2.0 ALTERNATIVES

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2.0 ALTERNATIVES

2.1 Introduction

The purpose of this chapter is to describe the alternatives evaluated in this EIS. Both the CEQ's NEPA Implementation Procedures (40 CFR 1502.14) and the USACE NEPA Implementation Procedures (33 CFR Part 325, Appendix B) require consideration of a range of alternatives for a proposed action. Defining a reasonable range of alternatives, as described in Section 2.2, is a key element for subsequent analyses in an EIS. This chapter outlines the process used to develop the reasonable range of alternatives to the Applicant's Preferred Alternative, explains why certain alternatives were removed from further consideration, and describes the alternatives carried forward for detailed analysis. As part of the alternatives screening process, several alternatives were evaluated for their ability to meet the overall purpose and need for the proposed Project, as presented in Chapter 1. This evaluation concluded with a reasonable range of alternatives (see Section 2.8 for a full description of each alternative), together with the No Action Alternative, including:

- No Action Alternative: None of the action alternatives evaluated in this EIS would be permitted or built;
- Alternative 1: variable flow up to 75,000 cfs maximum sediment diversion (Applicant's Preferred Alternative);
- Alternative 2: variable flow up to 75,000 cfs maximum sediment diversion including marsh terracing outfall feature;
- Alternative 3: variable flow up to 50,000 cfs maximum sediment diversion;
- Alternative 4: variable flow up to 50,000 cfs maximum sediment diversion including marsh terracing outfall feature;
- Alternative 5: variable flow up to 150,000 cfs maximum sediment diversion; and
- Alternative 6: variable flow up to 150,000 cfs maximum sediment diversion including marsh terracing outfall feature.

The subsequent sections of this chapter include a brief overview of the intent and function of sediment diversions (see Section 2.1.1), the steps taken to develop alternatives (see Section 2.2), a discussion of the effectiveness of different alternatives at meeting the proposed Project purpose and need (see Sections 2.3 through 2.5), a summary of the alternatives considered but eliminated from detailed analysis (see Section 2.6), a description of the No Action Alternative (see Section 2.7), and a description of the Applicant's Preferred Alternative and other action alternatives carried forward for further environmental review (see Section 2.8). Chapter 1 describes the objectives of the Applicant's Preferred Alternative as well as the Project purpose and need, which were instrumental in identifying the reasonable range of alternatives, as described in subsequent sections.

2.1.1 Overview of Sediment Diversions

As defined in Chapter 1, Section 1.3, the Applicant has proposed constructing a large-scale sediment diversion connecting the Mississippi River with the adjoining Barataria Basin (see Section 2.8.1 for a full description of the Applicant's Preferred Alternative). Sediment diversions are intended to divert sediment, fresh water, and nutrients from a river into an adjacent basin via controlled conveyance channels in an effort to reintroduce deltaic deposition of sediments and thereby create, restore, and sustain wetlands. In general, sediment diversion projects are designed to convey the nutrients and sediments present in freshwater river flows to the area receiving the diverted flows (Andrus 2007, Day et al. 2009, Kolker et al. 2012, DeLaune et al. 2013, Kemp et al. 2014, Wang et al. 2014). Based on previous studies, including results of an extensive data-gathering and modeling initiative undertaken by CPRA in collaboration with several non-governmental organizations (CPRA 2011), sediment diversions will best meet objectives of capturing sediment and building wetlands when located and designed to maximize capture and distribution of coarse-grained sediment, including sands (greater than 63 microns in diameter) and coarse silts (32 to 63 microns)[5] (Meselhe et al. 2011, Meselhe et al. 2012). These larger-sized sediments are less prone to resuspension within the receiving basin and promote consolidation (Allison and Meselhe 2010). This allows for a more rapid vertical accumulation of organic material (DeLaune et al. 2013), resulting in quicker emergence of wetlands in the outfall area that are then able to support vegetation that traps available sediment across a range of particle sizes (Allison and Meselhe 2010). Although capture of these larger sediments is critical, successful sediment diversions will also convey organic material and finer-grained sediments (less than 32 microns) intended to disperse farther into the basin to sustain and nourish existing wetlands (Nyman et al. 1990, DeLaune et al. 2013).

As the intent of sediment diversions is often to maximize development of new wetlands and increase the health of or sustain existing wetlands, the following considerations are typically accounted for during design:

- Intake structure considerations – Intake structures for sediment diversions are constructed at depositional point bar locations along the inside bends of the river, which have a high potential for natural sediment accumulation. From an engineering standpoint, the sediment diversion intake structures are also designed and located at a depth sufficient to capture a higher concentration of coarse-grained sediment transported along the riverbed or in the lower portion of the water column (CPRA 2011, Meselhe et al. 2012, Nittrouer et al. 2012).

[5] Wentworth (1922) terms the sediment in the 250 to 63 micron range as fine and very fine sand; 63 to 32 microns as coarse silt; and below 32 microns as medium to very fine silt.

- Sediment deposition area considerations – Sediment diversion outfalls are sited in shallow water areas in the basin, which have the ability to accept large volumes of diverted sediment, fresh water, and nutrients (Meselhe et al. 2017) as well as a morphology that promotes sediment retention (for example, soils less subject to subsidence, presence of fringing marshes to contain sediments, and protection from disturbance such as waves) (Sha et al. 2018).

