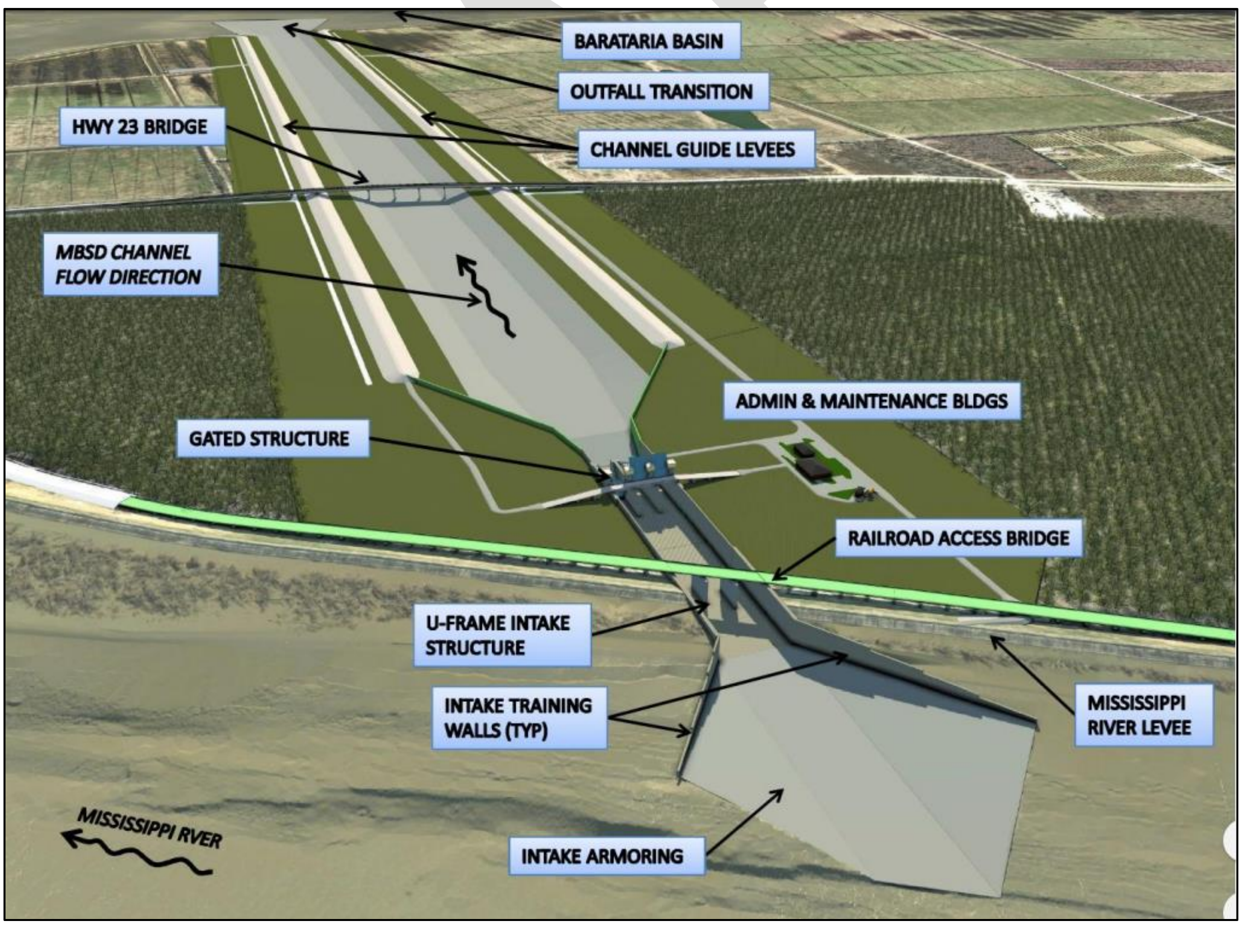
Appendix A: Monitoring and Adaptive Management Plan for the Proposed MBSD Project

Revised Draft of the Initial
MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR THE
MID-BARATARIA SEDIMENT DIVERSION PROJECT
(CPRA PROJECT NUMBER BA-0153)



29 January 2021

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ADCIRC	Advanced Circulation Model	12
ADCP	Acoustic Doppler Current Profiler	29
AM	Adaptive Management	1
AMO	Atlantic Multi-decadal Oscillation	5
AMT	Adaptive Management Team	14
APA	Applicant's Preferred Alternative	22
BACI	Before-After-Control-Impact (Study)	21
BBES	Barataria Bay Estuarine Stock	60
BICM	Barrier Island Comprehensive Monitoring	24
CASM	Comprehensive Aquatic Systems Model	12
CEM	Conceptual Ecological Model	4
cfs	Cubic Feet per Second	22
Chl	Chlorophyll	8
CIMS	Coastal Information Management System	85
CMP	Coastal Master Plan	2
CMR	Capture Mark Recapture	61
CoNED	Coastal National Elevation Database	37
CPRA	Coastal Protection and Restoration Authority	1
CRHA	Capture Release Health Assessment	61
CRMS	Coastwide Reference Monitoring System	21
CTD	Conductivity/Temperature/Depth	32
DEIS	Draft Environmental Impact Statement	1
DIVER	Data Integration, Visualization, Exploration, and Reporting	86
DMT	Data Management Team	82
DWH	Deepwater Horizon	1
DO	Dissolved Oxygen	8
DRP	Draft Restoration Plan	1
E&D	Engineering and Design	10
EIS	Environmental Impact Statement	11
ENSO	El Niño Southern Oscillation	5
EwE	Ecopath with Ecosim (and Ecospace) Model	12
FIMP	Fisheries-independent Monitoring Plan	22

LIST OF ACRONYMS (*continued*)

Acronym	Description	Page First Used
FWOP	Future Without Project	12
FWP	Future With Project	12
GRSLR	Gulf-regional Sea Level Rise	5
HCAB	Harmful Cyanobacterial and/or Algal Bloom	53
HSI	Habitat Suitability Index	11
IMPLAN	Impact Analysis for Planning	13
LA TIG	Louisiana Trustee Implementation Group	1
LCA	Louisiana Coastal Area (Ecosystem Restoration Study)	12
LDEQ	Louisiana Department of Environmental Quality	19
LDWF	Louisiana Department of Wildlife and Fisheries	19
LiDAR	Light Detection and Ranging	37
LMRFC	Lower Mississippi River Forecasting Center	29
LOI	Loss on Ignition	44
MAM	Monitoring and Adaptive Management	1
MMSN	Marine Mammal Stranding Network	62
MR	Mississippi River	3
MR&T	Mississippi Rivers & Tributaries Project	5
MRHDMS	Mississippi River Hydrodynamic and Delta Management Feasibility Study	12
N	Nitrogen	32
NFWF	National Fish and Wildlife Foundation	2
NOAA	National Oceanic and Atmospheric Administration	25
NRDA	Natural Resource Damage Assessment	1
NTU	Nephelometric Turbidity Unit	55
OM&M	Operations, Maintenance and Monitoring	81
OMRR&R	Operation, Maintenance, Repair, Replacement and Rehabilitation	1
OMT	Operations Management Team	17
P	Phosphorus	32
PDARP	Programmatic Damage Assessment and Restoration Plan	1
PDDA	Project Delta Development Area	22
PDT	Project Design Team	12
PEIS	Programmatic Environmental Impact Statement	1

LIST OF ACRONYMS (*continued*)

Acronym	Description	Page First Used
PIA	Project Influence Area	22
QA/QC	Quality Assurance/Quality Control	18
RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act	2
RM	River Mile	36
RSET	Rod Sediment Erosion Table	46
RSLR	Relative Sea Level Rise	5
S	Sulfur	32
SAV	Submerged Aquatic Vegetation	8
SLR	Sea Level Rise	2
SME	Subject Matter Expert	19
SWAMP	System Wide Assessment and Monitoring Program	21
TC	Total Carbon	45
TN	Total Nitrogen	45
TP	Total Phosphorus	45
TSS	Total Suspended Sediments	8
TWIG	The Water Institute (of the Gulf)	2
UAS	Unmanned Aircraft System	61
USACE	United States Army Corps of Engineers	1
USFWS	United States Fish and Wildlife Service	88
USGS	United States Geological Survey	29
WY	Water Year	81

1. INTRODUCTION

1.1. Purpose of the Project Monitoring and Adaptive Management Plan

Following the 2010 Deepwater Horizon (DWH) explosion and oil spill, the Natural Resource Damage Assessment (NRDA) Trustees identified implementation of monitoring and adaptive management (MAM) as one of the NRDA programmatic goals in the Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (PDARP/PEIS; DWH Trustees, 2016). As described therein, the MAM Framework provides a flexible, science-based approach to implement effective and efficient restoration over several decades and to provide long-term benefits to the resources and services injured by the DWH oil spill. This MAM plan for the Mid-Barataria Sediment Diversion Project (the Louisiana Coastal Protection and Restoration Authority's (CPRA's) Project Number BA-0153; hereafter 'the Project'), has been drafted by the State and federal Project partners on the Louisiana Trustee Implementation Group (LA TIG).

This MAM plan serves as a companion to the Project Draft Phase II Restoration Plan (DRP); the Project Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) Plan; and the Project Mitigation Plan prepared for the Project's draft Environmental Impact Statement (DEIS). This MAM plan provides a framework for adaptive management (AM) decision-making and implementation that:

- Discusses the basics of MAM and presents a conceptual understanding of a sediment diversion of Mississippi River water into the Barataria Basin that underpins the selection of key monitoring variables for the Project, and also identifies key uncertainties that may affect the ability of the Project to achieve its restoration objectives (Section 1);
- Outlines the structure for governance of Project operations and AM, including specifying the roles and responsibilities of State and federal partners (Section 2);
- Identifies monitoring needs and the key performance measures associated with each objective that the State and the LA TIG will use to evaluate progress towards meeting the Project restoration objectives and to inform AM (Section 3). This includes describing assess progress toward meeting the restoration objectives as described in the DRP. This also includes the methods for specific types of monitoring and a discussion of the spatial and temporal extent of pre-operations baseline monitoring that will be conducted before, and post-construction monitoring that will be conducted after, the Project begins operating;
- Describes the framework for assessing Project success based on performance measures and potential AM actions including potential operational shifts to minimize impacts from the Project, if practicable given the Project's goals, objectives, and success criteria (Section 4), and the schedule for evaluating decision criteria that could trigger or lead to changes in management actions (Section 5).
- Discusses the above information in relation to the concurrent development of State and LA TIG programmatic adaptive management as outlined in the *Louisiana Adaptive Management Status and Improvement Report: Vision and Recommendations* (The Water Institute of the Gulf 2020), including data management (Section 6), and reporting (Section 7); and
- Establishes the basis for an estimated budget for Project-specific MAM (Section 8).

MAM Plans are by nature living documents and never "final". This Plan will be "draft" at least until if, and if so when, the US Army Corps of Engineers (USACE) New Orleans District issues approval and issuance of the permits and authorizations required for the Project. CPRA at that point will then add any

Compliance Monitoring requirements contained in those permits to this Plan.

1.1.1. Purpose of Adaptive Management

A distinctive feature of coastal Louisiana is that its industry, natural resources, communities, and culture are intricately linked to, and reliant on, its wetland environment. Individually managing each of these systems is difficult due to their inherently uncertain and highly dynamic nature and the high level of integration between the systems. Predicting the effects of coastal Louisiana's restoration projects with complete certainty is impossible due to

- shifting ecological baselines associated with continued, ongoing land loss, including sea level rise (SLR), subsidence, water cycles, tropical storms and hurricanes;
- incomplete understandings of ecosystem structure and function; and
- imprecise and complex relationships between project features and corresponding outcomes.

Adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). The primary incentive for implementing AM is to increase the likelihood of achieving desired project outcomes given the identified uncertainties. It is an iterative process that integrates monitoring and evaluation of ecosystem variables in response to management actions with flexible decision-making, where management approaches are adjusted based on observed outcomes (NRC 2004). Adaptive management provides an organized, coherent, and documented process for promoting learning that will improve decision-making. Within the context of DWH NRDA restoration, AM includes informing the selection, design, and implementation of restoration projects; implementing corrective actions, when necessary, to projects that are not trending toward established performance criteria; and making adjustments over time to projects that require recurrent or ongoing decision making.

1.1.2. Overview of CPRA Programmatic Adaptive Management

The State of Louisiana has long recognized the importance of utilizing AM to improve its coastal program, and has conducted specific AM activities for implemented projects. Adaptive Management has been a key feature of Louisiana's Coastal Master Plan since 2012, thus allowing for flexibility in program implementation as conditions change, resolution of uncertainties to improve future decision-making, and modification of constructed projects while informing the development of future projects. Indeed, the Louisiana Legislature's mandate for CPRA to update Louisiana's Coastal Master Plan (CMP) every six years to account for changes in information, tools, and on-the-ground situations, is an example of, and a mandate for, AM.

In March 2018, the LA TIG funded a project focused on formalizing programmatic AM for restoration in coastal LA by describing the status of, and identifying opportunities for, institutionalizing AM within CPRA and the LA TIG. That work, conducted in partnership with The Water Institute of the Gulf (TWIG), was intended to integrate across the multiple implementing mechanisms (e.g., CPRA, LA TIG, the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE) Program, National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefits Fund) (The Water Institute of the Gulf, 2020). CPRA's programmatic AM will create a structure and process for building institutional knowledge, iteratively incorporating new information that continually improves our system understanding, facilitating informed adjustment of management actions, and improving decision-making to help achieve the long-term sustainability of our coast, and will build the knowledge base by engaging stakeholders and through internal and external communication. The goal of CPRA programmatic AM is to maximize the success of the coastal protection and restoration program by utilizing robust decision-making.

1.1.3. Project-Level Adaptive Management

Project AM is particularly important because of its scale and scope. Project-level AM focuses on identifying project uncertainties (Section 1.4) and, where feasible reducing those uncertainties through project design, scientific analysis, or monitoring to inform management actions. Conceptual (Section 1.3) and numerical modeling (Section 1.5) provides the expectations against which MAM Plan monitoring (Section 3) and evaluation (Section 4) has been developed, both with regards to anticipated Project effects and the constantly changing baseline. As outlined in Section 4, monitoring data and associated assessments will inform AM evaluations, decisions, and actions.

1.2. Restoration Type Goals, Project Purpose and Need, and Project Restoration Objectives

The DWH oil spill caused extensive impacts to marsh habitats and species in Louisiana. These habitats have a critical role in the overall productivity of the northern Gulf of Mexico. In DWH Trustees (2016), the DWH Trustees found that coastal and nearshore habitat restoration is the most appropriate and practicable mechanism for restoring the ecosystem-level linkages disrupted by this spill. Nearshore habitats provide food, shelter, and nursery grounds for numerous ecologically and economically important species, including fish, shrimp, crabs, sea turtles, birds, and mammals.

The overall programmatic goal for the Project is to Restore and Conserve Habitat. The Restoration Type is Wetlands, Coastal, and Nearshore Habitats Restoration. The goals of this Restoration Type, outlined in Section 5.5.2.1 of the PDARP/PEIS (DWH Trustees, 2016) are to:

- Restore a variety of interspersed and ecologically-connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities.
- Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability.
- While acknowledging the existing distribution of habitats throughout the Gulf of Mexico, restore habitats in appropriate combinations for any given geographic area. Consider design factors, such as connectivity, size, and distance between projects, to address injuries to the associated living coastal and marine resources and restore the ecological functions provided by those habitats.

The Project's purpose and need, as articulated in the DEIS, is:

> "… to restore for injuries caused by the DWH oil spill by implementing a large-scale sediment diversion in the Barataria Basin that will reconnect and re-establish sustainable deltaic processes between the Mississippi River [MR] and the Barataria Basin through the delivery of sediment, freshwater, and nutrients to support the long-term viability of existing and planned coastal

> restoration efforts. The proposed Project is needed to help restore habitat and ecosystem services injured in the northern Gulf of Mexico as a result of the DWH oil spill."

Specific restoration objectives for the Project are to

- Deliver freshwater, sediment, and nutrients to Barataria Bay through a large-scale sediment diversion from the MR;
- Reconnect and re-establish sustainable deltaic processes between the MR and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation); and
- Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services.

Section 2.3.3 of the OMRR&R Plan and Section 1.5 of the DRP both describe operational features of the proposed Project.

1.3. Conceptual Ecological Model

1.3.1. Purpose of the Conceptual Ecological Model

Conceptual ecological models (CEM) are simplified, qualitative illustrations of the general relationships among the essential components of the ecosystem. CEMs help build understanding and consensus regarding the set of working hypotheses that explain the current natural system and the potential effects of the project on that system. The development of the CEM also helps to identify critical uncertainties and potential options to reduce these uncertainties. However, there are several types of CEMs, and the relative utility of each type depends on the management purpose (Fischenich 2008).

For the development of the Project CEM, a large number of models that were developed for other restoration projects and programs in Louisiana and the other Gulf states were reviewed. Relevant components from those past efforts were incorporated into a new Project-specific CEM to portray the status of knowledge about the Barataria Basin ecosystem and determine the components of the ecosystem that are most critical to monitor. The spatial scale of the Project CEM is the Barataria Basin, and the temporal scale is a 50-year Project timeframe and planning horizon.

The Project CEM starts with the idea that historical hydrologic alterations underlie the impaired status of the ecosystem. The CEM represents the current condition where levees and other anthropogenic alterations, sea level rise and climate change combine to create a dysfunctional system compared to pre-European settlement. The model can also represent the potential for a sediment diversion project to address some of those hydrologic alterations and associated impacts.

1.3.2. Components of the Conceptual Ecological Model

To inform this Plan, the Project partners developed a driver-stressor type of CEM (Fischenich 2008) that generally follows the top-down hierarchy similar to CEMs developed for Louisiana Coastal Area Program projects (e.g., CPRA and USACE, 2010, 2011). This CEM identifies specific external *Drivers* and *Stressors* on the existing Barataria Basin, the *Effects* of those drivers, or processes occurring within the ecosystem, and the physical, chemical, biological, and/or ecological *Attributes* that can best serve as indicators of ecosystem condition. In doing so, the CEM helps identify the specific parameters to monitor to assess ecosystem change (both benefits and impacts) resulting from the proposed actions.

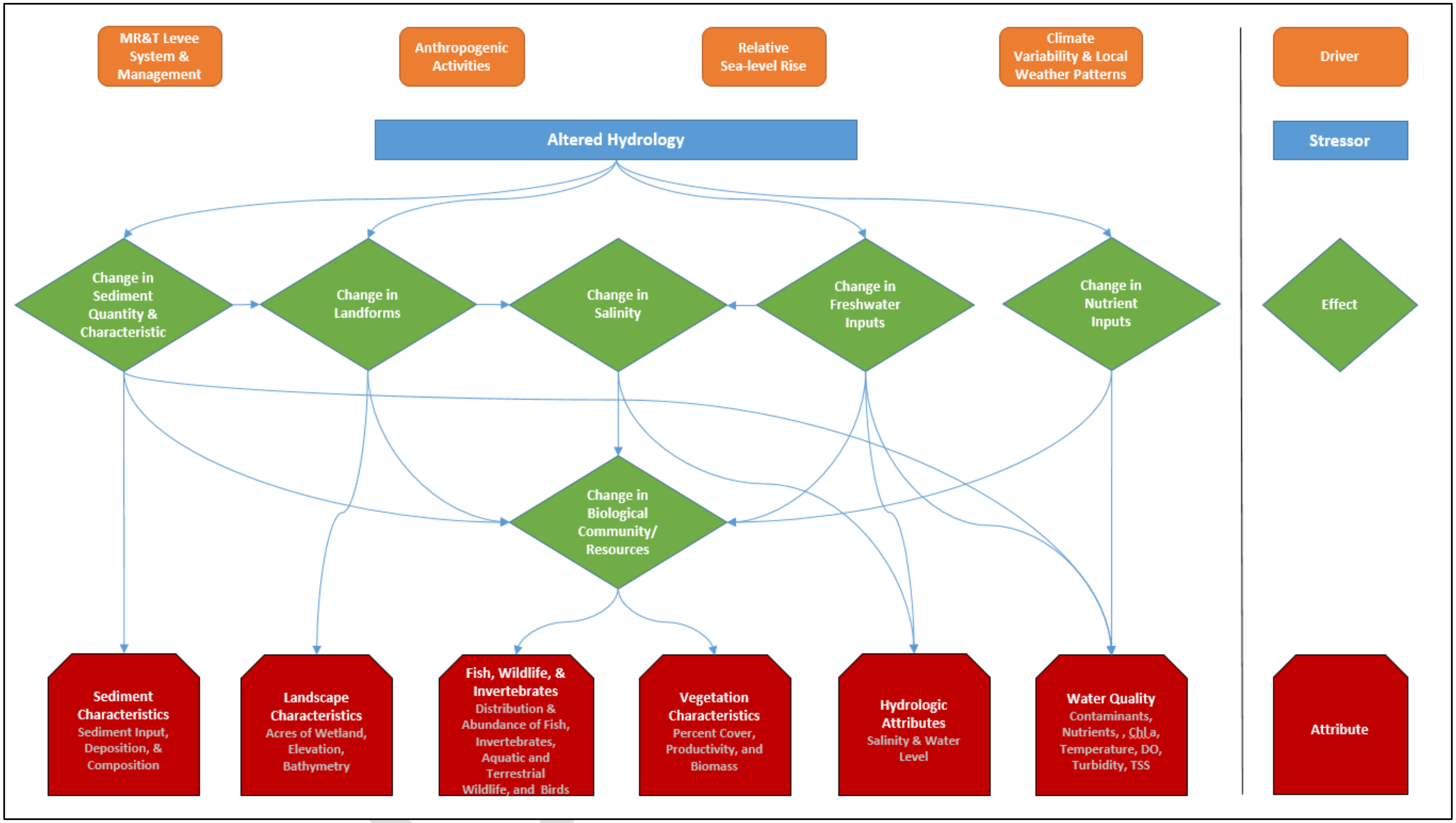
1.3.2.1. Drivers

Drivers are the major, natural and/or anthropogenic external forces that influence and govern system outcomes. The drivers that were identified as the major influences on the Project are

- The Mississippi Rivers and Tributaries (MR&T) Levee System and Management: Land loss in the Mississippi River Delta has been primarily attributed to levee system construction limiting the flow of sediment and water into embayments and surrounding wetlands.
- Anthropogenic Activities: Additional alterations to the Barataria Basin landscape besides the construction of levees have further altered hydrologic patterns. Land loss within the basin has been exacerbated by canal construction; conversion of natural habitat to agricultural, industrial, and other suburban and urban uses; and catastrophic events like the DWH oil spill.
- Relative sea level rise (RSLR), which refers to local perceived rates of SLR once Gulf-regional SLR (GRSLR) is combined with either uplifting or subsiding vertical land motions. Local rates of RSLR may be lesser or greater than regional SLR depending on the nature and magnitude of those land motions. For project-effects modeling associated with the 2017 CMP, 2015-2065 GRSLR scenarios varied between 0.43 and 0.83 m (Pahl, 2017). Plausible subsidence across southeastern Louisiana varies substantially (Figure 1.3-2).
- Climate Variability and Local Weather Patterns: Climate has been described as “what you expect” and weather as “what you get.” Specific forces that result in changes in local weather patterns drive climate and climate change. The primary driving force of annual climate cycles is the sun, while longer and more aperiodic climate cycles like the Atlantic Multi-decadal Oscillation (AMO) and El Nino-Southern Oscillation (ENSO) influence hurricane activity and rainfall patterns and intensity. Climate change is affecting these patterns by the heating of the ocean, causing a rise in sea-surface water temperature and thermal expansion affecting SLR. Local weather patterns affect rainfall, evapotranspiration, wind, and temperature. Rainfall and evapotranspiration affect the amount of freshwater within Barataria Basin through direct effects on the basin and driving sources of freshwater (surface and groundwater) entering the system, influencing local salinities both seasonally and between years. Wind can drive substantial fluxes of water into and out of estuarine systems. North winds can force water out of estuaries and south winds can raise water levels by up to 0.5 meters (Reed et al., 1995). Wind-driven tides can override lunar tidal cycles. Wind-driven waves can cause marsh erosion and re-suspend sediment (Allison et al., 2017). As described above, temperature affects climate cycles; on the local level, temperature is an important factor controlling the productivity, biomass and composition of phytoplankton, vegetation, and faunal species (Nuttle et al., 2008).

1.3.2.2. Stressors

Stressors are natural systems physical or chemical changes produced or affected by drivers, and are directly responsible for significant changes in biological components, patterns, and relationships in natural systems. Altered hydrology is the primary stressor manifested in Barataria Basin because of the interactions between the aforementioned drivers, and that describes the intended effects of the Project. The Project would construct a controlled breach in the levee system, resulting in the reconnection of the MR to the Barataria Basin and re-establishment of sustainable deltaic processes within the Basin.



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447 ***Figure 1.3-1.*** Conceptual Ecological Model for the Barataria Basin Sediment Diversion project developed by the Trustee Implementation Group's Monitoring
448 and Adaptive Management Team. The Attributes listed are a subset or examples of the full set of monitoring parameters proposed in Section 3.
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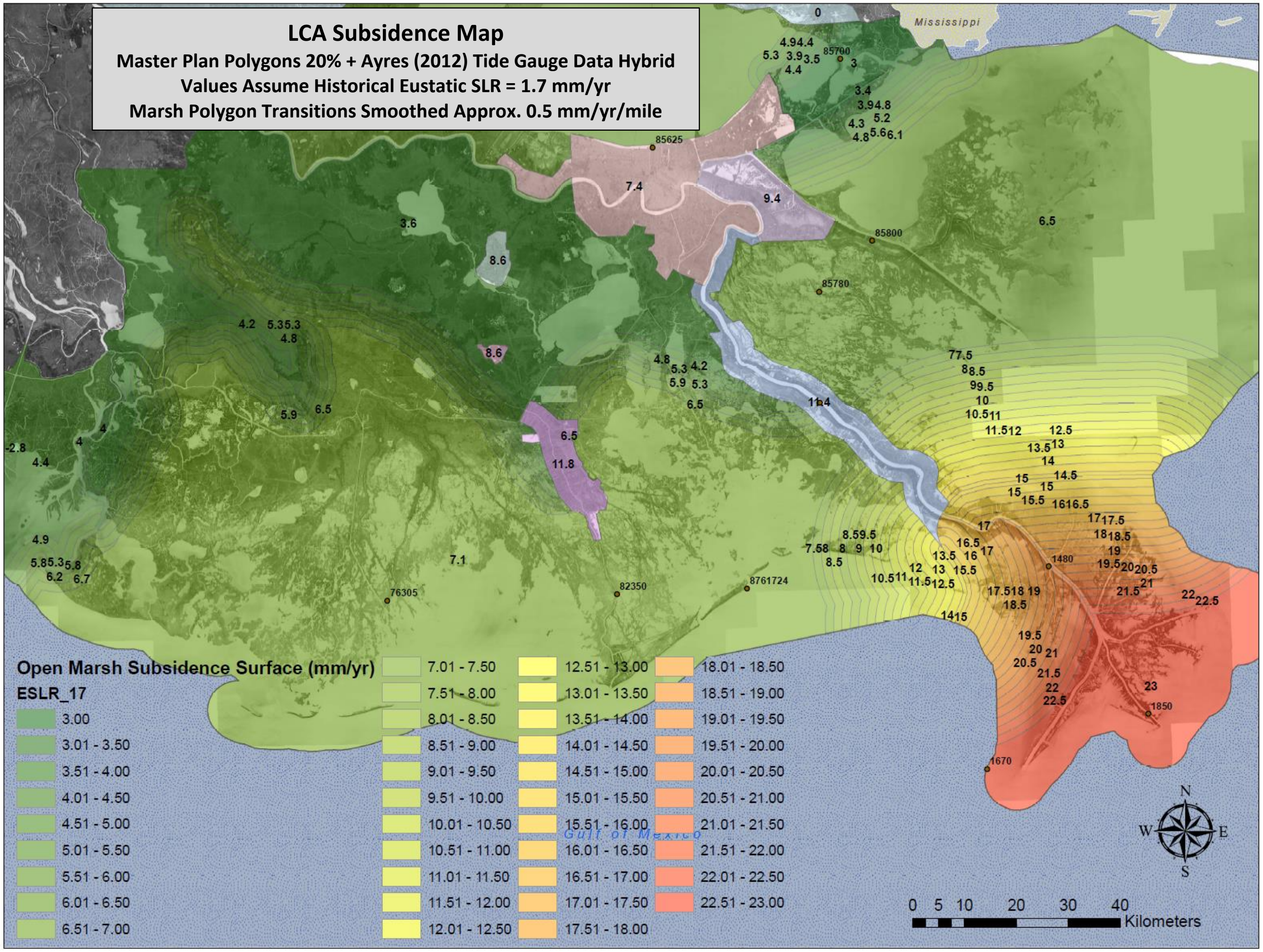


Figure 1.3-2. Estimates of plausible, spatially-variable subsidence developed for the Louisiana Coastal Area Program Delta Management Feasibility Study investigations were used as inputs for the Delft3D Basin-wide Model-based Project alternatives analysis.

1.3.2.3. Effects

Effects are biological, physical or chemical responses within the natural system that are produced or affected by Stressors. The Effects listed in Figure 1.3-1 represent those physical and ecological phenomena whose patterns of occurrence are potentially attributable to alterations in Barataria Basin hydrology. The processes that are initially affected by changes in hydrology would be the amount of sediment, freshwater, and nutrients entering Barataria Basin. Altering sediment delivery through diversion operation would change Basin landforms, beginning with delta formation at the outfall. Altering freshwater inflow would change the salinity in parts of the Basin, especially in the outfall area. These alterations along with changes in nutrient inputs would affect Basin flora and fauna.

1.3.2.4. Attributes and Relevant Monitoring Parameters

Attributes are a representative subset of all potential elements or components of natural systems. Attributes may include populations, species, communities, or chemical processes. Changes in the processes have effects on the attributes of Barataria Basin, including the landscape, sediment, fauna, flora, water quality, and hydrology. The specific parameters that will be assayed to define and describe these attributes are discussed in more detail in Section 3, and include

- Landscape Characteristics
  - Acres of Wetland, by type (freshwater swamp; fresh + intermediate, brackish, and salt marsh; submerged aquatic vegetation (SAV), etc.)
  - Wetland Surface Elevation
  - Estuarine Open Waterbody Bathymetry
- Sediment Characteristics
  - Sediment Input
  - Organic Matter Composition
  - Mineral Sediment Composition
- Fish, Wildlife & Invertebrates
  - Distribution and Abundance of Fish, Invertebrates, Aquatic and Terrestrial Wildlife (including dolphin health), and Birds
  - Alligator Nest Success
- Vegetation Characteristics
  - Percent Cover
  - Productivity
  - Biomass
- Hydrologic Attributes
  - Salinity
  - Water Level
- Water Quality
  - Contaminants
  - Nutrients
  - Chlorophyll (Chl) a
  - Temperature
  - Dissolved Oxygen (DO) Content
  - Turbidity
  - Total Suspended Sediments (TSS)

1.3.2.5. Use of the Conceptual Ecological Model

Tracing any single path in Figure 1.3-1 from Drivers through Attributes represents an individual logic flow through the CEM. A survey of each unique logic flow through the model by members of the LA TIG MAM Working Group found that some flows are more certain than are others. Other logic flows are burdened by a rapid accrual of uncertainty from top to bottom; especially longer logic flow paths and those flows that rely on processes or attributes that are driven by multiple variables.

For example, consider the relatively short logic flow through the model that states

> "Levees may lead to
> →Altered Hydrology, which may result in a
> →Change in Freshwater Inputs, which can be monitored through
> →Hydrologic Attributes."

This is one of the shortest logic flows in the model (three steps from top to bottom), and is one that the LA TIG MAM Working Group associated with a relatively low level of uncertainty. Contrast that to the logic flow that states

> "Climate Change may lead to
> →Altered Hydrology, which may result in a
> →Change in Sediment Quantity & Characteristic, which may result in a
> →Change in Landforms, which may result in a
> →Change in Salinity, which may lead to a
> →Change in Biological Community and/or Resources,
> which can be monitored through
> →Vegetation Characteristics."

This is one of the longest logic flows in the model (six steps from top to bottom). It also involves three processes (Change in Landform, Change in Salinity, and Change in Biological Community/Resources) that have multiple influencing variables, any one of which is providing only a partial influence on the Process in question. The Working Group associated longer, more complex logic flows with more uncertainty.

The LA TIG MAM Working Group generally agreed it would not be appropriate to focus adaptive management decision making for the Project strictly around the logic flows in the model, since the CEM does not explicitly identify uncertainties, particularly human system uncertainties. Instead, the group decided that the value in the CEM is as a broader and more general representation of the potential influences of Altered Hydrology on the monitoring parameters chosen to represent specific ecosystem Attributes.

1.4. Sources of Critical Uncertainty

The CEM represents a simplification of a large number of phenomena that will be occurring in and interacting with the landscape through time. While information flow through the CEM may appear deterministic and predictable, it is only so within the confines of the current state of the science regarding each of the Drivers, Stressors, Effects, and Attributes represented in Figure 1.3-1. In reality, uncertainty exists around every individual factor and process represented in the CEM. While the Project partners strove to account for those uncertainties, they do remain, and constrain both the conceptual and numerical modeling frameworks

1.4.1. Environmental Driver Uncertainties

Each of the drivers in the CEM has a certain level of uncertainty both as to how that driver will change in the future and as to how the diversion will interact to bring any change in that driver. For example, the purpose of the MR levee system and management is to prevent flooding. Much work is occurring during Project Engineering and Design (E&D) to ensure that neither construction nor operations of the Project will compromise that purpose. The levees, however, resulted in channelizing flow within the MR&T Project system rather than allowing flow into the estuaries via overbank flooding and crevasses, thereby limiting the delta-building process. More natural delta building has continued where the MR&T levees have been degraded (Bohemia Spillway) or absent (in the modern Balize Delta lobe downriver of Venice, LA). However, at present the mouth of the primary river distributaries in the Balize Delta (Pass a Loutre, South Pass, Southwest Pass) are on the edge of the continental shelf near the transition to the continental slope, which constrains further lateral expansion of subaerial wetlands.

Relative sea level rise, climate change, and local weather patterns likewise have substantial residual uncertainties. The 2017 CMP reviewed and used the most recent projections of GRSLR (Pahl 2017) and developed a lower and upper bound scenario for sensitivity and modeling. Reed and Yuill (2017) also developed Moderate and Less Optimistic Scenarios for subsidence by region (. However, while the plausible outcomes of GRSLR and subsidence are projections informed by the current scientific literature, the actual Gulf-regional and relative SLR rates that the Deltaic Plain will experience over the next 50 years are uncertain.

The MR watershed encompasses 40% of the contiguous U.S., which means that the climate and weather patterns that affect the diversion include those in the central U.S. The seasonality of weather produces generally-known temperature and weather patterns, including the generally-predictable hydrograph of the MR flow that will be used in the operation of the diversion. There is also a general predictability in the seasonality of extreme events such as winter fronts and hurricanes. Longer-term intensity and location of impact of those events is less predictable, as is how climate change may affect precipitation patterns within the MR basin, frequency of high flow events.

Climate patterns provide some level of predictability of effect, although specific recurrence intervals are more correctly defined as temporally aperiodic. On short timescales, the ENSO has a predictable effect on temperature and rainfall in regions of the U.S. On longer timescales, the North Atlantic Oscillation and AMO influence temperature and precipitation, as well as extreme events, on what are broadly ±30-year cycles. Over the longer term, gradual but persistent warming from climate change has the potential to alter current climate patterns. The annual cycle of Project operation planning provides the opportunity to identify shifts in patterns of climate and weather, and to incorporate new scientific knowledge, to plan for operations in the next year.

1.4.2. Uncertainty in the Degree of Altered Hydrology (Stressor)

Leveeing of the Mississippi River altered natural hydrology by hydrologically isolating the Barataria Basin from the river. To reverse that alteration, the proposed Project structure design relies on the difference between the stage of the MR and that of the Barataria Basin receiving waters (head differential) to facilitate the diversion of river water and the sediments and nutrients therein. As such, the most important assumption governing Project structure operations, in that it drives the presumed head differential, is the MR hydropattern. For the alternatives analyses in support of the Environmental Impact Statement (EIS), the historical 1964-2013 Mississippi River hydrograph was put into the Basin-wide Model as the MR condition for the 2020-2070 Project analysis period. It is highly likely, if not a near certainty, that the 1964-2013 hydrograph will not be the actual river condition during the first 50 years of Project operations. Thus, the actual schedule of opening and closing the diversion beyond the base flow remains highly uncertain because it will depend on actual MR stages throughout the Project's operational life.

1.4.3. Uncertainties in Responses of Environmental Resources to Project Inputs

There is a substantial amount of uncertainty surrounding individual physical and ecological phenomena represented in the CEM. Uncertainties of environmental resource response predominantly lie within the effectiveness of the diversion in transporting riverine sediment, freshwater, and nutrients into the receiving basin. Uncertainties associated with the calculations of critical model variables and how they influence key model outputs remain. The actual balance between land building and water quality impacts is also uncertain. Continued baseline and future effectiveness monitoring (Section 3) will improve the predictability of resource response. Future marsh experiments in controlled environments and in greenhouses, such as those conducted in the past by Graham and Mendelssohn (2014) and Poormahdi et al. (2018), can lead to a better understanding and predictability of how forming delta marshes incorporate the sediment and nutrients from the diversion. For now, uncertainties will be cataloged by the Project AM team (Section 12) for determination of priority and source of funding.

1.4.4. Uncertainties in Human Systems Response

Human community or socio-economic attributes (also known as human dimensions data) are priority datasets for management decision-making. However, the complexity in meaningfully collecting sociological data and the substantial uncertainty in either conceptual or numerical models has generally limited their formal inclusion in AM schemes.

Outputs from the Habitat Suitability Index (HSI) models, and even some of the Delft model outputs, are generally incompatible with available human system models, which ideally would be used to project catch or some other measure of resource exploitation based on population size, on which to underpin subsequent socioeconomic effects. As well, there is, in general, a very high degree of uncertainty in trying to model human response to projected biophysical and resource changes in either individuals or communities. Critical to this uncertainty is the ability or willingness to adapt, both of which can vary widely between communities, and even between individuals within a particular community.

1.5. Use of Numerical Models within Project Adaptive Management

1.5.1. Numerical Models Used in Project Planning

Project alternatives analysis was largely (but not solely) based on comparing the results of a suite of numerical models, within which ecosystem responses to proposed Project alternatives were analyzed. Numerical models were also used to inform Project E&D and MAM Plan monitoring and evaluation. The Project modeling suite contained the following specific numerical models.

- Version 3 of the Delft3D Basin-wide Model, developed by TWIG, simulated morphological changes and water quality-related dynamics in the Mississippi River, the Barataria and Breton Sound basins and the Balize Delta (Sadid et al., 2018). The Delft3D model is a modeling suite developed by Deltares (2014) and designed to model "hydrodynamics, sediment transport and morphology and water quality for riverine, estuarine, and coastal environments" (Sadid et al., 2018). The Basin-wide Model integrates hydrological, morphological, nutrient, and vegetation dynamics. Vegetation dynamics were modeled using two specific Louisiana vegetation models to simulate the spatial distribution of wetland vegetation and allocate above- and below-ground biomass.

  The Louisiana Coastal Area (LCA) Ecosystem Restoration Study's Mississippi River Hydrodynamic and Delta Management Feasibility Study (MRHDMS) originally developed the Basin-wide Model. Alternatives evaluations for the Project's EIS were informed by projections of how conditions would change over 50 years, expressed as the difference between a "future with project" (FWP) and "future without project" (FWOP) scenario, where each of the proposed alternatives were modeled as separate FWP scenarios.

- A Delft3D-based Diversion Outfall Model, first developed by TWIG and subsequently adapted by the Project Design Team (PDT, specifically Baird Engineering, Inc.), predicted input of river flows at the discharge location, suspended sediment flow rate and duration, and sand and silt volumes conveyed into the basin for land building. The spatial domain of the Diversion Outfall Model is smaller geographically but higher in resolution than the Basin-wide Model, allowing for model use for Project E&D.

- The Advanced Circulation Model (ADCIRC) estimated the wave environment and propagation of storm surges in Barataria Basin resulting from landscape changes projected to result from the Project alternatives. Originally developed by Drs. Rick Luettich and Joannes Westerink, "ADCIRC is a system of computer programs for solving time dependent, free surface circulation and transport ..." (https://adcirc.org/). ARCADIS runs ADCIRC for the Project partners.

- HSIs for a set of 11 aquatic and four terrestrial species or species groups project the response of higher trophic levels to proposed Project alternatives, and inform both the Project EIS and adaptive management. Some of the HSIs originated with the Department of Interior in the mid-1980s, while others were developed and updated to inform the State of Louisiana's Coastal Master Plan. Inherent to the nature of HSIs is that they only predict the suitability of a habitat, not actual habitat occupation by organisms, organismal populations or species biomass. As well, many of the available HSIs for commercially-valuable fish and shellfish species only provide suitability projections for certain life-history stages, such as larvae and/or juveniles, and not for the adults that are generally the targeted resources in coastal fisheries.

- Two Barataria Basin-specific ecosystem response models, the Comprehensive Aquatic Systems Model (CASM) and Ecopath with Ecosim (and with Ecospace; EwE), were originally developed for the LCA MRHDMS, and are being used to inform the Project EIS. Given the current predictive limitations of each model (Ainsworth et al., 2018), they were used to characterize the existing food web structure of the estuary. This helped understand potential pathways for change and informed the monitoring component of this plan.

- The Project Socio-Economic Working Group utilized the IMPLAN Company's Impact Analysis for Planning (IMPLAN) software to develop estimations of the benefits and impacts of Project alternatives on human systems. IMPLAN uses output datasets from the Basin-wide Model, ADCIRC, and the HSIs as input datasets for its calculations, as well as additional socio-economic data developed specifically for the Barataria Basin.

The uncertainty structure around the model suite was a factor of

1. Uncertainty associated with empirical datasets that served as inputs to each model. For example, there was uncertainty associated with the water level and salinity datasets (measurement error) used to initialize the Basin-wide Model; and
2. Uncertainty associated with the ability of any one individual model to predict the response of a specific parameter. For example, we have already clarified that the uncertainty of Delft Basin-wide Model estimates of salinity at a particular space and time was on average +/- 3.5 parts per thousand. This uncertainty then defined the uncertainty of a specific output dataset, which then served as an input dataset to the next subsequent model in the chain.

Uncertainties associated with any one model in the modeling suite perpetuate with information exchange with the next subsequent model, and so the total uncertainty compounded for any one alternative was evaluated through the sequence of models. Evaluations of the results of individual models without the acknowledged compounding uncertainty from previous models risk subsequent false assumptions of model output precision.

In the case of alternatives modeling for the Project EIS, there were uncertainties in the input datasets feeding the Basin-wide Model, and inherent limitations in the model to predict salinities, water levels, land building, and other outcomes. Model outputs should therefore be considered projections, not predictions, because they represent *what would have happened* had the set of conditions in the model been in place at the onset of a particular model production run, rather than a guarantee of *what will happen*. Accordingly, alternatives analysis was, for the most part, limited to the comparison between alternatives, e.g., FWP vs. FWOP, or FWP alternative A vs. FWP alternative B.

CPRA therefore prefers that the numerical modeling conducted for the DEIS not be used directly or solely to establish specific temporal benchmarks of project performance upon which the Project MAM plan will be based. These projections better serve as order-of-magnitude comparative benchmarks for a constrained set of biophysical parameters (e.g., amount of sediment transported through the Project structure), with perhaps some adjustment to acknowledge the model uncertainties.

1.5.2. Use of Data and Numerical Models to Inform Project Monitoring and Adaptive Management

Complex models such as the CASM and EwE ecosystem models listed above are also useful for identifying proxy variables for monitoring when the specific metric of interest cannot feasibly or effectively be monitored directly. For example, the EwE and CASM models will be used to identify additional future monitoring parameters, locations, and frequency (e.g., long-term biomass monitoring, lower trophic level organisms, detritus) to evaluate the Project's influence on food web dynamics. Those additional monitoring parameters may be incorporated into this MAM plan.

Numerical considerations of the data for monitoring parameters binned as Range variables in Section 4 could also be informed by historical data from within the Barataria Basin, although Project operations may lead to data values in time and space outside the available historical ranges. For the remainder of the objectives-related monitoring parameters outlined in Section 3, trends from the modeling are likely more appropriate points of comparison. Operational planning will occur on an annual cycle, allowing an AM approach to test and understand the most effective actual operation of the diversion, considering the uncertainties of annual river flow and how the climate and weather patterns drive basin hydrology.

Throughout the operational life of the diversion, CPRA will periodically utilize numerical modeling to better examine system responses, confirm project performance assumptions that are not directly measurable, and test the potential effects of adaptive operational modifications. The schedule for that modeling will depend on the frequency of Project operations and evaluations of the supporting monitoring data (Section 4).

The Project Adaptive Management Team (AMT) will utilize the most appropriate modeling tools to address AM-related questions. Currently, the CASM and EwE models are being used to assess baseline condition and in the future may be used to assess project-driven effects such as potential changes to aquatic biodiversity, trophic linkages and pathways, and overall assemblage structure. Additional refinements may be made to make the models more suitable for evaluating potential adaptive management actions. To accomplish this, additional modifications to the current ecosystem modeling tools must be accomplished to determine model predictive ability to examine potential adaptive management options. Initially, the AMT will focus on the EwE and CASM models used in project planning. In the future, the team may evaluate additional models for use in adaptive management.

To address the use of the models to predict changes under with-project conditions the EwE and CASM models will undergo sensitivity analyses to analyze response of the modeled food web to changes in salinity. A specific series of steps for a multi-model analysis will be identified to improve predictive capabilities and enable bracketing of the uncertainty associated with model projections. For example, two benthic-to-pelagic metrics, biomass and productivity, will be added as output to the two models and examined as time-series outputs including inter-annual and seasonal variability, in order to understand whether the metrics are sensitive to year-specific conditions or instead are very consistent between years and therefore unlikely to vary in the future. The variability in these metrics will then undergo a statistical analysis to relate them to the environmental conditions used as input to the models. New simulations will be performed by varying environmental conditions in a systematic way in order to attribute responses of the food web to changes in salinity

The EwE and CASM models described above will be periodically updated with data collected during pre-operations and post-construction of the Project. Pre-operations data will be used to refine responses of the individual components to environmental drivers. Post-construction monitoring data will be incorporated into model refinement to test, predict, and evaluate responses under with-project conditions.

Periodic evaluations of the models listed in Section 1.5.1, updates to working models including incorporation of new data, the state of the science regarding new models that may be developed over the Project life, and the appropriate use of those existing or new models, will be planned and led by the AMT.

