 2012. *Louisiana's Comprehensive Master Plan for a Sustainable Coast*. Coastal Protection and Restoration Authority of Louisiana. Baton Rouge, LA.
- Folse, T. M., J. L. West, M. K. Hymel, J. P. Troutman, L. A. Sharp, D. Weifenbach, T. McGinnis, and L. B. Rodrigue. 2008 (revised 2012). A Standard Operating Procedures Manual for the Coastwide Reference Monitoring System-*Wetlands*: Methods for Site Establishment, Data Collection, and Quality Assurance/Quality Control. Louisiana Coastal Protection and Restoration Authority, Office of Coastal Protection and Restoration. Baton Rouge, LA. 191 pp.
- LaCoast. n.d. "Calcasieu-Sabine Basin." [Lacoast.gov/reports/static/hilecp\\_3.pdf](http://lacoast.gov/reports/static/hilecp_3.pdf). (Accessed 2013.)
- Steyer, G.D., R.C. Raynie, D.L. Steller, D. Fuller, and E. Swenson. 1995 (revised 2000). Quality management plan for the Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01 (Revised June 2000). Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 97 pp.

## **ATTACHMENT I**

### **Project Monitoring Budget**

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CS-54 Monitoring Estimate 7/21/2016			Baseline																							
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
Monitoring	Comments	Cost	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	Total		
Aerial Photography	Analysis only. Assumes available coastwide imagery. L/W only	\$17,886	1		1			1										1						4		
Emergent Vegetation	2 days at stations inside the borrow area	\$13,000				1		1					1					1						4		
Monitoring Plan Development	Writing and Review	\$10,600	1																					1		
DO Monitoring	Inshore Borrow Area	\$8,500		1		1		1																3		
Fill/Borrow Area Surveys	Surveys to determine settlement rates	\$37,000		1		1		1										1						4		
Hydrology	Use CRMS data	\$10,000																					0			
OM&M Reports	Includes analysis and writing.	\$21,000				1			1					1									1	4		
Monitoring Admin	Annual Project Review and Budget Maintenance	\$3,000		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20		
CS-54 Monitoring Estimate 7/21/2016			Baseline																							
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
		Cost	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	Total		
Aerial Photography	Analysis only. Assumes available coastwide imagery.		\$17,886	\$0	\$17,886	\$0	\$0	\$17,886	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$17,886	\$0	\$0	\$0	\$0	\$0	\$71,544		
Emergent Vegetation	2 days at stations inside borrow area		\$0	\$0	\$0	\$13,000	\$0	\$13,000	\$0	\$0	\$0	\$0	\$13,000	\$0	\$0	\$0	\$0	\$13,000	\$0	\$0	\$0	\$0	\$0	\$52,000		
Monitoring Plan Development	Writing and Review		\$10,600	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$10,600		
DO Monitoring	Inshore Borrow Area		\$0	\$8,500	\$0	\$8,500	\$0	\$8,500	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$25,500		
Fill/Borrow Area Surveys	Surveys to determine settlement rates		\$0	\$37,000	\$0	\$37,000	\$0	\$37,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$37,000	\$0	\$0	\$0	\$0	\$0	\$148,000		
Hydrology	Use CRMS Data																						\$0			
OM&M Reports	Includes analysis and writing.		\$0	\$0	\$0	\$21,000	\$0	\$0	\$21,000	\$0	\$0	\$0	\$0	\$21,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$21,000	\$84,000		
Monitoring Admin	Annual Project Review and Budget Maintenance		\$0	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$60,000		
Total			\$28,486	\$45,500	\$17,886	\$79,500	\$0	\$76,386	\$21,000	\$0	\$0	\$0	\$13,000	\$21,000	\$0	\$0	\$0	\$67,886	\$0	\$0	\$0	\$0	\$21,000	\$451,644		