2. PROJECT OPERATIONAL AND ADAPTIVE MANAGEMENT GOVERNANCE

2.1. Description and Scope

This section outlines the makeup, roles and responsibilities of the State of Louisiana (CPRA) as the NRDA Implementing Trustee responsible for the governance of the Project, as well as the non-State entities that will inform the implementation of this plan. Figure 2.1-1 shows the general relationship between CPRA as the Implementing Trustee and the LA TIG. CPRA will have responsibility for the operation of the Project, within the limits of the permits and permissions granted to the Project and within the Project purpose, as found in the PDARP (DWH Trustees, 2016), and subsequent Restoration Plans that examine and authorize the Project. Proposals for operations or adaptive management decisions that would be outside the Project purpose or permitted constraints would require consultation with the LA TIG Agencies and Regulatory authorities.

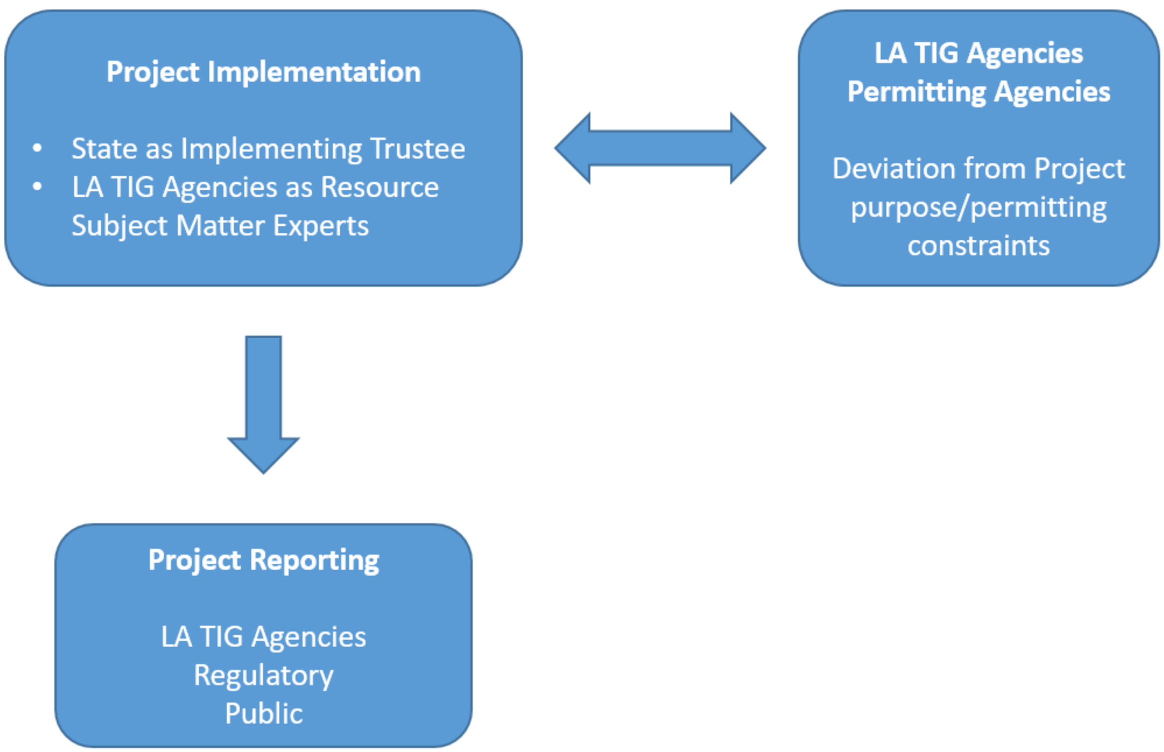


Figure 2.1-1. Relationship between the State of Louisiana and the LA TIG regarding governance of Project operations and adaptive management decision making. Section 7 contains information on Project Reporting.

In the context of the Project, governance refers to how CPRA, with input from other stakeholders, will make decisions over the life of the Project (Figure 2.1-2). Decisions will include, but not be limited to, continuation of and changes to Project operations, riverside management, monitoring, maintenance, and adaptive management actions.

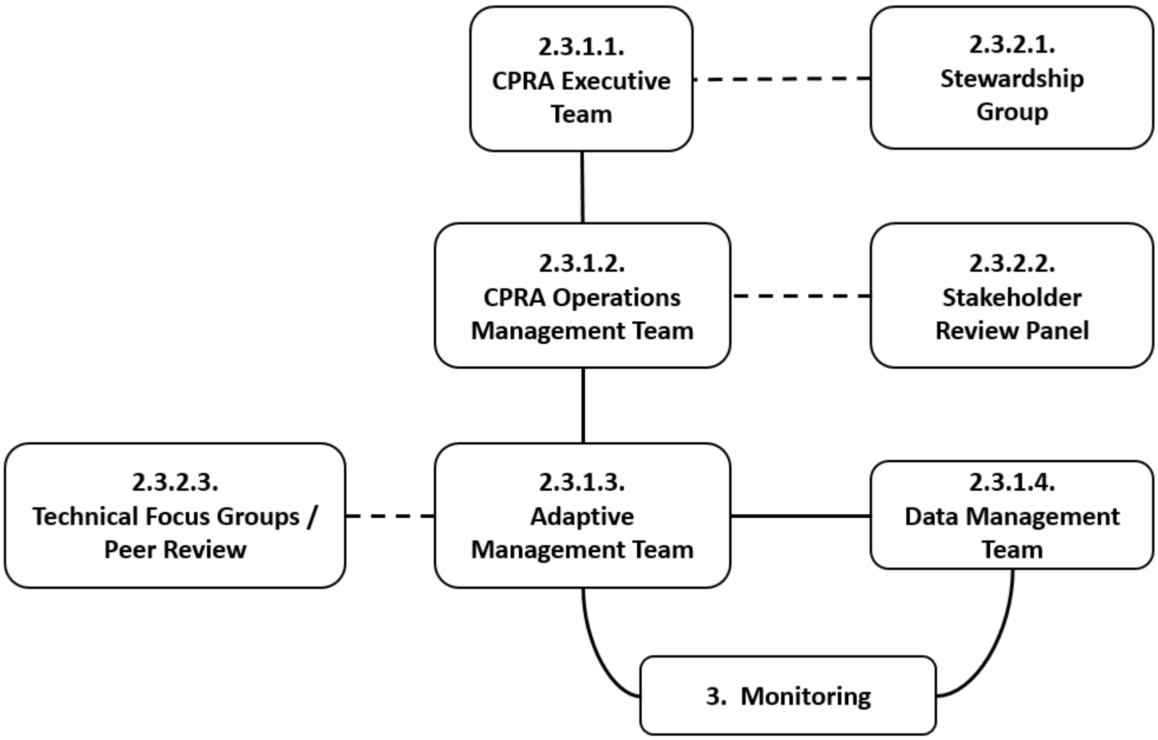


Figure 2.1-2. Information flow between the Project governance elements outlined in this section. Numbers refer to sections of text that further describe each governance element or activity. Solid lines indicate information flow underpinning CPRA Project operations and adaptive management decision making. Dashed lines indicate advisory opportunities from outside CPRA.

2.2. Data and Information Requirements

It is important that project decisions are transparent and data and science-based to the extent possible. This will require:

- A Monitoring Plan that outlines monitoring for sediment delivery efficiency and both ecological and sociological response.
- Data Analysis: The AMT (2.3.1.3) will analyze the Project data. A data analysis plan that provides details on when, where, and how data will be analyzed and what will be produced as a result of the assessment(s).
- Project-specific recommendations for adaptive management actions based on the data assessments, with input from the Technical Focus Groups (2.3.2.3) as needed. Draft recommendations will be assembled into a draft operations plan. It will be important to address and incorporate, to the extent practicable, public input into the operation plan early in the process.
- A Data Management Plan to describe how Project-specific data need to be managed to facilitate analysis (Section 7 of this Plan).

2.3. Governance Structure

2.3.1. Project Implementation Teams

2.3.1.1. CPRA Executive Team

2.3.1.1.1. Membership

- Executive Director
- Deputy Executive Director
- Engineering Division Chief
- Operations Division Chief
- Planning & Research Division Chief
- Project Management Division Chief

2.3.1.1.2. Responsibilities

- Approve overall recommendations and annual plan from the Operations Management Team (OMT) and AMT for Project operations
- Adoption of the Project Annual Operations Plan into the larger CPRA Annual Plan to authorize action and funding
- Interactions with CPRA Board and State Legislature
- Interaction with Stewardship / Associated Actions Group

2.3.1.2. Operations Management Team

2.3.1.2.1. Membership

- CPRA Operations Division/Diversion Program Assistant Administrator
- CPRA Project Engineer
- Additional State Agency support as needed

2.3.1.2.2. Responsibilities

- Operates structure in accordance with the water control plan: works on day-to-day issues of diversion operation.
- Works with AMT team on efficiency and project performance issues.
- Conducts public and stakeholder review panel meetings
- Receives information from data team, public information/comments from panel (described below), recommendations from panel
- Develops draft and final annual operations plans, maintain decision log, outfacing data reports, assessment
- Hosts and Runs Public Input Sessions
- Maintains the Project Decision Tracker, which will be a living document, available for public view, that tracks and documents potential management decisions, outcomes, and rationales. This tracker will include all suggestions and comments from public input, and document how each was addressed by CPRA

2.3.1.3. Adaptive Management Team

2.3.1.3.1. Membership

- CPRA Adaptive Management Lead and team
- CPRA Executive Division Senior Scientist
- CPRA Operations Division Monitoring Manager and Project Team
- CPRA Planning & Research Division Senior Scientists
- CPRA Planning & Research Division Liaison
- Agency Technical Representatives for Aquatic Resources

2.3.1.3.2. Responsibilities

- Focuses on the long term achievement of project's performance
- Basin modelling/existing conditions, Look at future projections: river flow, sediment availability, etc.
- Submit recommendations such as changes to operations, data collection, or other adaptive modifications.
- Managing the models and outputs, and evaluating long-term possibilities for adaptively managing the Project, including the evaluation of additional features and/or monitoring. In addition, they may be called upon to evaluate questions and/or issues that arise during operational periods.
- Periodic Adaptive Management Report: This report provides a longer-term view for planning purposes, including model outputs and evaluations of potential project features, alternate operations regimes, etc. The AMT may engage Technical Focus Groups (2.3.2.3.) to provide input and/or review of the report. See Section 5.2.3 for the planned reporting schedule.
- Issue-specific reports: The AMT may produce reports addressing specific issues to address questions and concerns that arise from stakeholders. The AMT may convene Technical Focus Groups (2.3.2.3) to assist in evaluation and reporting as needed.
- Coordination with overall Coastal Program Project Planning

2.3.1.4. Data Management Team

2.3.1.4.1. Membership

- CPRA Planning & Research Division/Research Section Data Manager
- Additional State Agency support

2.3.1.4.2. Responsibilities

- Manage (collate, host and archive) project monitoring data.
- Manage and/or directly conduct Project data Quality Assurance/Quality Control (QA/QC).
- Work with the OMT and AMT to develop data reports and data interpretations and assessments.
- Work with the AMT, Technical Focus Groups and/or the External Peer Reviewers (2.3.2.3).

2.3.2. Other Teams

2.3.2.1. Stewardship Group

2.3.2.1.1. Membership

- Agency representatives engaged in implementation of stewardship measures.

2.3.2.1.2. Responsibilities

- Provide insight, comments, and guidance on the Annual Operations Plan is at relates to the effective implantation of Project stewardship measures.

2.3.2.2. Stakeholder Review Panel

2.3.2.2.1. Membership

- CPRA Lead
- Federal agency representatives
- Barataria Basin Parishes: Jefferson, Lafourche, Plaquemines, St. Charles;
- Oyster, Shrimp, Crab, and Finfish Working Group Leads;
- Louisiana Department of Environmental Quality (LDEQ);
- Louisiana Department of Health and Hospitals;
- Louisiana Department of Natural Resources;
- Louisiana Department of Wildlife and Fisheries (LDWF);
- Navigation representative.

2.3.2.2.2. Responsibilities

- Provide insight and comment on a draft Annual Operations Plan
- Share expertise and perspectives on short term issues
- Disseminate information to other stakeholders / public

2.3.2.3. Technical Focus Group(s) / Peer Review

2.3.2.3.1. Membership

- Federal Subject Matter Experts (SMEs)
- State SMEs
- Non-agency (e.g., academic, non-governmental, private sector) SMEs

2.3.2.3.2. Responsibilities

- Provide technical support and use in long term project planning.
- Assist in the evaluation and interpretation of project monitoring
- External peer review of the Multi-year Monitoring and Adaptive Management Report, outside of the Technical Focus Groups, may be needed or desired

- Groups will be constituted and convened on an as-needed basis.
- Evaluate the state of science concerning adaptive management and tools for adaptive management

3. PROJECT MONITORING PLAN

3.1. Monitoring Plan Development

This section describes the plans to collect pre-operations and post-construction data. With collaboration with the partner resource agencies, CPRA, as the Implementing Trustee, has developed the draft plan with guidance from the Monitoring and Adaptive Management Procedures and Guidelines Manual (DWH Natural Resource Damage Assessment Trustees 2017). The plan describes the types of sampling, methods, and other data that will be used to evaluate Project performance and natural system change and inform AM decision making (Section 4). Monitoring variables were selected to evaluate Project performance in meeting objectives, inform modeling and projection, and conform to accepted measurement techniques.

The pre-operations and post-construction monitoring plans have the following goals:

1. Outline the early deployment of monitoring equipment and sites to ensure the pre-operations conditions are adequately characterized prior to Project implementation;
2. Identify essential variables for evaluating progress towards meeting Project restoration objectives, detecting system change and improving analytical tools over time; and
3. Ensure the update or development of standard operating procedures and quality plans.

3.2. Baseline and Project Monitoring Approach

Pre-operations baseline data collection defines current conditions and trends to compare against observed changes in the system that will occur following initiation of operations. The 'Before-After-Control-Impact' (BACI; Underwood 1992, Smith et al. 1993) monitoring approach in areas anticipated to change is commonly applied with ecosystem restoration projects, and will be used to evaluate parameter data as they pertain to the Project objectives (see Section 4). The long-standing network of existing gauges and sample locations across the Barataria Basin will enable a robust baseline for the Project, against which to compare post-construction data. Additionally, the network of Coastwide Reference Monitoring System (CRMS)-*Wetlands* and System-wide Assessment and Monitoring Plan (SWAMP) sites across coastal Louisiana will be used to understand broader regional drivers and ecosystem trends that may be separate from Project effects. As described in detail below, some of the CRMS-*Wetlands* and SWAMP sites, together with to-be-constructed sites dedicated to Project effects monitoring, will also provide direct observations of Project effects.

3.3. Monitoring and Assessment Design

The sampling design for SWAMP and the additional project-specific sampling proposed herein meets requirements for assessment and AM in the following ways:

- The design provides the basis to reduce uncertainty, improve analytical solutions, and support effective decisions that meet the infrastructure, resource, and social requirements.
- The system variables are measured at frequencies and spatial scales to support evaluation of Project performance.

- Consistency with existing long-term data collection facilitates multiple comparisons (e.g., BACI, baseline, gradient) of Project data. Long-term sampling such as CRMS and the LDWF fisheries-independent monitoring program (FIMP) will provide a solid baseline that can be followed and estimated through the Project life.
- The SWAMP coast-wide spatial coverage increasingly will help separate otherwise potentially confounding regional processes (e.g., RSLR, temperature), event perturbations (e.g., storms, drought,) and climate cycles from real Project effects

The locations, types of data collected, and frequency of post-construction data collection will be reviewed and refined during the Project lifespan to improve operations (e.g., sediment capture from the river and sediment retention in the basin). Monitoring design refinement may involve

- identifying and addressing spatial or temporal data gaps,
- adding or modifying parameters (e.g., physical, biological, chemical, geologic),
- changing, adding and/or removing data collection station locations, and
- undertaking special research or studies (e.g., landscape hydraulic studies; habitat mapping).

3.3.1. Sampling Stratification

A stratified sampling approach will

- structure sampling based on known landscape or population (fish and wildlife, human) attributes,
- improve sampling efficiency and thereby reduce monitoring effort and costs, and
- reduce the uncertainty of population estimates within each stratum, which could reduce the number of plot measurements.

Given the dynamic nature of the environment and Project, fixed sampling locations may need to be changed before and after the onset of Project operations. Thus, re-stratification may be necessary over the life of the Project. Examples of habitat strata (Figure 3.3-1) could include, but are not limited to, created and natural wetlands, marsh type, and land/terrestrial vs. open water/aquatic.

3.3.2. Estimation of Project Delta Development and Project Influence Areas

The proposed Project would introduce sediment, freshwater, nutrients and flows into the Barataria Basin, beyond that already provided by the Davis Pond Freshwater Diversion Project and the Naomi and West Point a la Hache siphons. Operational histories of those other projects will need to be examined to be able to parse out Project effects from those other structures. The extent of the area of influence will be different for specific system resources.

To guide selection of locations for pre-operations monitoring where potential data gaps may occur, two areas of projected Project effects were defined. A smaller Project Delta Development Area (PDDA; Figure 3.3-2) was defined as the spatial extent that the Delft Basin-wide Model projected bed elevation differences would occur between the FWOP and the FWP alternative corresponding to the Applicant's Preferred Alternative (FWP/APA) of a 75,000 cubic feet per second (cfs)-capable diversion structure without associated terraces. A slightly larger Project Influence Area (PIA; Figures 3.3-3 and 3.3-4) was defined that approximates the geographical extent that the Basin-wide Model projected water level differences between the FWOP and the FWP/APA.

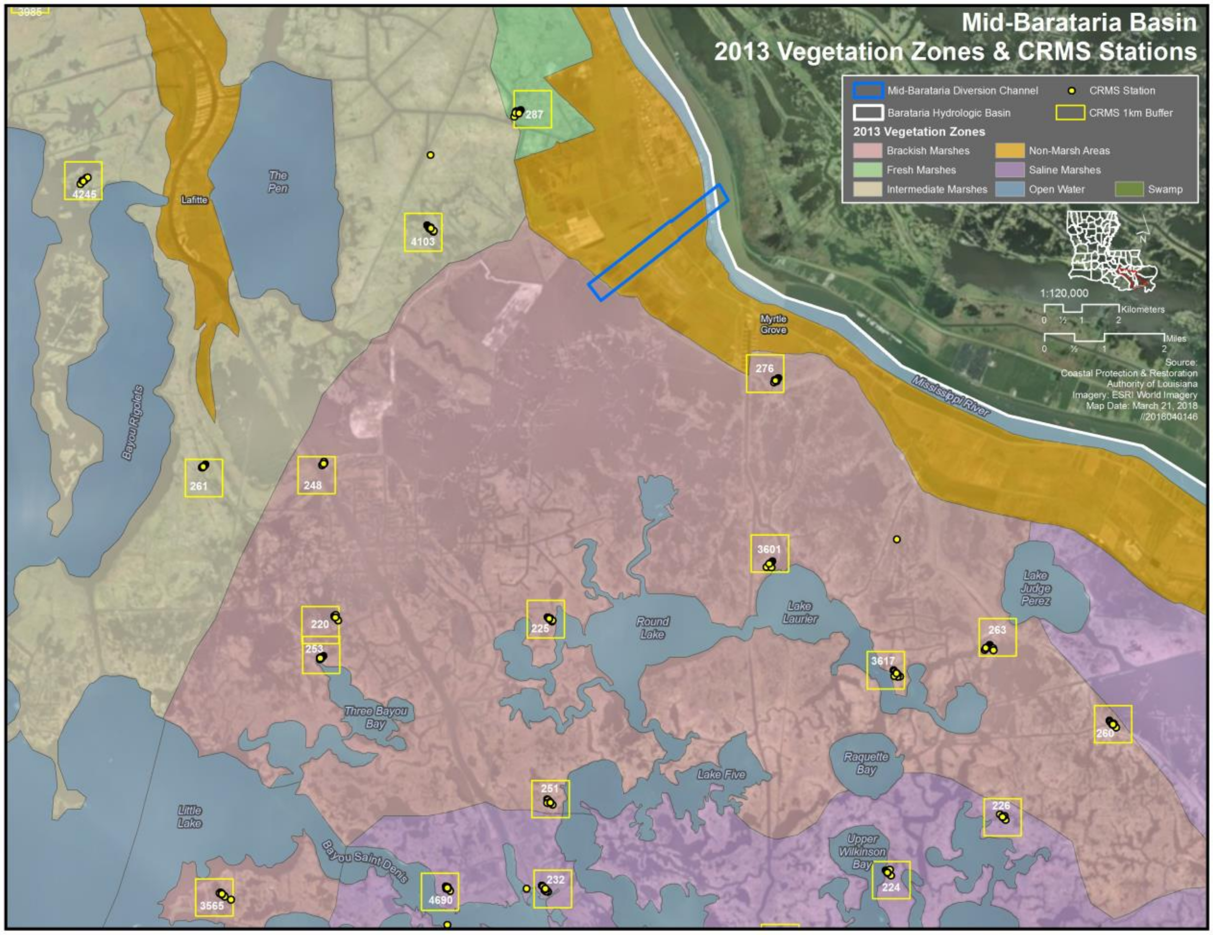


Figure 3.3-1. Example of supporting data to inform stratification and potential selection of additional sites based on vegetation community type from CRMS-*Wetlands* sites and other survey data in the diversion primary influence area. The blue polygon shows the location and orientation of the proposed Project conveyance channel.

While the geographic scope of the monitoring plan is therefore focused on the middle portion of Barataria Basin, it does include the entire basin. Additionally, the PDT is developing riverside monitoring. The Plan was developed with existing monitoring locations and expert knowledge, and is partially informed by statistical analyses completed coast-wide and for Barataria Basin (Hijuelos and Hemmerling 2016).

The monitoring plan includes continuous and discrete sampling of natural system variables, collecting and analyzing remotely-captured data (satellite, aerial), and periodic large-scale surveys. Continuous monitoring refers to the collection of data using automated data recording systems that are permanently deployed with constant and evenly-spaced sampling intervals (e.g., hourly). Discrete monitoring refers to on-the-ground collection usually conducted between longer intervals. Continuous sampling satisfies needs for rich temporal data, while discrete sampling allows for greater spatial information.

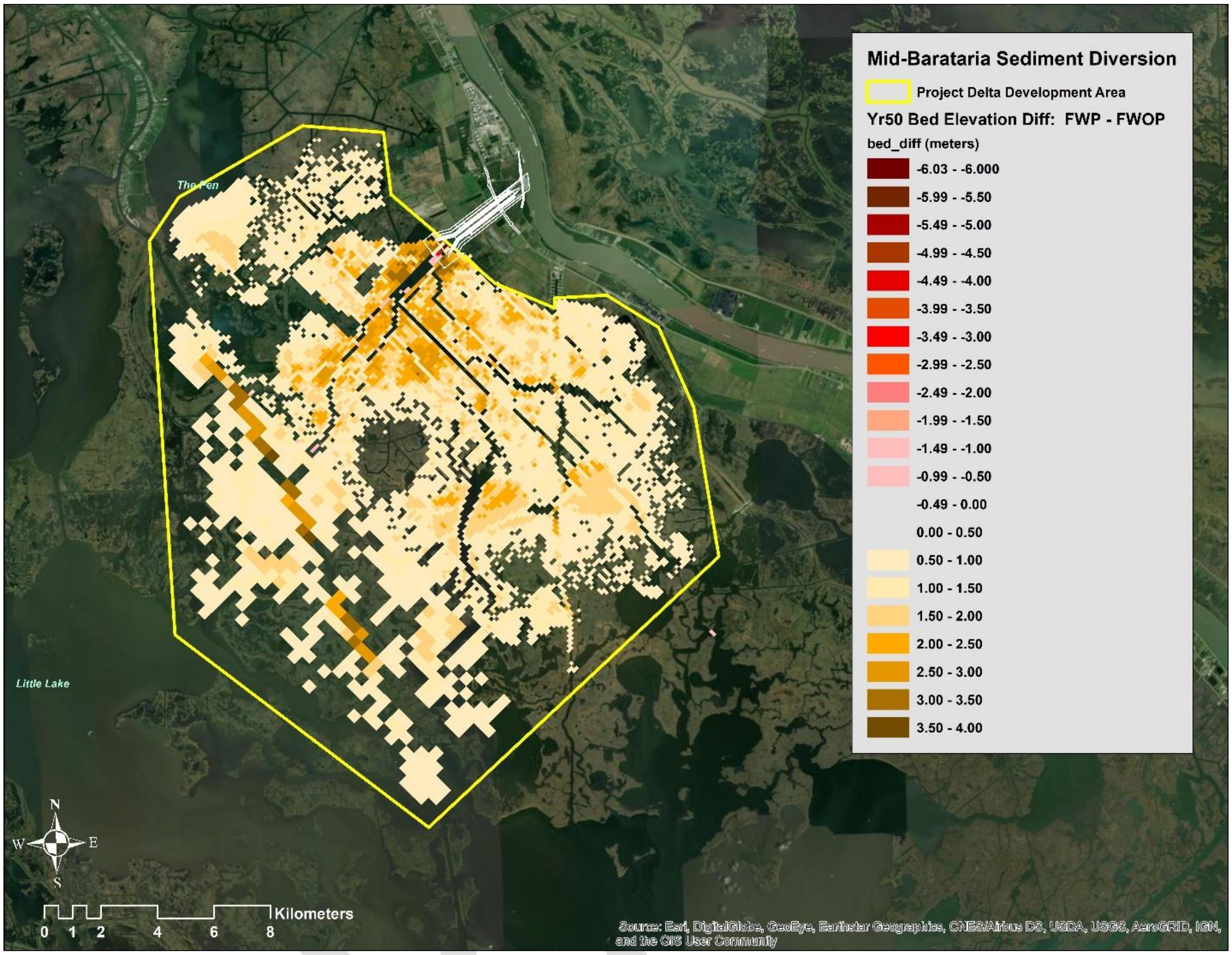


Figure 3.3-2. A Project Delta Development Area (yellow polygon) was defined around the Project outfall as the extent of the area where the Delft Basin-wide Model projected bed elevation differences greater than 0.5 meters between the Future without Project and the Future with Project for the 75,000-cfs Project alternative without terraces after 50-years of Project-effects modeling.

Project alternatives numerical modeling suggested that Project operations may have effects on ecosystem resources in the lower Breton Sound Basin and Mississippi River Balize Delta. Current plans are to rely on the existing SWAMP network sites to continue characterizing the status of those basins.

3.4. Data Sources

The field data to support assessment of baseline and project conditions for the Project have long-standing historic value and are expertise-driven.

3.4.1. CPRA-Coordinated Monitoring Data

CPRA, cooperating State and federal agencies, and TWIG have contributed to the development and ongoing implementation of SWAMP, which is being implemented throughout the Louisiana coastal zone as a long-term monitoring program to ensure a comprehensive network of data collection activities is in place to support the development, implementation, and AM of restoration and risk-reduction projects. While the Barrier Island Comprehensive Monitoring (BICM) and CRMS-*Wetlands* programs have been well established, SWAMP has also deployed monitoring stations in the bays, lakes, and bayous of the Barataria Basin to provide a more extensive spatial and temporal capacity to detect change and system function. The SWAMP monitoring design provides the framework upon which additional Project-specific locations and variables will be needed to evaluate Project effects.

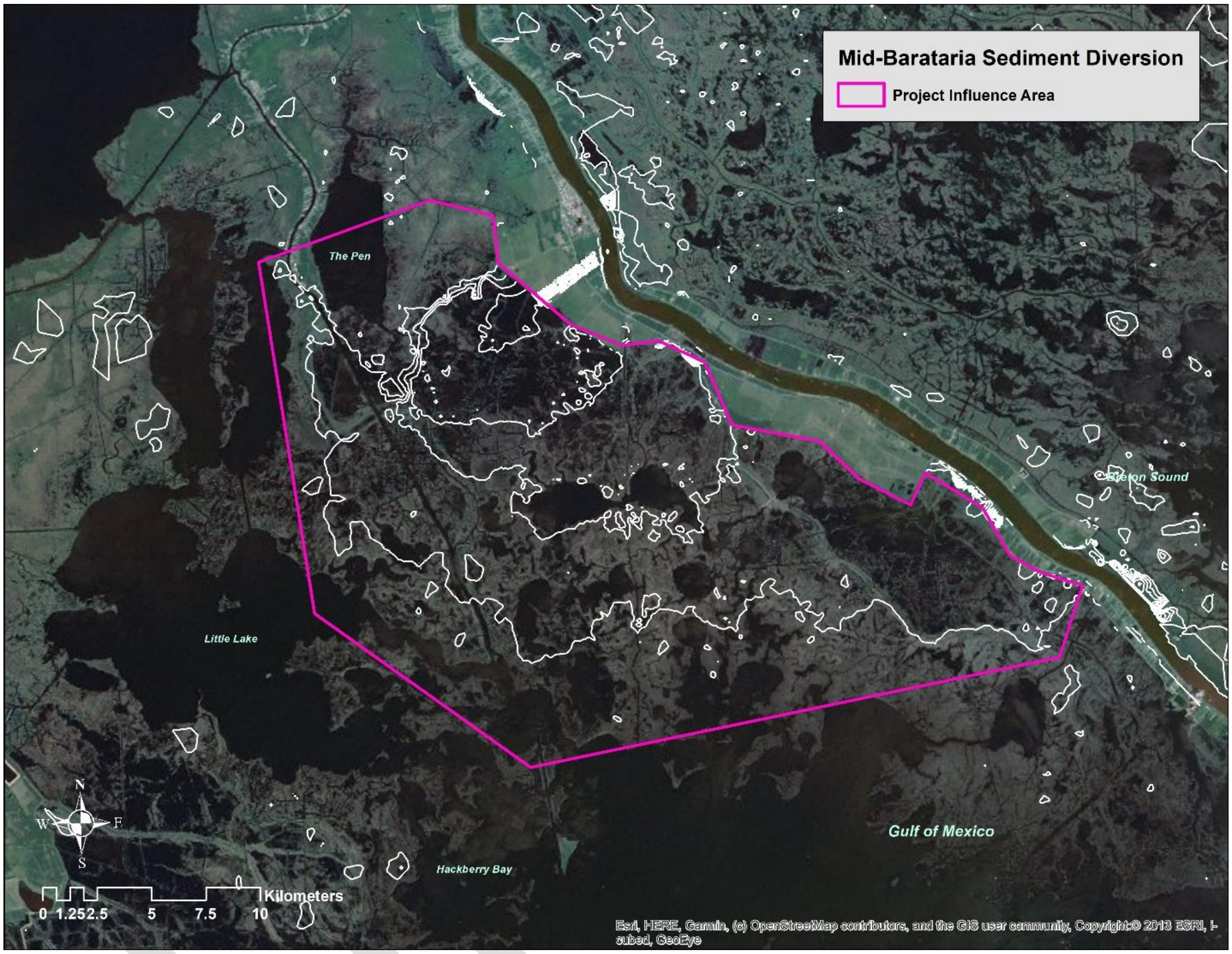


Fig. 3.3-3. A Project Influence Area (magenta polygon) was defined around the Project outfall as the maximum extent of the area where the Delft Basin-wide Model projected water level differences of at least 0.5 meters (white lines) between the Future without Project and the 75,000-cfs Applicant's Preferred Alternative without terraces. The water level differences shown are specifically for the third week of May during the first decade modeled, using a 2011 Mississippi River hydrograph.

3.4.2. Other Monitoring and Survey Data

There are numerous historic and ongoing data collection efforts in Barataria Basin that will provide data for baseline and project assessments of system resources and change (Hijuelos and Hemmerling 2016). CPRA is coordinating with other State and federal agencies to supplement and maintain quality long-term data collection efforts in the basin (e.g., LDWF fish and invertebrate sampling programs; LDEQ water quality sampling; repeated National Oceanographic and Atmospheric Administration (NOAA)/DWH-funded marine mammal surveys). Monitoring of previously-constructed restoration projects in the Project area (Figure 3.4-1) and Barataria Basin will provide valuable data to define historic and current trends, and thus clarify Project effects and potential synergistic or antagonistic responses from those of other restoration and risk reduction efforts in the basin. CPRA will continue to evaluate other sources of research, surveying, and monitoring data that are acceptable for Project use to reduce monitoring costs.

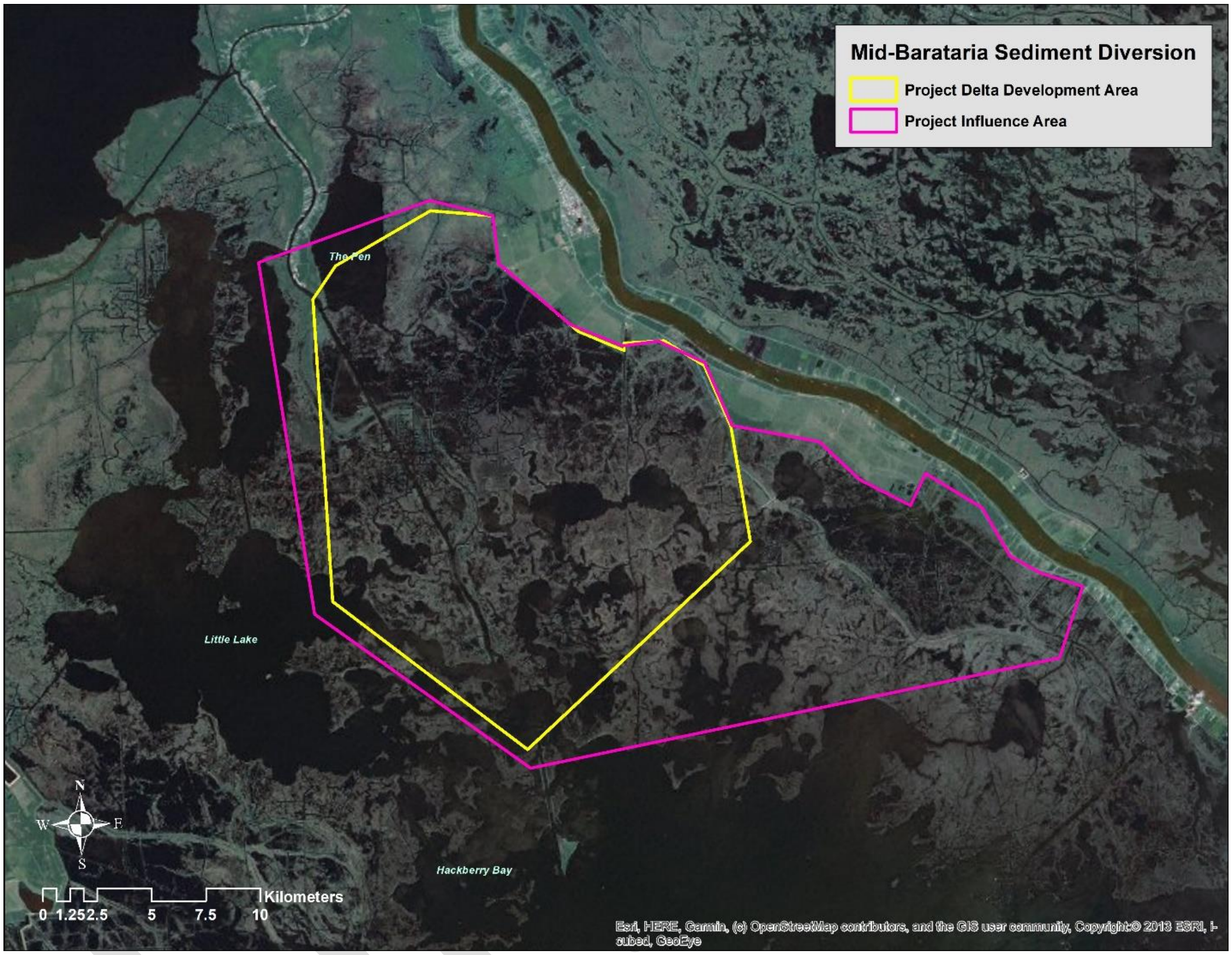


Figure 3.3-4. Comparison of the spatial extent of the Project Delta Development Area (yellow polygon) and the Project Influence Area (magenta polygon).

3.5. Pre-Operations (Baseline) Monitoring

To establish baseline conditions in the main stem of the MR and in the Barataria Basin, data will be collected prior to the onset of Project operations upriver of the diversion structure, from the Alliance South lateral sandbar in front of the eventual diversion structure, from near the planned structure intake, and from environmental gradients radiating from the outfall into Barataria Basin and from existing SWAMP monitoring stations in the Breton Sound Basin and the modern Balize Delta. In addition to the existing SWAMP monitoring locations, monitoring plans will evolve as needed to include additional variables and/or locations where data collection will be required to evaluate system change and Project performance. For example, the types and locations of river monitoring to inform operations will progressively be elaborated upon with progress on the design of the intake and conveyance structure and physical modeling.

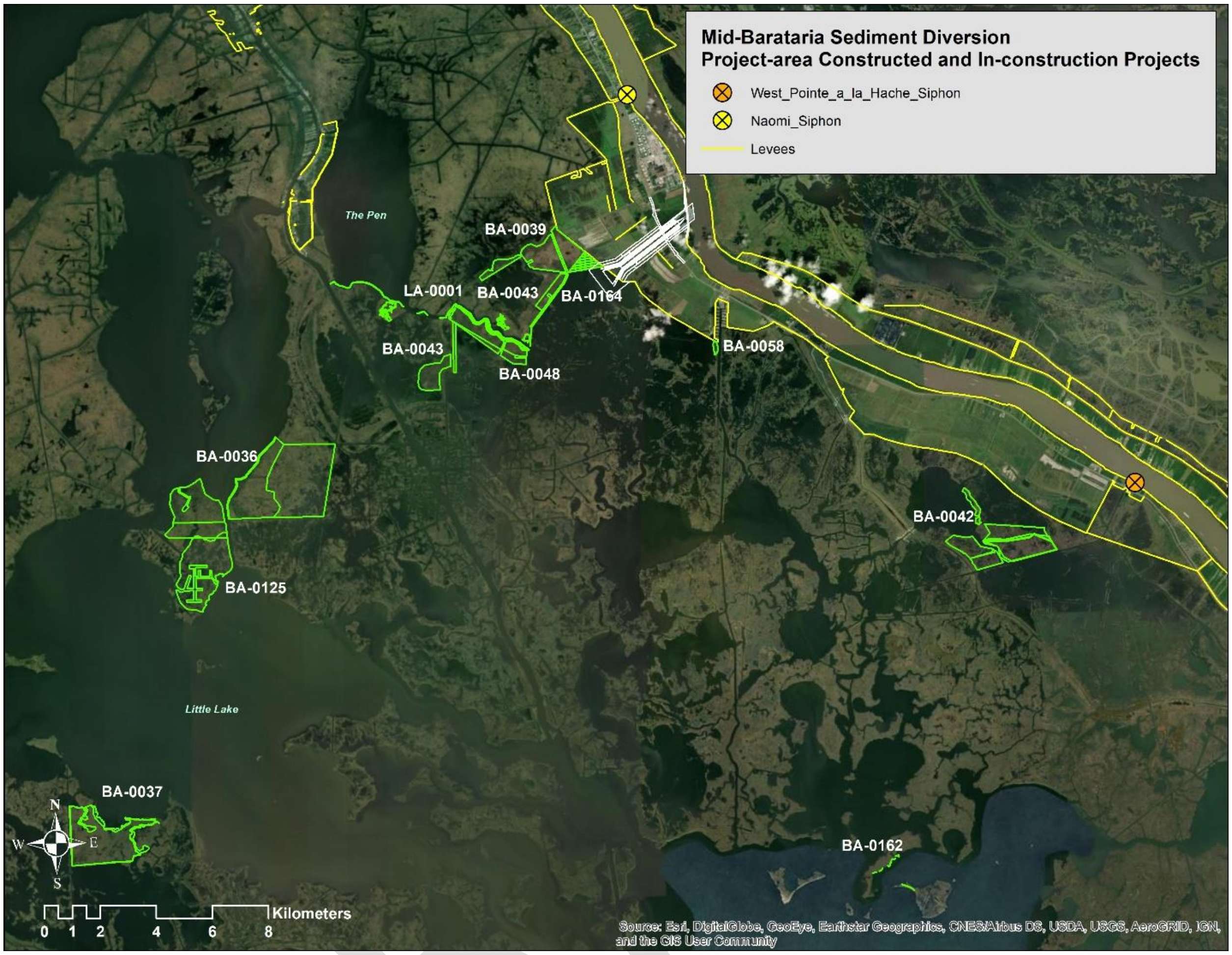


Figure 3.4-1. Previous restoration projects in the Project region are shown with the green polygons, and in relation to the locations of the existing freshwater siphon projects in the area. The white polygon shows the location and orientation of the proposed Project conveyance channel. Yellow polygons indicate levees.

Components of SWAMP monitoring in Barataria Basin are operational and others are in development, consistent with the SWAMP implementation strategy for the basin (Hijuelos and Hemmerling, 2016). Additional Project-specific monitoring sites (such as hydrographic and water quality data collection platforms) will be established to better inform Project effects. Specific locations for some additional monitoring sites have been identified, while decisions on others are still pending. While Project-specific baseline data will be collected for a minimum of three years prior to the onset of Project operations, the Plan will further describe other relevant long-term data that will be used to strengthen baseline trends assessment. For example, wetland condition variables and process rates have been monitored extensively in Barataria Basin at 65 CRMS-*Wetlands* sites for more than 10 years. In addition, there are numerous CPRA-coordinated project data sets and other long-term natural systems data that have been collected by researchers and both State and federal agencies that support comprehensive ecosystem and project-scale assessment (Hijuelos and Hemmerling 2016).

3.6. Post-Construction (Operations) Monitoring

Following the onset of Project operations, data collection will continue as discussed in Section 3.5 above, and from within the diversion conveyance channel. Post-construction, hydrographic stations in the MR will be real-time and accessible from satellite networks to enable forecasting water and sediment arrival. Along the gradient from the MR through the diversion and into the basin, CPRA is planning for the use of real-time data for key hydrographic variables (turbidity, stage, velocity, and water quality). CPRA will also monitor structural and operational features of the Project structure (see the OMRR&R Plan for those details).

3.7. Parameters for Evaluating Project Effectiveness and Ecosystem Response

Effectiveness monitoring provides the basis for determining whether the Project objectives outlined in Section 1.2 will be met. Those restated objectives (below) frame the structure and activities of the detailed pre-operations and post-construction monitoring plans that follow. The empirical parameters and any secondary calculations based on those parameters are outlined below relevant to each of the three Project objectives.

3.7.1. Objective #1: Deliver freshwater, sediment, and nutrients to Barataria Bay through a large-scale sediment diversion from the Mississippi River

Objective 1 reflects the primary operational goal of the Project and rationale behind the construction of a large sediment diversion, which is that operation of a diversion structure is the most efficient, effective and sustainable mechanism for moving large amounts of MR sand-size suspended sediments into the middle region of the Barataria Basin.

Many of the monitoring parameters and resulting calculations listed below will be limited to post-construction monitoring because they will involve monitoring aspects of the constructed Project structure. However, some in-river monitoring components will be developed for pre-operations monitoring to establish baselines of MR resource status and variability and to evaluate potential impacts in the MR and the Basin.

3.7.1.1. Empirical Monitoring Parameters in Support of Objective 1

3.7.1.1.1. Mississippi River water discharge

- Rationale: As proposed in the Project permit request, expectations for an MR discharge of 450,000 cfs on a rising limb at Belle Chasse will trigger Project operations beyond a base flow of up to 5,000 cfs. Sand-size sediment does not typically start mobilizing from lateral bars until the MR flow is at 600,000 cfs (Allison et al., 2012), but the first flush of fine sediments typically occurs at lower discharges. Mississippi River water discharge is thus fundamental to monitor throughout the Project life.

- Schedule: Real-time measurements planned currently for the entirety of both pre-operations and the 50 years of post-construction monitoring.

- Locations: Multiple upstream gauging stations will be monitored for different purposes. The U.S. Geological Survey's (USGS) Mississippi River at Memphis, Tennessee, gauge (#07032000) will be used to initiate planning for Project operations, given that typical water velocities in the MR mean that discharge at Memphis is a three-week lead-in to flows reaching the Project location. This data will be evaluated in concert with MR discharge forecasts provided daily by the National Weather Service's Lower Mississippi River Forecasting Center (LMRFC). Current plans are for observations at the USGS Mississippi River at Belle Chasse, LA gauge (#07374525), which is not included in LMRFC discharge forecasts to govern Project operations. Several years of anticipated pre-operations monitoring will allow for the confirmation of the mathematical relationship between Belle Chasse and the other gauges mentioned.

  The USGS Mississippi River at Baton Rouge, LA (#07374000) and the aforementioned Mississippi River at Belle Chasse, LA gauges will also be monitored to support continued estimations of coarse and fine suspended sediment load, as was done for the Delft Basin-wide Project modeling. This data will help verify past model estimates and support future modeling.

  The PDT has proposed that anticipated MR discharges at Belle Chasse of 450,000 cfs should initiate empirical, boat-based data collection of MR discharge at a cross-river transect (Table 3.7-1 and Figure 3.7-1) used during pre-operations to support E&D activities. The "2018 Reference Section" transect was used during the 2018 MR data collection.

Table 3.7-1. Endpoint coordinates of Mississippi River Project cross sections used for preliminary E&D. All coordinates are in UTM 15N meters NAD83. Transect locations are shown in Figure 3.7-1.

Location	Right Water Edge/ Right Descending Bank (Northing, Easting)	Left Water Edge/ Left Descending Bank (Northing, Easting)
Primary Reference Section	3286460.680, 793822.861	3286655.441, 794486.710
2018 Reference Section	3285238.719, 793987.484	3285299.128, 794737.097

- Methodology:
  - Continuous estimated MR discharge is provided in real time by USGS at the Baton Rouge and Belle Chasse gauge locations referenced above.
  - Direct empirical estimations of velocity will be made during operational events using Acoustic Doppler Current Profilers (ADCPs; see Oberg et al. 2005 for discussion of the methodology). Measured concurrently with bathymetric measurements of the cross-sectional area of flow, these data allow an estimation of MR discharge via Equation 1.

Discharge (cfs) = Cross-sectional area of flow (square feet) x velocity (f/s) ***Eqn. 1***

- Parties Responsible for Data Collection
  - Continuous discharge estimations at Mississippi River Memphis, Baton Rouge and Belle Chasse gauges: USGS
  - Boat-based direct empirical discharge estimations: CPRA contractor.

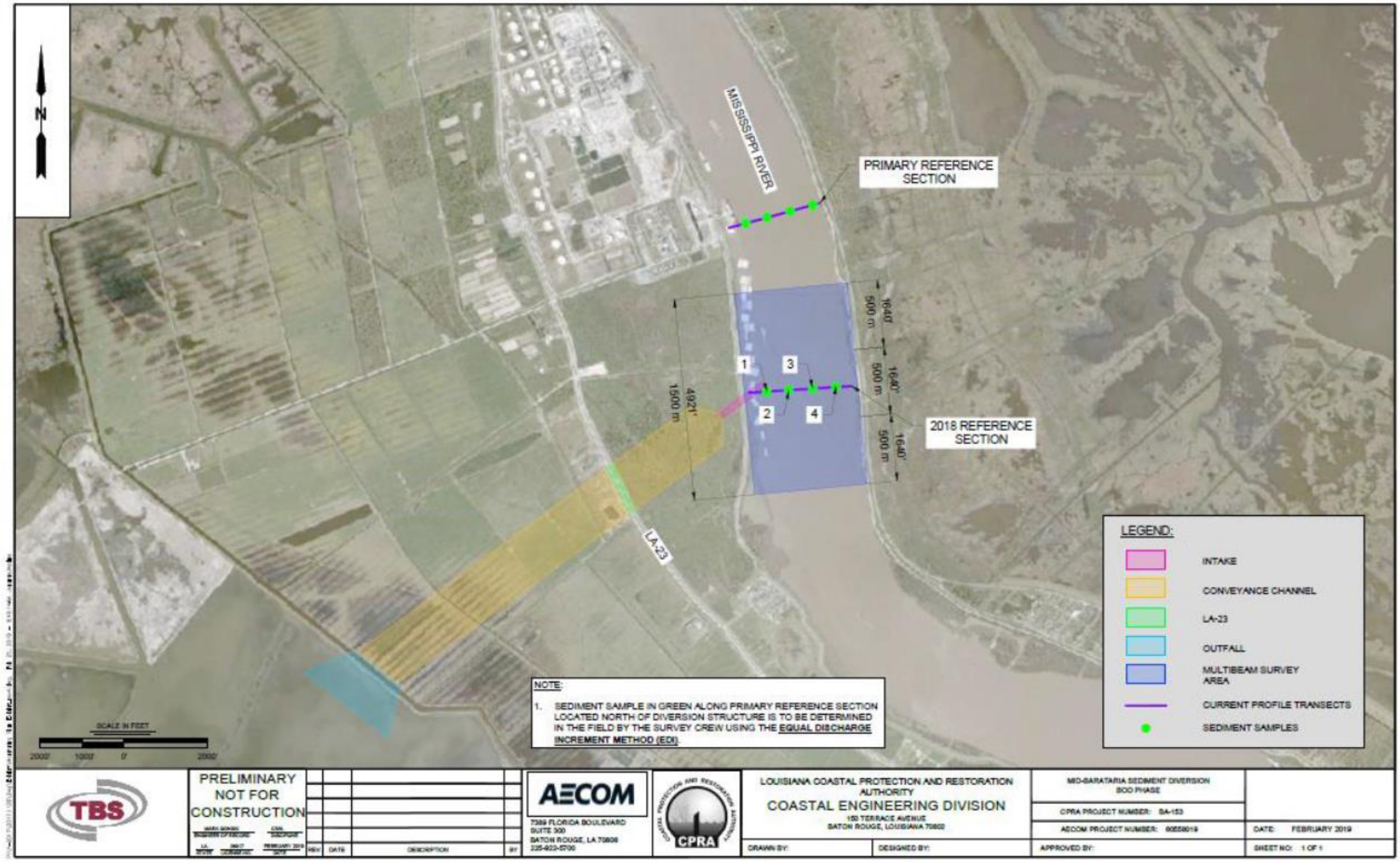


Figure 3.7-1. Location of the Mississippi River near the Mid-Barataria Sediment Diversion, showing transects and sampling points currently being studied for E&D purposes. The sampling points (green squares) on the two transects (purple lines) are shown in relation to the Project construction footprint, just south of the Alliance refinery.

3.7.1.1.2. Mississippi River suspended sediment concentrations

- Rationale: River suspended sediment measurements will provide estimations of the inorganic sediment load characteristic of the MR and the sediment load anticipated for the Project, analyzed on an event-by-event basis. Sediment characteristics in each flood event are dependent on weather and associated erosion within the entire MR watershed. As such, while each independent flood event may be similar to historical flood events, each event will be unique in the flow rates, wash load, duration, and ability to initiate bed load transport and suspension of sand within the diversion.

- Schedule: Real-time measurements are currently planned for the entirety of both pre-operations and the 50 years of post-construction monitoring at the USGS Baton Rouge and Belle Chasse gauges discussed for monitoring of *Mississippi River water discharge* (3.7.1.1.1). The PDT has not yet determined the frequency of additional boat-based data collection at the Belle Chasse gauge and at or nearer the Project structure.

- Locations: Suspended sediments will continue to be monitored at the USGS Baton Rouge and Belle Chasse stations to identify the sediment availability for the proposed diversions dependent on the characteristics of each individual flood event.

  The E&D activities are designed to investigate suspended sediment load at transects and sample points described in Table 3.7-1 and Figure 3.7-1 and those to be defined for the Project operational phase. Sediment concentration samples will be collected at four locations (vertical stations; Table 3.7-2) along each cross-section and at five depths at each of the vertical stations.

Table 3.7-2. Coordinates of sampling points on 2018 Mississippi River cross-section. Points correspond to those shown in Figure 3.7-1.

Point	Northing	Easting
1	3285250	794121
2	3285260	794280
3	3285280	794453
4	3285300	794622

- Methodology:

  USGS currently monitors turbidity at the Baton Rouge and Belle Chasse gauges via continuously-recording turbidity probes. However, USGS does not regularly collect physical samples of suspended sediments for laboratory analysis of grain size, nor to support estimates of sediment load at Belle Chasse. Data and samples collected from October 2012 through May 2016 do show a strong direct relationship between turbidity and both total suspended sediment concentration (USGS P80154; $R^2 = 0.8262$; n = 55) and estimated total suspended sediment discharge (USGS P80155; $R^2 = 0.5699$; n = 55) at the site.

  There were direct relationships between turbidity and the percent of suspended sediments smaller than 0.0625 mm ($R^2 = 0.4961$) and smaller than 0.125 mm ($R^2 = 0.5278$) for December 2015 - June 2016 samples collected at Belle Chasse, but the number of observations were small (n = 7 and 6, respectively), and the data reflect only a single MR flood season.

Observed gauge height did provide some predictability with suspended sediment mass for data and samples collected at Belle Chasse from December 2018 through January 2020. The direct relationship between gauge height and mass of suspended sediments larger than 0.063 mm (i.e., sand; USGS P91159) was strong (R^2 = 0.5636; n = 16), while the relationship between observed gauge height and the mass of suspended sediments smaller than 0.063 mm (i.e., silts and clays; USGS P91158) was weaker (R^2 = 0.2363; n = 16).

The USGS Mississippi River at Belle Chasse, LA gauge is roughly 13 miles north of the Project site. If used for the continuous monitoring of turbidity, discrete sampling of suspended sediments would be required at that site to establish the regression model needed to use turbidity as a surrogate for suspended sediments. Prior to selecting this site as the permanent continuous monitoring location for turbidity, suspended sediments sampling at the Project site may also be required to determine if there is a significant difference in turbidity between the two locations.

Sediment concentration samples at the reference and Project cross-sections will be taken using a P-6_200 isokinetic sampler. TSS and concentrations of sand (> 63 micron) and silt/clay (≤63 micron) will be determined using methods similar to the 2008-2011 (Allison, 2011) and 2018 (Allison et al., 2018) studies.

Replicate sediment concentration measurements will be made at the two most westward vertical stations at 70 and 90% water depth, to provide sufficient sand sample volume for sieve analysis. Conductivity/temperature/depth (CTD) casts will be made at the same time as the sediment concentration measurements at each vertical station to help calibrate measurements.

ADCP data will be collected during every isokinetic suspended sediment collection activity and the start and ending ensemble should be separately noted for the duration of each point collection (i.e., the interval between each bottle opening and closing). This data will be used to correlate the backscatter data to the sediment concertation data from the isokinetic sampling.

Sediment concentration samples will be collected at four locations (vertical stations) along each cross-section and at five depths at each of the vertical stations. The depths are 10, 30, 50, 70 and 90 percent of the local water depth. At each cross section, the Equal Discharge Increment method should be used in the field to determine the four vertical stations. The four vertical stations that were sampled at the 2018 cross section are located at coordinates in Table 3.7-2.

- Parties Responsible for Data Collection
    - Continuous turbidity and discrete suspended sediment load estimations at Mississippi River Baton Rouge and Belle Chasse gauges: USGS
    - Boat-based direct empirical suspended sediment load estimations: CPRA contractor.

3.7.1.1.3. Mississippi River nutrient concentrations

- Rationale: Nutrients in Mississippi River water, primarily nitrogen (N), phosphorus (P) and sulfur (S), are necessary for phytoplankton and emergent vegetation growth in estuarine ecosystems. While those resources in Barataria may benefit from diverted MR water, there are concerns that nutrient delivery in excess of the needs of primary producers could lead to phytoplankton blooms in the open estuary, growth alterations to emergent vegetation, and increases in the rate of bacterially-mediated soil organic carbon decomposition. Measuring nutrient concentrations entering into the diversion discharge will support the calculation of *Nutrient loads conveyed into Barataria Basin* (3.7.1.2.4).

- Schedule: Planned to occur biweekly during operational events (beyond base flow), and quarterly during base flow operations, during the 50 years of post-construction monitoring.

- Locations: Currently the USGS estimates MR (nitrate + nitrite)-N concentrations at the Mississippi River at Baton Rouge, LA gauge (#07374000) using a continuously-reading sensor. USGS periodically collects and analyses grab samples of river water at Baton Rouge for several chemical species of N, P and S.

- Methodology:

  USGS measures (nitrate + nitrite)-nitrogen at the Baton Rouge gauge using a continuously-reading sensor. USGS periodically collects and analyses grab samples of river water at both Baton Rouge and Belle Chasse for nitrate+nitrite (USGS P00631), (ammonia + ammonium)-N (USGS P00608, total Kjeldahl N (ammonia + organic N; USGS P00623), and total N (USGS P00602).

  Dissolved orthophosphate (PO_4^{3-}-P) is typically determined through wet chemistry of grab samples (USGS P00671), as is total P (USGS P00666). However, newer sensors that can detect orthophosphate may be installed at Baton Rouge and/or Belle Chasse. However, because orthophosphate adsorbs to clay particles in riverine water, it is necessary to use an acid digestion to free orthophosphate from suspended sediments to better characterize concentrations in the river. As well, total P in a sample of river water can be determined through similar laboratory analyses.

  Dissolved sulfate is likewise analyzed by USGS at the Baton Rouge gauge using the same grab samples and respective analytical chemical methods (USGS P00945).

- Parties Responsible for Data Collection

  Continuous sensor-based and discrete nutrient concentration sampling and analysis at the Mississippi River Baton Rouge and Belle Chasse gauges: USGS

3.7.1.1.4. Bathymetry of the Alliance South sand bar

- Rationale: Multi-beam bathymetric measurements will support estimations of sediment consumption and replenishment, and thus the productivity and sustainability of the Alliance South lateral sandbar as a sediment source for the project through calculations of the change in volume of the Alliance South sand bar. The multi-beam bathymetry will also record the morphology of the lateral bar and provide a calibration data source for the Deltf3D Outfall Management Model.

- Schedule: Planned annually during the pre-operations period and both before and after each Project operational event for the first five years of post-construction monitoring. The Project Operations Team will evaluate then what frequency of operations will be maintained.

- Locations: The Alliance South sandbar (Figure 3.7-2; will be monitored routinely with high-resolution velocity and bathymetric surveys along transects that were established for design data collection and earlier studies. Transects were arranged to capture upstream and downstream bar morphology changes. The monitoring of the bar dynamics during and after annual operations will be essential to understanding stability of the sand-size sediment supply through both diversion and replenishment of the lateral bar.

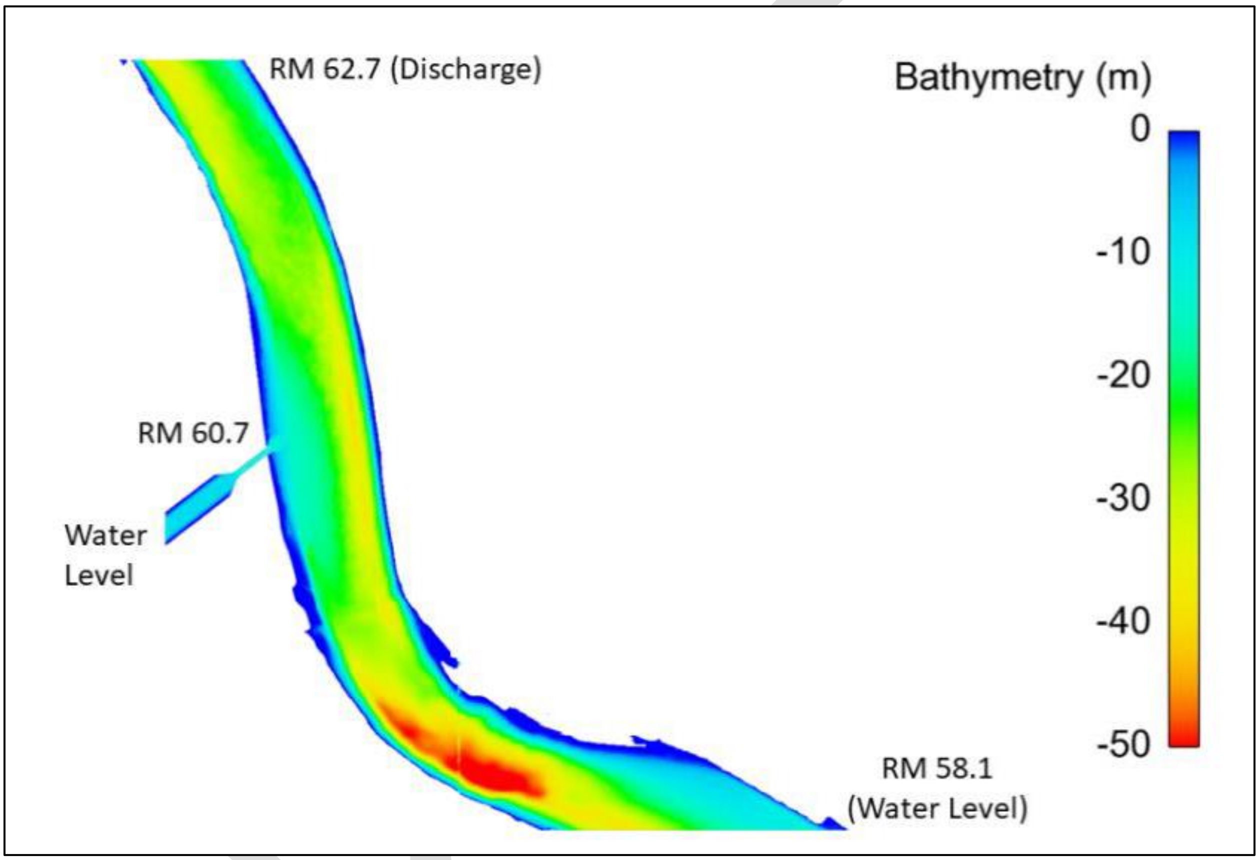


Figure 3.7-2. The lateral bar near the River Mile 60.7 diversion intake (area of shallow bathymetry in front of the diversion structure) will be monitored routinely with high-resolution velocity and bathymetric surveys along transects that have been established for design data collection and earlier studies. Figure from (Moffat & Nichol, 2012)

- Methodology: During Project E&D, the multi-beam surveys will be conducted during two discharge events and both before and after the flood season. The surveys during the flood event should be coordinated with the cross-section sampling, which will occur when the discharge at Belle Chasse is at least above 600,000 cfs. The PDT prefers that the other event survey occurs near 1,000,000 cfs or at the flood event peak, and then on the falling limb at 850,000 cfs or 600,000 cfs, depending on the flood event and the data needs for calibration/validation of the Delft Outfall Management Model.

The flood season survey should be made before the rising limb of the first event reaches 450,000 cfs at Belle Chasse and one during a falling limb of the river discharge at the end of the flood season, also below 450,000 cfs. These surveys should be carefully coordinated between CPRA, USGS and the sediment and water quality testing laboratories and monitoring teams.

The pre- and post-season surveys should cover the entire lateral bar, while the during-event surveys would be concentrated within 750 meters upstream and 750 meters downstream of the diversion sampling location. The event surveys will include the entire width of the river and be centered on the monitoring cross-section station. These during event surveys are required for tracking bed form movement and associated bedload transport. The bedload surveys shall be taken in 500-meter sections within the river to ensure an area is collected within an approximated 2-hour period. A 25-meter overlap between each 500-meter section is planned to provide adequate linkage of the survey transects. At each sampling station survey, there should be two surveys – one taken at the time of initial sediment sampling and the second survey should be taken within approximately 24 hours.

The rate and magnitude of change in the volume of the Alliance South sand bar will be calculated as

$$\textit{Rate of change} = \frac{(\textit{Volume of the Alliance South sand bar at time } x+1) - (\textit{Volume of the Alliance South sand bar at time } x)}{\textit{Time between measurements.}} \qquad \textbf{\textit{Eqn. 2}}$$

$$\textit{Magnitude of change} = (\textit{Volume of the Alliance South sand bar at time } x+1) - (\textit{Volume of the Alliance South sand bar at time } x) \qquad \textbf{\textit{Eqn. 3}}$$

- Parties Responsible for Data Collection
  - Repeated channel conditions surveys: USACE
  - Pre- and post-season surveys for at least the first five years of operations: CPRA contractor

3.7.1.1.5. Sedimentology of the Alliance South sand bar

- Rationale: Sediment sampling of the Alliance sand bar will support estimations of the sustainability of the sand bar as a coarse-grained sediment source for the project.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Sedimentology samples will be collected coincident with the *Bathymetry of the Alliance South sand bar* (3.7.1.1.4).

- Methodology: Bed samples will be taken at each vertical station using a BM-54 sampler (https://water.usgs.gov/fisp/products/4103004.html). These should be taken at the same time as the sediment concentration samples and CTD casts. The BM54 sampler will typically take a sample 3 inches deep into the sediment. Samples will be transported to the testing laboratory where the grain size of the sediment and sand- and silt-size sediment volumes will be determined. The PDT has coordinated with Mead Allison, who will be conducting a similar data collection for the Mid-Breton Project, to assure that they will take a similar depth sample with the Shipek sampler (*sensu* Ramirez and Allison 2013) and thus provide consistency in measurements.

- Parties Responsible for Data Collection
    - Pre- and post-operations sampling and sediment content analysis: CPRA contractor

3.7.1.1.6. River bathymetry at and around the Project structure inlet

- Rationale: Repeated bathymetric surveys of the MR and the Project structure inlet are necessary to support calculations of the rate and magnitude of change in river bathymetry at the Project structure inlet to determine if bed scour/erosion or shoaling are occurring. Both siltation and scour would limit Project operations, and would form the basis for AM actions. Erosion has been seen at the mouth of the West Bay Sediment Diversion where it penetrates the right descending bank of the river downstream of Venice, Louisiana (Brown et al., 2009), and in the batture in front of Mardi Gras Pass on the left descending bank downstream of the terminus of the MR&T levee (Lopez et al., 2014).

  Calculation of the rate and extent of change in the elevation of the MR bottom at the Project inlet structure inlet will indicate if siltation or scour is occurring.

- Schedule: Planned annually during the pre-operations period and both before and after each Project operational event for the first five years of post-construction monitoring. The Project Operations Team will evaluate then what frequency to maintain operations going forward in time. These surveys will be coordinated with the sampling multi-beam surveys and the pre- and post-flood event surveys to include the intake structure and MR bottom contiguous to the structure.

- Locations: Specifics will be coordinated with the event surveys – standard and reference cross sections.

- Methodology: Boat-based multi-beam bathymetry on 50-foot centers at the structure inlet and for 1,500 feet both upstream and downstream of the structure. Exact methodologies are expected to be similar to those used by the USACE New Orleans District when they conducted a multi-beam bathymetric survey from Mississippi River Mile (RM) 0 – 324 during July 2011 – June 2013. Data are available at https://www.mvn.usace.army.mil/Missions/Engineering/Channel-Improvement-and-Stabilization-Program/2013MBMR/.

  The rate and magnitude of change in river bathymetry will be calculated as

$$\begin{aligned} \mathit{Change\ rate} = (&(\mathit{River\ bathymetry\ at\ the\ Project\ structure\ inlet\ at\ time\ } x+1) \\ &- (\mathit{River\ bathymetry\ at\ the\ Project\ structure\ inlet\ at\ time\ } x)) \\ &/(\mathit{Time\ between\ measurements}) \end{aligned}$$

Eqn. 4

$$\begin{aligned} &\mathit{Change\ magnitude} \\ &\quad = (\mathit{River\ bathymetry\ at\ the\ Project\ structure\ inlet\ at\ time\ } x+1) \\ &\quad - (\mathit{River\ bathymetry\ at\ the\ Project\ structure\ inlet\ at\ time\ } x) \end{aligned}$$

Eqn. 5

- Parties Responsible for Data Collection: CPRA contractor

3.7.1.1.7. Topography/bathymetry of the Project Influence Area

- Rationale: Repeated topographical/bathymetrical monitoring of the Project Influence Area will support calculations of the rate and magnitude of change in topography/bathymetry of the Project outfall area and ensure the viability of the Project to convey river water, sediment and nutrients into Barataria Basin. Calculation of the rate and magnitude of change in landscape elevations (topography and bathymetry) of the PIA will indicate if siltation or scour is occurring.

- Schedule: Planned for both pre-operations and post-construction monitoring. Topography and bathymetry will be assayed once prior to the onset of Project operations, and then at years 5, 10, 20, 30, 40 and 50 after the onset of Project operations. Light Detection and Ranging (LiDAR) surveys will be scheduled preferentially in winter to survey as much as possible a "leaf off" environment, but that may not always be possible.

- Locations: The Basin-wide Model projected the extent of the PIA as shown in Figure 3.3-3. The actual extent of detailed receiving basin topographical and bathymetric monitoring may be modified as required based on the first five years of surveys.

  Elevation surveys may also need to be conducted up to two times at up to two additional wetland areas. A conventionally restored wetland and an unrestored wetland, as described in Section 4.1.3, may be used to assess the relative performance of different marsh restoration treatments.

- Methodology: Subaerial elevation surveys will require LiDAR and processing to reduce error associated with plant canopy. The bathymetric surveys may include traditional point survey and other instruments (fathometer, multi-beam) depending on the water depth and vertical/horizontal resolution required. CPRA expects that data collection will be similar to that used by USGS during collection of northern Gulf of Mexico combined bathymetric and topographic data within its Coastal National Elevation Database (CoNED), accessible at https://www.usgs.gov/land-resources/eros/coned

  The rate and magnitude of change in topography/bathymetry of the Project delta development area will be calculated as

  Rate of change = ((Topography/bathymetry of the Project delta development area at time x+1) – (Topography/bathymetry of the Project delta development area at time x)) / (Time between measurements)

  Eqn. 6

  Magnitude of change = ((Topography/bathymetry of the Project delta development area at time x+1) – (Topography/bathymetry of the Project delta development area at time x)

  Eqn. 7

- Parties Responsible for Data Collection: CPRA contractor

3.7.1.1.8. Bathymetries of canals in the Project Influence Area

- Rationale: Repeated bathymetrical monitoring will support calculations of the rate and magnitude of siltation or scour of the canals in the PIA and ensure the viability of commerce in the region. CPRA has pledged in the draft Project Mitigation Report to maintain navigational access of fastland communities to the basin, while those communities are viable, by promising to adjust Project operations, conduct maintenance dredging on, or implement outfall management measures that limit sediment aggradation in the Barataria Waterway and Wilkinson Canal when it can be demonstrated that siltation in those waterways is due to Project operations.

- Schedule: Planned for both pre-operations and post-construction monitoring. Bathymetries will be assayed twice prior to the onset of Project operations, and then after the completion of each Project operational event beyond base flow, or annually if no operational events occur, to determine any effects of Project base flows on canal bathymetries.

- Locations: For the Barataria Bay Waterway, surveying from the Pen to the open water mouth at Mud Lake. For Wilkinson Canal, surveying from the Myrtle Grove Marina to the open water mouth at Barataria Bay. Note the spatial extents of the canal surveys may be expanded or contracted depending on the results of repeated surveys and the determination of Project effects.

- Methodology: Methodology for the bathymetric surveys may include traditional point survey and other instruments (fathometer, multi-beam sonar) depending on the water depth and vertical/horizontal resolution required. Surveying of the Barataria Bay Waterway will be conducted in coordination with USACE.

  The rate and magnitude of change in bathymetry of the PIA will be calculated as

  Rate of change = ((Bathymetry of the Project Influence Area at time x+1) –
  (Bathymetry of the Project Influence Area at time at time x)) /
  (Time between measurements) **Eqn. 8**

  Magnitude of change = (Bathymetry of the Project Influence Area at time at time x+1) –
  (Bathymetry of the Project Influence Area at time x) **Eqn. 9**

- Parties Responsible for Data Collection
  - CPRA contractor
  - USACE

3.7.1.1.9. Water volume conveyed into Barataria Basin

- Rationale: Measuring the discharge of water through the diversion structure will provide direct estimates of riverine freshwater transfer into Barataria Basin and support estimations of *Sediment:water in the flows conveyed into Barataria Basin* (3.7.1.2.2), *Sediment volume conveyed into Barataria Basin* (3.7.1.2.3), and *Nutrient loads conveyed into Barataria Basin* (3.7.1.2.4). As per the Project permit request submitted to USACE, Project discharge will be capped at 75,000 cfs at *Mississippi River water discharges* (3.7.1.1.1) greater than or equal to

1,000,000 cfs.

- Schedule: Planned only for post-construction monitoring during the entire flood season each year for the life of the Project.

- Locations: Specifics locations within the conveyance channel will be identified by CPRA.

- Methodology: At the entrance of the intake and the bar area, it is anticipated that an array of velocity and turbidity instrumentation will be deployed. It is uncertain if sediment, water, and nutrient capture is best monitored in the conveyance channel. The most advantageous locations are under consideration by the PDT.

- Parties Responsible for Data Collection: CPRA contractor

3.7.1.1.10. Sediment concentrations in the flows conveyed into Barataria Basin

- Rationale: Measuring inorganic sediment concentrations in the diversion discharge will support the calculation of *Sediment:water in the flows conveyed into Barataria Basin* (3.7.1.2.2) and *Sediment volume conveyed into Barataria Basin* (3.7.1.2.3).

- Schedule: Planned only for post-construction monitoring during the entire flood season each year for the life of the Project.

- Locations: Sample locations will be the same as those developed for *Water volume conveyed into Barataria Basin* (3.7.1.1.9).

- Methodology: See discussion under *Water volume conveyed into Barataria Basin* (3.7.1.1.9). Analyses of sediment samples taken from the conveyance channel, including calculations of Sediment:water *in the flows conveyed into Barataria Basin* (3.7.1.2.2) and *Sediment volume conveyed into Barataria Basin* (3.7.1.2.3), will include measurement by primary grain size (sand/silt/clay).

- Parties Responsible for Data Collection: CPRA contractor

3.7.1.2. Multi-Parameter Calculations in Support of Objective 1

3.7.1.2.1. Mississippi River sediment load

- Rationale: The intent of the Project is to capture a substantial portion of the Mississippi River's sediment load for transport through the Project structure and into the receiving basin.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Sample locations will be the same as those developed for *Mississippi River water discharge (3.7.1.1.1)* and *Mississippi River suspended sediment concentrations (3.7.1.1.2)*.

- Methodology:

Mississippi River sediment load = Mississippi River water discharge (3.7.1.1.1) x Mississippi River suspended sediment concentrations (3.7.1.1.2)

Eqn. 10

3.7.1.2.2. Sediment:water in the flows conveyed into Barataria Basin

- Rationale: Based on extensive empirical data collection and numerical modeling, the Project is being designed to optimize the delivery of sediment into the Barataria Basin. Calculation of cumulative inorganic sediment:water is the fundamental metric of the efficiency of diversion sediment transport. Estimating the actual Project sediment:water through the calculations below is needed to confirm those design assumptions, or it could suggest opportunities for additional operational modifications to achieve subsequent improvements in sediment:water. These estimations will also be needed for subsequent numerical model refinement.

- Schedule: Planned only for post-construction monitoring.

- Locations: Depends on the specific monitoring locations developed for *Water volume conveyed into Barataria Basin* (3.7.1.1.9) and *Sediment concentrations in the flows conveyed into Barataria Basin* (3.7.1.1.10)

- Methodology:

$$SWR = \frac{\left(\frac{Sediment\ Concentrations\ in\ the\ flows\ conveyed\ into\ Barataria\ Basin\ 3.7.1.1.10}{Mississippi\ River\ suspended\ sediment\ concentrations\ (3.7.1.1.2)}\right)}{\left(\frac{Water\ volume\ conveyed\ into\ Barataria\ Basin\ (3.7.1.1.9)}{Mississippi\ River\ water\ discharge\ (3.7.1.1.1)}\right)}$$

Eqn. 11

3.7.1.2.3. Sediment volume conveyed into Barataria Basin

- Rationale: This calculation will establish estimates of the amount of inorganic sediment transported by the structure.

- Schedule: Planned only for post-construction monitoring.

- Locations: Same sampling stations identified for *Water volume conveyed into Barataria Basin* (3.7.1.1.9), and *Sediment concentrations in the flows conveyed into Barataria Basin* (3.7.1.1.10)

- Methodology:

*Sediment volume = Water volume conveyed into Barataria Basin (3.7.1.1.9) * Sediment concentrations in the flows conveyed into Barataria Basin (3.7.1.1.10)*

Eqn. 12

3.7.1.2.4. Nutrient loads conveyed into Barataria Basin

- Rationale: Nitrogen and phosphorus are the primary inorganic nutrients that support primary production in the estuarine emergent wetlands and open water bodies. Concerns exist that excess nutrient delivery to Barataria Basin could lead to phytoplankton blooms (see Section 3.7.3.9), harmful algal blooms (3.7.3.10) and/or the development of low dissolved oxygen (see Section 3.7.3.7). This calculation will establish estimates of the amount of nutrients transported by the structure.

- Schedule: Planned only for post-construction monitoring.

- Locations: Same sampling stations identified for *Mississippi River nutrient concentrations (3.7.1.1.3)* and *Water volume conveyed into Barataria Basin* (3.7.1.1.9)

- Methodology:

*N/P/S load = Water volume conveyed into Barataria Basin (3.7.1.1.9) * Mississippi River nutrient concentrations (3.7.1.1.3)* **Eqn. 13**

3.7.2. Objective #2: Reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin

3.7.2.1. Empirical Monitoring Parameters in Support of Objective 2

3.7.2.1.1. Water velocities at multiple locations in the Barataria Basin

- Rationale: The fundamental objective of hydrography is to document changes to the horizontal and vertical movement of water within the Project area. This has bearing on changes to the physical environment as well as to the deposition of sediments and the zonation and persistence of wetland vegetation.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Two velocity meters are currently being installed in Barataria Basin (Figure 3.7-3), with another four proposed. Project-specific velocity meter locations are still being determined.

- Methodology: Use of real-time or continuous ADCPs to determine velocity of water movement, may be depth-averaged or point values

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.2. Frequency, depth and duration of inundation at multiple locations on the marsh in the Project Influence Area

- Rationale: Measure the variability and patterns of water movement within the Project Influence Area and suitability for different types of habitats and organisms. Coastal water levels are important to understanding short term, high-intensity events that regulate organism access and materials exchange to and from the wetland surface. Long-term trends of optimal or prolonged inundation influence wetland plant productivity.

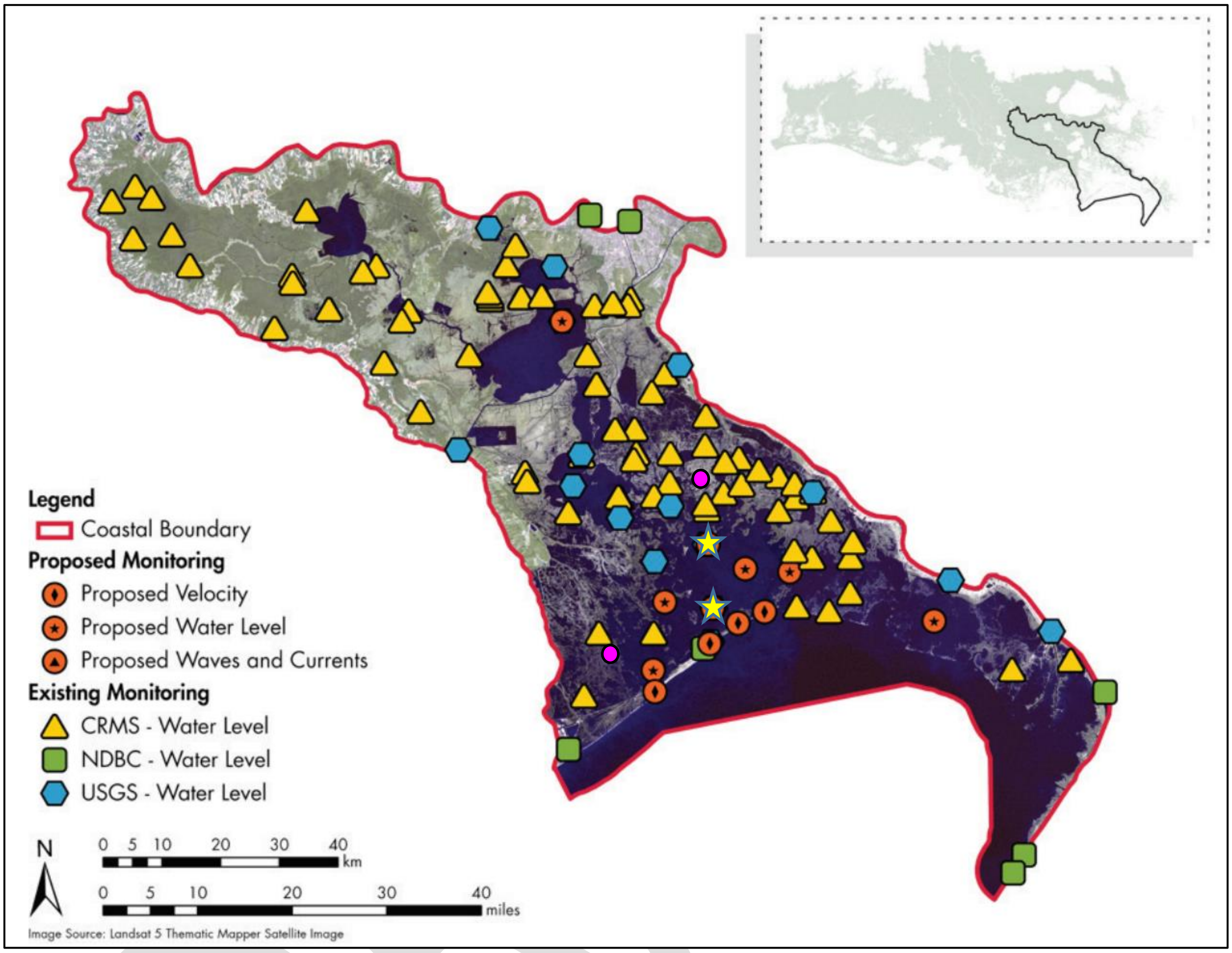


Figure 3.7-3. Existing hydrologic sampling stations within the Barataria Basin. The approximate location of two stations that CPRA contracted USGS to install are shown with magenta circles. Two ADCPs are currently being installed at the locations shown with the yellow stars.

- Schedule: Planned for continuous collection during both the pre-operations and post-construction monitoring phases.

- Locations: Currently there are 65 CRMS-*Wetlands* water level gauges (56 shown in Figure 3.7-3) and 15 data collection platforms in Barataria Basin. CPRA proposes to install five new CRMS-*Wetlands* stations in the basin, in the immediate outfall area. Two will be installed during pre-operations monitoring in existing PIA marshes, while three will be installed in the PIA after the onset of operations results in the subaerial development of new wetlands.

- Methodology: Empirical measurements of the height of the water level surface referenced to a geodetic or tidal datum will be made at the locations described above (Folse et al. 2020). Frequency, depth and duration of inundation will be calculated as

Frequency of inundation = Number of days annually where water level exceeds marsh surface elevation / 365 (366 for leap years)

Eqn. 14

Depth of inundation = Water depths at multiple locations on the marsh in the Project Influence Area – Marsh surface elevation

Eqn. 15

Duration of inundation = Number of consecutive days where water level exceeds marsh surface elevation

Eqn. 16

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.3. Soil bulk density

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties and sustainability in Barataria Basin. Soil bulk density is useful in understanding the relative exposure of an area to fluvial or marine sediment sources, and for a better understanding of the response of other soils parameters.

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils at existing CRMS-*Wetland* stations within Barataria Basin are sampled every 10 years. Soils from CRMS-*Wetlands* stations and new transect stations (below) in the PDDA will be sampled shortly prior to the onset of Project operations, and every five years after the onset of Project operations.

  Locations: Existing and five new CRMS-*Wetlands* stations in the PDDA (Figure 3.7-4). CPRA will augment that sampling 15 points along three transects (five points per transect) radiating from the Project outfall to encompass the Project delta development area. Exact transect locations are will be determined by the Project AMT.

- Methodology: Soil cores will be obtained with a push corer (Folse et al. 2020). Bulk density will be determined for 4-cm depth increments within cores. Mass per unit volume of water and soil particles on a dry and wet basis will be calculated.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.4. Soil organic matter content

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties and sustainability in Barataria basin. Organic matter content of wetland soils is a key determinant of soil development and quantifies organic contributions to soil volume. Organic matter burial is especially important for maintaining soil elevation and a positive feedback from plant productivity of existing wetlands. Carbon accumulation in emergent wetlands is also an important ecosystem service of these communities.

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils will be sampled shortly prior to the onset of Project operations, and every five years thereafter.

- Locations: Same sampling locations identified for *Soil bulk density* (3.7.2.1.3).

- Methodology: Soil cores will be obtained with a push corer. Organic matter content will be determined by loss on ignition (LOI), wherein a soil sample is combusted at a temperature that burns off organic matter and retains mineral content. LOI will be determined for 4-cm depth increments within cores as per the existing CRMS methodology (Folse et al. 2020).

- Parties Responsible for Data Collection: CPRA contractor.

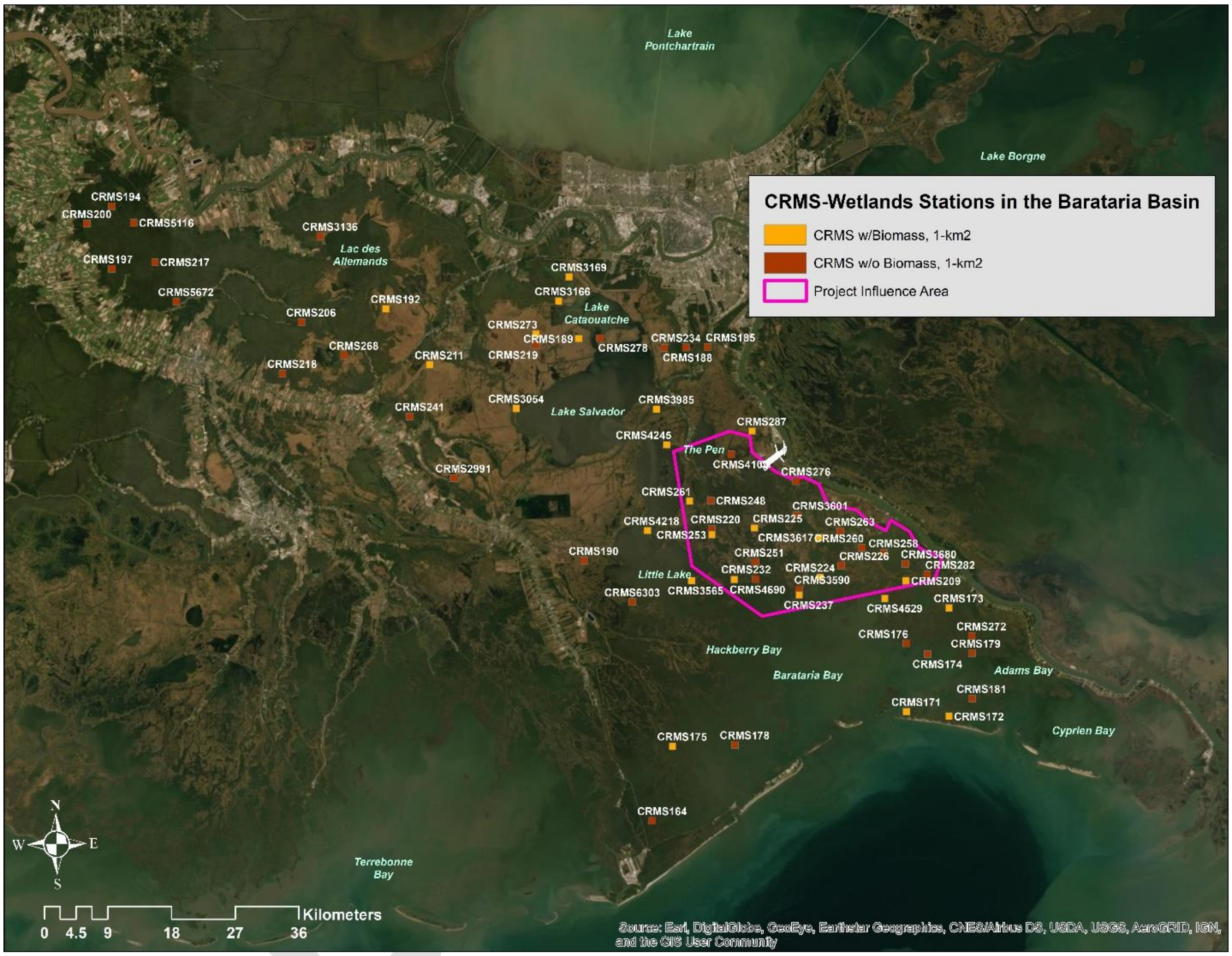


Figure 3.7-4. Existing CRMS-*Wetlands* locations for vegetation community sampling in Barataria Basin.

3.7.2.1.5. Soil mineral matter grain size

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties and sustainability in Barataria Basin. Mineral content of wetland soils is a key determinants of soil development and are often used to describe the role of mineral contributions to soil volume.

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils will be sampled shortly prior to the onset of Project operations, and every five years thereafter.

- Locations: Same sampling locations identified for *Soil bulk density* (3.7.2.1.3).

- Methodology: Soil cores will be obtained with push corer. Grain size will be determined on residual mineral matter following *Soil organic matter content* (3.7.2.1.4) (Folse et al. 2020).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.6. Soil total nutrients

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties and sustainability in Barataria Basin. The soil biogeochemical environment determines nutrient availability and the capacity for plants to uptake essential macro- and micro-nutrients for growth. Soil nutrition can provide an understanding of nutrient limitation to plant vigor. Measurements of soil total nutrients (i.e., TN, TP, TC), when coupled with other measures, can provide an understanding of what nutrients limit plant production and the burial rate of common limiting nutrients, such as nitrogen and phosphorus.

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils will be sampled shortly prior to the onset of Project operations, and every five years thereafter.

- Locations: Same sampling locations identified for *Soil bulk density* (3.7.2.1.3).

- Methodology: Soil cores will be obtained with a push corer. Soil total carbon is a direct measure of total carbon content with combustion and gas analysis. Indirectly, a conversion factor applied to the organic matter content can be used to determine soil carbon content based on literature or local relationships. Direct measure of total nitrogen with combustion and gas analysis. Direct measure of total phosphorus content with spectrophotometry following acid digestion.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.7. Rate of accretion above feldspar marker horizons

- Rationale: Understand the spatial extent and magnitude of effect of the Project on building and sustaining emergent wetland elevation.

- Schedule: Planned for both pre-operations and post-construction monitoring. Sampling sites will be visited twice annually.

- Locations: Existing CRMS-*Wetland* stations within the Project Influence Area (Figure 3.7-4), plus five additional CRMS or CRMS-like stations installed within the Project outfall area.

- Methodology: Installation of feldspar marker horizons and determination of mass/volume of material deposited above the horizon will be as per the CRMS-*Wetlands* Standard Operating Procedures (Folse et al., 2020).

Rate of accretion is determined as the slope of repeated measurements of accretion over time above feldspar marker horizons.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.8. Soil strength

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties and sustainability in Barataria basin and enable identification of changes and suitability for various types of habitats and organisms. Also, determine whether total organic matter changes following diversion operation. Measures of soil strength may be deemed important for understanding resistance to erosion.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: See discussion of CRMS-*Wetland* and additional Project-specific stations under *Rate of accretion above feldspar marker horizons* (3.7.2.1.7).

- Methodology: Methodology for sampling soil strength will be identified after consultations with the academic community (see discussion in Jafari et al. (2019). Both *in-situ* and laboratory instruments are available for measuring the shear failure or 'strength' of soils, depending on depth and soil type.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.1.9. Marsh surface elevation change rate in the Project Influence Area

- Rationale: Understand trends of vertical soil elevation change rates within the project area in relation to measured geodetic datums. Rod sediment erosion table (RSET) pin heights form the basis for calculations of marsh surface elevation change.

- Schedule: Planned for both pre-operations and post-construction monitoring. Marsh surface elevation change will be calculated semi-annually, consistent with existing CRMS-*Wetlands* protocols.

- Locations: See discussion of CRMS-*Wetland* and additional Project-specific stations under *Rate of accretion above feldspar marker horizons* (3.7.2.1.7).

- Methodology: Installation of RSETs and measurement of average elevation of the marsh surface will be as per the CRMS-*Wetlands* Standard Operating Procedures (Folse et al., 2020). The rate of change of marsh surface elevation is determined as the slope of repeated measurements over time of RSET pin heights.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.2. Calculations in Support of Objective 2

3.7.2.2.1. Sediment dispersal and retention on the emergent marsh surface

- Rationale: Estimate the amount of sediment retained in geographic areas of the project area.

- Schedule: Planned for both pre-operations and post-construction monitoring. Sampling sites will be visited twice annually. Calculations will be made annually.

- Locations: See discussion of CRMS-*Wetland* and additional Project-specific stations under *Rate of accretion above feldspar marker horizons* (3.7.2.1.7).

- Methodology: Mineral sediment content in the material accreting on the marsh surface will be determined following collection of *Rate of accretion above feldspar marker horizons* (3.7.2.1.7) and S*oil organic matter content* (3.7.2.1.4).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.2.2. Soil organic matter density

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties in Barataria basin

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils will be sampled shortly prior to the onset of Project operations, and every ten years thereafter.

- Locations: Same sampling locations identified for *Soil bulk density* (3.7.2.1.3).

- Methodology: Conversion: soil organic matter percent is converted into a mass per unit volume

- Parties Responsible for Data Collection: CPRA contractor.

3.7.2.2.3. Soil mineral matter density

- Rationale: Understand the spatial extent and magnitude of effect of the Project on emergent wetland soil properties in the Barataria basin

- Schedule: Planned for both pre-operations and post-construction monitoring. Soils will be sampled shortly prior to the onset of Project operations, and every ten years thereafter.

- Locations: Same sampling locations identified for *Soil bulk density* (3.7.2.1.3).

- Methodology:

Mineral density = Soil bulk density (3.7.2.1.3) – *Soil organic matter density* (3.7.2.2.3)

Eqn. 17

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3. Objective #3: Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services

The objective of physical terrain measurements is to determine topographical and areal changes of natural or restored landscapes and built structures that are vulnerable to submergence. The physical terrain of the coastal environment in this context refers to natural land (e.g., wetlands, barrier islands, uplands, ridges). The coastal terrain serves a multitude of functions from buffering storms, filtering nutrients, pollutants, and sediments, and supporting a variety of flora and fauna. As a result, land submergence threatens all aspects of the coastal ecosystem, from increasing fetch in open water bodies to reducing habitat for ecologically important fish and wildlife (Chesney et al., 2000; Fagherazzi & Wiberg, 2009).

3.7.3.1. Land and water extent / Area of new delta formation in the Project Influence Area

- Rationale: The Project is intended to build and more importantly sustain new emergent wetlands during 50 years of operations. Extent of land and water within the Barataria Basin is thus a fundamental metric for determining Project success. Periodic monitoring of land and water extent will allow for calculation of area of new delta formation.

- Schedule: Planned for 2-3 measurements of the Project Influence Area pre-operations and every three-to-five years post-construction.

- Locations: Project Influence Area within the Barataria Basin (see Figure 3.3-3).

- Methodology: Remote sensing / satellite imagery will be used to determine the spatial extent of emergent wetland and open water areas within the basin, consistent with the methods used for the CRMS Program (Folse et al. 2020). The area of new delta formation is calculated as

  Area of new delta formation = (Land and water extent within the Barataria Basin at time x) - (Land and water extent within the Barataria Basin prior to onset of operations)

  Eqn. 18

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.2. Emergent wetland area

- Rationale: Measure changes in wetland spatial extent by traditional wetland type (fresh + intermediate, brackish, and salt marsh; to relate to Basin-wide Model projections) and by recent Louisiana Vegetation Class (*sensu* Snedden 2019) in the Project area.

- Schedule: Planned for 2-3 measurements of the Project Influence Area pre-operations and every five years post-construction.

- Locations: Project Delta Development Area within the Barataria Basin (see Figure 3.3-2).

- Methodology: Specification of some of the satellite-based data under *Land and water extent within the Barataria Basin* (3.7.2.1.3) to parse out vegetated emergent wetlands (i.e., will not include non-vegetated subaerial flats), as described in Folse et al. (2020).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.3. Vegetation Cover, Abundance, and Height

- Rationale: Assess condition and changes in vegetation in the Basin. Data collected form the basis for assignment of *Emergent and submerged vegetation community type* (3.7.3.5) and detection of invasive species (e.g., hydrilla, water hyacinth, salvinia) presence and location as an indicator of ecosystem change and range shift.

- Schedule: Data are and will be collected annually both pre-operations and post-construction.

- Locations: 65 existing and five new Project-specific CRMS-*Wetlands* stations (Figure 3.8-5).

- Methodology: Permanent plots. Methods are detailed in Folse et al. (2020).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.4. Submerged aquatic vegetation area

- Rationale: SAV provides fish and shellfish habitat, improves water quality, and contributes organic matter to the estuarine ecosystem. Measuring changes in SAV spatial extent in Barataria Basin is therefore important for multiple stakeholders. The objective of the Project to build emergent wetlands in existing open water bodies does imply localized losses of SAV, particularly close to the Project outfall. As well, SAV abundance and distribution is highly variable year to year, which will be necessary for Project partners to consider in data evaluation.
- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Barataria Basin

- Methodology: Exact methods will be consistent with discussions of best practices outlined in Handley et al. (2018).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.5. Emergent and submerged vegetation community type

- Rationale: Assess changes in vegetation structure in the Barataria Basin, including both the PIA and PDDA.

- Schedule: Planned annually for both pre-operations and post-construction monitoring.

- Locations: 65 CRMS-*Wetlands* and 5 new Project-specific stations (Figure 3.7-10)

Methodology: Permanent plots, data collected at the end-of-season; visual estimate of the percentage cover by plant species; different canopy heights are measured (carpet, understory, overstory). Data document changes in the coverage of all species and note any presence of invasive species. Methods are detailed in Folse et al. (2020).

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.6. Emergent vegetation biomass in the Project area.

- Rationale: Assess changes in vegetation structure in the Project Influence Area.

- Schedule: Planned for both pre-operations and post-construction monitoring. The SWAMP Program is collecting both above- and below-ground biomass at a subset of CRMS-Wetlands stations coast-wide, and is currently planning on a 5-year return rotation for that sampling. CPRA will rely on that same return schedule, and conduct two pre-operation biomass samples and post-construction samples every five years throughout the 50-year Project study period.

  Locations: The SWAMP Program is augmenting the non-destructive *Vegetation Cover, Abundance, and Height* (3.8.3.3) at 25 of the 65 existing CRMS-*Wetlands* stations in Barataria with plots for the destructive sampling of aboveground and belowground biomass (Figure 3.7-10). Not all of the CRMS-Wetlands stations in the Project Influence Area have been identified for biomass collection (e.g., CRMS stations 225, 232, 253, 3617, and 4103). CPRA will extend biomass collection to those stations for purposes of supporting Project adaptive management, and will include biomass collection in the 3-5 new CRMS stations that will be established in the Project outfall area.

- Methodology: Direct measure of standing live and dead plant material that is destructively harvested for herbaceous wetlands. Live aboveground biomass will be separated and measured for each species in the harvest plot. Species-specific biomass data support an understanding of individual species tolerance and/or competitiveness with system change. The production of belowground biomass often exceeds that of aboveground biomass. The total live belowground biomass may complement measurements of soil strength. Disparities in root-to-shoot biomass may provide an indicator for plant health.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.7. Dissolved oxygen

- Rationale: DO monitoring is necessary for understanding pelagic and benthic respiration (Kemp et al., 1992) and it affects the availability of nutrients (Valiela, 1995). Chronic or acute effects of low DO could cause displace organisms or change community structure of aquatic fauna.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: 27 sampling stations currently in Barataria Basin: seven sampled continuously, 23 sampled monthly, since at least November 2015. See Figure 3.7-5.

- Methodology: Concentration of oxygen dissolved in water or percentage saturation. Measured as mg oxygen per liter sampled discretely, or by *in situ* sonde.

- Parties Responsible for Data Collection: CPRA contractor.

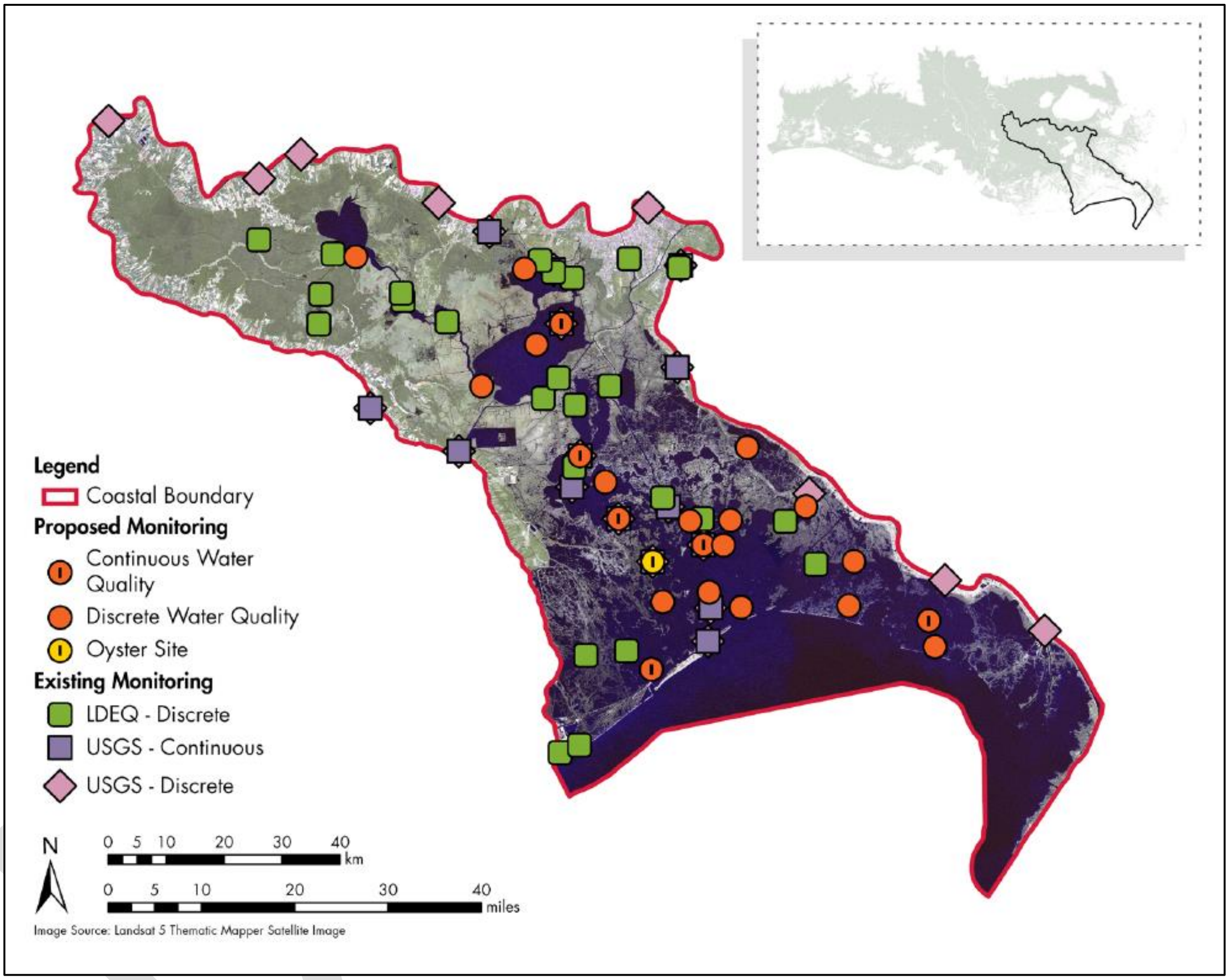


Figure 3.7-5. Existing and proposed locations for SWAMP discrete and continuous water quality sampling in Barataria Basin. Figure from Water Institute for the Gulf (2019).

3.7.3.8. Salinity

- Rationale: Estuarine salinity affects the distribution, growth, and productivity of nekton communities (Minello et al., 2003; Zimmerman et al., 2000), vegetation community composition (Pennings et al., 2005), and ultimately the functions and services that wetlands provide (Odum, 1988).

- Schedule: Planned for both pre-operations and post-construction monitoring.
- Locations: 77 stations currently monitored continuously in Barataria Basin: 65 CRMS-Wetlands stations and 12 SWAMP stations. See Figure 3.7-6.

- Methodology: Concentration of dissolved ions or salts in water typically measured with conductivity probes and may be reported in practical salinity units (PSU) or other (reference SWAMP)

- Parties Responsible for Data Collection: CPRA contractor.

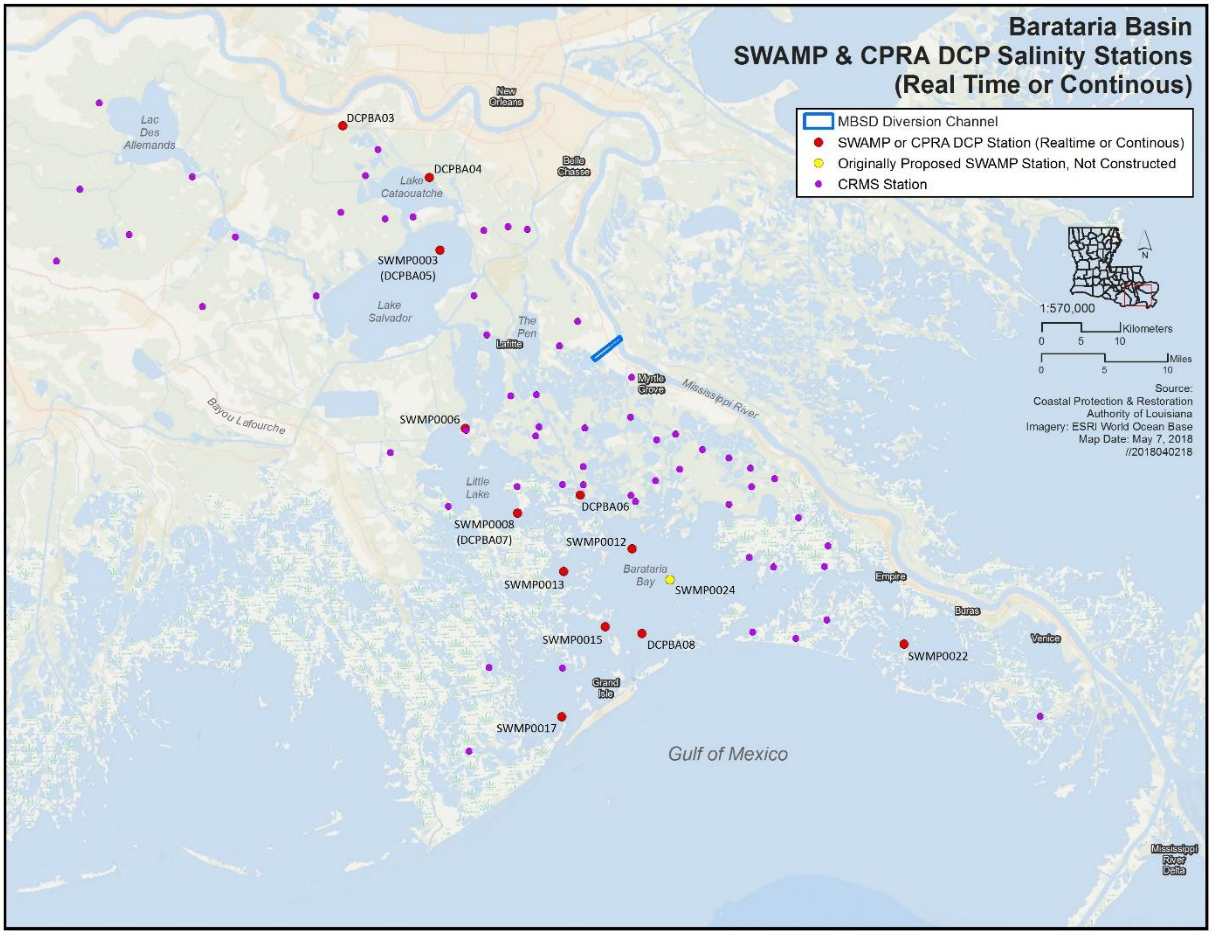


Figure 3.7-6. Existing locations for salinity sampling in Barataria Basin.

3.7.3.9. *Chlorophyll a*

- Rationale: *Chl a* is an indicator of the presence of water column primary production by phytoplankton, and thus aids estimates of the total quantity of carbon produced by primary producers.

- Schedule: Planned for both pre-operations and post-construction monitoring. Sites are sampled either continuously using *in situ* instruments (e.g., sondes) or discretely via boat-based grab samples.

- Locations: See discussion of discrete and continuous measurements under *Dissolved oxygen* (3.7.3.7). The Project Management Team will also explore the viability of using aerial imagery (e.g., satellite and/or low-altitude plane/drone-based imagery) to improve the spatial extent of

Chl a observations.

- Methodology: Concentration of *Chl a* in water, usually measured with fluorescence techniques to indicate the biomass of phytoplankton (reference SWAMP). Sondes record measurements every 30 minutes.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.10. *Phytoplankton Species Composition (including Harmful Cyanobacterial/Algal Bloom Species)*

- Rationale: Phytoplankton blooms are controlled by several factors, such as nutrient type and loading rate, light availability, water residence time, temperature, and grazing by zooplankton and benthic filter feeders (Boyer et al., 2009). In the event of an observed increase in *Chlorophyll a* (3.7.3.9), determination of the cyanobacterial and/or eukaryotic algal species present can provide an indication of the ecological effects of a bloom. As well, species determination can inform whether known harmful cyanobacterial and/or algal bloom (HCAB) species (e.g., *Mycrocystis aeruginosa*) are present, and whether follow-up sampling for associated toxins is warranted.

- Schedule: Planned for both pre-operations and post-construction monitoring. No regular schedule. Activities would be dependent on observations of elevated *Chlorophyll a* (3.7.3.9).

- Locations: Discrete sampling locations would be dependent on observations of elevated *Chlorophyll a* (3.7.3.9).

- Methodology: Samples would be taken at field locations of observed elevated *Chlorophyll a* (3.7.3.9) for return to an analytical laboratory facility for species identification.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.11. *Harmful Cyanobacterial/Algal Bloom Toxins*

- Rationale: A number of cyanobacterial and eukaryotic algal species are capable of producing toxins that pose a risk to aquatic and human resources in the Barataria Basin.

- Schedule: Planned for both pre-operations and post-construction monitoring. No regular schedule. Activities would be dependent on observations of elevated *Chlorophyll a* (3.7.3.9) that warrant follow-up surface water samples in the Barataria Basin for determination of *Phytoplankton species composition* (3.7.3.10).

- Locations: See discussion for *Phytoplankton species composition* (3.7.3.10).

- Methodology: Water sample analysis for toxins associated with any harmful cyanobacterial/algal species identified during *Phytoplankton species composition* (3.7.3.10) sampling.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.12. Nutrient constituents in Barataria Surface Waters

- Rationale: Nutrients stimulate the growth of aquatic primary producers. The primary limiting nutrients often include nitrogen, phosphorus, and silicate. The types of nutrients and ratios in Basin surface waters are subject to changes in MR concentrations (Turner & Rabalais, 1991) and operations of existing and proposed siphons and diversion structures.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Same 27 stations described for *Dissolved oxygen* (3.7.3.7).

- Methodology: Concentration of selected elements or molecules dissolved in water (reference SWAMP). Measured as mass of nutrient per liter of sample.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.13. Temperature of Barataria Surface Waters

- Rationale: Estuarine temperature affects the distribution, growth, and productivity of nekton communities (Minello et al., 2003; Zimmerman et al., 2000), vegetation community composition (Pennings et al., 2005), and ultimately the functions and services that wetlands provide (Odum, 1988).

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Same 153 stations described for *Salinity* (3.7.3.8).

- Methodology: Temperature will be measured with thermometers or thermocouples and will be reported in degrees Centigrade.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.14. Turbidity of Barataria Surface Waters

- Rationale: The turbidity of Barataria Basin surface waters influences both primary producers (e.g., phytoplankton and SAV) and consumers (e.g., filter feeders and visual predators) in the estuary. Numerical modeling of Project alternatives supports an expectation of short-term increases in turbidity in Basin surface waters during Project operations.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Same 27 stations described for *Dissolved oxygen* (3.7.3.7).

- Methodology: Optical (or other) measure of water clarity, which can be influenced by particles or dissolved colored materials and may be reported in various turbidity units (reference

SWAMP). Measured as Nephelometric Turbidity Units (NTUs)

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.15. Total suspended solids in Barataria Surface Waters

- Rationale: The transport of substantial amounts of suspended sediments in diverted Mississippi River water into the Basin will result in likely increases to localized suspended sediment concentrations in Barataria surface waters, especially during Project operational flows.
- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Same 27 stations described for *Dissolved oxygen* (3.7.3.7).

- Methodology: Concentration of particles larger than 2 microns in the water column, comprising organic or inorganic matter, which are filtered from a complete water sample and then dried and weighed.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.16. Lower Trophic Level Organisms

- Rationale: Lower trophic level organisms (e.g., amphipods) are a foundational component of the Barataria Basin food web, and provide a critical link between wetland restoration and ecological service flows to injured fish and water column invertebrates. The Project may influence environmental conditions (salinity, sediment composition) that are known to regulate local distribution of lower trophic level assemblages in estuarine systems. Additionally, this data set was identified as needed for improvement of the CASM ecosystem model described in Section 1.5.1 by an independent, external advisory panel.

- Schedule: Once pre-construction to create a baseline inventory, and every ten years after operations begin.

- Locations: Sampling protocols will be designed to capture the spatial variation within the Barataria Basin.

- Methodology: Sampling protocols will be designed to capture the temporal variation within selected locations in the Barataria Basin and to address key management questions and data needed to refine ecosystem models of the Barataria Basin food web for application in the adaptive management framework. This will include benthic infauna and epifauna.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.17. Aquatic Invasive (Algae and Invertebrate) Species

- Rationale: The transport of substantial amounts of diverted Mississippi River water into Barataria Basin may result in the introduction of new invasive species, or increased numbers and/or spatial extent, of aquatic invasive species.

- Schedule: Planned for both pre-operations and once every five years after operations begin.

- Locations: Will be identified following the onset of Project operations.

- Methodology: A rapid assessment survey will identify the presence of invasive algae and invertebrates (e.g., zebra mussel). A team of trained field samplers (scientists or trained volunteers) will visit in-water structures (e.g., marinas) and other selected habitats within Barataria Basin to observe, identify, and record estuarine algal and invertebrate organism presence, abundance, and location. Samples will be collected for identification in a laboratory.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.18. Nekton (Fish and Shellfish) Species Abundance and Composition/Assemblage

- Rationale: Documenting the distribution and abundance of important fish and invertebrate species, within the project area allows for examination in trends of time (such as Catch per Unit Effort) or in space and allows for the detection of new or increased presence and range shifts or expansions, of aquatic invasive fishes and invertebrates.

  The objective of nekton community sampling is to document the population status of commercially- and recreationally-important fish and invertebrate species, as well as, representative guilds. Sampling is designed to: (1) evaluate patterns of distribution, (2) evaluate changes in abundance and composition, and (3) evaluate habitat association patterns.

  To meet the monitoring objective for nekton community composition, sampling must be effective at detecting changes in abundance of resident and transient species to fully capture the diversity of species and their life stages. Several fisheries-independent gear types are used by LDWF across the freshwater to marine gradient (Table 3.7-3), including: entanglement nets, trawls, seine, and electrofishing. Collection of finfish and shellfish (shrimp, crab) using standardized gear can be used as an indicator of relative abundance and can be used to develop diversity indices and to quantify resource availability within estuarine habitats. Standardized gear also targets specific size classes, which provides an opportunity to examine ecological differences among life stages of a given species (Livingston, 1988). CPRA may additionally perform analyses to evaluate food web changes (e.g., stable isotope analysis on nekton gut contents).

- Schedule: Planned for both pre-operations and post-construction monitoring. See Table 3.7-4 for discussion of sampling frequencies for fisheries-independent data collection. Data collection for fisheries-dependent data collection is generally accomplished with creel surveys (weekly) and trip-ticket and oyster boarding (both variable in terms of frequency and number of data collection points.

- Locations: See Figures 3.7-7 and 3.7-8.

- Methodology: Individuals species sampling methods are as per LDWF 2018.

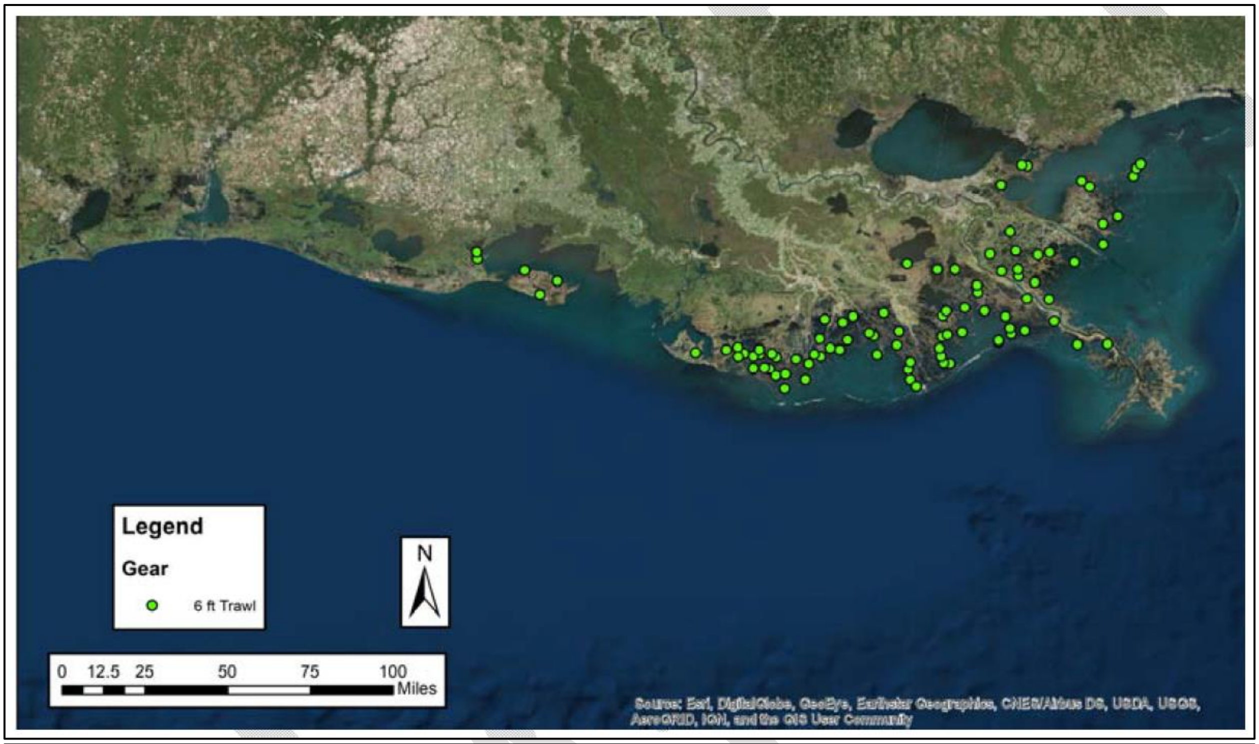
- Parties Responsible for Data Collection: CPRA contractor.

Table 3.7-3. Example fish and shellfish and the gear type that is generally used to assess abundance and other population characteristics.

Scientific Name	Common Name	Gear Type
Anchoa mitchilli	Bay anchovy	Trawls
Brevoortia patronus	Gulf menhaden	Trawl/Gillnet
Callinectes sapidus	Blue crab	Trawl/Seine
Cynoscion nebulosus	Spotted seatrout	Gillnet/Trammel Net
Farfantepenaeus aztecus	Brown shrimp	Trawl/Seine
Leiostomus xanthurus	Spot	Trawl/Seine
Litopenaeus setiferus	White shrimp	Trawl/Seine
Micropogonias undulates	Atlantic croaker	Trawl/Seine
Micropterus salmoides	Largemouth bass	Gillnet/Electrofishing
Paralichthys lethostigma	Southern flounder	Trawls
Scomberomorus maculatus	Atlantic Spanish mackerel	Gillnet/Trammel Net

Table 3.7-4. Sampling details for selected fisheries-independent nekton community variables.

Gear Type	Sampling Frequency	Number of Sites
Trawl (6-ft)	Weekly: April – early May Semi-monthly: June-July	92
Trawl (16-ft)	Semi-monthly: April-July, December Monthly: August-November, January-March	92-102
Trawl (20-ft)	Semi-monthly: April, December Monthly: January, March, May, November	39
Seine	Monthly	102
Electrofishing	Monthly	12
Gill Net	Semi-monthly: April-September Monthly: October-March	52
Trammel Net	Monthly: October-March	45



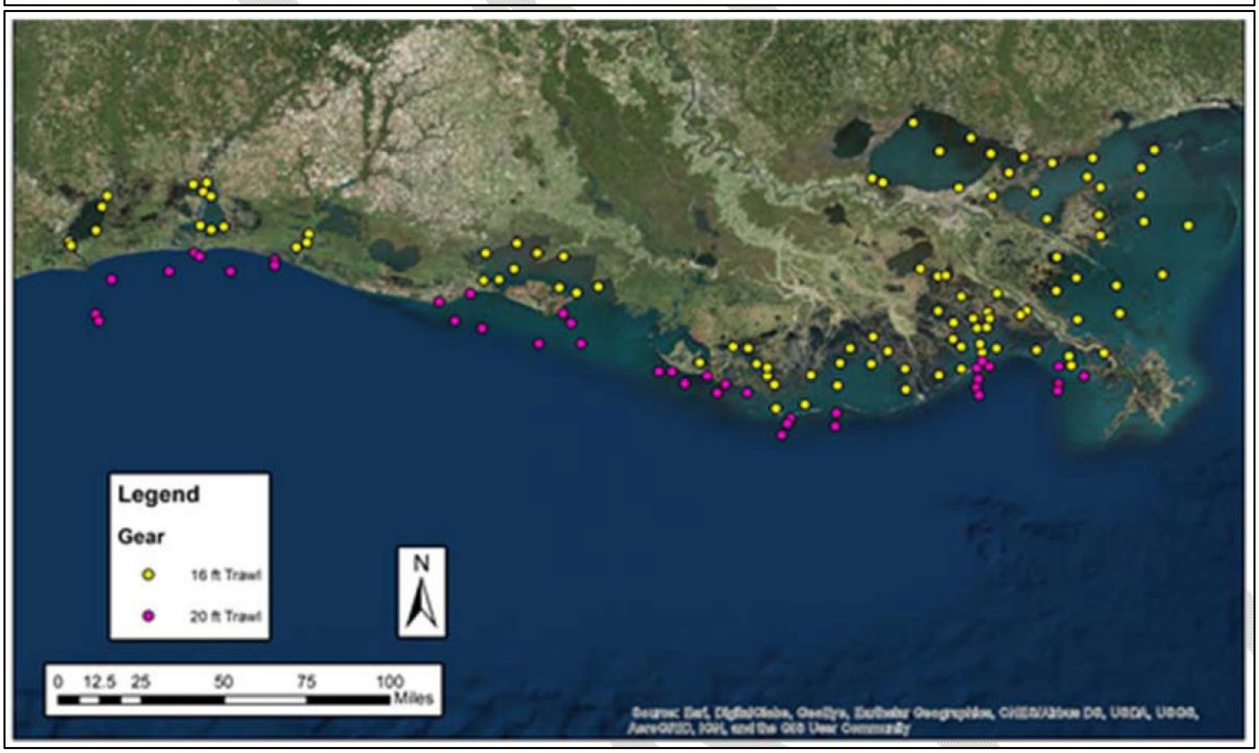
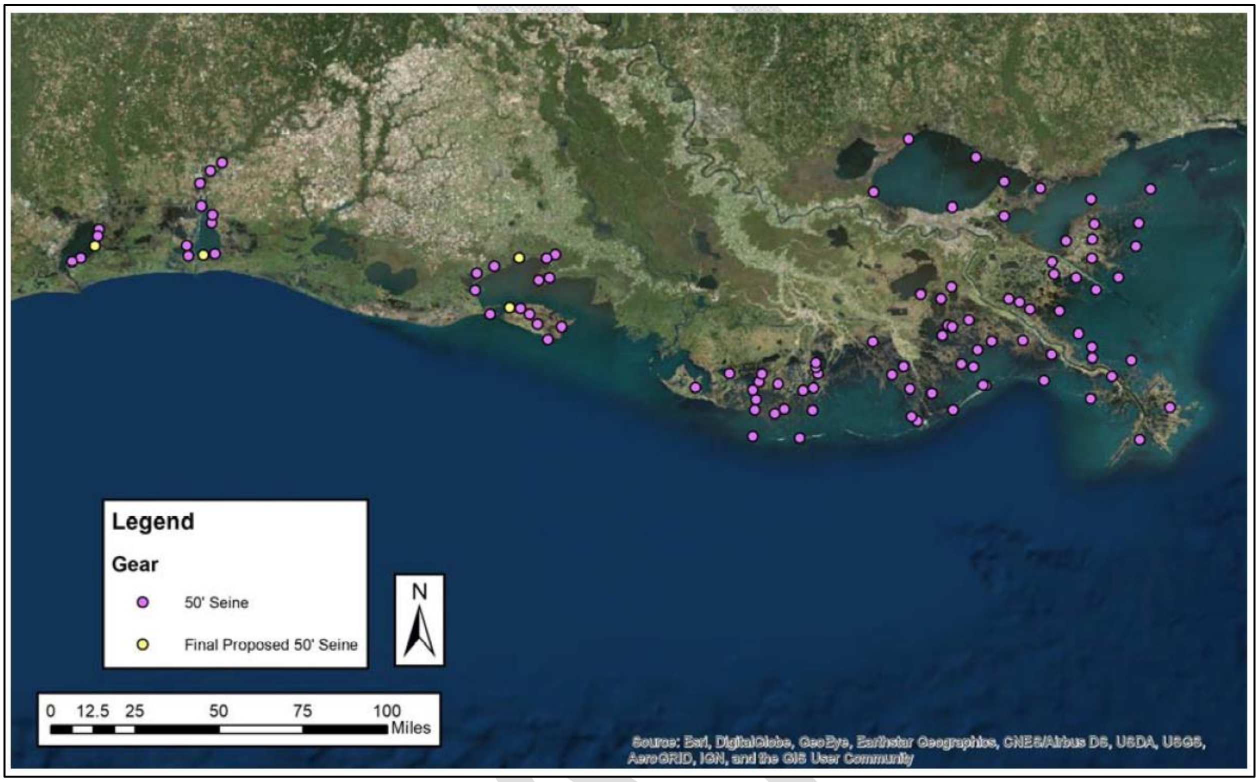


Figure 3.7-7. Existing LDWF trawl locations for along the Louisiana coast. Shown are locations of 6-ft (top) and 16-ft and 20-ft trawls (bottom). Figures from CPRA & LDWF 2019.



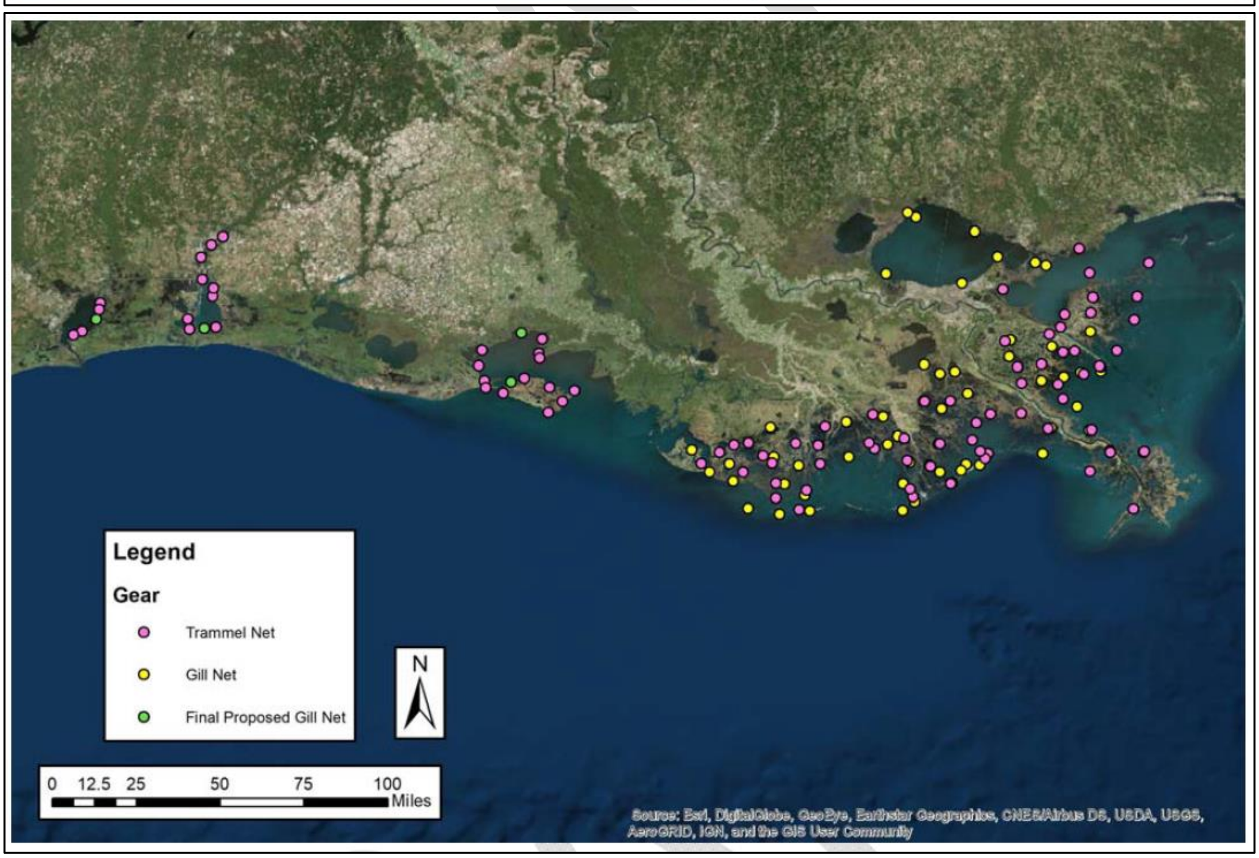


Figure 3.7-8. Existing LDWF seine (top) and trammel and gill net (bottom) sampling locations along the Louisiana coast. Figures from CPRA & LDWF 2019.

3.7.3.19. Atlantic Bottlenose Dolphins (<u>Tursiops truncatus</u>)

- Rationale

  Document changes to the abundance, distribution, population demography, density, survival, health and reproduction of the Barataria Bay Estuarine System (BBES) stock of bottlenose dolphins, their prey, and their habitat that may result from the operation of the Project and resulting low salinity.

  DWH Trustees have invested heavily in understanding the effects of DHW on the BBES stock of bottlenose dolphins. The BBES stock of dolphins was heavily impacted by the DWH oil spill (see the PDARP) and the DWH NRDA Trustees used a combination of stranding response and investigations, capture mark recapture, photo-id surveys, remote biopsies, and capture release health assessments from April 2010 through 2015 to investigate the injury to the population. Additional studies on BBES dolphins were conducted using capture release health assessments, capture mark recapture surveys, stranding response and investigations, and photo-ID surveys from 2016- 2019 in order to determine the long term effects of the spill on this population. Dolphins are resident in Barataria Basin and dolphins exposed to DWH oil during the spill continue to have underlying long-term health impacts from the spill.

  In addition, this plan is being implemented in conjunction with planned mitigation and stewardship measures (see the Project Mitigation Plan) to addresses CPRA's responsibility under the Bipartisan Budget Act of 2018 (Public Law 115-123; hereafter the Budget Act). Section 20201 of the Budget Act indicates that

  > *"(b) Upon the issuance of a [Marine Mammal Protection Act] waiver … the State of Louisiana shall, in consultation with the Secretary of Commerce [as delegated to NMFS]: (1) To the extent practicable and consistent with the purposes of the projects, minimize impacts on marine mammal species and population stocks, and (2) Monitor and evaluate the impacts of the projects on such species and population stocks."*

  Adaptive management strategies to BBES dolphins from Project operations include a framework for coordinating during operations, and a post-operational commitment to evaluate the ability of diversion operations to be modified to meet project goals while reducing impacts to marine mammals.

- Schedule: Planned for pre-operations and post-construction monitoring. The schedule for sampling frequency for the various methods may be different in pre-operations and post-construction phases. To collect the data necessary to monitor and evaluate the impacts of the Project on dolphins, a variety of methods may be used and results from the first five years of monitoring during operational years will guide scheduling or need for continuation for future years.
  - Pre-operations (five years): During the five years prior to operations, several methods will be used to identify baseline information on the abundance, distribution, density, health, stranding rates/types/causes, survival and fecundity of the resident population prior to operations to be able to identify changes once the Project is operational. Given the length of the time between past data collection efforts and project operations, this

additional sampling is necessary. In addition, a single effort in any given year may not be sufficient given inter- and intra-annual variability, seasonal habitat and potential dolphin distribution changes in Barataria Basin. The plan below presents a reasonable sampling design to capture both inter- and intra-annual variability.

- Enhanced stranding response and investigations (stranding rates, causes of illness and death, standardized effort) as part of this MAM plan would be ongoing beginning five years prior to operations.
- Capture-Mark-Recapture (CMR) surveys (abundance, distribution, density) will be conducted basin-wide.
- Visual assessment surveys (skin health, body condition, reproductive follow-up) will be performed.
- Capture Release Health Assessment (CRHA) sessions will be conducted to include animals captured in locations across the bay. Health data analyses will include a variety of samples and procedures.
- Tagging (movement and possibly salinity) will include approximately 90 animals total from several areas across the bay.
- Biopsies (for omics, hormones, fecundity, nutrition, contaminants, and disease) and associated analyses will be done over different geographic areas during years without a CRHA.
- Prey data (quantity, quality, species) will be collected and analyzed seasonally by the NRDA-funded FIMP, and from stranding samples. These data will be shared with marine mammal experts.
- These sensors may be paired with eDNA continuous sensors when possible.
- Baseline dolphin prey and habitat (water quality) monitoring will be fulfilled through other ongoing or planned resource monitoring. In the 5 years prior to operations, whole fish samples representative of dolphin prey (10 per prey type) will be collected, preserved and analyzed by calorimetry for evaluation of the nutritional content of current pre-operations prey.

- Post-Construction (10 years): Post-construction monitoring will occur for up to ten years beginning with the onset of Project operations. Annual review of the data collected and results will inform planning for the next year studies.
    - Enhanced stranding response and investigations (stranding rates, causes of illness and death, standardized effort, rapid response for live animals) as part of this MAM plan would be ongoing in the BBES and adjacent coastal areas.
    - CMR surveys bay-wide (abundance, distribution, density) will be conducted basin-wide periodically.
    - Visual assessment surveys (skin health, body condition, reproductive follow-up) will be done via unmanned aircraft system (UAS; i.e., drone) and vessel-based assessments.
    - CRHA (health status) will be done periodically across geographic areas.
    - Biopsies (omics, hormones, fecundity, nutrition, contaminants, and disease) will be done during years without a CRHA.
    - Tagging (movement and salinity) will include approximately 140 animals total over 10 years.
    - Prey data (quantity, quality, and calorimetry) will be collected and analyzed seasonally by FIMP, and from stranding samples.

- Locations:
  Basin-wide environmental data collected through the current and additional real-time salinity stations and other efforts (e.g., dolphin prey base collected through the FIMP program, contaminants, HCABs, salinity/temperature) will inform stranding investigation and monitoring efforts.
    - Pre-Operations: Basin-wide studies will occur as described above ensuring that the full areas of dolphin habitat within Barataria Basin are represented.
    - Post-Construction: The basin-wide abundance, distribution and density surveys identified above will continue post-operations. Initial health assessments will be focused basin-wide, with out-year locations being dependent upon potential changes in habitat and dolphin distribution.

- Methodology: The methodologies proposed here allow for data collection efforts supported through the Project. Data consistency and scientific integrity of the data will be important. Several categories of data must be collected to monitor and evaluate the effects of the Project on dolphins using various data collection methods (Table 3.7-5). Efforts carried out separately from the Project can be leveraged, but surveys specific to this plan must be able to be integrated with past, present and future data collection, including with the DWH NRDA long-term data set.
    - Enhancing the Marine Mammal Stranding Network (MMSN): At least five years prior to operations, the core team will provide for an enhanced MMSN to establish baseline stranding information pre-operations. Support for stranding response personnel, active surveillance for strandings to determine mortality rates and for diagnostic analyses to determine causes of illness and death would be necessary. For instance, if strandings increase above the pre-operation level (mean plus 2 standard deviations) or there is an increase in the proportion of cases with cause of illness/death determined to be low salinity exposure, then an increase in effort, analyses, and response is triggered.
    - Periodic visual health assessment in specific geographic areas: Use UAS, vessel-based, or alternative techniques to visually assess the health of dolphins as described above. The assessment will be adaptive. For instance, if mortality increases in specific regions, dolphin body condition decreases, or skin lesions become more prevalent, sampling frequency may be increased (see Table 4.2-3). This effort might be combined with stranding response active surveillance to maximize efficiency.
    - CRHA with or without tagging: These assessments will be performed similar to the assessments from 2010-2018; however, diagnostics, tag types, and sample analyses may be different. Tagging would be performed depending on the timing of the assessments and availability of satellite tags with or without salinity sensors.
    - CMR Surveys: These surveys will be conducted similar to the 2019 CMR survey and may incorporate UAS and additional simultaneous photography for visual health assessments. If mortality or morbidity increases in specific areas, targeted CMR surveys may be implemented or increased in frequency.
    - Remote biopsy studies: Remote biopsy may be undertaken particularly in years in which CMR or CHRA studies are not being completed and there is a need to have additional information on some health parameters, nutritional parameters, and hormone status, particularly reproductive hormones in the population. In addition, biopsy frequency or implementation may occur in response to increased morbidity or mortality. These studies provide information on pregnancy, other steroid hormone status that may inform nutritional status, and other parameters such as stable isotopes or contaminants.

- If fisheries surveys indicate that the prey base has shifted, and dolphin body condition decreases, a bioenergetics study would occur.
- Additionally, a monitoring lab and office will be established within an existing facility, with associated equipment (e.g., vessels, trailers, truck, freezer).

- Parties Responsible for Data Collection

  A core monitoring team composed of federal, State, non-governmental organizations, and academic institutions will be created and stationed in Barataria Bay to implement the monitoring strategy for up to 15 years (five years pre-construction; 10 years post-construction). The team will accomplish monitoring and response fieldwork, data analyses, tracking, sample processing, necropsies, and surveys. It will also increase capacity, public awareness, and education opportunities within Louisiana.

3.7.3.20. Eastern Oysters (Crassostrea virginica)

- Rationale: Document oyster population dynamics and abundance to assess the status and trends of the resource within the project area. The distribution of oysters within an estuary is largely a function of salinity, freshwater input, depth, and substrate (Melancon et al., 1998), although sedimentation, coastal disturbances and overharvesting also control their distribution (Oyster Technical Task Force, 2012). Storm surge and wave action can also result in the destruction of oyster reefs, killing of spat and juvenile oysters, or displacement of oysters onto habitats that cannot support them (Banks et al., 2007).

- Schedule: Planned for both pre-operations and post-construction monitoring. LDWF samples with at varying frequencies depending on the methodology and the time of year:
  - Dredge:
    - Monthly , except for July
    - LDWF may also sample weekly in April and May in order to adaptively manage the oyster fishery
  - 1-m^2 quadrat:
    - Coast-wide annually between late June and early July
    - In the Barataria and Pontchartrain Basins only, twice annually in May-June and September-October

- Locations: 34 existing locations shown in Figure 3.7-9.

- Methodology: The LDWF oyster-sampling plan uses square meter plots and dredge sampling to assess oyster density, abundance, and mortality. CPRA proposes to continue that monitoring at the current sampling spatial and temporal density (see Banks et al. 2016).

- Parties Responsible for Data Collection: CPRA contractor.

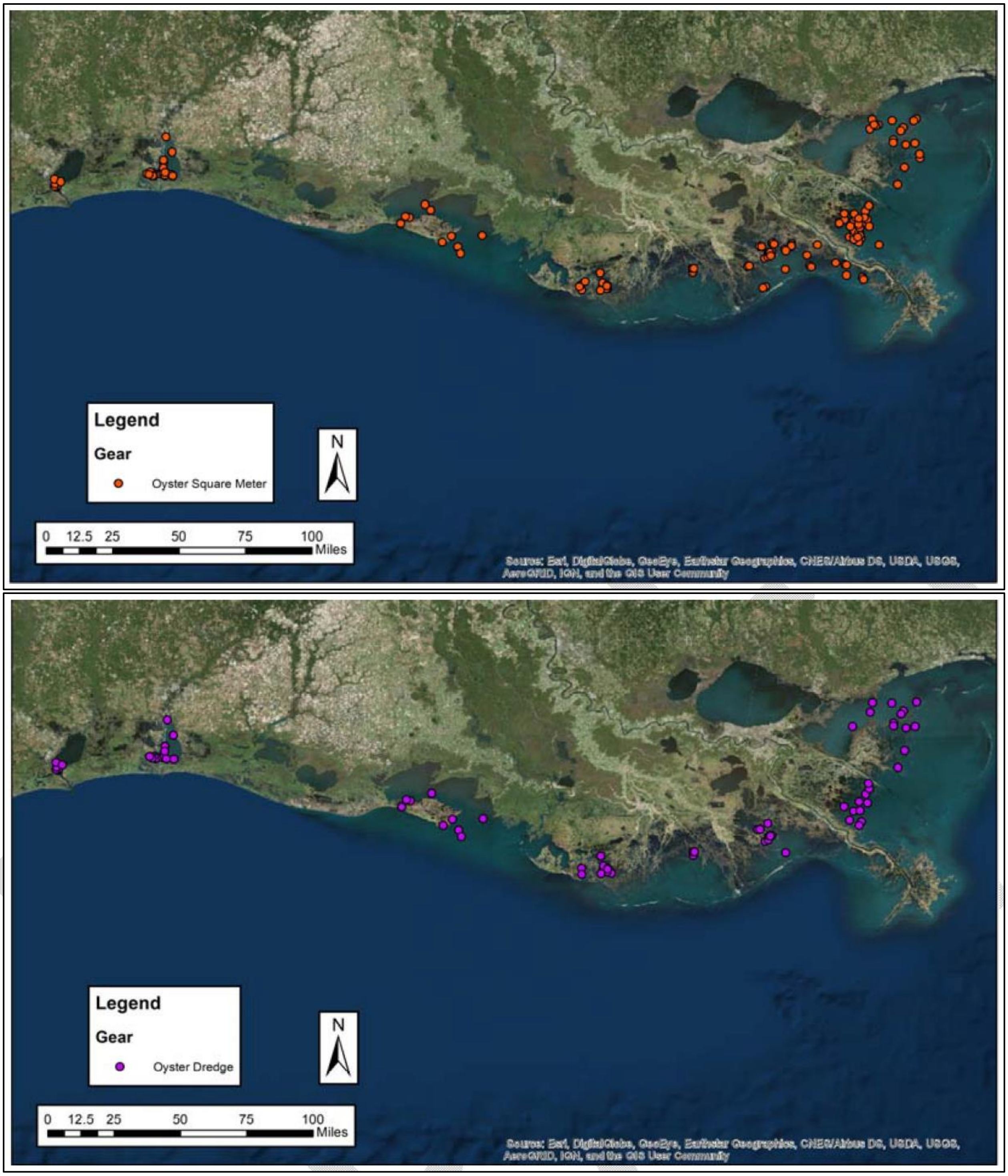


Figure 3.7-9. Existing LDWF locations for oyster density sampling along the Louisiana coast. Shown are locations for square-meter (top) and dredge sampling (bottom). Figures from CPRA & LDWF 2019.

3.7.3.21. Wildlife

- Rationale: Document changes in selected wildlife abundance within the project area. The data will support estimations of *Aquatic resource and terrestrial wildlife utilization of created/restored habitat (3.7.3.22).* The following wildlife species are priorities for Project monitoring, as there were identified in the NRDA PDARP (DWH Trustees 2016) as having been injured during the 2010 spill, were the subject of Project-effects estimation of habitat suitability (via the use of HSIs), or were otherwise identified as priorities for continued monitoring by Project partners.
  - *Alligator mississippiensis* (American alligator),
  - *Anas carolinensis* (green-winged teal),
  - *Anas fulvigula* (mottled duck),
  - *Mareca strepera* (gadwall), and
  - *Pelecanus occidentalis* (brown pelican.

- Schedule: Planned for both pre-operations and post-construction monitoring.

- Locations: Survey locations for the species listed above will be consistent with existing LDWF aerial surveys paths.

- Methodology:
  - LDWF conducts annual aerial surveys coast-wide to estimate the number of waterfowl (Figure 3.7-10). The survey consists of 27 north-south transect lines from the Gulf northward to U.S. Highway 90 that are one-quarter mile in width and vary in length from 8 to 48 miles. Survey lines are spaced at 7.5-mile intervals in the southwest and at 15 miles in the southeast resulting in 3% and 1.5% sampling rates in the two areas, respectively. A fixed wing aircraft is used for this inventory from an altitude of 125 feet at approximately 100 mph. The number of ducks and type of waterfowl species are recorded by habitat type on each survey line. The AMT will rely on the continuation of those data-collection efforts, and will consult with LDWF staff to determine reasonable approaches to estimate those relevant population estimates for the PIA.
  - LDWF conducts nesting surveys for brown pelicans. The AMT will rely on the continuation of those data-collection efforts, and will consult with LDWF staff to determine reasonable approaches to estimate those relevant population estimates for the PIA.
  - LDWF also conducts annual aerial surveys coast-wide to estimate the number of alligator nests, for purposes of setting the annual limits for the taking of eggs in support of the alligator farming industry. The AMT will rely on the continuation of those data-collection efforts, and will consult with LDWF staff to determine reasonable approaches to estimate those relevant population estimates for the PIA.

- Parties Responsible for Data Collection: LDWF.

3.7.3.22. Aquatic resource and terrestrial wildlife utilization of created/restored habitat

- Rationale: Estimate utilization of created or restored habitat by aquatic resources and terrestrial wildlife. The DWH PDARP (DWH Trustees 2016) discussed several fish and wildlife species that served as indicators of injury to the coastal vegetated marsh ecosystem caused by the 2010 spill (though it is noted that these were not the only species for which Deepwater Horizon injuries were documented):
    - *Fundulus grandis* (Gulf killifish),
    - *Cyprinodon variegatus* (sheepshead minnow),
    - *Palaemonetes pugio (*grass shrimp)
    - *Callinectes sapidus* (blue crab)
    - *Littorina irrorata* (marsh periwinkle), and
    - *Uca longisignalis* (Gulf marsh fiddler crab).

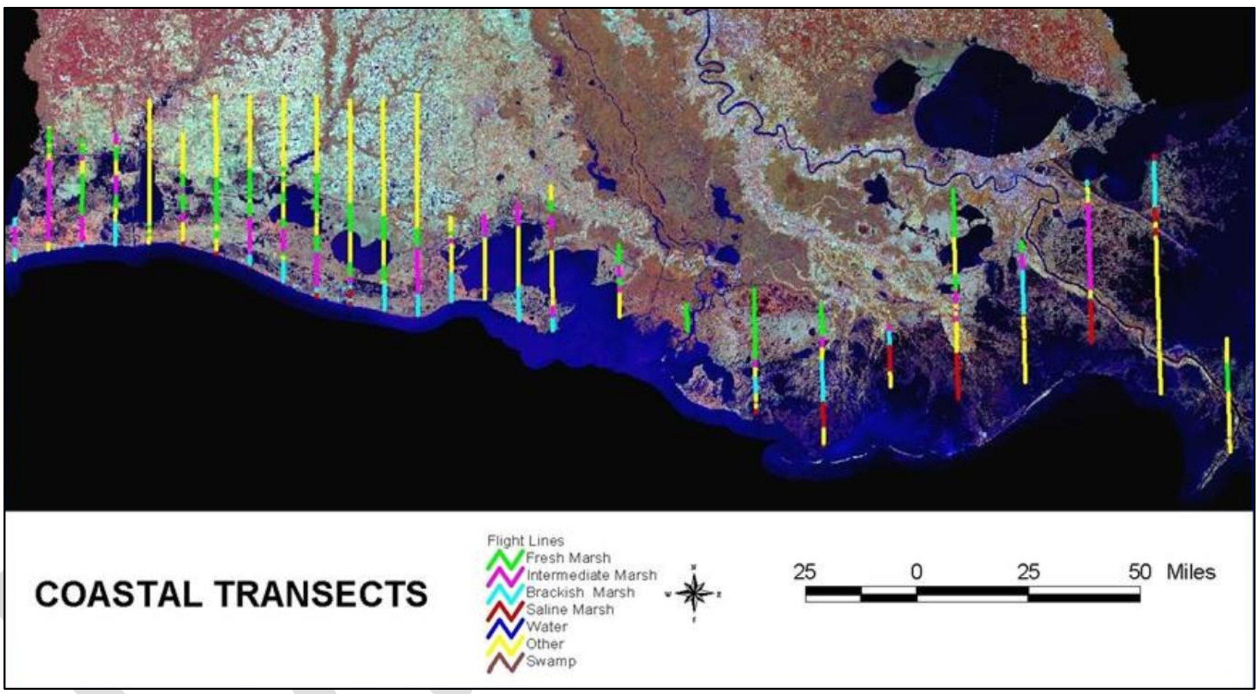


Figure 3.7-10. Locations of coastal transects flown by LDWF for waterfowl population estimations. Transects are shown in relation to marsh type from 2001 (see Linscombe and Hartley (2011). Figure courtesy of LDWF.

- Schedule: Planned to occur once pre-operations and every five years post-construction.

- Locations: Will include a mix of existing marsh sites within the PIA and newly-created marshes in the PDDA, and in two additional wetland areas (a conventionally restored wetland and an unrestored wetland) as described in Section 4.1.3, for purposes of assessing the relative ecosystem function of different marsh restoration treatments.

- Methodology:
    - Entrapment gears will be used to sample nekton such as *Gulf killifish and* grass shrimp in the tidal creeks, marsh and at the marsh edge.
    - Data from *Nekton (Fish and Shellfish) Species Abundance and Composition/Assemblage* (3.7.3.18), *Eastern Oysters* (3.8.3.20), and *Wildlife* (3.7.3.21) surveys will be combined with data collection at historically-occurring emergent wetlands within the Project Influence Area and newly-created emergent wetlands in the Project delta development area to provide an estimate of wildlife utilization.
    - *Gulf marsh fiddler crabs* will be surveyed non-destructively, through either burrow counts or visual counts of individual crabs (see discussion in Miller (no date)).
    - Marsh periwinkles will be sampled through visual counts.

- Parties Responsible for Data Collection: CPRA contractor.

3.7.3.23. Socio-economic Data

At this time, CPRA is proposing to rely on the Human Dimensions data collection in Barataria Basin outlined in the SWAMP implementation plan (Hijuelos and Hemmerling, 2016; https://cims.coastal.louisiana.gov/RecordDetail.aspx?Root=0&sid=11464). To summarize the proposed information outlined in Table C:1 therein, the categories (*in italics*) and variables proposed by Hijuelos and Hemmerling (2016) are

- *Population and Demographics*
    - Number of Households
    - Total Population
    - Race and Ethnicity
- *Housing and Community Characteristics*
    - Residential Stability
    - Home Ownership
    - Residential Occupancy Rates
    - Property Values
- *Economy and Employment*
    - Economic Development
    - Income Levels
    - Poverty Rates
    - Unemployment Levels
- *Ecosystem Dependency*
    - Nature Resource Extraction (agriculture and forestry, fisheries landings, oil & gas production)
    - Cultural and Traditional Uses of Natural Resources
    - Natural Resource-based Employment (agriculture, forestry, fishing and hunting, and oil & gas)
    - Tourism, Commercial and Recreational Use of Natural Resources (e.g., number of recreational fishing and hunting licenses, number of recreational trips to the area)

- *Residential Properties Protection*
  - Residential Risk Reduction
  - Households Receiving Structural Protection
  - Residential Properties Receiving Nonstructural Protection
- *Critical Infrastructure and Essential Services Protection*
  - Risk Reduction for Critical Facilities
  - Miles of Levees Created and Maintained
  - Number of Critical Facilities Protected by Levees
  - Public and Commercial Properties Receiving Nonstructural Protection

- Parties Responsible for Data Collection: Most of these parameters are collected and archived by the US Census Bureau or other federal agencies. CPRA or its contractor will obtain and analyze the federal data.

3.7.4. Compliance Monitoring

The purpose of compliance monitoring is to document the ability of those managing the Project to meet permitting requirements. ***This placeholder exists for descriptions of the collection of compliance data. If, and if so when, the Project permit is approved and issued and those requirements are identified, the corresponding details will be developed.***

3.7.4.1. National Historic Preservation Act, Section 106 Monitoring Requirements

- Rationale: In compliance with Stipulation X. Monitoring Plan of the Programmatic Agreement among USACE, the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and CPRA, CPRA will monitor the effects of the diversion on archaeological sites within the Operations Impact Area of Potential Effect.

- Schedule: Planned to occur once pre-operations and annually, after the cessation of operational flows and return to base flow, for the first ten years after the onset of Project operations.

- Locations: Documented historical sites in the Project Influence Area.

- Methodology: CPRA will use a team of Secretary of the Interior Qualified Archaeologists to conduct a one-day reconnaissance of the PIA by boat. This reconnaissance team will take photographs and document visible changes to the landscape, with the particular attention to any evidence of previously undiscovered cultural resources and the appearance of human remains at known archaeological sites. If the reconnaissance team locates an apparent cultural resource or human remains, CPRA will notify all Signatories to this Agreement within three days. A report documenting the results of the annual survey will be provided to all consulting parties with 30 days after completion of the survey.

- Parties Responsible for Data Collection
  - CPRA
  - Contracted team of Secretary of the Interior Qualified Archaeologists

4. EVALUATION AND PROJECT-LEVEL DECISIONS FOR CONDUCTING MANAGEMENT ACTIONS

Evaluation in the context of the MBSD Project MAM Plan refers to the consideration of data collected from the monitoring protocols outlined in Section 2. Those data will inform future Project management decisions aimed at improving Project effectiveness and limiting ecological and/or human impacts when possible. This section describes the general types and anticipated frequency of evaluations that will ultimately inform management actions, such as operations refinements and outfall management measures, changes to monitoring protocols, and refinements to modeling assumptions. Table 4-1 outlines the general classes of evaluations that correspond to the Project objectives that are described in detail in Section 1.

Table 4-1. A description of how evaluation will support the fundamental and secondary objectives.

Types of Monitoring (Section)	**Fulfills:**	**Overarching Questions Linking Evaluation to Decision-making**
Effectiveness (Section 3.6)	Fundamental Project Objectives (1,2,3)	How can the components of the Project (intake, channel, outfall transition) and/or operation strategies be optimized for sediment delivery between the river and basin? What measures are available? Is the pace or magnitude of wetland habitat creation and sustainability meeting expectations, within natural constraints?
Compliance (Section 3.8)	Resource management and permit conditions	How can Project components and/or operations be optimized to balance Project objectives and impacts?

Decisions on Project management actions, including the development and amendment of annual Operations Plans, will be made based on evaluation of the Project monitoring data. The basis for initiation of Project operations is outlined in Section 4.2 of the OMRR&R main report. The OMT will work with the AMT and other adaptive management partners to decide on continuation, alteration or discontinuation of operations (and subsequent amendments to the Annual Operations Plans) and/or the need for outfall management actions or other management responses during individual structure openings (events) and on annual and multi-year cycles as outlined in Section 5.

It is important to note that while Project alternatives modeling informs expectation of biophysical responses to Project operations, it isn't possible to know for certain prior to the onset of Project operations what the monitoring data will show, and thus what specific changes in Project operations or outfall management actions will be necessary. In the initial drafting of this section the focus has been to provide some considerations of the response to the Project Effectiveness data (Table 4-1), especially the efficiency by which the Project captures sediment from the MR and transports that sediment through the conveyance channel and into the Project receiving basin. CPRA expects these data will underpin the immediate needs and opportunities for adaptive management decision making.

To date, CPRA and LA TIG partners have proposed categorizing the monitoring parameters and evaluations into four categories. These categories reflect how the monitoring data would be evaluated, and whether the data evaluations would warrant or trigger considerations of some type of adaptive management action such as a change in operations or the implementation of outfall management. Those four categories are:

- Range: Data for these parameters will be evaluated with the goal of maintaining observations within a range of values based on documented historical and/or current variability, as well as scientific understandings of the parameter. Adaptive management actions will be considered if values were observed outside the range for a particular parameter.
- Presence/Absence: Data for these parameters will be evaluated in the binary of parameter occurrence or absence. Adaptive management actions will be considered if values occurred in the undesirable half of the binary (i.e., absent when presence is desired, or vice-versa).
- Trend: Data for these parameters will be evaluated as a progression of values in time and space. Adaptive management actions will be considered if the expected or desired trend (at least in part informed by Project alternative numerical modeling) does not occur or reverses from historical patterns.
- Context: Data for these parameters would be collected and analyzed due to broader interests in the values and trends. However, at this point, we do not anticipate data observations for these parameters triggering any considerations of adaptive management actions.

Initial categorization of each monitored parameter described in Section 3 is outlined in the tables below, with an emphasis on the term initial. Consistent with the idea of Project adaptive management, it is plausible that there may be changes in categorization of monitored parameters over time, as additional observations are made and data collected.

The authors also acknowledge that these bins may be artificially discrete. For example, a parameter might be assigned to be evaluated within a Range of values, but repeated observations of a Trend of values increasing unabated towards the maximum “acceptable” value within that Range might realistically trigger adaptive management considerations before values are observed exceeding that maximum.

4.1. Evaluation of Project Effectiveness Monitoring Data

There will be extensive monitoring of the Mississippi River, conveyance structure and Barataria Basin to inform Project effectiveness and document natural and human community response, as outlined in Section 3. Evaluation and decision making should be tempered by expected and empirical outcomes and the disparate timescales over which meaningful and discernable trends are exhibited by the resource or landscape. For example, the hydrologic impacts of the Project on basin habitats will be sudden and widespread; however, the emergence of new land area or plant community changes may experience various lag effects. There should be caution against premature evaluations on processes that require an accumulation of interacting processes over time; such an approach avoids cross-scale issues common to some large-scale restoration projects (Walters 1997). It is envisioned that peer review and collaborative analysis approaches will converge on accepted time scales for certain resource evaluations, especially as they pertain to further constraining an operation regime designed to meet the primary Project objectives.

4.1.1. Evaluation of Monitoring Data in Support of Project Objective 1: Deliver Freshwater, Sediment, and Nutrients to Barataria Bay through a Large-Scale Sediment Diversion from the Mississippi River

The overt, empirical basis for Project structure operations, at least in the initial years, will be continuous monitoring of *Mississippi River water discharge* (3.7.1.1.1). Additionally, early in Project operations, *Mississippi River suspended sediment concentrations* (3.7.1.1.2), *Water volume conveyed into Barataria Basin* (3.7.1.1.9) and *Sediment concentrations in the flows conveyed into Barataria Basin* (3.7.1.1.10) will be collected and analyzed immediately, as they will provide the technical rationale for confirmation and potential changes in operations to optimize *Sediment:water in the flows conveyed into Barataria basin* (Section 3.7.1.2.2).

Longer-term plans for the specific time intervals to conduct evaluations have not been determined. Measurements and surveys of each operational event could occur at higher frequencies during early operations, for example, to evaluate the sediment transport performance of all the conveyance features. As learning increases, the evaluations may shift from event-based to periodic (e.g., annual) intervals to inform operation decisions. However, it is not possible in advance of Project operations to predict how quickly Project managers will learn from each operational event. A performance metric such as *Sediment: water in the flows conveyed into Barataria basin* (Section 3.7.1.2.2) may initially be studied on multiple events within a year, but as river discharge and sediment availability relationships improve, evaluations may be limited to the water year.

Equally important is the determination of the extent to which Project operational flows are leading to changes in *Topography/bathymetry of the Project outfall area* (3.7.1.1.7), especially erosion of the native soils and sediments in the outfall area. Erosion may exceed deposition at some specific locations, especially immediately after operations commence. Project managers will need to make those assessments quickly and determine whether erosion and deposition patterns are within or exceed expectations, and whether immediate adaptive management of operations is warranted.

4.1.2. Evaluation of Monitoring Data in Support of Project Objective 2: Reconnect and Re-establish Sustainable Deltaic Processes between the MR and the Barataria Basin

The parameters listed in Table 4.1-2 and Section 3.7.2 are proposed to support Objective 2 by informing how the Project would reconnect the Mississippi River to the Barataria Basin and re-establish delta building in the Basin. Objective 2 is explicitly centered on the movement of water and sediment through the Basin and the response of soil-building processes; specifically, the repeated addition of riverine mineral sediments to Basin wetland soils and the resulting increase in marsh soil surface elevation that help those marshes be sustainable intertidal habitats in the face of relative SLR.

Water velocities at multiple locations in the Project Influence Area (3.7.2.1.1) during both Project base flows and operational events will be followed to determine whether Project flows result in broader erosion of existing marsh or open water bottoms than the Project alternatives numerical modeling suggested. Excessive erosion would reduce the overall goal of building and maintaining emergent wetland in the Basin. Note that the focus of this monitoring would be outside of the immediate Project outfall area. For areas most proximal to the discharge of the Project, numerical modeling has projected the scouring of some existing marsh and subaqueous water bottoms. This phenomenon is necessary for the Project flows to build the distributary network in the receiving area needed to distribute freshwater, nutrients and sediments into the Basin.

Likewise, Project alternatives modeling has projected that *Frequency, depth and duration of inundation at multiple locations on the marsh in the Project Influence Area* (3.7.2.1.2) will increase during Project operations. The Project partners will monitor this parameter to determine if, and if so the extent to which, Project operations will result in inundation patterns that are limiting subaerial wetlands in the PIA. This limitation, if present, could result from excessive water levels physically inundating wetland surfaces, and/or the imposition of an inundation stress on emergent wetland vegetation. Currently the available science informing what inundation patterns are either optimal for or detrimental to marsh vegetation growth is inexact, and hinders establishing firm limits. As a result, no explicit thresholds in inundation have been established *a priori*, and instead the intention is to monitor this parameter to see whether an increasing trend in inundation results over time from Project operations. While the Project Operations and Adaptive Management Teams await scientific advances and Project-specific data to inform eventual thresholds on optimal versus detrimental inundation to specific plant species, a consistent increase in inundation would be more broadly recognized as undesirable.

The hydrologic flows resulting from Project operations are ultimately what will transport the mineral sediments in diverted Mississippi River flows (Objective 1) into the Barataria Basin and distribute those sediments into open waterbodies and onto the marsh surface. The two remaining parameters proposed as adaptive management triggers in Table 4.1-2 reflect the fate and effect of those sediments.

Most central to the overall intention of the Project, and thus the determination of Project success and effects, is the effect of diverted freshwater, nutrients and sediments on the *Marsh surface elevation change rate in the Project Influence Area* (3.7.2.1.9), as measured at CRMS-*Wetlands* sites. The Project is intended to create and sustain emergent marshes in the Basin indirectly by stimulating plant growth that will contribute organic matter to the marsh soil profile, and by directly transporting mineral sediments onto the marsh surface and into the soil profile. Both of these processes would be manifested by increases in marsh surface elevation over time, with sustainability defined as rates of increase exceeding local estimates of RSLR and thus sustaining subaerial emergent marsh. Observations of declines in marsh surface elevation, especially at CRMS-*Wetlands* sites that currently demonstrate other elevation change patterns, would suggest either limitations in diverted material flows to the marsh or that Project operations are imposing other stresses on the wetlands.

Similarly, calculations of *Sediment dispersal and retention on the emergent marsh surface in the Project Influence Area* (3.7.2.2.1) will elucidate Project success by determining patterns of mineral sediment distribution onto, and into the soil matrix of, the wetlands in the PIA. This parameter will be an important one for the Project Operations and Adaptive Management Teams to monitor because unlike the well-recognized benefits of filling open water bottoms with sediment and establishing new emergent wetlands, the available science suggests that there is a "Goldilocks" optimum to the benefits of dispersed sediments to intact marshes. Too few sediments transported to the marsh surface may not stimulate plant growth and maintain *Marsh surface elevation change rate in the Project Influence Area*, while too great a sediment delivery can impose lethal physical stresses to the native vegetation and lead to mineral lenses in the soil profile that hinder future marsh growth. It would be up to Project managers to weigh the costs and benefits of observed short-term sediment depositional patterns to the long-term goals of the Project.

CPRA has proposed that a number of soil development parameters be relegated for now as Context variables; i.e., parameters for which data will be collected, but which at this time are not being identified as representing overt triggers for adaptive management consideration (see Section 4.2). As proposed, if there are issues noted with the soil-related triggers above, these parameters will be more fully investigated to determine why issues were identified.

4.1.3. Evaluation of Monitoring Data in Support of Project Objective 3: Create, restore, and sustain wetlands and associated ecosystem services

If the processes represented by the monitoring parameters designated in support of Objective 2 represent the secondary effects on Barataria Basin hydrology and soils of diverted Mississippi River freshwater, nutrients and sediments, then Objective 3, and the parameters intended to support the evaluations of meeting Objective 3 (Section 3.7.3) and the needs for adaptive management actions (Table 4.1-3), are the tertiary effects of the diverted flows, and are the primary goal of and need for this project. The proposed Objective 3 parameters are specifically concerned with the actual development of new wetlands resulting from sediment dispersal into the Basin, changes in water quality, and the response of living resources (plant, animal and human) to the diverted freshwater, nutrients and sediments.

As defined by Objective 3, *Land and water extent/Area of new delta formation* (3.7.3.1) and *Emergent wetland area* (3.7.3.2) would be priority parameters for mid-term consideration. These two parameters specifically follow the Objective 2 observations of dispersal of materials by the Project, and whether those material flows are resulting in new or sustained emergent wetlands within the Basin. This report has discussed earlier why the projections of wetland loss and gain from numerical modeling are inappropriate as temporal benchmarks of Project performance. However, the modeling can provide an order-of-magnitude estimate of what land gain and loss could be expected if the Project were to be operated over a particular time period under conditions (river discharge, operational frequency, sediment content, etc.) similar to those modeled. Those evaluations cannot be made *a priori*, and so will need to wait on both actual operations and the expected frequency of land/water data collection. That said, land building or land-loss that is anomalous to the model's order-of-magnitude projections are expected to trigger closer looks at other variables (e.g., those described under Objective 2) that might provide an explanation for why.

To quantify the restoration benefits of the marsh that develops in the diversion outfall area, a Before-After-Control-Impact study will be established. Ecosystem function in the created marsh will be compared to the pre-construction existing condition using the following datasets: *Land and water extent* (3.7.3.1), *Emergent wetland area* (3.7.3.2), *Vegetation Cover, Abundance, and* Height (3.7.3.3), *Emergent and submerged vegetation community type* (3.7.3.5), *Emergent vegetation biomass in the Project area* (3.7.3.6), *Topography/bathymetry of the Project delta development area* (3.7.1.1.7), *Lower trophic level organisms* (3.7.3.16), *Nekton species abundance and composition/assemblage* (3.7.3.18), and *Aquatic resource and terrestrial wildlife utilization of habitat in the Project Influence Area* (3.7.3.22).

To compare the wetland function of a marsh built by a sediment diversion to that of a marsh built by conventional wetland restoration (marsh creation from dredged sediments), a study will be established to compare three types of wetland treatments. MAM partners will develop the experimental design for the study once the study goals and objectives are finalized. Assessment will rely heavily on the data collection that was otherwise established for this Project, planned coast-wide LiDAR surveys, existing CRMS-*Wetlands* stations (for unrestored marsh), and pre- and post-construction sampling from a conventionally-restored marsh. Wetland function will be evaluated using the same parameters listed in the paragraph above.

Regarding water quality parameters, the adaptive management focus would be on the response of *Dissolved oxygen* (3.7.3.7) and *Salinity* (3.7.3.8), as these are expected to drive many of the biological responses described below in the Basin, as well as fundamentally defining the ability of Project operations to still retain a functional estuary, from a *Salinity* standpoint. On that latter point, while Project alternatives numerical modeling does project that salinities will freshen substantially during Project operations beyond base flows, the same modeling projects a rapid return to a full range of estuarine salinities in the Basin once base flows are reinstated. Observations of freshwater salinities that persist throughout the Basin even after Project operations cease would trigger adaptive management considerations.

Concerns have been expressed about the potential for Project operations to result in the development of phytoplankton blooms, and especially HCABs). A phased adaptive management approach is proposed here to monitor for that potential. In lieu of institutionalizing comprehensive water quality monitoring for HCABs and HCAB toxins, the Project partners propose to systematically monitor *Chlorophyll a* (3.7.3.9) using *in situ* sondes and possibly remote sensing. Observations of anomalously large-scale (spatially) and/or rapid (temporally) increase in *Chl a* during or after Project operational events under this approach would trigger follow-on boat-based sampling of the waters in question for determination in the lab of *Phytoplankton species composition* (3.7.3.10), to determine if HCAB species are present in the assumed phytoplankton bloom, and for *Harmful algal bloom toxins* (3.7.3.11) to determine toxin presence/absence if HCAB species are present. It is anticipated at this time that only the presence of *Harmful algal bloom toxins* would trigger consideration of adaptive management actions.

The proposal described above for a Presence/Absence approach to evaluating *Salinity* data is similar to the proposal for evaluating a number of living resources; namely, *Submerged aquatic vegetation area* (3.7.3.4), *Emergent and submerged vegetation community type* (3.7.3.5), *Nekton species abundance and composition/assemblage* (3.7.3.18), and *Aquatic resource and terrestrial wildlife utilization of habitat in the Project Influence Area* (3.7.3.22). The reason for this proposal is the same as described earlier as well. We expect, from the results of the Project alternatives numerical modeling, that Project operations will result in some persistent and some temporary changes in the salinity structure of the estuary, including localized salinity decreases (especially closer to the Project outfall). Living resource distributions are expected to likewise change, at least in so far as that described by the Basin-wide Model (for vegetation) and model outputs for fish and wildlife. No adaptive management considerations are proposed in the event that there are not persistent and large-scale changes in estuarine species distributions throughout the Basin as a whole; i.e., that Project operations do not result in major and widespread Basin-wide losses of estuarine plants and animals. Explicit in this proposal is the idea that localized estuarine species losses where salinities decrease would not trigger AM considerations.

The project may cause a change in the occurrence of invasive species. The new or increased occurrence of invasive nekton species (*Nekton species abundance and composition/assemblage* (3.7.3.18)) or invasive aquatic invertebrate or algal species (*Aquatic Invasive (Algae and Invertebrate) Species*) would trigger an adaptive management action to control species that are deemed as a threat to ecosystem function. The new or increased occurrence of invasive vegetation species (*Emergent and submerged vegetation community type* (3.7.3.5)) would be noted as a sign of changing conditions, and would provide context, but would not trigger an adaptive management action.

The exception to this Presence/Absence consideration of living resources data would be for consideration of *Emergent vegetation biomass in the Project Influence Area* (3.7.3.6), measure at the existing and proposed CRMS-*Wetlands* stations. As mentioned earlier, Project effects numerical modeling projects localized increases in *Marsh surface elevation change rate in the Project Influence Area* (3.7.2.1.9) during Project operations. It is uncertain how exactly emergent plant biomass will respond to the environmental changes resulting from Project operations, but currently the proposed approach around this variable is to consider some kind of adaptive management action if there are repeated, consistent year-over-year decreases in emergent plant biomass.

To evaluate changes in the Barataria Basin food web, multiple datasets will be used. Changes in community assemblage over time will be clarified through *Nekton species abundance and composition/assemblage* (3.7.3.18) and in *Lower Trophic Level Organisms* (Section 3.7.3.16). Questions about changes in the biodiversity of the aquatic food web, the food web links, and the benthic: pelagic ratios (biomass and productivity, including interannual and seasonal variability) over time will be explored through the use of ecosystem models refined and run as described in Section 1.5 and by incorporating additional information collected as described in *Lower Trophic Level Organisms* (Section 3.7.3.16) *Nekton species abundance and composition/assemblage* (3.7.3.18), and *Aquatic resource and terrestrial wildlife utilization of habitat in the Project Influence Area* (3.7.3.22). Refined models will also be used to qualify the ecosystem benefits of the Project; test and understand ongoing and potential future changes resulting from management actions to existing conditions; statistically relate environmental condition variability to food web responses; improve predictive capabilities.

4.2. Evaluation of Context Variables

Comprehensive evaluation of all monitored parameters is anticipated to occur at every five years (see 5.2.3). Some of these variables will be monitored due to substantial interest in changes in value, but we do not anticipate the data serving as triggers for adaptive management at this time (although consistent with the idea of adaptive management, those parameter classifications/considerations could change in the future); and are thus classified as Context variables. Other variables listed below are not proposed in themselves as potential triggers for adaptive management, but may contribute to calculations of other variables that are presented above as adaptive management triggers.

However, it is not that these parameters would not inform adaptive management considerations. In fact, when observations of the more actionable parameters described in Section 4.1 trigger adaptive management consideration, it is entirely likely that related or contributing parameter data will also be analyzed to help inform decision making on the best course of action. For instance, if consideration of an adaptive management action is triggered based on observations of *Sediment dispersal and retention on the emergent marsh surface in the Project Influence Area* (3.7.2.2.2) below the desired range of values, the Adaptive Management Team would likely examine *Soil mineral matter density* (3.7.2.2.4) or *Rate of accretion above feldspar marker horizons* (3.7.2.1.7) to help inform why dispersal may be insufficient.

Parameters proposed for classification as Context variables are

- Mississippi River nutrient concentrations (3.7.1.1.3)
- Sedimentology of the Alliance South sand bar (3.7.1.1.5),
- Sediment concentrations in the flows conveyed into Barataria Basin (3.7.1.1.10),
- Mississippi River sediment load (3.7.1.2.1),
- Sediment volume conveyed into Barataria Basin (3.7.1.2.3),
- Nutrient loads conveyed into Barataria Basin (3.7.1.2.4),
- Soil bulk density (3.7.2.1.3),
- Loss of soil organic matter on ignition (3.7.2.1.4),
- Soil mineral matter grain size (3.7.2.1.5),
- Soil total nutrients (3.7.2.1.6),
- Rate of accretion above feldspar marker horizons (3.7.2.1.7),
- Soil strength (3.7.2.1.8),
- Soil organic matter density (3.7.2.2.3),
- Soil mineral matter density (3.7.2.2.4),
- Nutrient constituents in Barataria surface waters (3.7.3.12),
- Temperature of Barataria surface waters (3.7.3.13),
- Turbidity of Barataria surface waters (3.7.3.14),
- Total suspended solids in Barataria surface waters (3.7.3.15),
- Lower Trophic Level Organisms (3.6.3.16)
- Wildlife (3.7.3.21), and
- Socio-economic data (3.7.3.23).

4.3. Evaluation of Compliance Monitoring Data

This placeholder exists for descriptions of the evaluation of compliance data. If the Project permit is approved and issued identifying those requirements, the corresponding details will be developed accordingly.

4.3.1. National Historic Preservation Act, Section 106 Findings

Details and a matching table will be developed if, and if so when, the Project permit is issued.

Table 4.2-1. Parameters monitored to ensure Project Objective 1 (Delivery of freshwater, sediment, and nutrients), proposed frequency of evaluation, categorization of parameter evaluation, and criteria that would trigger consideration of undertaking adaptive management action.

Parameter/Calculation	Frequency of Evaluation	Category	Observations Triggering Adaptive Management Consideration	Examples of Potential Adaptive Management Actions
Mississippi River water discharge (3.7.1.1.1)	Pre-operations: Continuous Post-construction: Continuous	Range	MR discharges less than 450,000 cfs would constrain operations to a base flow of up to 5,000 cfs, dependent on head differential between MR and basin. MR discharges 450,000 – 1,000,000 cfs would result in operational flows, also dependent on head differential between MR and basin. MR discharge greater than 1,000,000 cfs would constrain operational flows to maximum 75,000 cfs Outside that, irregular discharge patterns beyond those observed in the historical record (e.g., persistent high or low discharges outside expected seasonal patterns) would trigger consideration of flow alterations.	Adjust the extent that the Project structure is opened between operational and base flows, within permitted ranges.
Mississippi River suspended sediment concentrations (3.7.1.1.2)	Pre-operations: Continuous Post-construction: Continuous	Context/ Range	Initial considerations as a Context variable may be amended in the future to a Range variable, with learning following some period of data collection. As Range, decline of concentrations below expected for a particular *Mississippi River water discharge* (3.7.1.1.1)	None in the short term while this is considered a Context variable.
Bathymetry of the Alliance South sand bar (3.7.1.1.4)	Pre-operations: Annually Post-construction: before/after each Project operational event for first five years, bi-annually thereafter	Range	Excessive magnitude or rate of erosion in bar bathymetry would trigger consideration of adaptive management. Numerical criteria are pending continued high-resolution modeling outcomes by the PDT.	To be determined.
Topography/bathymetry of the Project Delta Development Area (3.7.1.1.7)	Pre-operations: Once prior to onset of operations Post-construction: before/after each Project operational event for first five years, bi-annually thereafter	Trend	Year-to-year observations of a magnitude or rate of erosion of the Project outfall area, compared to model projections as order-of-magnitude expectations. Deposition in the Project outfall area without the development of a deltaic distributary network, compared to model projections as order-of-magnitude expectations.	Outfall management actions
Bathymetry of canals in the Project Influence Area (3.7.1.1.8)	Pre-operations: Twice prior to onset of operations Post-construction: After each operational event beyond base flow, or annually if no operations in a particular year	Range	Magnitude or rate of deposition in the Barataria Waterway and Wilkinson Canal that limit boat traffic in those waterways.	Conduct maintenance dredging of the canals to address impacts from the Project, or Implement outfall management measures to limit the loss of sediments to the canals
Water volume conveyed into Barataria Basin (3.7.1.1.9)	Post-construction: Continuous	Presence/ Absence	As per the Project permit request, operational discharge will not exceed 75,000 cfs when *Mississippi River water discharge* (3.7.1.1.1) is at or above 1,000,000 cfs.	Adjust the extent that the Project structure is opened between operational and base flows to maintain proposed operational and base flow discharges.
Sediment:water in the flows conveyed into Barataria Basin (3.7.1.2.2)	Post-construction: Biweekly during operational events, quarterly during base flows	Range	Persistent (greater than 5 year) sediment:water below initial operations values; declines in sediment:water through time during operational events and base flows. Numerical criteria are pending continued high-resolution modeling outcomes by the PDT.	Adjust timing of Project operational flows in relation to river discharge and suspended sediment concentration
Nutrient loads conveyed into Barataria Basin (3.7.1.2.4)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Context	None in the short term while this is considered a Context variable.	None in the short term while this is considered a Context variable.

Table 4.1-2. Parameters monitored to ensure Project Objective 2 (Reconnect and Re-establish Deltaic Processes), proposed frequency of evaluation, categorization of parameter evaluation, and criteria that would trigger adaptive management action.

Parameter/Calculation	Frequency of Evaluation	Category	Observations Triggering Adaptive Management Consideration	Examples of Potential Adaptive Management Actions
Water velocities at multiple locations in the Barataria Basin (3.7.2.1.1)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	Observed water velocities causing unanticipated erosion (based on numerical and physical modeling) in the Project Influence Area, outside the immediate receiving basin.	Outfall management actions
Frequency, depth and duration of inundation of marsh at locations in the Project Influence Area (3.7.2.1.2)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Trend	Persistent (greater than 5-year) trend of increasing frequency of inundation would trigger consideration of adaptive management if data and learning could lead to identification of a threshold. No explicit threshold value has been identified at this time. Potential for a revision of the parameter to be binned as Range if data and learning allow.	Adjust the extent that the Project structure is opened between operational and base flows Outfall management actions
Marsh surface elevation change rate in the Project Influence Area (3.7.2.1.9)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Trend	A decline in marsh surface elevation that exceeds the projected rate (considering RSLR) within the Project Influence Area would trigger consideration of adaptive management	Outfall management actions
Sediment dispersal and retention on the emergent marsh surface in the Project Influence Area (3.7.2.2.1)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	Absence of sediment dispersal onto marsh surface, or substantially lower values than modeling results as order-of-magnitude expectations. Values would be based on high-resolution design modeling, which is still ongoing.	Outfall management actions

Table 4.1-3. Parameters monitored to ensure Project Objective 3 (Create, restore, and sustain wetlands and associated ecosystem services), proposed frequency of evaluation, categorization of parameter evaluation, and criteria that would trigger adaptive management action.

Parameter/Calculation	Frequency of Evaluation	Category	Observations Triggering Adaptive Management Consideration	Examples of Potential Adaptive Management Actions
Land and water extent / Area of new delta formation (3.7.3.1)	Limited analysis dependent on frequency of data collection, comprehensive analysis every five years after the onset of Project operations	Trend	Land building that does not occur after a reasonable amount of time, using the Delft Basin-wide Project modeling as an order-of-magnitude projection (e.g., if no land gain after five years IF the project operated during the first decade as proposed in response to environmental drivers).	Outfall management actions
Emergent wetland area (3.7.3.2)	Limited analysis dependent on frequency of data collection, comprehensive analysis every five years after the onset of Project operations	Trend	Repeated observations of loss of existing and lack of creation of new emergent wetlands from the Project Influence Area, using the Delft Basin-wide Project modeling as an order-of-magnitude projection (e.g., if no land gain after five years IF the project operated during the first decade as proposed in response to environmental drivers).	Outfall management actions
Submerged aquatic vegetation area (3.7.3.4)	Limited analysis dependent on frequency of data collection, comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	Repeated observations of a complete loss of submerged aquatic vegetation from the Barataria Basin	Outfall management actions
Emergent and submerged vegetation community type (3.7.3.5)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	A persistent (greater than five-year) shift in vegetation communities to a fully freshwater + intermediate character of the Barataria Basin	Outfall management actions
Emergent vegetation biomass in the Project Influence Area (3.7.3.6)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Trend	Reductions in emergent vegetation biomass in the Project Influence Area over a five-year period (dependent on Project operations) that suggests excessive inundation or other imposed stresses on the vegetation.	Outfall management actions ; changes in diversion operations timing or volume.
Dissolved Oxygen (3.7.3.7)	Pre-operations: Continuous Post-construction: Continuous , Comprehensive analysis every five years after the onset of Project operations	Range	Changes in oxygen within a “normoxic” range (4-14 mg/L) would be viewed as acceptable Development of hypoxic conditions ($dO_2 < 4$ mg/L) that persist throughout the Basin for more than 3 months after Project operations return to base flow, as a result of Project operations in areas currently and historically normoxic.	Outfall management actions
Salinity (3.7.3.8)	Pre-operations: Continuous Post-construction: Continuous , Comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	Observations of freshwater salinities that persist throughout the Basin for more than 3 months after Project operations return to base flow would trigger adaptive management considerations.	Outfall management actions
Chlorophyll a (3.7.3.9)	Pre-operations: Continuous (sondes), periodic if remote sensing used Post-construction: Continuous (sondes), periodic if remote sensing used	Trend	Increase in chlorophyll concentrations suggestive of a harmful algal bloom would trigger follow-up discrete sampling for *Phytoplankton species composition (3.7.3.10*)	Outfall management actions
Phytoplankton species composition (3.7.3.10)	Pre-operations: Discrete sampling only Post-construction: Discrete sampling only	Presence/ Absence	Presence of cyanobacterial and/or eukaryotic algal species associated with harmful algal blooms would trigger analysis of discrete samples from 3.7.3.9 for *Harmful algal bloom toxins* (3.7.3.10)	Outfall management actions
Harmful algal bloom toxins (3.7.3.11)	Pre-operations: Discrete sampling only Post-construction: Discrete sampling only	Presence/ Absence	Presence of cyanobacterial and/or eukaryotic algal bloom toxins could trigger consideration of a receiving basin adaptive management action	Outfall management actions
Aquatic Invasive (Algae and Invertebrate) Species (3.7.3.17)	Pre-operations: Once Post-operations: Once per five years	Presence/ Absence	The new or increased presence of aquatic invasive species could trigger an adaptive management action to address species viewed as an ecosystem threat.	If presence of aquatic invasive species is deemed a threat to ecosystem function, control or eradication measures may be initiated.

Table 4.1-3 (*continued*). Parameters monitored to ensure Project Objective 3 (Create, restore, and sustain wetlands and associated ecosystem services), proposed frequency of evaluation, categorization of parameter evaluation, and criteria that would trigger adaptive management action.

Parameter/Calculation	Frequency of Evaluation	Category	Observations Triggering Adaptive Management Consideration	Adaptive Management Actions to Consider
Nekton (Fish and Shellfish) Species Abundance and Composition/Assemblage (3.7.3.18)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Presence/ Absence	-Measuring a persistent basin-wide decline in abundance over five years for an estuarine assemblage could trigger an adaptive management action (NOT a change in community assemblage or location-specific shift from marine to freshwater character of the assemblage). The new or increased presence of aquatic invasive species could trigger an adaptive management action to address species viewed as an ecosystem threat. Sufficient project monitoring indicates that freshwater inflows to the Basin may be reduced while still maintaining the efficacy of the Project consistent with goals and objectives.	Outfall management actions If presence of aquatic invasive species is threat to ecosystem function, control or eradication measures may be initiated.
Bottlenose Dolphins (*Tursiops truncatus*) (3.7.3.19)	Variable depending on specific parameters	Range	Sufficient project monitoring indicates that freshwater inflows to the Basin may be reduced while still maintaining the efficacy of the Project consistent with goals and objectives.	Project optimization
Eastern Oysters (*Crassostrea virginica*) (3.7.3.20)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Range	Persistent decline in parameter values that suggests the loss of a viable population in the Basin or current seed grounds could trigger consideration of actions outlined in the mitigation strategy, such as relocation of seed grounds to more environmentally-suitable areas within the Basin or establishment of brood-stock reefs to address larval supply. Observations that Project operations result in hydrodynamic barriers to larval dispersion	Analysis of project operations and resulting conditions across the basin.
Aquatic resource and terrestrial wildlife utilization of habitat in the Project Influence Area (3.7.3.22)	Limited analysis annually, comprehensive analysis every five years after the onset of Project operations	Trend	Measuring a persistent decline in aquatic resource and/or terrestrial wildlife utilization of habitat in the Project Influence Area.	Outfall management actions

5. MONITORING AND ADAPTIVE MANAGEMENT SCHEDULE

5.1. Project Monitoring Schedule

5.1.1. Pre-operational Monitoring

The Pre-operations Monitoring Plan introduced in Section 3 are currently being planned as up to a five-year effort (no less than three), to establish a robust baseline condition within the Project receiving area and the larger Barataria Basin while the Project undergoes E&D and construction. Critical in that baseline monitoring will also be clarifying spatial variability in the data, as well as inherent temporal trends in the data that might refine considerations of when to undertake adaptive management action.

5.1.2. Post-operational Monitoring

Given the intended 50-year life of the Project that is guiding Project E&D, at least some of the attributes outlined in Section 3 will be collected for that entire time. However, the planned length of monitoring for all attributes will ultimately depend on evaluation of the early datasets for responsiveness and variability.

5.2. Timeline of Adaptive Management Decision-Making and Implementation

The overall timeline of adaptive management will include activities that take place during individual structure openings (events), annually, as well as activities occurring on a five-year planning cycle that will more comprehensively consider and integrate data across a longer cycle. Periods for evaluation of whether each adaptive management trigger has been met vary by parameter; see section 4 for details.

5.2.1. Event Timeline

Evaluation and decision-making at the level of individual structure openings will occur as discussed in Section 4. Decisions made during individual events will be memorialized in the annual and multi-year reporting described below.

5.2.2. Annual Timeline

Figure 5.2-1 proposes two categories of actions that would occur on an annual basis. The top of the figure illustrates a more expedited consideration of a limited set of operations performance data from the Water Year (WY) operations that ends on September 30, to provide CPRA with a rapid summary of the past year's Project operations and to support annual State funding requests for continued operations during the upcoming State Fiscal Year. In contrast, the bottom of the figure illustrates the consideration of a more comprehensive set of WY operations data that underpins the development of annual Operations, Maintenance and Monitoring (OM&M) Reports and the formal Operations Plan. Both sets of actions center on the annual management of the Project by the Operations Management Team and continuous collection of the data outlined in Section 3.

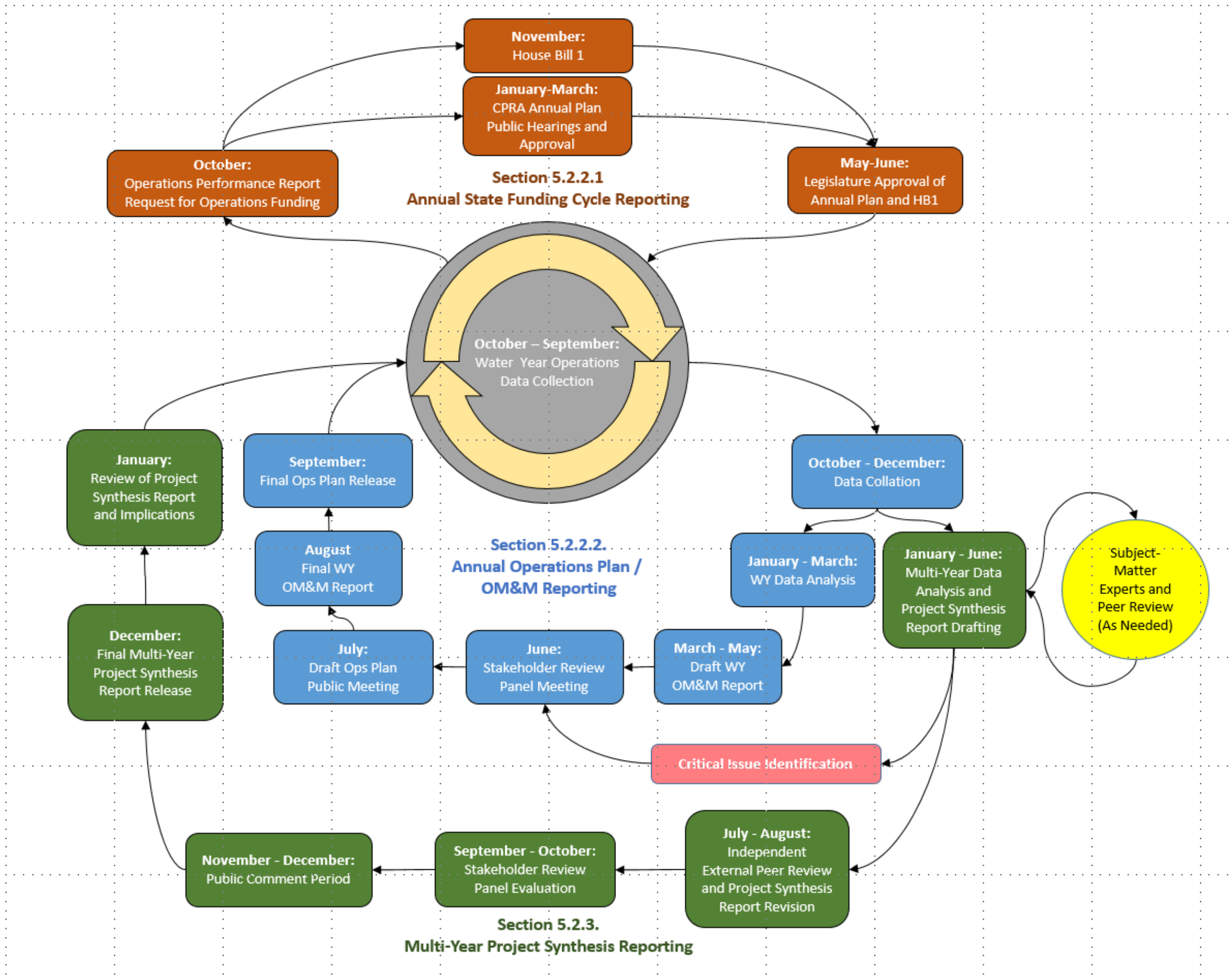


Figure 5.2-1. Idealized timeline of Annual Cycle Adaptive Management Activities discussed in Section 5.2.2 and the Multi-year Project data evaluations discussed in Section 5.2.3. The steps illustrated in the orange boxes are discussed in Section 5.2.2.1. The steps illustrated in the blue boxes are discussed in Section 5.2.2.2. The steps illustrated in the green boxes are discussed in Section 5.2.3.

5.2.2.1. State Funding Cycle Reporting

- October
  - Immediately following the end of the WY, the Data Management Team (DMT) and OMT will work to develop an Operations Performance Report to underpin upcoming State Fiscal Year funding requests.
- November
  - CPRA will submit the upcoming State Fiscal Year project operations funding request to the State's Division of Administration for inclusion in the draft of House Bill 1.
- January - March
  - The upcoming State Fiscal Year Project operations funding request will be included in the draft of CPRA's Annual Plan, which CPRA submits annually for a 3 year-budget outlook. Typically, CPRA releases the draft Annual Plan for public comment in January for the upcoming fiscal year, with CPRA Board vote for approval of the Annual Plan occurring during the last Board meeting prior to the beginning of the annual Session of

the Legislature. Following approval by the Board, CPRA submits the Annual Plan to the Legislature for consideration.

- May-June
  - Typically, the Legislature votes on both House Bill 1 and the CPRA Annual Plan late in the annual Legislative session. Both bills must pass the Legislature to appropriate Project operational funds in the next State Fiscal Year starting on July 1.

5.2.2.2. Annual Operations Plan / OM&M Reporting

The following idealized annual timeline may be adjusted to allow the Annual Operations Plan to be included in CPRA's Annual Plan and aligned with the State's funding cycle.

- October to December, Year
  - Data collection will largely follow a WY schedule, but due to the nature of some data collection/analysis, the WY data inventory will likely not be complete until the end of the calendar year.
- January – March
  - Analysis of the WY data by the Data Management and Analysis Team
- March – June
  - Preparation of the draft WY OM&M Report
- June: Stakeholder Review Panel Meeting
  - CPRA will solicit input and perspectives from stakeholders on the information contained within the draft OM&M report and the proposed Operations Plan for the upcoming WY.
  - CPRA may convene additional meetings throughout the year as deemed appropriate and/or necessary.
- July: Public Meeting - General Comments, Draft Operations Plan
  - CPRA will present the draft Operations Plan for the upcoming year, to gather input for possible incorporation into that plan, and to consider possible items to be evaluated and or addressed in an OM&M or Adaptive Management report
- August
  - Completion and release of previous WY OM&M Report, prior to the release of the draft operations plan. WY Project data will be uploaded to the Diver data server (Section 6).
- September: Final Operations Plan
  - Completion and public release of the upcoming WY Operations Plan, prior to October implementation.

5.2.3. Multi-year Project Synthesis Reporting

In addition to the annual timeline of adaptive management activities, additional review and comprehensive synthesis of monitoring data and evaluation of management options will occur at five-year intervals, allowing for the consideration and evaluation of multiple years of monitoring data and assess processes on a longer time scale.

The comprehensive data syntheses will be based on multiple years-worth of Project Effectiveness evaluations (Section 4) and other data. The syntheses will be developed consistent with processes used to conduct other comprehensive data reviews.

5.2.3.1. October-December: Data Collation

The DMT will collate multi-year data in the last quarter of the Calendar Year following the end of a particular WY, with the same rationale as described in Section 5.2.2.2 above.

5.2.3.2. January-June: Data Analysis and Project Synthesis Report Drafting

The AMT will lead the analysis of the multi-year datasets and the drafting of the Multi-year MAM Report, in coordination with the OMT. Given the nature of the data, CPRA expects to conduct analyses using a mix of AMT members directly and outside contractors as needed. Note that any serious issues initially identified during this analysis/synthesis could be addressed by the AMT and PMT outside of the rest of the review and communication process below, and brought to the attention of the Stakeholder Review Panel during their June meeting (5.2.2.2).

5.2.3.3. July-August: External Peer Review and Revision

The AMT will coordinate an external peer review of the draft Multi-year MAM Report. The Team will develop the protocols for the external review in coordination with the Stakeholder Review Panel to ensure an objective process. This draft schedule assumes a 45-day review of the draft report, after which the AMT and any relevant contractors will revise the report based on the reviews received.

5.2.3.4. September-October: Stakeholder Review Panel Evaluation

The AMT will work with the OMT to present the revised draft Multi-year MAM Report to the Stakeholder Review Panel and solicit a review and comments from the Panel. CPRA will conduct this presentation as an in-person meeting or a web seminar with the Panel members. The Panel will have four weeks to review the report, after which time the AMT and its contractors will revise the document into a final draft report based on the reviews received.

5.2.3.5. November-December: Public Comment Period

The AMT will coordinate with the OMT to make the revised draft Multi-year MAM Report available for a 30-day public comment period on the final draft report, after which the Adaptive Management Team and any relevant contractors will revise the report based on the reviews received. CPRA will then publicly release the final report.

5.2.3.6. January: Review of Project Synthesis Report Implications

The AMT and OMT will review the Multi-year MAM Report for implications to Project operations and/or additional management actions. Recommendations based on that review will be made to the CPRA Executive Team, and if adopted will be discussed at the next Annual Cycle Stakeholder Review Meeting and Public Meetings.

6. DATA MANAGEMENT

6.1. Data Description

Data collected as part of this Project will occur via site visits, field surveys, *in situ* continuous recorder devices, and remote sensing. As discussion in Section 3, data types include hydrologic (e.g., water level, water velocity), bathymetric/topographic (e.g., land/water area, elevations, accretion), geotechnical (e.g., soil characteristics), geophysical (e.g., sidescan sonar), chemical (e.g., salinity, water quality), biological (e.g., fish, invertebrates, wildlife, vegetation), and geospatial (e.g., vector, raster, aerial and satellite imagery). A substantial amount of data will be collected via existing programs, including those coordinated by CPRA (e.g., CRMS, BICM, SWAMP) as well as other agencies (e.g., LDWF, LDEQ, USGS, NOAA). Additional data collection will occur from targeted project-specific monitoring and research. The timing and frequency of data collection varies by parameter, ranging from continuous sampling (e.g., water level), to biannual or annual (e.g., biological surveys), to every few years (e.g., land change).

To the extent practicable, data collection will follow relevant standard operating procedures (SOPs). These include, but are not limited to

- A Standard Operating Procedures Manual for the CRMS – *Wetlands* (Folse et al., 2020).
- Standard Operating Procedures for Geo-scientific Data Management, Louisiana Sand Resources Database (Khalil et al., 2016)
- A Contractor's Guide to the Standards of Practice For CPRA Contractors Performing GPS Surveys and Determining GPS Derived Orthometric Heights within the Louisiana Coastal Zone (CPRA, 2016)
- Coast-wide and Barataria Basin Monitoring Plans for Louisiana's SWAMP (Hijuelos and Hemmerling, 2015)

Electronic data files will follow the file naming convention used by CPRA's Coastal Information Management System (CIMS) as outlined in Appendix 4 of Khalil et al. (2016). Metadata will be developed for project data, and to the extent practicable will follow Federal Geographic Data Committee and International Organization for Standardization standards.

6.2. Data Review and Clearance

All data collected as part of the Project will undergo proper QA/QC, review, and clearance procedures consistent with the guidelines developed by the NRDA Cross-TIG Monitoring and Adaptive Management work group (https://www.gulfspillrestoration.noaa.gov/project?id=71). CPRA's DMT will be responsible for data stewardship following CPRA's documented policies, SOPs, data conventions, and QA/QC procedures (e.g., Folse et al., 2020; Khalil et al., 2015; CPRA, 2016; CPRA, 2017). Data integrity will be checked with detailed and complex QA/QC software routines prior to input into the database, and additional automated routines when input into the database. CPRA staff and contractors who collect and input data into the database may also provide feedback on data quality and software routines to the DMT. Following data QA/QC, CPRA will give the other TIG members time to review the data before publishing on a public site.

6.3. Data Storage and Accessibility

All data collected and analyzed as part of this project will be stored on either CPRA's CIMS website (https://cims.coastal.louisiana.gov/default.aspx) and/or the NOAA's Data Integration, Visualization, Exploration, and Reporting (DIVER) tool. CPRA will submit Project data to CIMS and/or DIVER as soon as possible and no more than one year from when data are collected. NOAA will provide a link to CIMS in the DIVER Restoration Portal.

CIMS is the official repository for environmental, modeling, and monitoring data for restoration projects undertaken by the state, as well as programmatic data collected by CRMS and BICM. CIMS combines a network of webpages hosted by CPRA, a GIS database, and a relational tabular database into one public-facing, GIS-integrated system capable of data visualizations and data delivery. Data preservation of the CIMS database/application suite is largely done through regular tape back-up and/or cloud storage for disaster recovery and continuation of service. All data and documents in the CIMS database/application suite are publicly available will continue to be available in perpetuity and/or for the life of the agency.

DIVER serves as the public NOAA repository for data related to the DWH Trustees' NRDA efforts. To provide additional context to the NRDA data, the site also includes historical (pre-2010) contaminant chemistry data for the onshore area of the Gulf of Mexico, as well as contaminant chemistry data collected during the response efforts and by the responsible party, British Petroleum. These data are available to the public and are accessed through a query and mapping interface called DIVER Explorer. Categories of Trustee NRDA data in DIVER include:

- photographs of the emergency response, the oiled animals, plants, fish, and beaches;
- telemetry information collected from remote sensing devices such as transmitter data from animal monitoring;
- field observations such as notes about the condition of animals found in the spill and extent of oiling in marshes;
- instrument data such as water temperatures and salinity collected during the spill; and
- sample results of laboratory analysis on tissue, sediment, oil, and water.

CPRA and NOAA are discussing ways to establish links between the two systems or at least ways to point to NRDA project data stored in each system, so CIMS users can easily find relevant data stored in DIVER and vice versa.

6.4. Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy, through either the CIMS Data Portal (https://cims.coastal.louisiana.gov/) and/or the DIVER Explorer (https://www.diver.orr.noaa.gov) within one year of data collection. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed will provide notice, and an opportunity to comment or object, to the other LA TIG Trustees prior to releasing any project data that is the subject of the request.

Any data that is protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act will not be publicly distributed.

7. REPORTING

7.1. DIVER Restoration Portal Reporting

Once finalized, this MAM Plan will be uploaded to the DIVER Restoration Portal and made publicly available through the DIVER Explorer https://www.diver.orr.noaa.gov/) and Trustee Council website (https://www.gulfspillrestoration.noaa.gov/). CPRA will also upload future revisions of the MAM Plan to the DIVER Restoration Portal following development and approval by the LA TIG, following discussions between CPRA and the TIG about the magnitudes of Plan amendments that would warrant reposting.

MAM activities and corresponding documents will be reported annually in the DIVER Restoration Portal. This will include information on the monitoring parameters, performance criteria (if applicable), monitoring duration and frequency, etc.

7.2. Mid-Basin Sediment Diversion Project Annual Operations Plans

The basis of Project operations is the main OMRR&R Plan, and the Annual Operations Plan is its yearly implementation. Information and lessons learned from the previous year will be taken into account when adjusting the operations plan for each upcoming year. Draft Annual Operations Plans will be presented to the Stakeholder Review Panel and at public meetings to solicit comments, perspectives, and insights. Following any revisions, the plan will be finalized for approval by the CPRA Executive Director.

7.3. Annual Operations Performance Reports

The Project DMT will develop Annual Operations Performance Reports to underpin CPRA's annual Project operations funding requests to the CPRA Board and the Louisiana Legislature. These reports will be limited to a summary of the Project Effectiveness monitoring data available in October of any particular Calendar Year, immediately following the end of a WY. Once developed, these reports will be posted onto CPRA's CIMS website, as well as uploaded to the DIVER Explorer and Trustee Council websites.

7.4. Annual Operations, Maintenance & Monitoring Reports

Annual OM&M Reports of Water Year Project Effectiveness and Status & Trends Data will be developed by the Operations Management Team that provides data collection results, attribute outcomes, operations information, maintenance updates, recommendations for monitoring, additional project features, lessons learned, etc. from the previous year's operations. As described in Section 5.2.2, these reports will provide a summary of the monitoring data collected during the WY regarding Project Operations and river and basin responses. Some descriptive and initial statistical analyses will be conducted on the WY data. However, more robust analyses will be relegated to the Multi-Year Report described below. Once developed, CPRA will post these reports the CIMS website, as well as upload them to the DIVER Explorer and Trustee Council websites.

7.5. Multi-year Monitoring and Adaptive Management Reports

Multi-year Monitoring and Adaptive Management Reports will be developed as described in Section 5.2.3 to provide a comprehensive analysis of Project Effectiveness and Status & Trends Data during the duration of the project. To the extent practicable, the interim and final MAM reports will be consistent with the MAM report template in the Deepwater Horizon TIG MAM Manual. Once developed, CPRA will post these reports the CIMS website, as well as upload them to the DIVER Explorer and Trustee Council websites .

7.6. Compliance Reporting

7.6.1. US Fish & Wildlife Service Coordination Act Annual Report

CPRA's responsibilities with regards to the US Fish & Wildlife Service (USFWS) Coordination Act require the development and communication of an annual report outlining data specific to USFWS trust resources in the Barataria Basin. CPRA intends for that report to represent a subset of, but otherwise largely mirror the level of analysis in, the Annual OM&M Reports (7.4). The final format, content, and review process for this report will be developed by CPRA and USFWS.

7.6.2. Louisiana Trustee Implementation Group Annual Report

CPRA will develop an annual report to the LA TIG outlining data specific to NRDA trust resources in the Barataria Basin. CPRA intends for that report to represent a subset of, but otherwise largely mirror the level of analysis in, the Annual OM&M Reports (7.4). The final format, content, and review process for this report will be developed by CPRA and the LA TIG.

8. MONITORING AND ADAPTIVE MANAGEMENT BUDGET

Under development

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10. INVENTORY OF PROJECT-RELATED DISCRETE/APERIODIC STUDIES

This section will be populated through time as outstanding research needs are identified.

11. PROJECT ADAPTIVE MANAGEMENT DECISION LOG AND CATALOG OF UPDATES TO THE MONITORING AND ADAPTIVE MANAGEMENT PLAN

This section will be populated through time as this Plan is updated.

Appendix B: Mitigation and Stewardship Plan for the Proposed MBSD Project

Mid-Barataria Sediment Diversion
Draft Mitigation and Stewardship Plan

1. INTRODUCTION

The Coastal Protection and Restoration Authority of Louisiana (CPRA) is proposing to construct, operate, and maintain the proposed Mid-Barataria Sediment Diversion Project (Project). The Project is intended to address injuries caused by the *Deepwater Horizon* (DWH) oil spill by implementing a large-scale sediment diversion in the Barataria Basin. The sediment diversion will reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin through the delivery of sediment, fresh water, and nutrients to support the long-term viability of existing and planned coastal restoration efforts.

The Project has the potential to directly and indirectly impact—both beneficially or adversely—wetlands and other waters of the United States, U.S. Army Corps of Engineers (Corps) civil works projects, threatened and endangered species, marine mammals, essential fish habitat (EFH), and other elements of the environment, as identified in the National Environmental Policy Act (NEPA) draft environmental impact statement (DEIS) for the Project.

The Purpose of this Mid-Barataria Sediment Diversion Mitigation and Stewardship Plan (Mitigation Plan) is to demonstrate how incidental adverse impacts of the Project will be avoided, minimized, or mitigated to the extent required under applicable federal law. In particular, the objectives of the Mitigation Plan include identifying mitigation that will: (1) offset unavoidable adverse impacts to jurisdictional waters of the United States; and (2) ensure the Project is not contrary to the public interest, pursuant to section 404 of the Clean Water Act (CWA) and sections 9 and 10 of the Rivers and Harbors Act.

The Mitigation Plan also identifies: (1) conservation measures to avoid and minimize potential effects to species listed as threatened or endangered under the federal Endangered Species Act (ESA); and (2) conservation recommendations provided by the National Marine Fisheries Service (NMFS) and adopted by the Corps to conserve, avoid and/or minimize adverse effects to EFH; and (3) stewardship actions to address project-related changes to the environment.

2. PROJECT OVERVIEW

The Project is a controlled intake diversion structure in Plaquemines Parish, Louisiana connecting the Mississippi River with the adjoining Barataria Basin. The structural features of the Project will be located on the west bank of the Mississippi River at River Mile (RM) 60.7. The Project is intended to convey sediment, fresh water, and nutrients from the Mississippi River into an outfall area within the Barataria Basin in Plaquemines and Jefferson Parishes. After passing through a proposed intake structure complex at the confluence of the Mississippi River and the proposed intake channel, the sediment-laden water would be transported through a conveyance channel to an outfall area in the mid-Barataria Basin.

Flow in the diversion would be variable, with the gates opening when the Mississippi River gage in Belle Chasse reaches 450,000 cubic feet per second (cfs). The diversion would reach a peak flow of 75,000 cfs into the mid-Barataria Basin when the Mississippi River discharge is 1,000,000 cfs or more. When Mississippi River flows are below 450,000 cfs at Belle Chasse, the Project would maintain a background (base) flow of up to 5,000 cfs to protect, sustain, and maintain newly vegetated or recently converted fresh, intermediate, and brackish habitats near the diversion outflow.

As more fully explained in Section 5 below, the Project is anticipated to have major, permanent benefits on wetlands and other U.S. jurisdictional waters in the Barataria Basin. The purpose of the diversion of fresh water, sediments, and nutrients into the Barataria Basin is to build, sustain, and maintain wetlands and riverine deltaic processes in an area that has been isolated from natural flooding inputs from the Mississippi River. A consistent and large magnitude input of sediment will lead to accumulation of diverted sediments and formation of new sub-areal features available for plant colonization. Direct deposition within existing wetlands contributes to surface accretion helping to offset the effects of sea level rise and subsidence.

3. PROJECT SITE

The Project Area is shown in Figures B-1 and B-2 below. A detailed description of the ecologic characteristics of the Project site is presented in Ch. 3 of the NEPA DEIS.

The marshes of the mid-Barataria Basin are increasingly fragmented due to increased saltwater intrusion, subsidence, and erosional forces and are losing land area at a more rapid rate than other areas of the basin (Ayres 2012; Couvillion et al. 2016; CPRA 2012 and 2017). As a result, this portion of the Basin is viewed as an area of critical need within the Barataria Basin that may benefit most markedly from a sustained infusion of sediment, fresh water, and nutrients from a sediment diversion.

If no action were taken, the trend of increasing land loss in the Barataria Basin would continue, resulting in the conversion of up to nearly 274,000 acres of emergent wetlands and other subaerial (above the water surface) landforms to subaqueous (below the water surface) shallow water by the year 2070 (see Table 4.2-3).

The Barataria Basin was identified in the Louisiana Trustee Implementation Group's (LA TIG) Final Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana (SRP/EA #3) as a focus area for restoration activities because within Louisiana, the Barataria Basin suffered the most severe and persistent oiling from the DWH oil spill (LA TIG 2017). It is also an "area of critical need" due to its significant and continuing land loss. In the SRP/EA #3, the LA TIG identified a combination of sediment diversions and marsh creation projects as the preferred restoration strategy for the Barataria Basin.

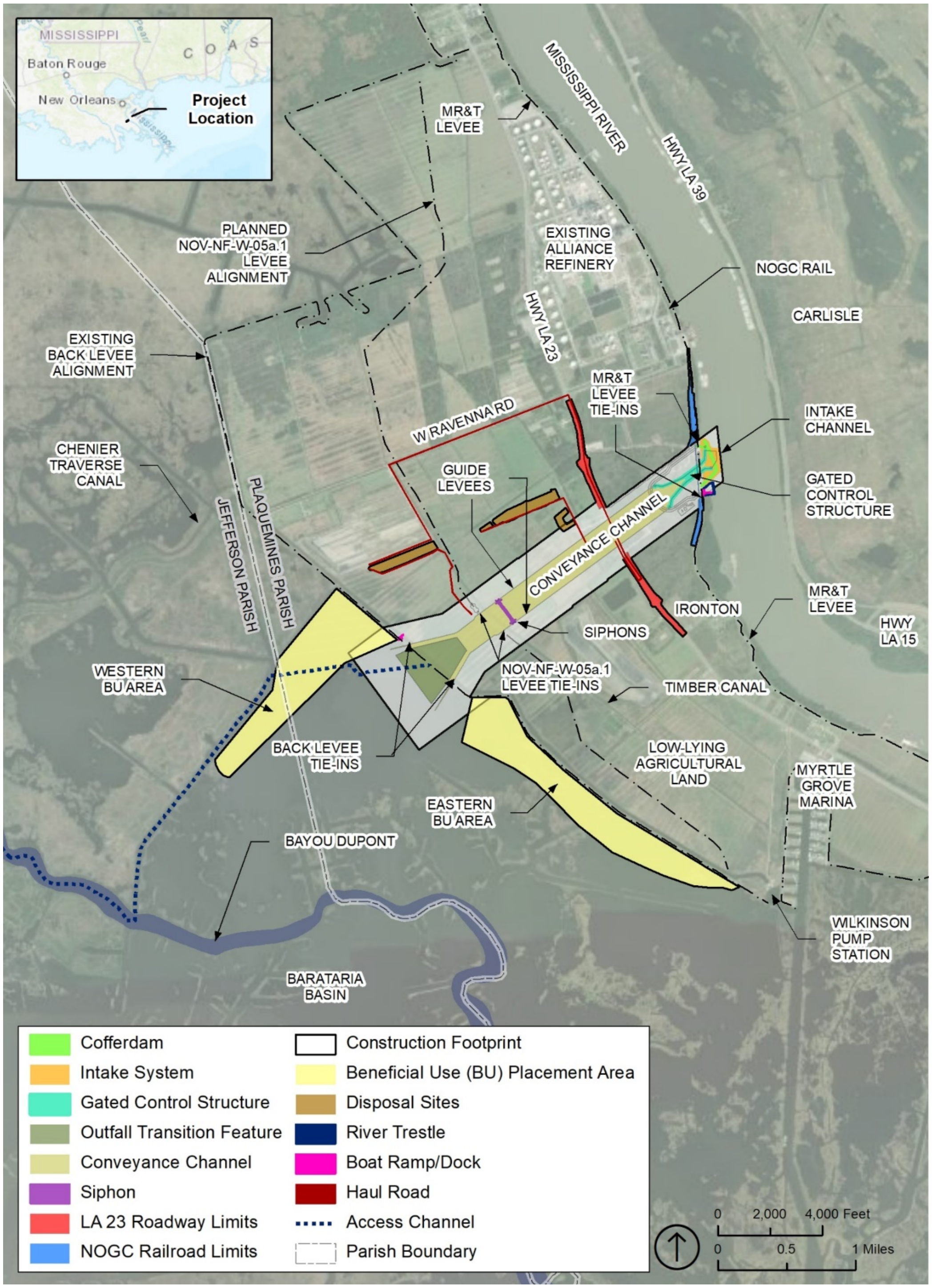
MISSISSIPPI
Baton Rouge
New Orleans
Project Location
MR&T LEVEE
MISSISSIPPI RIVER
HWY LA 39
PLANNED NOV-NF-W-05a.1 LEVEE ALIGNMENT
EXISTING ALLIANCE REFINERY
NOGC RAIL
CARLISLE
EXISTING BACK LEVEE ALIGNMENT
HWY LA 23
MR&T LEVEE TIE-INS
INTAKE CHANNEL
W RAVENNA RD
CHENIER TRAVERSE CANAL
GUIDE LEVEES
GATED CONTROL STRUCTURE
CONVEYANCE CHANNEL
PLAQUEMINES PARISH
JEFFERSON PARISH
IRONTON
MR&T LEVEE
HWY LA 15
SIPHONS
WESTERN BU AREA
NOV-NF-W-05a.1 LEVEE TIE-INS
TIMBER CANAL
BACK LEVEE TIE-INS
LOW-LYING AGRICULTURAL LAND
MYRTLE GROVE MARINA
EASTERN BU AREA
BAYOU DUPONT
WILKINSON PUMP STATION
BARATARIA BASIN
Cofferdam
Intake System
Gated Control Structure
Outfall Transition Feature
Conveyance Channel
Siphon
LA 23 Roadway Limits
NOGC Railroad Limits
Construction Footprint
Beneficial Use (BU) Placement Area
Disposal Sites
River Trestle
Boat Ramp/Dock
Haul Road
Access Channel
Parish Boundary
0 2,000 4,000 Feet
0 0.5 1 Miles

Figure B-1.

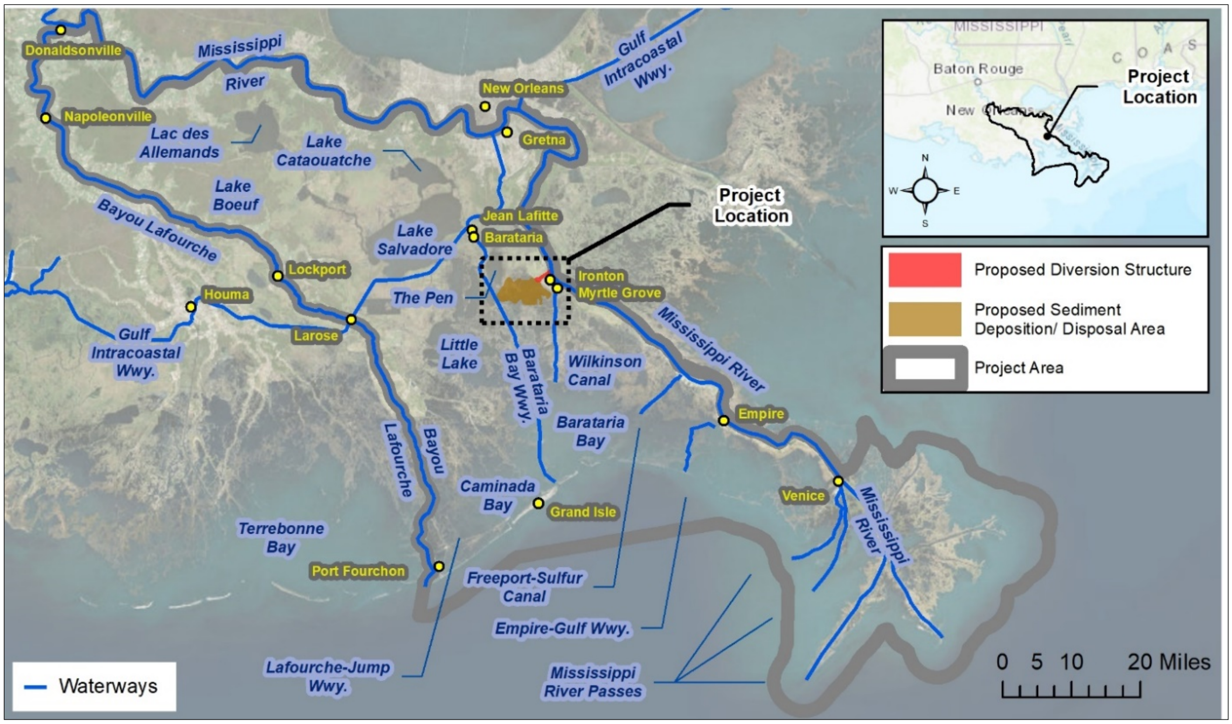

Figure B-2.

The proposed location for the Project is in the Middle Basin. As described in more detail in the DEIS, a project in the Middle Basin allows for capture and redistribution of fine-grained and coarse-grained sediments, is buffered from excessive erosional forces, and is better protected from extreme changes in salinity. Conversely, the upper Barataria Basin wetlands are still relatively intact and more protected from the combined influence of erosion, relative sea-level rise and saltwater intrusion compared to lower reaches of the basin. The upper Barataria Basin continues to be the least fragmented of marshes and forested wetland in the Barataria Basin (Couvillion et al. 2016) and was relatively protected from the oiling of the DWH oil spill (PDARP/PEIS Chapter 4). The lower Barataria Basin consists of large expanses of relatively deep open water. Due to the combination of deeper water, highly fragmented marsh, and higher relative sea level rise rates, there is less opportunity for effective sediment capture and an expected longer timeframe for a diversion project in the lower Barataria Basin to demonstrate benefits. It would take longer, and require a larger sediment volume, for the coarse-grained sediments that are the foundation of wetland creation to accumulate and reach a subaerial elevation suitable for marsh development.

4. PERMITTING HISTORY AND RELATED MITIGATION GUIDELINES AND REQUIREMENTS

4.1. Oil Pollution Act

On March 20, 2018, consistent with Oil Pollution Act (OPA), the LA TIG published the SRP/EA #3. In the SRP/EA #3, the LA TIG Trustees selected a large-scale sediment diversion for further planning as part of a suite of restoration projects that constitutes the Applicant's Preferred Alternative for restoring DWH oil spill injuries through restoration in the Barataria Basin. The Trustees further selected the Project, among others, for advancement and further evaluation under OPA and NEPA in a Phase II Restoration Plan and NEPA analysis.

4.2. Clean Water Act Section 404/Rivers and Harbors Act Section 10

Because the Project would involve the discharge of dredged and fill material into waters of the United States and requires construction to be performed in the Mississippi River and the Barataria Basin, a CWA Section 404 permit and a Rivers and Harbors Act (RHA) Section 10 permit are required for construction and operation of the Project. Permits for activities requiring approval under both Section 10 of the RHA and Section 404 of the CWA are processed simultaneously by the Corps.

CPRA submitted a Joint Permit Application on June 23, 2016, to the Corps' New Orleans District (CEMVN) for Section 404/10 permits. On March 26, 2018, CPRA submitted a revision to the permit application including a revised statement of Purpose and Need.

The Corps' decision whether to issue Section 404/10 permits will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest.[i] Relevant factors in such evaluation include: "conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people."[ii] Compensatory mitigation may be required to ensure that an activity requiring authorization is not contrary to the public interest.[iii]

In addition, pursuant to CWA Section 404, compensatory mitigation is required to offset environmental losses from unavoidable impacts to waters of the United States.[iv] The U.S. Environmental Protection Agency (EPA) and the Corps have articulated the policy and procedures to be used in the determination of the type and level of compensatory mitigation necessary (Section 404(b)(1) Guidelines).[v] The Section 404(b)(1) Guidelines state that "the district engineer will issue an individual Section 404 permit only upon a determination that the proposed discharge complies with applicable provisions of 40 CFR Part 230, including those which require the permit applicant to take all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the United States."[vi] Practicable means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Under the Section 404(b)(1) Guidelines, impacts must first be avoided and minimized.[vii] Avoidance of impacts to aquatic resources involves the least-damaging project type, spatial location and extent compatible with achieving the purpose of the project. Avoidance is achieved through an analysis of appropriate and practicable alternatives and a consideration of the impact footprint. Minimization involves managing the severity of a project's impact on resources at the selected site. Minimization is achieved through the incorporation of appropriate and practicable design and risk avoidance measures. If impacts cannot be avoided or minimized, compensatory mitigation should be provided.[viii]

Compensatory mitigation involves replacing or providing substitute resources for impacts that remain after avoidance and minimization measures have been applied. The Section 404(b)(1) Guidelines make the purchase of mitigation bank credits and in-lieu fee payments the preferred mitigation methods over permittee responsible mitigation.[ix] Where justified, the mitigation technique selected may be out of order in terms of mitigation preference. The implementation of the compensatory mitigation should be in advance of or concurrent with the impacts.[x]

4.3. Rivers and Harbors Act Section 408

Section 408 of the RHA provides that the Corps may grant permission for another party to alter a Civil Works project upon a determination that the alteration proposed will not be injurious to the public interest and will not impair the usefulness of the Civil Works project.[xi] As in the context of Section 404/10 permits, the Corps may require mitigation to ensure the proposed alteration is not injurious to the public interest.[xii]

The Project has the potential to alter Corps civil works projects and requires Section 408 permission to proceed. The following Corps civil works projects are located within the Project area: the Mississippi River Ship Channel Gulf to Baton Rouge Project, Saltwater Sill Mitigation Project, Gulf Intracoastal Waterway, Barataria Bay Waterway, Bayou Lafourche and Lafourche-Jump Waterway, Mississippi River and Tributaries Project – Mississippi River Levee, Hurricane and Storm Damage Risk Reduction System Projects, Larose to Golden Meadow Project, and Davis Pond Freshwater Diversion Project.

CPRA submitted a Section 408 Permission Request Letter on January 13, 2017 to CEMVN for a Section 408 permission. CEMVN determined that Section 408 permission was required with respect to the Mississippi River Ship Channel, the Mississippi River & Tributaries Levees, and the New Orleans to Venice (NOV) Non-Federal Levee (NFL) Corps, New Orleans District projects.

4.4. National Environmental Policy Act

NEPA requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. NEPA does not require federal agencies to prescribe mitigation for effects of their actions.

Because federal approvals, including Section 404 and 10 permits and Section 408 permission, are required for the Project, the Project is a federal action subject to NEPA. The Corps is the lead federal agency for compliance with NEPA. The Corps determined that the Project may significantly affect the quality of the human environment and therefore, decided to prepare an EIS. The Corps prepared a DEIS dated March 5, 2021, in accordance with NEPA and applicable NEPA implementation regulations (43 U.S.C. § 4321 *et. seq*.; 40 C.F.R. § 1500, as amended; 33 C.F.R. § 325, Appendices B and C). The Corps requested that six federal and state agencies with statutory authority or special expertise with an environmental issue participate in the EIS process as cooperating agencies, including the Environmental Protection Agency ("EPA"), the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS), the NOAA Damage Assessment, Remediation, and Restoration Program (DARRP), the U.S. Department of Interior's (DOI) U.S. Fish and Wildlife Service (USFWS), the Louisiana State Historic Preservation Office (LA SHPO), and the Louisiana Department of Transportation and Development (LDOTD). The Corps also invited several federal, state and local agencies to participate in the EIS process as commenting agencies, including the U.S. Geological Survey (USGS), the Natural Resources Conservation Service (NRCS), the Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), the Louisiana Department of

Wildlife and Fisheries (LDWF), the Louisiana Department of Natural Resources (LDNR), the Louisiana Office of State Lands (OSL), the Louisiana Department of Environmental Quality (LDEQ), the Plaquemines Parish Government (PPG), and the Jefferson Parish Government (JPG).

Impacts identified in the DEIS and associated technical analyses (as well as in other analyses outside of the NEPA process, such as the public interest review) were used as the basis for mitigation in the Mitigation Plan. A final EIS is expected to be published in 2022. If impacts are identified in the final EIS that were not identified in the DEIS, CPRA will coordinate with the Corps and other participating agencies to revise the Mitigation Plan accordingly. The FEIS will also inform decisions made by the LA TIG regarding restoration planning and related funding decisions relevant to the Deepwater Horizon natural resource damage settlement. The DEIS evaluates any environmental consequences associated with implementation mitigation and stewardship measures presented here. That evaluation is included in Appendix R of the DEIS.

4.5. Endangered Species Act

Section 7(a)(2) of the ESA requires federal agencies to consult with NMFS and/or the USFWS (collectively the Services) to ensure that effects of actions that the federal agencies authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat. During this consultation, the federal action agency prepares an initial assessment of the potential impacts of the proposed action on listed species and critical habitat. If the action agency determines that an action is not likely to adversely affect listed species or critical habitat, and the Services agree with that assessment, the ESA consultation is concluded informally.

If the action agency determines that an action is likely to adversely affect listed species or designated critical habitat, the action agency prepares an assessment of those potential impacts and provides it to the Services. The Services then evaluate the impacts to listed species and their designated critical habitat, including impacts resulting from any indirect and cumulative effects.[xiii] Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur.[xiv] Cumulative effects are effects of future State, tribal, local or private actions (not Federal actions) that are reasonably certain to occur in the action area.

The evaluation of the impact of the proposed action may take into account the actions to benefit or promote the recovery of listed species that are included by the federal agency as an integral part of the proposed action. If the applicable Service determines that the action is not likely to jeopardize the continued existence of the listed species and not likely to destroy or adversely modify its designated critical habitat, it will issue a “no jeopardy” biological opinion and an incidental take statement (ITS), detailing the amount and extent of anticipated incidental take. 50 C.F.R. § 402.14(i). The ITS will include reasonable and prudent measures—actions the Director believes necessary or appropriate to minimize the impacts, i.e., amount or extent, of incidental take. The ITS will also include additional terms and conditions that the federal agency and any applicant must implement to minimize the impact of such incidental take. If the applicable Service determines that the action is likely to jeopardize the listed species or to destroy or adversely modify its designated critical habitat, it will issue a “jeopardy” biological opinion and identify a reasonable and prudent alternative to the proposed action.

The Corps will submit a biological assessment to the Services and initiated Section 7 consultation for the Project in February 2021. The Corps will consult with the Services under Section 7. Such consultation is anticipated to result in a biological opinion from each Service in November 2021.

4.6. Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires federal agencies to consult with FWS and the head of the agency exercising administration over the wildlife resources of the particular State regarding activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat.[xv] FWS and the state agency may make recommendations for consideration by the federal agency; the agency may consider the recommendations, but is not required to follow them.[xvi]

Pursuant to FWS guidance,[xvii] mitigation is accomplished through the use of a five-step process for reducing or eliminating losses from a project: avoidance, minimization, rectification, rectification over time, and compensation. Compensation is used to mitigate for unavoidable losses after the first four components of mitigation have been applied. Compensation means full replacement—substitution of fish and wildlife resource losses with resources considered to be of equivalent biological value—of project-induced losses to fish and wildlife resources.

Under the policy, the mitigation goal depends on the category of resource to be impacted by the action, as follows:

- Resource category 1: Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section.
  - Mitigation goal: no loss of existing habitat value.
- Resource category 2: Habitat to be impacted is of high value for evaluation species and is relatively scarce.
  - Mitigation goal: no net loss of in-kind habitat value.
- Resource category 3: Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant
  - Mitigation goal: no net loss of habitat value while minimizing loss of in-kind habitat value.
- Resource category 4: Habitat to be impacted is of medium to low value for evaluation species.
  - Mitigation goal: minimize loss of habitat value.

The Corps initiated consultation with the FWS and the state under the Fish and Wildlife Coordination Act on January 19, 2021. FWS made the following recommendations:

1. The Service recommends the construction of crevasse projects that may include terracing to offset the indirect loss of 926 acres on the Delta NWR and 37 acres on the Pass-A-Loutre (PAL) WMA. Funding for these crevasse projects is currently available from a variety of sources, including the Coastal Wetland Planning, Protection and Restoration Act ("CWPPRA"), but should funding not be available through those sources to implement the crevasse projects, funded through Operations and Maintenance costs associated with the project or set aside in the Monitoring and Adaptive Management Plan to ensure wetland

losses in Delta NWR and PAL WM will be addressed. Any CWPPRA funding for these crevasse projects should be in addition to, and should not displace, CWPPRA funding that would otherwise be used to implement crevasse projects in Delta NWR and PAL WMA. The Service recognizes that the Birdfoot Delta Hydrologic Restoration Project, the Engineering and design of which were funded pursuant to Deepwater Horizon Oi Spill, Louisiana Trustee Implementation Group Final Restoration Plan and Environmental Assessment #7: Wetlands, Coastal and Nearshore Habitats and Birds (November 2020), will, if funded for implementation, provide further benefits to the Delta NWR and PAL WMA and offset the indirect losses on those resources from the MBSD. For additional information on possible projects, associated permits, and for all activities occurring on the Delta NWR, please coordinate with this office and the Southeast Louisiana Refuges by contacting Barret Fortier (985.882.2011, barret_fortier@fs.gov), and for similar information on any activities planned for Pass a Loutre WVA contact LDWF, Mr. Vaughn McDonald 225-765-2708, atvmcdonald@wlf.la.gov).
Applicant Response: CPRA agrees to Conservation Recommendation 1.

2. The impacts to Essential Fish Habitat should be discussed with the NMFS to determine if the project complies with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Magnuson-Stevens Act; P.L. 104-297, as amended) and its implementing regulations.
Applicant Response: CPRA agrees to Conservation Recommendation 2 and is actively coordinating with NMFS regarding potential impacts to Essential Fish Habitat.

3. In order to better coordinate and consider the overall health of the Barataria basin, the Service recommends that a basin-wide operations and basin monitoring data repository be developed. The data and conclusions should be readily available to help in the general coordination among diversion operators, within their authorizations, and to understand both adverse and beneficial impacts to the overall basin. The Service and other natural resource agencies should be involved in reviewing and commenting on this data repository.
Applicant Response: CPRA agrees to Conservation Recommendation 3 and has developed a data repository consistent with this Recommendation. CPRA looks forward to discussing that repository with the Service and other natural resource agencies.

4. Monitoring of the Davis Pond and Caernarvon Diversions indicated that some contaminants were being introduced into the receiving areas from the Mississippi River. To address potential impacts of future contaminants on fish and wildlife resources, the Service recommends that pre and post sampling of fish and shellfish from the outfall area and the Mississippi River be undertaken. The Service recommends that CPRA, in coordination with the Service, develop a list of contaminants to be analyzed. The list of contaminants to be analyzed would be taken from the most recent EPA Priority Pollutants and Contaminants of Concern (COC) list. Periodic post-operational sampling should start after sufficient time for potential contaminants to accumulate (i.e., 3 to 5 years) and the frequency of subsequent periodic sampling (e.g., 3 to 5 years) would be predicated upon levels of contaminants detected. Expansion of sampling to local nesting bald eagles (e.g., fecal and blood samples analyzed for the same contaminant) would also be predicated upon the type and level of contaminants detected. If high levels of contaminants are found, the Service and other resource agencies should be consulted. This adaptive sampling plan should be developed in

cooperation with the Service and other natural resource agencies and implemented prior to operation.
Applicant Response: CPRA agrees to Conservation Recommendation 4.

5. The Service recommends that consideration be given to operating the diversion in a manner that would prevent or minimize adverse impacts to wetlands due to prolonged inundation and focus on the overall enhancement of the entire project area to the greatest extent possible.
   Applicant Response: CPRA agrees to Conservation Recommendation 5.

6. The Service recommends development of a detailed Monitoring and Adaptive Management (MAM) Plan to inform operational decisions in order to minimize adverse impacts where possible. The MAM Plan should be developed through coordination with the Service, NMFS, and other resource agencies. At a minimum, the MAM Plan should address the following issues:
   a. Receiving area water levels should be monitored to minimize any potential adverse impacts such as inundation impacts (refer to Services' recommendation 5, which should be included as part of the MAM plan).
   b. The operational plan should include provisions for water level triggers to mitigate effects from coastal flood advisories during operation.
   c. Implementation of water quality sampling for concentrations of nutrients and dissolved oxygen prior to and during operation to help determine impacts from diverted water on nutrient concentrations and resulting water quality effects.
   d. Concentrations of EPA Priority Pollutants and Contaminants of Concern (COC) should be sampled in fish and shellfish from the outfall area and Mississippi River prior to and following operation to determine potential adverse effects to fish and wildlife. The frequency, intensity, and potential expansion of the sampling should be predicated upon containment levels detected (refer to the Services' Recommendation 4 which should be included in the MAM plan).
   e. There should be monitoring of below- and above- ground biomass to understand inundation and salinity effects on wetland health.
   f. Measurement of sediment accretion (water bottom and on the marsh surface) and bulk density should be conducted throughout the receiving area to provide the data needed to optimize sediment delivery and distribution to receiving area wetlands.
   g. MAM plan results (i.e., sedimentation, fishery, water quality monitoring, etc.) should be used to refine and improve future operations (refer to the Services' Recommendation 3).

   Applicant Response: CPRA agrees to Conservation Recommendation 6 and has worked closely with the Service, NMFS, and other resource agencies to develop a MAM plan that satisfies the components of this Recommendation.

7. The Service recommends adaptively managing the diversion outfall area to minimize stage increases and to maximize distribution and capture of suspended sediments within the immediate outfall area. This is needed to prevent the loss of diversion efficiency should diverted water attempt to circumvent the wetlands and flow directly into Wilkinson Canal or the Barataria Bay Waterway rather than flow over marsh where it will do the most good and ensure achieving project goals. Dredged material associated with achieving this

recommendation should be beneficially used to create, restore, or enhance marsh within the basin or surrounding areas.
Applicant Response: CPRA agrees to Conservation Recommendation 7.

8. A report documenting the status of implementation, operation, maintenance and adaptive management measures should be prepared every three years by the managing agency and provided to the USACE, the Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, Louisiana Coastal Protection and Restoration Authority, and the Louisiana Department of Wildlife and Fisheries. That report should also describe future management activities and identify any proposed changes to the existing management plan.
Applicant Response: CPRA agrees to Conservation Recommendation 8.

9. Further detailed planning of project features and any adaptive management and monitoring plans should be developed in coordination with the Service and other State and Federal natural resource agencies so that those agencies have an opportunity to review and submit recommendations on work addressed in those reports and plans.
Applicant Response: CPRA agrees to Conservation Recommendation 9 and the MAM plan referenced in Conservation Recommendation 6 includes provisions on governance that establish the suggested inter-agency coordination.

10. The pallid sturgeon is found in the Mississippi River and is adapted to large, free-flowing turbid rivers with a diverse assemblage of physical characteristics that are in a constant state of change. Entrainment associated with the diversion of river water to coastal estuaries is a potential effect that should be addressed in coordination with the Service. The Service recommends consultation under the Endangered Species Act (ESA) with this office for pallid sturgeon.
Applicant Response: CPRA agrees to Conservation Recommendation 10 and is actively coordinating with the Service regarding potential impacts to pallid sturgeon.

11. West Indian manatees occasionally enter Louisiana coastal waters and streams during the warmer months (I.e., June through September). During in-water work in areas that potentially support manatees all personnel associated with the project should be instructed about the potential presence of manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and state law. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with manatees, although passively taking pictures or video would be acceptable. For more detail on avoiding contact with manatees refer to the Endangered and Threatened Species section of this document and contact this office. Should a proposed action directly or indirectly affect the West Indian manatee, further consultation with this office will be necessary.
Applicant Response: CPRA agrees to Conservation Recommendation 11.

12. If implementation of the proposed action has the potential to directly or indirectly affect the red knot, piping plover, and eastern black rail or their habitat, further consultation with this office will be necessary.

Applicant Response: CPRA agrees to Conservation Recommendation 12 and is considering the species listed therein as part of the ongoing Endangered Species Act consultation with the Service.

13. Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. During project construction, a qualified biologist should inspect the proposed construction site for the presence of documented and undocumented wading bird colonies and bald eagles.
    a. All construction activity during the wading bird nesting season (February through October 31 for wading bird nesting colonies, exact dates may vary) should be restricted within 1,000 feet of a wading bird colony. If restricting construction activity within 1,000 feet of a wading bird colony is not feasible, CPRA should coordinate with FWS to identify and implement alternative best management practices to protect wading bird nesting colonies.
    b. During construction activities, if a bald eagle nest is within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary, and those results should be forwarded to this office.

    Applicant Response: CPRA agrees to Conservation Recommendation 13.

14. The Service recommends that CPRA and the USACE contact the Service and LDWF for additional consultation if: 1) the scope of location of the proposed project is changed significantly, 2) new information reveals that the action may affect listed species or designated critical habitat, 3) the action is modified in a manner that causes effects to listed species or designated critical habitat, or 4) a new species is listed or critical habitat designated. Additional consultation as a result of any of the above conditions or for changes not covered in this consultation should occur before changes are made or finalized.
    Applicant Response: CPRA agrees to Conservation Recommendation 14.

4.7. Magnuson–Stevens Fishery Conservation and Management Act

Under the Magnuson–Stevens Fishery Conservation and Management Act **(**MSA), NMFS approves, implements, and enforces fishery management plans (FMPs) that are developed and prepared by regional fishery management councils.[xviii] FMPs must identify EFH for each life stage of the managed fish species based on certain guidelines, minimize adverse fishing effects on EFH, and identify other actions to encourage the conservation and enhancement of EFH.[xix] EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”[xx] Once designated, the MSA requires that federal agencies consult with NMFS regarding actions that may adversely affect EFH.[xxi]

The MSA consultation obligation is triggered when a federal action “may adversely affect” identified EFH.[xxii] EFH consultations evaluate potential adverse effects of actions separately from any proposed compensatory mitigation, even though the net effect of a particular project could be considered neutral or even positive for EFH if sufficient compensatory mitigation is attached to the action.[xxiii] Where consultation is required, NMFS must provide EFH conservation recommendations (which may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH), and the federal agency must respond to the recommendations, but is not required to follow them or to ensure that its action will not adversely affect EFH.[xxiv]

The Corps contacted NMFS regarding EFH consultation in December 2019 to notify NMFS that the Project may impact EFH. The Corps will provide an EFH assessment and requested EFH consultation with NOAA in February 2021. NMFS will issue a response to the EFH consultation in June 2021, and may make conservation recommendations at that time.

4.8. Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) prohibits the taking and importation of marine mammals and marine mammal products unless the taking or importation is authorized or exempt. Under certain circumstances, NMFS and USFWS may waive the requirements of the MMPA for species under their jurisdictions so as to allow the taking, or importing of any marine mammal, or any marine mammal product.

Congress passed the Bipartisan Budget Act of 2018, Public Law 115-123 (BBA-18), which recognized the consistency of the Project, among other CPRA projects, with the findings and policy declarations in Section 2(6) of the MMPA. As such, the BBA-18 included a requirement that the Secretary of Commerce, as delegated to the Assistant Administrator of the NMFS, issue a waiver of the MMPA moratorium and prohibitions for the Project. Based on this direction from Congress, on March 15, 2018, the Secretary of Commerce waived application of the MMPA to the Project pursuant to BBA-18 and Section 101(a)(3)(A) of the MMPA: "National Marine Fisheries Service hereby issues this waiver pursuant to title II, section 20201 of the Bipartisan Budget Act of 2018 and section 101(a)(3)(A) of the MMPA for the three named projects, as selected by the 2017 Louisiana Comprehensive Master Plan for a Sustainable Coast. The requirements of sections 101(a) and 102(a) of the MMPA do not apply to any take of marine mammals caused by and for the duration of the construction, operation, or maintenance of the three named projects."

BBA-18 also required the State of Louisiana, in consultation with the Secretary of Commerce, to the extent practicable and consistent with the purpose of the Project, to minimize impacts on marine mammal species and population stocks and monitor and evaluate the impacts of the Project on such species and population stocks.

4.9. National Historic Preservation Act

The National Historic Preservation Act (NHPA) and its implementing regulations[xxv] set out the requirements and process to identify and evaluate historical resources, determine effects on these resources, and resolve adverse effects on properties eligible for the National Register of Historic Places that occur as a result of the federal agency's permitted undertaking. Where adverse effects are found, consultation among the federal agency, applicant, and consulting parties, including the Advisory Council on Historic Preservation (ACHP) in some cases, is pursued to develop avoidance alternatives or mitigation measures to resolve adverse effects.[xxvi]

The Corps sent a letter of introduction and invitation to informally begin the NHPA consultation process on October 21, 2016. The Corps also made participating requests to the following Tribal

Nations: Alabama Coushatta, Caddo Nation of Oklahoma, Chitimacha, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw, Mississippi Band of Choctaw, Muscogee Nation, Seminole Nation of Oklahoma, Seminole Tribe of Florida, Tunica-Biloxi Tribe of Louisiana. The Alabama Coushatta, the Caddo Nation of Oklahoma, and the Choctaw Nation of Oklahoma are participating. In 2017, the Corps initiated formal consultation between the ACHP, State Historic Preservation Officer (SHPO), and participating Tribal Nations.

The Corps consulted with the SHPO and Federally-recognized Tribal Nations to identify concerns and determine survey requirements for Section 106 compliance. All consulting parties agreed to a Construction Impacts Area of Potential Effect (APE) of approximately 3,095 acres that encompasses the footprint of all Project features and an Operational Impacts APE of approximately 70,630 acres within the Barataria Basin.

Cultural resources surveys were conducted from August to October 2019 within the Construction Impacts APE and the Operational Impacts APE. The cultural resources surveys found: 1) no historic properties are within the Construction Impacts APE; 2) the majority of the 31 previously recorded archaeological sites within the Operational Impacts APE are submerged due to forces such as subsidence and erosion and, as a result, no longer contain integrity; 3) four (4) previously-recorded archaeological sites within the Operational Impacts APE do retain integrity despite impacts from subsidence and erosion and these 4 archaeological sites are historic properties eligible for listing in the NRHP; and 4) two (2) new archaeological sites were identified in the cultural resources survey of the Operational Impacts APE, but only one of these sites contains integrity but its NRHP eligibility is undetermined. Section 106 Consultation is expected to conclude concurrent with the Final EIS or Record of Decision (ROD) with execution of a Programmatic Agreement. At that time, CPRA will update this Mitigation Plan to reference that Programmatic Agreement.

5. STEWARDSHIP MEASURES INCLUDED AS PART OF THE PROJECT

The purpose of Project is to restore for injuries caused by the DWH oil spill by implementing a large-scale sediment diversion in the Barataria Basin that will reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin through the delivery of sediment, fresh water, and nutrients to support the long-term viability of existing and planned coastal restoration efforts. The intent of sediment diversions, such as the Project, is to maximize development of new wetlands and increase the health of or sustain existing wetlands. Sediment diversions will best meet the objectives of capturing sediment and building wetlands when located and designed to maximize capture and distribution of coarse-grained sediment. Sediment diversions are designed at a discharge capacity (specific to the location) sufficient to mobilize and entrain (via turbulence in the water column) the appropriate range of sediment sizes, as well as draw material from the more sediment-rich portions of the river bed. (CPRA 2011; Allison et al. 2014).

The Project is designed to provide large-scale wetland restoration benefits while promoting an estuarine characteristic within the Basin. The Project's operations plan as analyzed triggers the opening of the gates when the Mississippi River gage in Belle Chasse reaches 450,000 cfs and reduces the flow to a maximum base flow of 5,000 cfs when the gage falls below 450,000 cfs. This operation plan allows for diversion operations that capture the high sediment loads associated with rapidly rising river discharges and thus (1) more effectively allows for distribution of fine-grained and coarse-grained sediments, which in turn promotes the long-term sustainability of existing coastal resources that are currently degraded, (2) effectively addresses relative sea-level rise, and (3) effectively promotes the infilling of shallow open water areas.

The Project would maintain a background (base) flow of up to 5,000 cfs to protect, sustain, and maintain newly vegetated or recently converted fresh, intermediate, and brackish habitats near the diversion outflow. The 5,000 cfs base flow maximizes wetland benefits, resulting in approximately 30 percent more wetland area maintained and sustained because of the increase in fine materials transported, relative to a future without sediment diversion or an operation plan with no base flow after 50 years. The 5,000 cfs base flow effectively promotes the long-term sustainability of existing marshes and sustainability of newly created wetland habitats.

At the end of the 50-year analysis period, the Project is projected to create and sustain 12,700 acres of wetland habitat in the Barataria Basin when compared to the No Action Alternative.

In addition to these wetland benefits, the Project will also result in the following habitat/aquatic species benefits: increase submerged aquatic species, increased shallow bottom habitat, net increase in essential fish habitat, moderate benefits to largemouth bass, moderate benefits to red drum, moderate benefits to gulf menhaden, minor benefits to bay anchovy, negligible to minor benefits to white shrimp and negligible to minor benefits to blue crab.

6. AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

6.1. Avoidance and Minimization Measures

The Project was designed and selected among other alternatives to minimize incidental environmental impacts, while achieving wetland benefits described above. The alternatives evaluated under the NEPA environmental review include both structural and non-structural alternatives, including sediment diversions with different variable flow rates (50,000 and 150,000 cfs), and alternatives that include marsh terracing outfall features.

CPRA has committed to implement Best Management Practices (BMPs) and environmental protection measures (EPMs) to minimize the impacts associated with the construction and operation of the Project on each element of the environment. Such BMPs and EPMs are described in Appendix A.

6.2. Clean Water Act Section 404 Compensatory Mitigation

This section of the Mitigation Plan identifies compensatory mitigation to offset unavoidable adverse impacts to jurisdictional waters of the United States, including wetlands and special aquatic sites (i.e., riffle/pool complexes).

6.2.1. Wetlands and Jurisdictional Waters

Impacts. The Project would directly impact 182.9 acres of jurisdictional wetlands and 305.6 acres of waters of the U.S., however, wetlands created or sustained by the Project will be significantly greater than wetlands negatively impacted. Any permanent losses will be offset by wetland creation associated with the Project. The Project will also cause (1) moderate, short-term to permanent, adverse and beneficial impacts on existing wetland soils in the outfall area due to existing soils and associated ecological communities being buried (adverse impact), and new soils and ecological communities being established (beneficial impact); and (2) moderate, short-term, adverse erosion and loss of some emergent wetlands near the outfall transition feature (offset when total wetland impacts are considered over the life of the Project).

Mitigation**.** As discussed above, the Project itself is projected to create and sustain 12,700 acres of tidal wetland habitat in Barataria Basin through operation of the diversion by 2070. In addition to the wetland benefits built into the Project, CPRA will mitigate direct impacts (construction excavation and placement) to wetland soils to the extent practicable including both beneficial use placement and upland reuse (e.g. filling existing borrow pits).

The construction footprint by design is constrained to minimize excavation and fill activities in the Mississippi riparian wetland area. It is anticipated that the limited quantity of wetland soil requiring excavation would result in dredge material displacement, processing, and use in upland construction. Excavation of the conveyance channel could result in excess upland and wetland soils that would need disposal. The nearby disposal areas that have been identified currently exist as abandoned borrow pits that were excavated for Post-Katrina HSDRSS levee construction. These abandoned borrow pits could be filled to mitigate pre-existing impacts to the landscape and congruent with landowner and Parish interests.

In the area of the outfall transition feature, if sufficient suitable upland or wetland soil is available during construction, the beneficial placement of these soils would occur in two locations currently occupied by open water in the basin. The placement of beneficial use materials would be designed to create new emergent wetland, nourish existing wetlands, or provide shallow habitat.

In the Basin, the selected construction access routes—to allow access channels for vessels, equipment, and material transport—will be designed to avoid or minimize wetland impacts to the greatest extent practicable, along with minimizing the excavation footprint and subsequent volume of material displaced. The placement of soils in areas adjacent to channel excavation would be done in a manner to minimize the disruption of water circulation. Prior to construction completion, the material would be left in place as habitat enhancement or backfilled into the impacted access channel.

6.3. Public Interest Mitigation – Clean Water Act Section 404, Rivers and Harbors Act Sections 10 and 408

The purpose of the mitigation proposed in this section of the Mitigation Plan is to ensure that the Project is not contrary to the public interest, pursuant to Section 404 of the CWA and Sections 10 and 14 of the Rivers and Harbors Act. Mitigation measures have been developed to address certain impacts identified in the NEPA DEIS and in the public interest review.

6.3.1. Impacts to Navigation

Impacts. Based on basin-wide modeling, the accumulation of sediment may affect navigation channel depths over time. Project impacts to navigation would be primarily limited to changes in bed elevation (siltation) that may occur in the Barataria Bay Waterway and Wilkinson Channel.

Mitigation. CPRA will undertake the following actions to mitigate impacts to navigation within the Project area.

- CPRA will undertake project specific Adaptive Management (AM) for the operation of the Mid-Barataria Sediment Diversion in regard to data collection, monitoring, and implementation of AM decisions.
- Monitoring will assess the Project's effect on bathymetry, consider required or authorized elevations, and operations and maintenance of the navigation channel.
- To the extent the Barataria Waterway aggrades to a degree that inhibits navigation as a result of Project operations, CPRA will take one or more of the following actions to mitigate the identified Project impact:
  - adjust operations of the Project,
  - conduct maintenance dredging of the canal to address impacts from the Project, or
  - implement outfall management measures to limit the loss of sediments to the waterway.
- To the extent that Project operations lead to aggradation within Wilkinson Canal to a degree that inhibits navigation, and as long as Wilkinson Canal is being used for that purpose, CPRA may take one or more of the following actions to mitigate the identified Project impact:
  - adjust operations of the Project,
  - conduct maintenance dredging of the canal to address impacts from the Project, or
  - provide alternative boat access to Myrtle Grove and Woodpark communities.

Site Selection. Mitigation will occur at the site of the impact.

6.3.2. Property Impacts

Impacts. Property related impacts from the Project are described in detail in Chapter 4 Section 20 of the DEIS, and briefly summarized below.

Inundation

In the absence of the Project, the properties in the tidal floodplain in the Project Area are subject to high rates of land subsidence and sea level rise, which has resulted in an increased frequency of nuisance flooding. With the implementation of the Project, the communities outside flood protection subject to increased water surface elevations or tidal durations could extend from the lower portion of Bayou Barataria to Grand Bayou (see Figure B-3). The majority of these areas are mapped as *Coastal High Hazard Areas*[37] (Figure B-4).

[37] Coastal High Hazard Area - n area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The coastal high hazard area is identified as Zone V on Flood Insurance Rate Maps (FIRMs) (https://www.fema.gov/coastal-high-hazard-area).

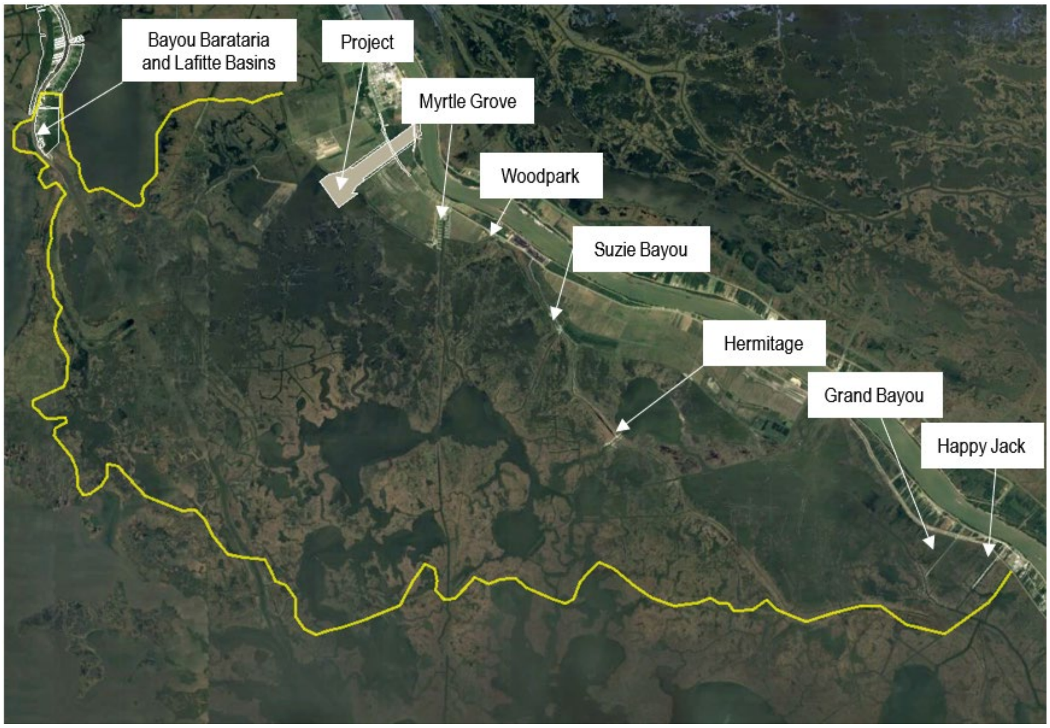

Figure B-3. Communities and Subdivisions Subject to Potential Inundation with the Project and the Maximum Extent of Inundation Impacts (yellow line).

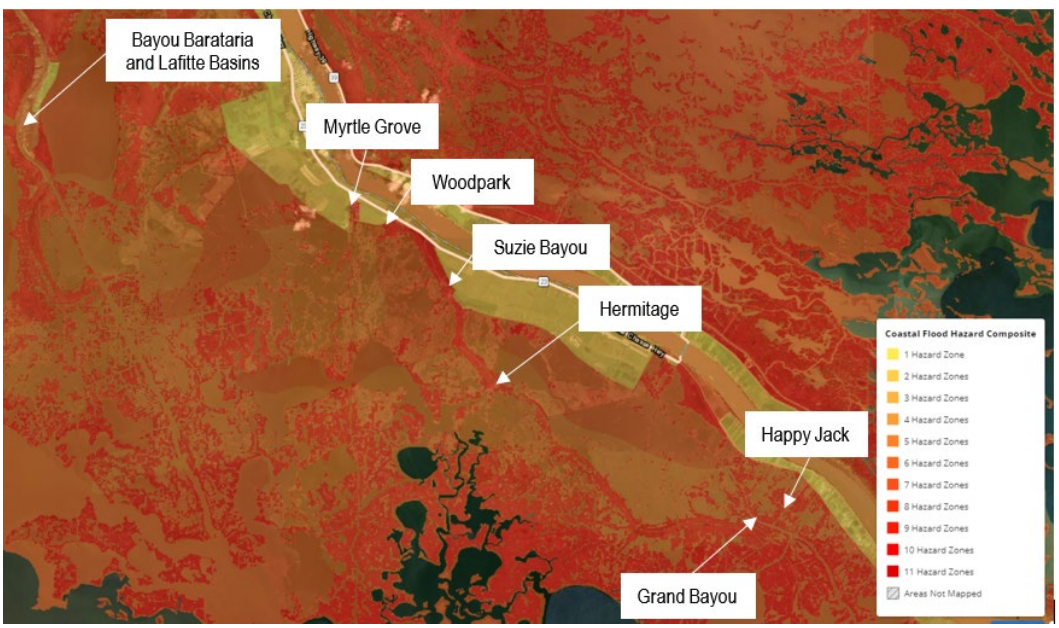

Figure B-4. The Communities and Subdivisions Subject to Potential Inundation with the Project Are Largely Designated as Coastal High Hazard Areas. Image and data from the NOAA Coastal Flood Exposure Mapper (https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html).

With the Project, there are foreseeable inundation impacts to properties that occur outside of a defined flood protection system. These properties generally occupy two land area categories (termed, *polderlands* and *tidelands*) that have different levels of exposure to tidal and meteorological flooding events:

Tidelands

Tidelands properties (subdivisions) subject to additional inundation from the Project may include the following:

- Myrtle Grove
- Woodpark
- Suzie Bayou/Deer Range
- Hermitage
- Grand Bayou
- Happy Jack

These properties currently experience a low-to-moderate frequency of short duration and shallow flood events from astronomical and meteorological tides. Within the next 20 to 50 years, these communities are projected to be regularly flooded due to the effects of subsidence and sea level rise (SLR) irrespective of the Project.

In general, each of these subdivisions has parcels that rank from 8 to 10 (out of 11 total hazards) of the coastal flood hazard composite.[38] Hazard zones that are common to tidelands properties are described below, which shows a composite score of hazards that sum to 10 (also see Figure B-5).

Hazard Zones:

- FEMA Zones (% annual chance): V zone (1%) & A zone (1%) & 0.2%
- High Tide Flooding
- Sea Level Rise (Above MHHW): 1 ft & 2 ft & 3 ft
- Storm Surge (by Hurricane Category): 1 & 2 & 3

These subdivisions are occupied by residences and largely non-residential campsites, and other properties with storage structures. Although these properties are currently subject to *Plaquemines Parish Floodplain Management Regulations*[39] or other state or local regulations that prescribe standards for the purpose of flood damage prevention and reduction, improvements on some properties may pre-date those regulations.

[38] See definition of Coastal Flood Hazard Composite (https://coast.noaa.gov/data/digitalcoast/pdf/flood-exposure-faq.pdf).
[39] The floodplain management regulations include zoning ordinances, subdivision regulations, building codes, health regulations, and special purposes ordinances.

Project related impacts may include:

- Shallow inundation of roads, driveways, non-habitable structures (e.g., carports, parking areas, storage structures), and property at grade
- Variable duration of annual flood events and inundation depth depending on river stage and diversion operation capacity

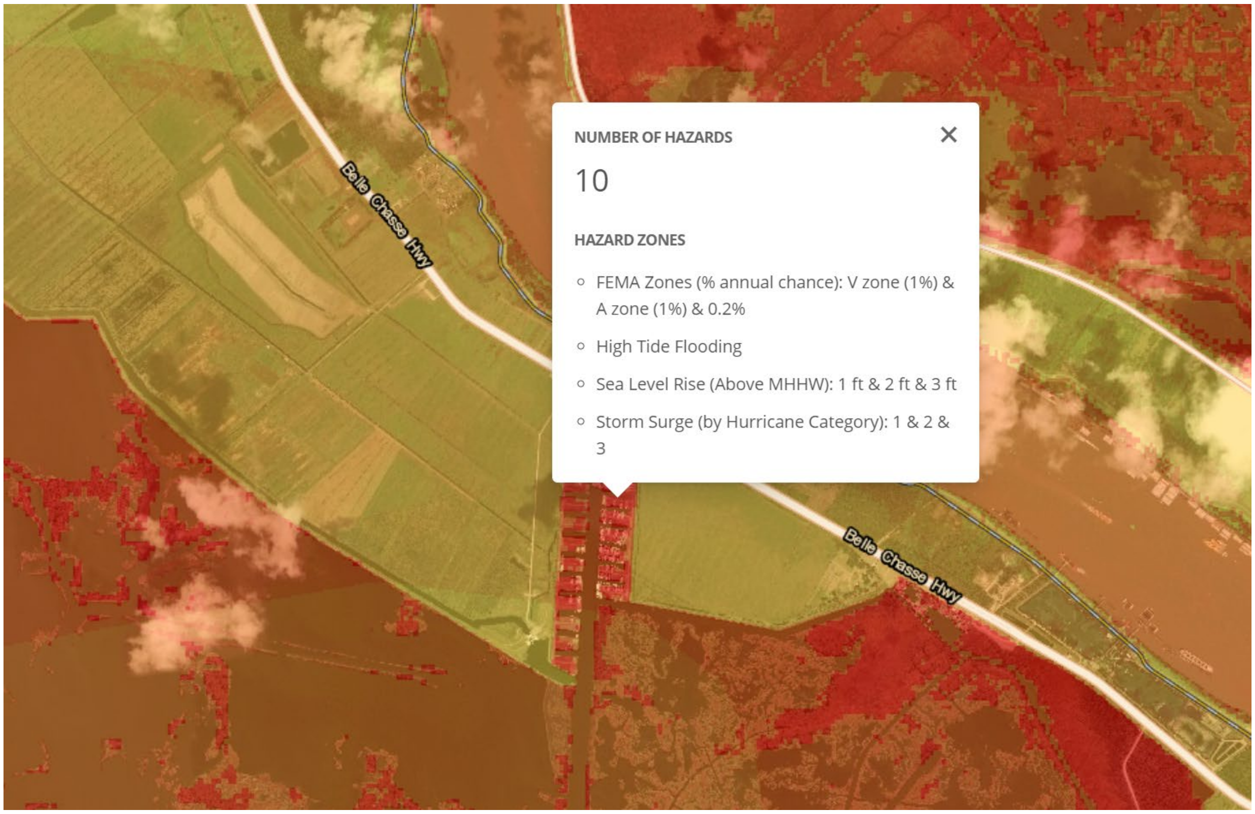

Figure B-5. Example of Tidelands Properties in the Project Area from the Myrtle Grove Subdivision and the composite Number of Coastal Hazards. Image and data from the NOAA Coastal Flood Exposure Mapper.

Polderlands

These properties currently experience infrequent flooding events from astronomical and meteorological tides but are generally subject to inundation with tropical events (surge and wave height > 3 ft), additionally by intense rainfall, which may affect the pumping capacity and removal of floodwaters.

Polderland properties subject to Project inundation may include the following:

- Agricultural lands occurring between the Plaquemines Parish back levee and proposed location of the NOV-NF Levee 05a.1 (see Figure B-6)
- Lafitte Area Independent Levee District (tidal protection basins, TPB; Figure B-7)
    - Lower Barataria/Privateer Dr TPB
    - Lower LA 45 TPB

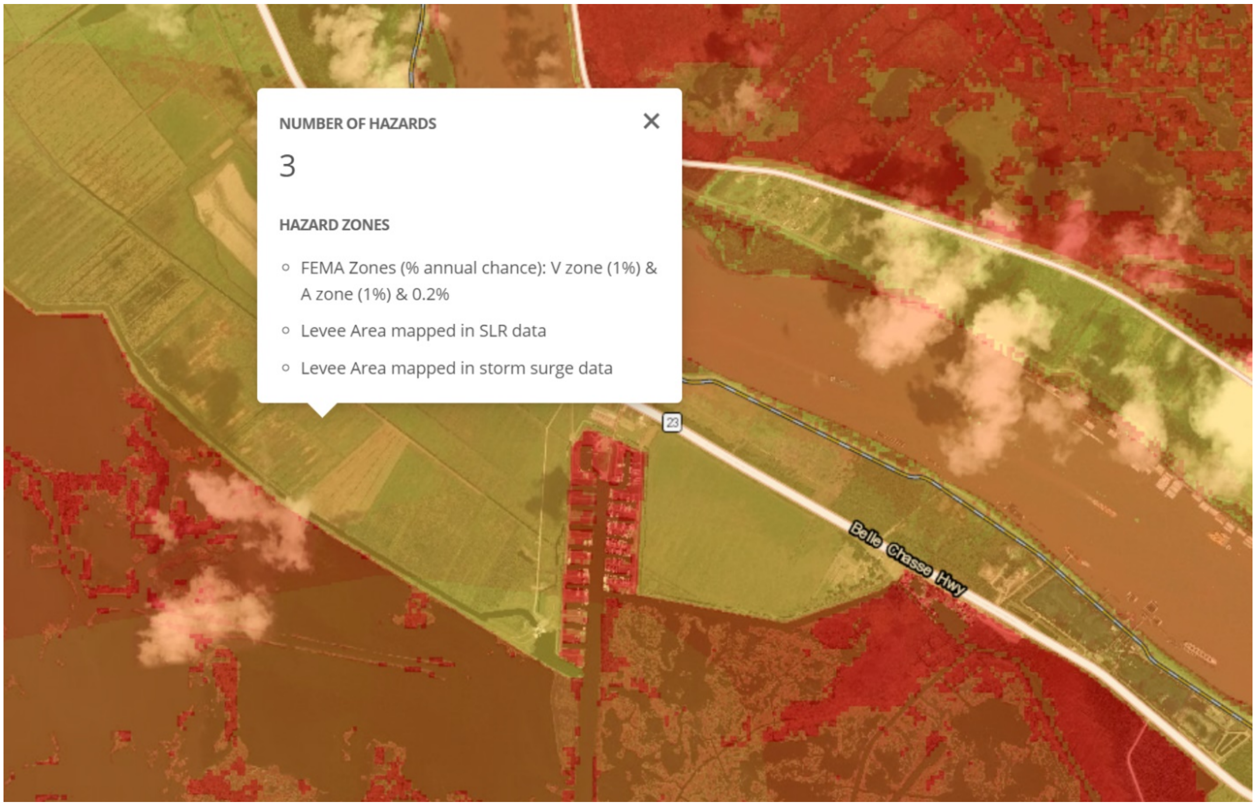

Figure B-6. An Example of Agricultural Polderlands that May Be Inundated with the Project, Located within the Plaquemines Parish Back Levee. Under current conditions, the back levee is subject to breaching and overtopping and subsequent inundation of the polder when low intensity tropical storms with onshore winds that produce water levels > 3.5 ft. Image and data from the NOAA Coastal Flood Exposure Mapper.

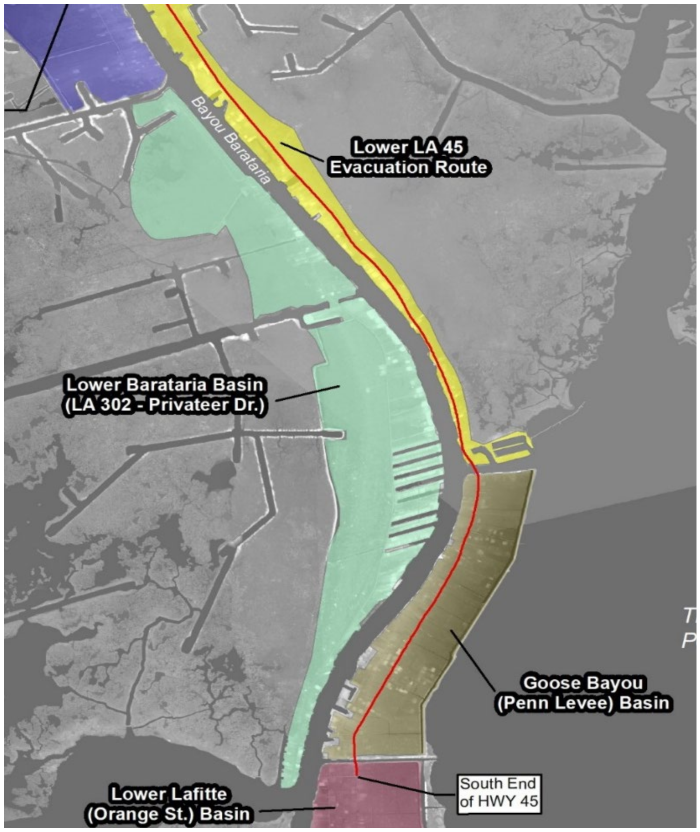

Figure B-7. The Lafitte Area Tidal Protection Basins (polderlands) that Have a Marginal Risk of Being Inundated by the Project Are the Lower LA 45 (yellow) Basin and the Lower Barataria Basin (green). Other basins, such as Goose Bayou and Lower Lafitte, will have received upgraded tidal protection (>7.0 ft) prior to the Project operation.

<u>Mitigation.</u> CPRA is evaluating the areas that could be exposed to Project-related inundation and researching regulatory and policy issues that pertain to polderlands and tidelands in the Project area. A comprehensive inventory of potentially affected properties and land services planning is progressing under an assumption that CPRA would mitigate for inundation caused by the Project to properties, which could take the form of:

- Monitoring and adaptive management of operations
- Assisting property owners to elevate homes and other structures on private properties
- Property rights acquisition (e.g., flowage easement, fee acquisitions, or other). CPRA would prefer to acquire easement rather than acquiring full ownership of affected properties.
- Structural mitigation (e.g., elevating public roadways, utility upgrades, water control structures, or other structural measures to offset additional inundation)

<u>Site Selection</u>. Mitigation could occur at the site of the impact, or other locations where structural measures would reduce inundation, or through property rights agreements.

6.3.3. Aquatic/Fisheries Impacts

Impacts to Oysters and Oyster Fisheries. The oyster resources within the Basin are projected to see declines in both the No Action Alternative (NAA) and the Project related to loss of habitat primarily driven by changes the estuary's salinity structure. The oyster fishery is expected to experience major, permanent, adverse impacts under the Project relative to the NAA primarily driven by project-related reductions in salinity within the Basin. This determination considers expected impacts on oyster abundance as well as the anticipated response from commercial fishers. The potential impacts of fecal coliform contamination from introduced Mississippi River water could also have a major, adverse impact on beneficial uses related to oyster harvest. However, Project-related changes in the salinity structure within the lower Basin may also allow for re-habilitation of historic oyster growing areas that are currently non-supportive and may help mitigate impacts to other areas. Because these areas would be located further away from the project outfall area than current oyster seed grounds, they would also be less susceptible to fecal coliform impacts.

Mitigation. CPRA is proposing options to both mitigate for the loss of oyster habitat within the Basin as well as the potential impacts to the oyster fishery within the Basin, including potential water quality impacts to beneficial uses related to oyster harvest. Given that, it is assumed that any potential mitigation to the oyster resource is of benefit to the oyster industry and may mitigate for the potential effects of the Project. Furthermore, given the dynamic conditions of any estuarine system, and the uncertainty around future conditions some of the mitigation measures will rely on data from the MBSD Adaptive Management Plan in order to appropriately site and scale the measure based on post-operational conditions. CPRA intends to implement the stewardship measures listed below for impacts to oysters. As the EIS identified the potential for the Project to result in disproportionate impacts to some low income and minority commercial oyster fishers, CPRA is considering options to tailor these measures to ensure they reach those populations. This is further discussed in Section 6.3.8 below.

- **Re-establishment of Reefs within Public Seed Grounds**
  Currently there are three public oyster areas within the Barataria Basin, the Hackberry Bay Seed Reservation, and the Little Lake and Barataria Seed Grounds. Given the current salinity regime only the Hackberry area experiences oyster recruitment and growth on a recurring basis with some years showing no production due to suppressed salinities. The Little Lake Seed Ground salinities are too low except during significant periods of drought and the Barataria Seed ground salinities are elevated to promoting deleterious impacts from disease and predation. Predictive modeling indicates that conditions within the Hackberry seed ground may be further lowered with Project operations. Conversely, modifications to the salinity regime of the lower Basin may allow for reestablishment of oyster recruitment and growth within the historically fished areas of the lower Basin. This mitigation measure would address the loss of a public oyster area with the potential establishment of a new area in the lower Basin if future conditions allowed. The Monitoring and Adaptive Management plan will include that after evaluation of the Hackberry area post initial Project operation, and with a favorable evaluation of lower Basin salinities and fecal coliform contamination, a new Public Seed Ground (or reservation) will be established on the state owned water-bottoms within the Barataria Basin. This will include either the

relocation of native cultch materials or the provision of new cultch material to establish the oyster beds.

- **Provision of Cultch Material**
  Cultch material will be provided to the Louisiana Department of Wildlife and Fisheries for resource enhancement. This may be accomplished either on the public or private growing areas. It is anticipated that this material will be used to augment programs like the Public Seed Ground Cultch Plant program or those geared to leased production such as the Private Oyster Lease Rehabilitation Program.

- **Broodstock Reefs**
  Historically, Louisiana estuaries have had an adequate supply of oyster larvae to replenish reefs that were impacted by natural and anthropogenic events. However, modification to the estuaries now highlight that is not the case in many areas. To mitigate for potential future adverse changes in hydrology, circulation, and overall habitat from the MBSD Project, broodstock reefs may be used to provide a larval supply to areas either separated hydrologically, or located in a salinity regime that does not result in an annual recruitment event. Through the Monitoring Program, hydrologic data will be assessed to understand the salinity regime within the Basin, and density and abundance estimates of the Basin oyster resource will be used to determine the need for and potential location of these broodstock reefs. Additionally, theses reefs will be located, where possible, in shallow or intertidal areas to enhance that resource as well as protect new reefs from predators.

- **Alternative Oyster Aquaculture (AOC)**

  To adjust to changing coastal conditions new techniques may be initiated or expanded to assist the oyster industry in remaining sustainable into the future. One such technique is the use of alternative oyster culture opportunities. This technique allows for the cultivation of oysters while taking into account the possibility of natural and anthropogenic changes to an estuary. In Louisiana, the technique most often associated as alternative culture is that of "off-bottom" culture.

  Off-bottom culture of oysters is done within floating or suspended containers that provide protection from predation and siltation as well as the give the operator ability to move to different growing areas in response to episodic events or longer-term changes in salinity.

  The State of Louisiana recognizes AOC as an area of the oyster industry that can help diversify the oyster industry and add a level of sustainability as the industry adjusts to a changing coast. Specifically, to best address mitigation for the potential effects of the MBSD Project on the oyster fishery within the Barataria Basin specific components of an AOC Program may include:

  1. *Introduction and Training*
     Establish a training program and information exchange for oyster industry members interested in transitioning/entering AOC activities. This program would introduce industry members to the tools, techniques, laws, and other necessary information necessary to participate in the AOC sector.

2. *Startup Assistance*
   Small grants may be made available to procure equipment necessary to enter the alternative oyster aquaculture industry, including seed oyster production.
3. *Designated Use Areas*
   The State recognizes that siting and permitting may be a barrier to entry in alternative oyster culture. Therefore, areas on state-water bottoms could be designated specifically for use by oyster growers engaged in alternative oyster culture and permitted as such by the State. While it would be the intent to locate these areas within the impacted Basin, future conditions will dictate the availability and location. Site selection may also include locations in adjacent Basins with suitable conditions.

- **Marketing**
  A Marketing program in cooperation with the oyster industry and partners would further mitigate potential changes in harvest. Additionally, marketing will be a key component in the establishment of the AOC program and other efforts.

<u>Impacts to Finfish Fisheries</u>. Impacts assessed as a result of the Project vary between species. However, with the exception of flounder and spotted seatrout, the Project is predicted to have negligible impacts on the vast majority of commercially important fishes and in many cases trend to positive impacts. While the overall Project impact to the saltwater commercial finfish industry is anticipated to be small, there are still several mitigation measures being proposed for implementation by the State to address these impacts. These measures will also help to mitigate effects in other fisheries as fishermen may choose to switch to saltwater and freshwater finfish after operation of the Project.

<u>Mitigation.</u>

- **Marketing**

  The finfish industry has long realized that effective marketing is invaluable to the adaptability and sustainability of the industry. Historically, the finfish industry has utilized marketing to aid in the exploitation of new resources adjusting to changes along Louisiana's coast. The State will work with the Seafood Promotion and Marketing Board and the Louisiana Finfish Task Force to assist in the marketing needs of fisheries impacted in the Barataria Basin as well as to help transition to other species if abundance patterns change.

<u>Impacts to Shrimp Fishery</u>. The Project is projected to have a major, adverse permanent impact on the brown shrimp resource and a negligible to minor beneficial permanent impact on the white shrimp resource. Together these two species account for almost all of the shrimp landed from the Project Area. Given the resultant impacts to the individual species, and the reliance of fishermen on both species, an overall Project effect determination of a moderate to major permanent adverse impact to the commercial shrimp fishery is given. This is largely driven by the predicted reduction in brown shrimp abundance and uncertainty around the offset of increased white shrimp production.

Mitigation. Proposed mitigation strategies for shrimp are directed at the fishery rather than the resource. As the EIS identified the potential for the Project to result in disproportionate impacts to some low income and minority shrimp fishers, CPRA is considering options to tailor these measures to ensure they reach those populations. This is further discussed in Section 6.3.8 below.

- **Vessel Refrigeration**

  When discussing how the industry might best adjust to coastal change and restoration projects (LSF 2019) vessel refrigeration was repeatedly mentioned as strategy to help mitigate those changes. Equipping a vessel with refrigeration can both extend the time the vessel can transit to and remain on the fishing grounds (or fish new areas) or allow for a better-quality product that results in a higher price. Modeled after previous state-run programs, grants can be made available to offset the cost of purchase and installation of the necessary equipment. This grant program would be initiated prior to start of project operation.

- **Marketing**

  The Louisiana Shrimp Industry routinely describes marketing as the one of the primary needs for the industry. Competition from imports suppresses domestic shrimp demand and price and places an overwhelming stress on the industry. To mitigate for additional stresses potential changes in brown shrimp abundance may have, marketing would be used to help increase market-share of domestic shrimp. Specific targets could include marketing of the Barataria white shrimp resource similar to the success had in other estuaries of Louisiana (see Vermilion Bay).

- **Gear Improvements**

  Grants may be made available to help offset costs of rigging vessels with different types of gear (for example skimmer to trawl) or substitute gears that would increase efficiency and therefore lower overall costs to the industry to mitigate for any realized changes in abundance of brown shrimp (e.g., spectra trawl to replace nylon trawl).

Overall Fisheries Mitigation.

- **Workforce and Business Training**
  A common mitigation strategy mentioned within various sectors of the commercial fishing industry is workforce training. Under several survey activities workforce training and business training are listed as ways to either transition into new employment or enhance revenue within current employment, respectively. This training would be made available to qualified participants within the commercial fishing industry.

Implementation of Aquatic Stewardship Measures. The table below outlines the details associated with the implementation of the aquatic/fisheries stewardship measures. Where possible, information is included as to timing, duration, potential linkages to existing programs, anticipated amounts and the entity(ies) associated with the day to day implementation of the activity. Details for many of the Measures are not yet finalized and are reflected as such below.

Measure	Location	Implementation Period	Program Status	Agency
Re-establishment of Reefs within Public Seed Grounds	Barataria Basin	Operation	New	LDWF
Provision of Cultch Material	Barataria/Outside	Construction/ Pre-operation	Augment Existing program	LDWF
Provision of Broodstock Reefs to provide larval supply, as needed	Barataria	Operation	Companion to NRDA program	LDWF
Alternative Oyster Culture (AOC) *Introduction and Training*	Barataria/Outside	Pre-operation	Augment proposed program	LDWF
Alternative Oyster Culture (AOC) *Startup Assistance*,	Barataria/Outside	Pre-operation	Augment proposed program	LDWF
Alternative Oyster Culture (AOC) *Designated Use Areas*	Barataria/Outside	Pre-operation and Operation	Augment proposed program	LDWF
Marketing to Support the Oyster Industry	Industry	Pre-operation and Operation	Augment existing program	LDWF & Office of Lt. Governor
Marketing to Support the Finfish Industry	Industry	Pre-operation and Operation	Augment existing program	LDWF & Office of Lt. Governor
Grant Program to Equip Fishing Vessels with Refrigeration	Basin/Industry	Pre-operation and Operation	New	LDWF
Marketing to Support the Louisiana Shrimp Industry	Industry	Pre-operation and Operation	Augment existing program	LDWF & Office of Lt. Governor
Grant Program to Support Gear Change/Improvements	Basin/Industry	Pre-operation and Operation	Reproduce previous programs	LDWF
Workforce and Business Training for Commercial Fishers	Basin/Industry	Pre-operation	New	TBD

6.3.4. ESA-Listed Species

Impacts. Impacts to ESA-listed species from construction and operations of the Project are described in detail in the Biological Assessment and in the DEIS Chapter 4 Section 12. Effects determination for six of the ten listed species and designated critical habitat are anticipated to be *Not Likely to Adversely Affect* or *No Effect.* Effects determinations for the remaining four species (pallid sturgeon, green sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle are anticipated to be *Likely to Adversely Affect* and are anticipated to include:

(1) Minor adverse effects to pallid sturgeon from underwater noise associated with pile driving in the River during construction.

(2) Minor to moderate impacts due to loss of individuals through entrainment by the diversion structure during operations.

(3) Minor adverse impacts to green, Kemp's ridley, and loggerhead sea turtles due to reductions in certain prey species and increased negative interactions with commercial shrimp fishing due to the spatial shift in shrimp fishing effort due to the Project.

Mitigation. Formal consultation may result in the identification of Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&C's) to avoid and minimize effects to listed species and designated critical habitat. CPRA will undertake the RPMs and implement the T&C's identified in the Services' Biological Opinions for the Project.

6.3.5. Non-ESA Listed Fish and Wildlife

Impacts. The MBSD Project anticipates benefiting the Barataria Basin with a basin wide increase of 12,684 marsh acres and near field (e.g., close proximity to the outfall) increase of 13,151 marsh acres (3,848 AAHUs) over the 50-year period of analysis. The near field area (13,151 acres) focuses on a smaller lower-salinity portion of the basin (primarily an area of wetland gain) near the diversion outfall. The larger basin benefits (12,684 net acres) include the lower basin brackish and saline marsh losses, which offsets some of the fresh/intermediate gains seen in the diversion outfall area resulting in an overall smaller net wetland gain across the basin than when compared to the near field area alone.

The APE would directly impact 182.9 acres of jurisdictional wetlands and 266.3 acres of vegetated shallows (SAV) and other waters of the U.S. Of the 182.9 acres (-135.7 Average Annual Habitat Units AAHUs)) of total permanent direct wetland impacts, 21.6 acres (-12.1 AAHUs) are of bottomland hardwood forest, 151 acres (-102.4 AAHUs) are of wet pasture, and 10.3 acres (-21.2 AAHUs) are of scrub/shrub. The Project is expected to benefit (nourish and restore) 13,151 acres (3,848 AAHUs) of marsh. Project benefits far outweigh the permanent loss in existing wetland function; thus offsetting the need for compensatory mitigation.

Because sediments, freshwater, and nutrients transported by the Mississippi River would be diverted up river from the Birdfoot Delta of the Mississippi River, the Birdfoot Delta would experience an additional projected indirect loss of 2,891 acres of wetlands by 2070 when compared to the No Action Alternative. Changes in land area in the Birdfoot Delta between the Applicant's Preferred Alternative and the No Action Alternative would be relatively minor (3 to 6 percent in operational years 2030 to 2060). The expected total project benefits would far outweigh the indirect negative impacts to the Birdfoot Delta. However, of the loss to the Birdfoot Delta a portion, 926 acres of marsh is projected to be lost in the Delta National Wildlife Refuge (Delta NWR) and 37 acres on the Pass-A-Loutre Wildlife Management Area (PAL WMA) because of the reduced sediment being delivered to the area.

6.3.6 Marine Mammals

Impacts to Bottlenose Dolphins. Impacts on BBES dolphins under the Project action alternatives include: (1) immediate and permanent, major, adverse impacts on survival from low salinity throughout the BBES stock area; (2) adverse effects on health and reproduction from multiple stressors including low salinity exposure, wetland loss in the BBES stock area (also occurring under the No Action Alternative), lower temperatures, an increased risk of HABs, and the residual effects from the DWH oil spill; and (3) based on the estimated decreases in survival rates, there may be a substantial reduction in population numbers. Thus, the Project action alternatives would likely have permanent, major, adverse impacts on BBES dolphins. The measures noted below will be implemented by NOAA and partners on behalf of CPRA in recognition of the anticipated impacts to bottlenose dolphins.

Operational Minimization Measures. CPRA will examine operational strategies to minimize (to the extent practicable consistent with the purposes and performance of the project) the Project's impacts on bottlenose. Given the dynamic conditions of any estuarine system, and the uncertainty around future conditions, the minimization measures will rely on the MBSD Monitoring and Adaptive Management Plan to inform future implementation.

State-wide Stewardship Measures. CPRA will also support non-operational stewardship measures to reduce existing and future threats to BSE and coastal dolphins throughout Louisiana. While these measures will may not minimize impacts from the Project on BBES dolphins, they could enhance individual dolphin survival from other anthropogenic stressors. These measures will also improve understanding and management of Louisiana dolphins.

- **Statewide Stranding Program**
  A statewide stranding program for a 20-year period to begin immediately following current funding expiration in 2026 will be provided. Stranding response in Louisiana would improve the survival and health outcomes of marine mammal populations injured by the DWH spill, especially coastal and estuarine stocks of bottlenose dolphins. Enabling a more rapid response to a live stranded cetacean will increase that animal's chance of survival by reducing the time spent on the beach, reducing stress on the animal, providing rapid treatment and, if appropriate, transport to an authorized rehabilitation facility for additional treatment and care. In addition, this program will increase the quality and quantity of data that can be collected from dead stranded cetaceans, by decreasing decomposition time on the beach and ensuring that fresher carcasses are recovered for necropsy. This will improve the ability to diagnose causes of illness and death in cetaceans to better understand natural and anthropogenic threats, which will inform restoration planning, monitoring and adaptive management.
- **Human Interaction/Anthropogenic Stressor Reduction**
  CPRA will reduce existing and future stressors to bottlenose dolphins statewide, including within Barataria Bay, in several ways:
  - Reduce bottlenose dolphin mortalities from rod and reel fishing gear,
  - Reduce intentional injury and mortality (e.g., shooting) to bottlenose dolphins,
  - Reduce illegal feeding of bottlenose dolphins,
  - Evaluate the potential impacts of noise, vessels, and other direct threats to identify and implement stewardship measures designed to address these threats
- **Contingency Fund for Unusual Mortality Events**
  As described in the DEIS, survival rates of BBES dolphins are likely to be greatly reduced upon operation of the Project. To respond to the expected increase in dolphin strandings, CPRA will establish funds for stranding surge capacity in Barataria Basin. The national UME Contingency Fund is extremely limited and is used to respond and investigate UMEs nationally. Additional funds for a Barataria Basin UME will be made available upon onset of operations for immediate use in or be reimbursable to the stranding network.

6.3.7 Essential Fish Habitat

Impacts. Impacts to Essential Fish Habitat (EFH) as managed under the Magnuson-Stevens Act from construction and operations of the Project are described in detail in the Essential Fish Habitat Assessment and in the DEIS Chapter 4 Section 10.3.3 and Section 10.4.3. Impact to EFH and managed species include:

(1) Negligible to minor impacts from construction due to structure placement, dredging, and turbidity and sedimentation.

(2) Major beneficial changes from conversion of less sensitive soft bottom habitats to higher value submerged aquatic vegetation and marsh habitats within Barataria Basin.

(3) Moderate adverse impacts in the birdfoot delta from loss of marsh habitat.

(4) Minor adverse impacts on reef fish from changes in prey species (gray snapper) and salinity and nursery habitat (lane snapper).

(5) Major adverse impacts to brown shrimp and oysters from decreased salinities.

Mitigation. Formal consultation on EFH with NMFS may result in the identification of EFH Conservation Recommendations. CPRA will evaluate NMFS' conservation recommendations based on a scientific review of anticipated effects in relation to the recommended measures.

6.3.8 Environmental Justice

Impacts. Impacts to Environmental Justice populations from the Project are described in detail in Chapter 4 Section 15 of the DEIS, and briefly summarized below.

The Project is projected to have minor to major impacts on populations near the Project outfall (within 10 miles to the north and 20 miles to the south) outside of levee protection due to increases in tidal flooding and storm hazards. These impacts may be disproportionately high and adverse for some low income and minority populations to the extent these populations are uniquely vulnerable to tidal flooding and storm hazards. The effects would be most pronounced in operational years before 2030, after which time, impacts would be more minor as compared to the No Action Alternative. All tidal flooding impacts would be reduced to minor by 2070, when the dominant driver of tidal flooding would be relative to sea-level rise.

The Project is also projected to adversely impact low-income and minority populations engaged in commercial and subsistence fishing and dependent on adversely impacted fisheries in the Barataria Basin. These impacts may be disproportionately high and adverse depending on the degree of engagement and dependence by these populations on these fisheries.

Mitigation. To address identified potential for disproportionately high and adverse impacts to subsistence oyster and brown shrimp fishing, CPRA will provide public access opportunities within the Barataria Basin. This is intended to address effects on proximity of resources for both consumptive and non-consumptive use. These effects will be primarily addressed through the provision of public shoreline access and watercraft launching around the project area to assist recreational and sustenance fishing. Additional measures may also be taken to address items such as wildlife viewing and other recreational activities.

CPRA is continuing to evaluate mitigation measures to address the unique vulnerabilities that minority and low-income commercial fishing populations may experience. Unique vulnerabilities may include difficulty switching to other industries due to economic challenges, age, educational or training background, and cultural or language barriers. These populations may also be less likely or able to relocate to other geographic areas for alternative employment opportunities due to economic or cultural reasons. Species substitution may require traveling long distances or investing in expensive new equipment, which adds costs that may be challenging for low-income and minority fishers.

CPRA is considering how the commercial shrimp and oyster fishing mitigation measures described in Section 6.3.3 above can be adapted to address the potential for disproportionately high and adverse impacts (e.g., equity considerations relating to: startup grants, workforce training, shrimping vessel refrigeration and gear improvement grants, and overall fisheries workforce and business training).

In addition, CPRA will provide mitigation for potential tidal flooding and storm hazard impacts as explained in Section 6.3.2 above. These measures include the possibility of acquiring property interests ranging from fee title to flowage easements from affected property owners. CPRA would prefer to acquire easement rather than acquiring full ownership of affected properties. CPRA is also considering structural measures (e.g., elevating public roadways, utility upgrades, water control structures, or other structural measures to offset additional inundation) to reduce the tidal flooding and storm hazard impacts on communities near the Project outfall and outside of levee protection.

In addition, to address the potential for disproportionately high and adverse impacts from tidal flooding and storm hazards, CPRA is continuing to evaluate mitigation measures to address the unique vulnerabilities that minority and low-income populations may experience. Unique vulnerabilities include residing in sub-standard housing, having limited access to information about emergencies and hazard responses, as well as economic and social obstacles to relocating, finding housing, commuting to employment opportunities, or responding to environmental damage to homes and businesses.

Consistent with CEQ's guidance regarding outreach and engagement to low income and minority populations, CPRA engaged in additional outreach to the low income and minority populations potentially impacted by increases in tidal flooding and storm hazards, as well as those low income and minority populations reliant on commercial or subsistence fishing, prior to issuance of the DEIS to seek their input on additional or alternative mitigation measures. CPRA is continuing to evaluate additional mitigation measures, including the feedback received through that outreach. CPRA further encourages and requests low income and minority populations that may be adversely impacted by the Project to provide comments on the mitigation measures identified in this Plan, and to identify alternative or additional mitigation measures to CPRA through their comments on the DEIS. CPRA will thereafter consider those measures and append this Mitigation Plan as appropriate.

6.3.9 Cultural Resources

Impacts. Impacts to Cultural Resources from the Project are described in detail in Chapter 4 Section 23 of the DEIS, and briefly summarized below.

USACE determined, and consulting parties concurred, the Project will have an adverse effect on four (4) historic properties (archeological sites) eligible for the NRHP located within the Operational Impacts APE. Examples of potential direct impacts on these historic properties during Project operations would include burial from sediment deposition and erosion resulting from changes in flow velocity. Given the large size and submerged nature of much of the Operational Impacts APE, as well as the multiple other processes affecting these submerged areas (such as subsidence, erosion, and channel dredging), it is not possible to fully separate the Project-caused impacts on historic properties from those impacts caused by subsidence, erosion and other processes unrelated to the Project, particularly over the 50-year analysis period in the EIS.

Mitigation. CPRA, USACE, the Louisiana State Historic Preservation Office (SHPO), Federally-recognized Tribes, and the Advisory Council on Historic Preservation are currently consulting pursuant to Section 106 of the National Historic Preservation Act regarding the effects of the Project on historic properties in the APE. The consulting parties are developing a Programmatic Agreement (PA) for the Project. As currently proposed, the PA includes an alternative mitigation plan, agreed to by the Applicant, to resolve adverse effects within the Operational Impacts APE. That alternative mitigation plan includes a peer-reviewed scholarly ethnohistoric publication regarding Tribes in the Barataria Basin and larger Mississippi River Delta region, a compilation of information intended to only be available to Tribes, and public-facing components that may include a website or K-12 educational materials or other accessible materials providing greater information to the public-at-large. It also includes the agreed upon plan for monitoring Project impacts on cultural resources within the Operations Impacts APE as well as an unanticipated discoveries plan. CPRA anticipates that the PA will be executed concurrent with the Final EIS or Record of Decision (ROD).

7. PLAN IMPLEMENTATION

7.1. Performance, Monitoring, Maintenance, and Adaptive Management

Evaluation metrics and implementation guidance and goals are identified in the Monitoring and Adaptive Management Plan for the Project (MAM Plan), developed by the LA TIG. Performance evaluation metrics and parameters are also adopted for the Project to ensure that the Project is achieving its intended restoration benefits.

Such performance metrics and parameters would help determine if the Project and the related mitigation are achieving the overall objectives of the Project and this Plan. These standards are based on attributes that are objective and verifiable by field measurements and analysis. Data collection and analysis will be based on methods established and/or approved by CPRA using established best-practices.

The MAM Plan also identifies monitoring, maintenance, and adaptive management requirements to ensure that mitigation components and the Project restoration objectives are achieving the performance standards. Certain mitigation measures contained in the Mitigation Plan will be specifically contained within the MAM Plan.

The Mitigation Plan contains different types of mitigation with varying times to reach maturity or to become established. As such, the monitoring, maintenance, and adaptive management requirements for the different types of mitigation components vary. Some mitigation components provide immediate benefits and require no ongoing monitoring, maintenance efforts, and adaptive management. Other components will need to be monitored, maintained, and adaptively managed over time to ensure that they are achieving their intended effects.

Once construction is completed, CPRA will be responsible for monitoring the Project site mitigation areas, as set forth in the MAM Plan and until any performance goals are met and the Corps approves any required mitigation.

It is anticipated that some active management and maintenance activities would need to occur to maintain the long-term viability and sustainability of the proposed mitigation. Maintenance activities would occur on an as needed and/or as identified basis. CPRA will continue to monitor and maintain the site until the mitigation project has met its stated goals and objectives as confirmed by the Corps. It is anticipated that once the goals and objectives have been met, the mitigation site would be a self-sustaining system.

If monitoring reports comparing mitigation progress to performance standards indicate that mitigation progress is falling short of the identified performance standards, consultation with the Corps would be initiated regarding the need for adaptive management.

8. FINANCIAL ASSURANCES

If the *Deepwater Horizon* Louisiana Trustee Implementation Group (LA TIG) decides to fund the Project, that funding will include an allocation of funds adequate to ensure each component of this Mitigation Plan will be funded as part of the LA TIG's funding decision.

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[i] 33 C.F.R. § 320.4.
[ii] 33 C.F.R. § 320.4.
[iii] 33 C.F.R. § 320.4(r).
[iv] 40 C.F.R. § 230.93(a)(1).
[v] 33 C.F.R. Part 332; 40 C.F.R. Part 230.
[vi] 40 C.F.R. § 230.93(a)(1).
[vii] 40 C.F.R. § 230.93(e).
[viii] 40 C.F.R. § 230.93(e).
[ix] 40 C.F.R. § 230.93(b)(4).
[x] 40 C.F.R. § 230.93(m).
[xi] 33 U.S.C. § *408(a).*

[xii] U.S. Army Corps of Eng'rs, EC 1165-2-200 (2018), available at, https://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-220.pdf?ver=2018-09-07-115729-890.
[xiii] 50 C.F.R. § 402.14(g)(3), (4).
[xiv] 50 C.F.R. § 402.02.
[xv] 16 U.S.C. § 662.
[xvi] 16 U.S.C. § 662 ("The reporting officers in project reports of the Federal agencies shall give full consideration to the report and recommendations of the Secretary of the Interior and to any report of the State agency on the wildlife aspects of such projects, and the project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits.")
[xvii] 1981 Fish and Wildlife Service Mitigation Policy, 46 Fed. Reg 7644-7663 (Jan. 23, 1981). FWS adopted the 1981 guidance for personnel involved in making recommendations to protect or conserve fish and wildlife resources, including under the Fish and Wildlife Coordination Act.
[xviii] 16 U.S.C. § 1852(h)(1). The applicable regulations define "council" as including the Secretary, as applicable, when preparing certain FMPs. 50 C.F.R. § 600.810(a).
[xix] 16 U.S.C. § 1853(a)(7).
[xx] *Id*. § 1802(10). The FMPs must include a textual description of the EFH as well as maps that display the geographic locations of EFH, explicitly distinguish EFH from non-EFH areas, and any habitat areas of particular concern. 50 C.F.R. §§ 600.815(a)(1)(iv)(B) & (a)(1)(v).
[xxi] 16 U.S.C. § 1855(b)(2). While state agencies are not required to consult with NMFS on state actions that may adversely affect EFH, NMFS is required to provide EFH conservation recommendations for any state action that would adversely affect EFH. *Id*. § 1855(b)(4)(A); 50 C.F.R. § 600.925(c)(1).
[xxii] 16 U.S.C. § 1855(b)(2).
[xxiii] NMFS, Essential Fish Habitat Consultation Guidance, Version 1.1 (2004).
[xxiv] 16 U.S.C. § 1855(b)(4).
[xxv] 36 C.F.R. part 800.
[xxvi] 36 C.F.R. § 800.6.

Appendix C: Matrix of Eliminated Alternatives

The matrix in this appendix describes specific geographical and operational aspects of the proposed MBSD Project that were considered but not carried forward for detailed analysis in the Draft RP; see the following table. Because this matrix is pulled directly from the DEIS (USACE, 2021), its references direct readers to chapters and subsections of the DEIS rather than the Draft RP. Thus, readers should plan to consult the DEIS when reviewing this appendix.

Background Regarding the Development of the Matrix

CEMVN worked with the LA TIG and cooperating agencies through an AWG to develop and implement a process to identify and screen various alternatives for a MBSD. Members of the AWG included representatives from CEMVN, CPRA, and the Project Federal Coordination Team (FCT), including representatives from NOAA, NMFS, USEPA, USFWS, DOI, and USDA. The screening process considered the following:

- Information available from previous studies, including those described in Section 2.1 of the DEIS, relevant to the currently Proposed MBSD Project, which included scoping analyses and full studies;
- Decision-making needs of the lead agency (USACE) and cooperating agencies (see Chapter 1 of the DEIS for additional information about roles of the lead and cooperating agencies);
- NEPA requirements (40 CFR 1502.14);
- NRDA restoration planning efforts;
- Information and modeling input provided by CPRA; and
- Public and agency scoping comments.

The screening process involved the development and use of matrices to show the basic assumptions employed, the data and information analyzed, and the reasons and rationale used. The process began with identifying possible alternatives for consideration and developing relevant screening criteria. The AWG then began filling in the matrix by identifying why each alternative did or did not meet each of the identified screening criteria. Overall, the group collaborated to refine and conduct the alternatives screening process to evaluate a wide range of alternatives, taking into consideration practicability, location, design, and operation in an objective and transparent manner.

The AWG met nine times between February 7 and July 3, 2018, and coordinated with the MBSD EIS USACE/FCT/LA TIG group four times (at the February 27, March 27, April 24, and May 22, 2018 USACE/FCT/LA TIG group meetings). The AWG agreed upon the key parameters of the reasonable range of alternatives via teleconference on April 5, 2018. Following this preliminary identification of the reasonable range of alternatives, the AWG began an iterative process of preparing a draft of Chapter 2 of the DEIS. CEMVN prepared an initial draft of Chapter 2 of the DEIS on April 18, 2018, for review and comment by the LA TIG. CEVMN and the LA TIG worked collaboratively through July 3, 2018, to develop the final draft Chapter 2 for inclusion in the DEIS. During this process, CPRA provided additional information regarding the Applicant's Preferred Alternative and the alternatives identified and selected by the AWG to be included in the reasonable range for analysis in the EIS. While the matrix, included below, continued to be a valuable tool during the drafting of Chapter 2, the ultimate analysis and conclusions of the AWG, as reviewed and agreed by the CEVMN, are reflected in the text of Chapter 2 of the DEIS.

Table C-1.
Description of Eliminated Alternatives and the Basis for Not Carrying Each Forward for a Detailed Review

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
22	Diversion	Design options	Construct guide levee with earthen material instead of concrete walls to allow for sustenance fishing when the structure is not in operation.	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, not a reasonable alternative because the diversion will be fenced to protect public safety. Fishing will be available at either end of the diversion structure (either in the Mississippi River or the Barataria Basin), but not as part of the Applicant's Preferred Alternative or any of the action alternatives.
23	Diversion	Design options	Construct the MBSD structure with geopolymer concrete	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, CPRA and its CMAR contractor are evaluating materials types for the diversion structure and this comment will be considered as part of that process.
24	Diversion	Design options	Justify having two gates versus the more cost effective option of one gate	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, the engineering review conducted as part of the Section 408 analysis will consider this issue in regards to maintaining the integrity of the federal levee. The recommendations resulting from that review will be integrated into each of the alternatives considered in the EIS. Additionally, a reduction in the number of gates (< 3) would result in the need for a larger structure to achieve proposed flow rate.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
25	Diversion	Design options	Consider alternative rail alignment that excludes costly upgrades	Scoping		Multiple rail alignment alternatives were considered by the Applicant. The Applicant's current design for the Proposed Project includes a rail alignment that maintains the current alignment and does not include costly upgrades. This alignment will be carried forward for detailed analyzed in the EIS.
26	Diversion	Flood reduction options	Rather than place excavated material into proposed disposal areas, use that material to raise ground in Ironton, fortify the back levee, or fill in borrow pits	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, excavated material that is considered suitable for levee construction will be used for construction of the conveyance channel guide levees and the temporary reroute of the MRL levee system to maintain protection during construction of the Project. Material deemed unsuitable for use in levees is expected to be used beneficially. Additionally, CPRA is considering flood risk and potential mitigation measures that will be considered and included in the EIS analysis. See Chapter 4, Section 4.20 regarding Public Health and Safety, and Section 4.27, Mitigation Summary.
27	Diversion	Flood reduction options	Use some sediment from conveyance channel to create ring levees and raise homes for Ironton and other communities	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, CPRA, CEMVN and cooperating agencies are considering mitigation from flood risk as part of the EIS analysis. See Chapter 4, Section 4.20 regarding Public Health and Safety, and Section 4.27, Mitigation Summary.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
28	Diversion	Flood reduction options	Place material in the western reach of the Barataria Waterway to reduce tidal events in Upper Barataria and lessen potential Project-induced flooding impacts	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, CPRA, CEMVN and cooperating agencies are considering mitigation from flood risk as part of the EIS analysis. See Chapter 4, Section 4.20 regarding Public Health and Safety, and Section 4.27, Mitigation Summary.
29	Diversion	Flood reduction options	Build guide levees to 100-year hurricane and flood protection standard so that guide levees and highway bridge will not have to be modified in future	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, existing levee system is not built to 100-yr level of protection; levees will be designed consistent with direction from CEMVN based on integration into the existing system. As of 9/17/18, a levee design grade of EL 15.6 was recommended, which is equal to the design grade recommended by USACE for the Reach NOV-NF-W-05c, 50-yr (2063).
3	Diversion	Freshwater diversion	Freshwater diversion similar to those previously implemented	Previous studies	CPRA Master Planning	Addressed in Chapter 2 (evaluation of functional alternatives)
15	Diversion	Freshwater diversion	Ironton-Gated concrete box culverts at intake, conveyance channel, outflow channel into basin, pilot channel with locks also considered. 5 kcfs, 15 kcfs. RM 59.8	Previous studies	MRSNFR Study 2000	Addressed in Chapter 2 (evaluation of functional alternatives)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
7	Diversion	Location options	Upriver over existing borrow pits to avoid stressed wetland area at proposed location and increase distance to residences	Scoping		Addressed in Chapter 2 (evaluation of location within Basin)
8	Diversion	Location options	Down river toward Venice or even below Venice to protect a bigger area from storm surge and land loss	Scoping		Addressed in Chapter 2 (evaluation of location within Basin)
9	Diversion	Location options	Not in vicinity of future RAM Terminals Coal Export Facility	Scoping		See analysis in Chapter 2 for explanation of locations carried forward for detailed analysis. The Ram Terminal is no longer proposed at that location. Reasonably foreseeable projects are addressed in the EIS in Chapter 4.
10	Diversion	Location options	Optimize tidal mixing: Move marsh creation area to freshwater areas extending into brackish areas to allow for tidal mixing and prevention of hypoxia	Scoping		Locations responsive to this comment are in the upper Basin. Location within the Basin is addressed in Chapter 2 (evaluation of location within Basin).
11	Diversion	Location options	Proposed location of MBSD at RM 60.7	Application		Addressed in Chapter 2 (evaluation of location within Basin)
12	Diversion	Location options	Magnolia @RM 47.5	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (LCA, 2008-2014), 15 kcfs & 70 kcfs	Addressed in Chapter 2 (evaluation of location within Basin)
13	Diversion	Location options	Woodland @RM 51	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (LCA, 2008-2014), 15 kcfs & 70 kcfs	Addressed in Chapter 2 (evaluation of location within Basin)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
14	Diversion	Location options	Myrtle Grove @ RM 59	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (LCA, 2008-2014), 15 kcfs & 70 kcfs	Addressed in Chapter 2 (evaluation of location within Basin)
16	Diversion	Location options	RM 60.8-61.3 (Between Alliance Refinery and Myrtle Grove)	Previous studies	Myrtle Grove Ecosystem Restoration Project (CWPPRA)	Addressed in Chapter 2 (evaluation of location within Basin)
17	Diversion	Location options	Myrtle Grove @ RM 60.2	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (LCA, 2008-2014)	Addressed in Chapter 2 (evaluation of location within Basin)
1	No diversion	Marsh creation	Marsh creation through Mississippi River dredging/pipeline sediment delivery	Scoping		Addressed in Chapter 2 (evaluation of functional alternatives)
20	Diversion	Maximize sediment options	Pipe sediment directly into MBSD conveyance channel through dedicated dredging to maximize sediment/water ratio	Scoping		This alternative was determined not to be practical or feasible from a technical or economic standpoint. Utilizing the lateral bar adjacent to the diversion in the Mississippi River as a sediment source for the piped sediment would decrease the efficiency of the diversion and availability of sediment. Piping sediment from a more distant source would not be cost efficient due to the distance and maintenance of pipeline and could result in impact to navigation. Further, piping sediment directly into the conveyance channel could alter the movement of sediment within the channel, increasing maintenance costs. (See EIS Chapter 2, Section 2.4.4)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
21	Diversion	Maximize sediment options	Use vortex generators near the intake of diversion structure or in conveyance channel to create turbulence near the bottom to keep sediment suspended while flows are low to increase amount of sediment transfer and keep channel bottom from shoaling	Scoping		A vortex generator (VG) is generally considered an aerodynamic device, consisting of a small vane usually attached to a lifting surface (or airfoil, such as an aircraft wing) or a rotor blade of a wind turbine. As a result, a vortex generator is not a reasonable/feasible alternative in an aquatic environment. CPRA did, however, consider turbulence inducing structures intended to support sediment suspension during flow through the channel into the basin. Results from modeling of such structures found that the sufficient sediment exists in the system to meet the target sediment to water ratio without the need of additional turbulence structures. Further, the presence of such structures would lead to additional energy loss through the structures, and therefore, was not practical or technical feasible. As a result, turbulence generating structures were not carried forward for detailed review.
51	Diversion	Operations-trigger	Mimic Historic Hydrology: 5,000 cfs diversion at 50% duration river stage. Every 5th year 150,000 cfs	Previous studies	Myrtle Grove Alt R3	Would not transport sufficient water, nutrients and sediment from the Mississippi River to the Barataria Basin to meet purpose and need. Consequently, not carried forward for detailed review.
52	Diversion	Operations-trigger	Mimic Historic Hydrology: 75,000 cfs at 50% duration river stage diverted for 3 months at 5-year intervals	Previous studies	Myrtle Grove Alt M3: Mimic Historic Hydrology	At the proposed durations and intervals, this operational scenario would not transport sufficient water, nutrients and sediment from the Mississippi River to the Barataria Basin to meet purpose and need. Consequently, not carried forward for detailed review.
55	Diversion	Operations-trigger	Triggers specific to the health of different species (shrimp, oyster, marine mammals, protected species, overall fishery, EFH), or existing wetlands	Scoping		Not technically feasible or reasonable. Data/technology do not currently exist to support this operational regime. Consequently, not carried forward for detailed review. Nevertheless, adaptive management of the proposed diversion will be addressed in the Operations Plan and Monitoring and Adaptive Management Plan.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
56	Diversion	Operations-trigger	Maintain inter-annual consistency in operation	Scoping		Not technically feasible because of the natural variability in the Mississippi River system. Operations will be largely determined by flows within the Mississippi River and water levels in the Barataria Basin. Flows in the Mississippi River are naturally variable, changing throughout each year and between years.
57	Diversion	Operations-trigger	Time pulses to maximize sediment capture	Scoping		As part of the project design, CPRA considered multiple pulsing scenarios with the goal of maximizing sediment capture and transport. That analysis showed that applying pulsing to project operations significantly reduced the days of operation, and consequently this operational scenario would not transport sufficient water, nutrients, and sediment from the Mississippi River to the Barataria Basin to meet the purpose and need. Consequently, not carried forward for detailed review.
58	Diversion	Operations-trigger	Seasonal triggers	Scoping		Addressed in Chapter 2 (evaluation of operational triggers)
59	Diversion	Operations-trigger	Salinity, turbidity, and water temperature triggers	Scoping		Operating a diversion using these triggers would not meet project purpose and need, as salinity and temperature are not tied specifically to sediment availability, and real time sediment monitoring is not currently technically feasible (real time sediment monitoring does not provide consistent and reliable data to support diversion operations). Consequently, this alternative was not carried forward for detailed review. Nevertheless, adaptive management of the proposed diversion will be addressed in the Operations Plan and Monitoring and Adaptive Management Plan.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
60	Diversion	Operations-coordination	Coordinate operations with other diversions in area to maximize benefits	Scoping		Coordination with all other diversions in the area is not practical or technically feasible because CPRA does not control the operations of all other diversions and siphons in the Barataria Basin. Nonetheless, as part of evaluating the location and operations of the proposed Project and potential alternatives, CPRA and the AWG assumed operations of other diversions consistent with their current or anticipated operational protocols. Further, potential impacts to the Davis Pond Freshwater Diversion will be considered as part of the 408 process. CPRA will coordinate to the extent possible with other entities responsible for operation of other diversions and siphons.
61	Diversion	Operations-coordination	Create a basin-wide operation plan to coordinate all diversions and siphons to maximize benefits	Scoping		Coordination of a basin-wide operation plan is not practical or technically feasible due to varied ownership and operational responsibility for other diversions and siphons in the Barataria Basin. Nonetheless, as part of evaluating the location and operations of the proposed Project and potential alternatives, CPRA and the AWG assumed operations of other diversions consistent with their current or anticipated operational protocols. Further, potential impacts to the Davis Pond Freshwater Diversion will be considered as part of the 408 process. CPRA will coordinate to the extent possible with other entities responsible for operation of other diversions and siphons.
62	Diversion	Operations-trigger	Make real-time trigger data publicly available	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, river flow data is publicly available.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
63	Diversion	Operations-NA	Develop operation plan in coordination with fishing, navigation, agencies, and non-profit organizations	Scoping		Not an alternative as contemplated by NEPA. Analysis as an alternative would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives selected for more detailed review. In any case, CPRA's proposed operations plan has been developed following significant engagement with the public, NGOs and other agencies. Additional comments regarding the operational plan should be made during the DEIS comment period.
69	Diversion	Operations-trigger	Maintain 200,000 cfs downstream of diversion	CPRA PED	Tech Memo-TO 05, TO 41, TO 44	This alternative was determined not technically feasible or reasonable. Reducing the water levels downstream in the Mississippi River is likely to result in salt water intrusion that could threaten several downstream freshwater drinking sources.
70	Diversion	Operations-trigger	600,000 cfs at Belle Chasse trigger	CPRA PED	Tech Memo-TO 05, TO 41, TO 45	Addressed in Chapter 2 (evaluation of operational triggers)
71	Diversion	Operations-trigger	450,000 cfs at Belle Chasse trigger	CPRA PED	Tech Memo-TO 05, TO 41, TO 46	Addressed in Chapter 2 (evaluation of operational triggers)
72	Diversion	Operations-trigger	Trigger for discharge at rising limb only	CPRA PED	Tech Memo-TO 05, TO 41, TO 47	Addressed in Chapter 2 (evaluation of operational triggers)
73	Diversion	Operations-trigger	Asymmetrical Trigger- for rising limb effect	CPRA PED	Tech Memo-TO 05, TO 41, TO 48	Addressed in Chapter 2 (evaluation of operational triggers)
74	Diversion	Operations-trigger	Pulsing	CPRA PED	Tech Memo-TO 05, TO 41, TO 49	Addressed in Chapter 2 (evaluation of operational triggers)
75	Diversion	Operations-trigger	Pulsing with reduced summer opening	CPRA PED	Tech Memo-TO 05, TO 41, TO 50	Addressed in Chapter 2 (evaluation of operational triggers)
76	Diversion	Operations-trigger	Pulsing with summer closed	CPRA PED	Tech Memo-TO 05, TO 41, TO 51	Addressed in Chapter 2 (evaluation of operational triggers)
77	Diversion	Operations-trigger	Simple sediment trigger	CPRA PED	Tech Memo-TO 05, TO 41, TO 52	Addressed in Chapter 2 (evaluation of operational triggers)
78	Diversion	Operations-trigger	Asymmetrical sediment trigger	CPRA PED	Tech Memo-TO 05, TO 41, TO 53	Addressed in Chapter 2 (evaluation of operational triggers)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
53	Diversion	Operations-base flow	Base flow: No base flow—when there are no benefits of silt, close off the freshwater.	Scoping		Addressed in Chapter 2 (evaluation of base flow)
54	Diversion	Operations-base flow	Base flow: Analyze impacts of different base flow scenarios	Scoping		Addressed in Chapter 2 (evaluation of base flow)
64	Diversion	Operations-base flow	None	CPRA PED	Tech Memo-TO 46	Addressed in Chapter 2 (evaluation of base flow)
65	Diversion	Operations-base flow	1,000 cfs	CPRA PED	Tech Memo-TO 47	Addressed in Chapter 2 (evaluation of base flow)
66	Diversion	Operations-base flow	2,500 cfs	CPRA PED	Tech Memo-TO 48	Addressed in Chapter 2 (evaluation of base flow)
67	Diversion	Operations-base flow	5,000 cfs	CPRA PED	Tech Memo-TO 49	Addressed in Chapter 2 (evaluation of base flow)
68	Diversion	Operations-base flow	10,000 cfs	CPRA PED	Tech Memo-TO 50	Addressed in Chapter 2 (evaluation of base flow)
39	Diversion	Operations-flow rates	2,100 cfs	Previous studies	Myrtle Grove Freshwater Diversion (BA-24) (1996-1998)	Addressed in Chapter 2 (evaluation of functional alternatives)
40	Diversion	Operations-flow rates	2,500 cfs	Previous studies	Myrtle Grove Ecosystem Restoration Project (CWPPRA), Delta Building Diversion at Myrtle Grove (NMFS)	Addressed in Chapter 2 (evaluation of functional alternatives)
41	Diversion	Operations-flow rates	5,000 cfs	Previous studies	Myrtle Grove Ecosystem Restoration Project (CWPPRA), LCA Recon Rpt/EIS	Addressed in Chapter 2 (evaluation of functional alternatives)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
42	Diversion	Operations-flow rates	10,000 cfs	Previous studies	Myrtle Grove Ecosystem Restoration Project (CWPPRA)	Addressed in Chapter 2 (evaluation of functional alternatives)
43	Diversion	Operations-flow rates	15,000 cfs	Previous studies	Myrtle Grove Ecosystem Restoration Project (Fed/State 1997-98), Myrtle Grove Ecosystem Restoration Project (CWPPRA), MRSNFR Study, LCA Recon Rpt/EIS, Delta Building Diversion at Myrtle Grove (NMFS), Medium Diversion at Myrtle Grove with Dedicated Dredging (USACE)	Addressed in Chapter 2 (evaluation of functional alternatives)
44	Diversion	Operations-flow rates	20,000 cfs	Previous studies	Myrtle Grove Ecosystem Restoration Project (CWPPRA)	Addressed in Chapter 2 (evaluation of functional alternatives)
45	Diversion	Operations-flow rates	38,000 cfs	Previous studies	LCA Recon Rpt/EIS	Addressed in Chapter 2 (evaluation of functional alternatives)
46	Diversion	Operations-flow rates	45,000 cfs	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (USACE)	Addressed in Chapter 2 (evaluation of functional alternatives)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
47	Diversion	Operations-flow rates	70,000 cfs	Previous studies	Medium Diversion at Myrtle Grove with Dedicated Dredging (USACE)	Addressed in Chapter 2 (evaluation of functional alternatives)
48	Diversion	Operations-flow rates	75,000 cfs	previous studies	LCA Recon Rpt/EIS, Medium Diversion at Myrtle Grove with Dedicated Dredging (USACE), MR Delta Management Study	Addressed in Chapter 2 (evaluation of functional alternatives)
49	Diversion	Operations-flow rates	150,000 cfs	Previous studies	LCA Recon Rpt/EIS, Medium Diversion at Myrtle Grove with Dedicated Dredging (USACE), MR Delta Management Study	Addressed in Chapter 2 (evaluation of functional alternatives)
50	Diversion	Operations-flow rates	250,000 cfs	Previous studies	CPRA 2012 Master Plan	Addressed in Chapter 2 (evaluation of functional alternatives)
80	Diversion	Operations-gate closure	300,000 cfs at Belle Chase to avoid backflow from head differential	CPRA PED	Tech Memo-TO 46	Alternative determined to be not reasonable or feasible. Operation/flow rate of the diversion will depend on a combination of flow rate in the MS River and head differential in the Basin. It is not accurate or predictable to assert that 300,000 cfs in the MS River will avoid backflow. Not carried forward for detailed analysis in the EIS.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
18	Diversion	Outfall options	Construct canals, bayous, terracing, impoundments, weirs or Chenier-like ridges to manipulate the flow of water for water quality and sediment retention benefits, to create barriers for storm surge and wind, and to redirect waters away from oyster production and sensitive areas.	Scoping		This issue is addressed in Chapter 2 (evaluation of sediment diversion outfall features).-It should be noted that because operation of the proposed diversion will result in freshening within certain portions of the basin, it is not feasible to redirect waters to avoid certain areas within the basin. Potential impacts associated with changes in salinity are addressed in Chapter 4, Section 4.5. Mitigation, if any, to address potential effects from water flow and to water quality will be addressed in Chapter 4, Section 4.27.
19	Diversion	Outfall options	Pump tidal saline waters into diversion outfall area to mitigate excess nutrients and allow for oxygenation of river water	Scoping		This alternative does not meet purpose and need for the project. The intent is to restore the natural deltaic process between the Mississippi River and Barataria Basin through the introduction of freshwater, sediment, and nutrients from the MS River into the Basin. Additionally, the basin will experience periodic introduction of more saline water naturally through tidal processes and storm events. Potential impacts associated with changes in salinity are addressed in Chapter 4, Section 4.5.
6	No diversion	Restore barrier islands	Barrier Islands: Focus on rebuilding barrier islands for storm surge protection and to reduce land loss	Scoping		Addressed in Chapter 2 (evaluation of functional alternatives)
5	No diversion	Shoreline protection	Shoreline Protection: Protect the coastal shoreline with rock or beach nourishment (through dredging/pipeline sediment delivery from lower Mississippi River or gulf nearshore areas) for storm surge protection and to reduce land loss	Scoping		Addressed in Chapter 2 (evaluation of functional alternatives)

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
2	Diversion	Smaller diversion + marsh creation	Marsh Creation/Smaller Diversion: Smaller diversion/operate at lower flows (to lessen impacts on fisheries) in conjunction with Mississippi River dredging/pipeline sediment delivery	Scoping		Addressed in Chapter 2 (evaluation of functional alternatives)
4	No diversion	Structural barriers	Structural Barriers: Build rock barriers, retaining walls, a longer Barataria Land Bridge, or levees for storm surge protection and to reduce land loss/marsh erosion	Scoping		Addressed in Chapter 2 (evaluation of functional alternatives)
30	Diversion	Design-structural options	Siphon	Previous studies	Myrtle Grove Freshwater Diversion (BA-24) (1996-1998)	Addressed in Chapter 2 (evaluation of additional design considerations)
31	Diversion	Design-structural options	Gated concrete box culverts at intake, conveyance channel, outlow channel into basin	Previous studies	MRSNFR Study 2000	Aside from the box culvert component of this design, this alternative is consistent with the diversion designs carried forward for detailed review in the EIS. The environmental impacts potentially resulting from a box culvert design are substantially similar to the environmental impacts potentially resulting from an open cut U-frame intake. As a result, the environmental impacts of this alternative will be evaluated in the EIS, although the box culvert specific design is not carried forward for detailed analysis in the EIS.
32	Diversion	Design-structural options	Pilot channel with locks	Previous studies	MRSNFR Study 2000	This alternative is not feasible and is not consistent with the project purpose and need. The diversion channel is not intended for, nor will it allow, vessel access between the Mississippi River and Barataria Basin.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
33	Diversion	Design-structural options	Gated structure at intake, conveyance channel, outflow channel into basin	CPRA PED	Design consideration with HDR	This is the Applicant's Preferred Alternative. It is carried forward for detailed analysis in the EIS.
34	Diversion	Design-structural options	Gated structure at intake, conveyance channel, back structure	CPRA PED	Design consideration with HDR	Each of the alternatives carried forward for detailed evaluation includes a gated structure at intake and a conveyance channel. CPRA considered a diversion structure with a back gate structure. After detailed design consideration, however, CPRA proposed eliminating the back gate design and proceeded with a diversion structure with hurricane/guide levees and no back gate structure. CPRA worked with CEMVN to complete a USACE Risk Assessment of this proposed design. In any case, the inclusion or exclusion of a back structure would not result in notably different potential environmental effects as compared to the Applicant's Preferred Alternative or the other action alternatives, and consequently was not carried forward for more detailed review.
35	Diversion	Design-structural options	Closed Conveyance Channel	CPRA PED	Design consideration with HDR	Addressed in Chapter 2 (evaluation of additional design considerations)
36	Diversion	Design-structural options	Open Conveyance Channel	CPRA PED	Design consideration with HDR	This design feature is included with the action alternatives carried forward for detailed analysis in the EIS.
37	Diversion	Design-structural options	Channel Configurations: Dog-leg	Previous studies	CPRA's Delta Building Diversion Modeling effort	Addressed in Chapter 2 (evaluation of additional design considerations)
38	Diversion	Design-structural options	Channel Configurations: Straight	Previous studies	CPRA's Delta Building Diversion Modeling effort	Carried forward for detailed analysis in the EIS.
USACE-1a	Alternatives		Use of sediment retention features in the outfall area			Carried forward for detailed analysis as part of the action alternatives. See Chapter 2.

ID #	Diversion/ No Diversion	Alternative or Option Type	Description	Source	Source Details	Basis for Decision Not to Carry Forward for Detailed Review
USACE-1f	Alternatives		Creation of a distributary network in the outfall area			All action alternatives considered in the EIS include an Outfall Transition Feature that is intended to expedite formation of a distributary network of channels to naturally form in the outfall area. This network may be slightly modified or maintained through dredging to support sediment distribution throughout the basin over the duration of the project. Need for such action would be considered through adaptive management and therefore is not considered an alternative.
USACE-1b	Alternatives		Addition of marsh creation features in the Project Area			Addressed in Chapter 2 (evaluation of functional alternatives)
	Diversion		Multiple smaller diversions within Barataria Basin			Addressed in Chapter 2 (evaluation of functional alternatives)
	Diversion		MBSD with beneficial use of material dredged from navigation canals			This alternative was determined to be not feasible. Materials dredged from the public navigation canals is already dedicated to other beneficial use projects. Material dredged from private navigation canals is privately owned and not necessarily available to CPRA. Additionally, it is unknown if the material from maintenance dredging of canals would be appropriate for beneficial use projects. Therefore, the ability to utilize sediment dredged from such waterways is speculative at this point and therefore not practicable or feasible.