- Discharge capacity considerations – 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 riverbed (CPRA 2011, Allison et al. 2014).

2.2 Steps Taken to Identify and Evaluate Reasonable Alternatives

As described in Chapter 1, Section 1.6, this EIS will be used to inform the decision of the USACE regarding a CWA Section 10/404 permit application and request for Section 408 permissions and will also serve as the environmental review required by NEPA to inform the Trustees' OPA decision whether to fund the proposed Project identified in the LA TIG's Restoration Plan published concurrent with this EIS. Thus, CEMVN led an alternatives workgroup (AWG) in coordination with the LA TIG, including the Applicant (CPRA), and cooperating federal and commenting state agencies to identify a reasonable range of alternatives to be carried forward for further analysis in the EIS that meet the requirements for alternatives to be evaluated for the NEPA review process associated with each federal action (Section 10/404, Section 408, NRDA funding). The goal was to consider a broad range of possible alternatives and identify the reasonable range of alternatives that would be advanced for comparative analysis in the EIS and the LA TIG's Restoration Plan. The intent was to eliminate impractical, infeasible, and unreasonable alternatives early in the process and to focus on a more detailed evaluation of reasonable alternatives capable of meeting the proposed Project purpose and need and associated screening criteria. Additional screening criteria, (also referred to as review factors), were developed to also evaluate alternatives in a transparent and robust manner with respect to their effectiveness in meeting the proposed Project purpose and need.

The alternatives development and evaluation process relied on previous studies, including those conducted by the Applicant (CPRA) as part of developing its Preferred Alternative, that provide the scientific and engineering foundation for the evaluation of potential alternatives. Guided by the purpose and need for the proposed Project, the alternatives formulation process generally consisted of the following sequence of steps:

- develop screening criteria to evaluate the effectiveness of different alternatives in meeting the Project purpose and need;

- identify potential alternatives, including functional and operational/design alternatives, considering prior studies/analysis and public and agency scoping comments;

- evaluate potential alternatives through an iterative process applying the screening criteria and other factors/considerations derived from the Project purpose and need and public and agency scoping comments relevant to the specific analysis; and

- formulate and select Project alternatives for detailed analysis in the Draft EIS.

Throughout this process of alternatives development and evaluation, the following factors were considered: NEPA regulations; requirements of the CWA; requirements of the DWH oil spill NRDA Trustees under the OPA; recommendations in the 2017 Louisiana Coastal Master Plan; public and agency scoping comments regarding the proposed Project; and public and agency comments on the Draft EIS. Each of these topics is discussed briefly below.

- NEPA – To comply with NEPA, CEQ's regulations require that the EIS "rigorously explore and objectively evaluate all reasonable alternatives," including the No Action Alternative (40 CFR 1502.14). Reasonable alternatives "include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant." (CEQ 40 FAQ, Q. 2a [CEQ 1981]). In addition, the CEQ guidelines are clear that not every proposed alternative needs to be evaluated in the EIS; rather, the EIS should analyze a reasonable range of alternatives that capture the potential environmental consequences of actions capable of meeting the purpose and need (CEQ 40 FAQ, Q. 1b [CEQ 1981]). NEPA requires that a No Action Alternative be analyzed to determine the environmental consequences of not undertaking the proposed Project, and thereby providing a baseline against which the potential beneficial and adverse environmental impacts of action alternatives can be evaluated and compared. NEPA also requires that the potential environmental impacts of each action alternative be compared to each other.

- CWA – In accordance with the NEPA Implementation Procedures for the USACE's Regulatory Program (33 CFR App. B Part 325), the USACE is neither an opponent nor a proponent of the Applicant's proposed Project which is referred to as the "Applicant's Preferred Alternative." The USACE considers the "No Action" alternative, which is described as no construction requiring a USACE permit (33 CFR Part 325, App. B, ¶9.b(5)(a)), as well as functional (project substitutes), geographic (locational), and operational (design option) alternatives. The USACE's regulations further provide that only reasonable alternatives need to be considered in detail and that the reason for eliminating alternatives from detailed study should briefly be discussed in the EIS (33 CFR Part 325, App. B, ¶9.b(5)(a)). Reasonable alternatives are further described in the regulations as "those that are feasible, and such feasibility must focus on the accomplishment of the underlying purpose and need (of the applicant or the public) that would be satisfied by the proposed Federal action (permit issuance)." In addition to meeting the requirements of NEPA, the Applicant's Preferred Alternative must comply with the CWA Section 404(b)(1) guidelines in order for USACE to issue a DA permit. The Section 404(b)(1) guidelines require the examination of "practicable" alternatives to the Applicant's Preferred Alternative. "Practicable" alternatives are those that are available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall Project purposes (40 CFR 230.5). The guidelines specify that no discharge of dredged or fill material shall be permitted if there is "a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR 230.10). The USACE will utilize the alternatives analysis in this EIS for its public interest review and its evaluation of compliance with the Section 404(b)(1) guidelines (40 CFR part 230), where applicable, prior to its decision. The decision options available to the District Engineer, which will be described in the ROD and embrace all of the alternatives considered in this EIS, are to: issue the permit as requested; issue the permit with modifications or conditions; or deny the permit.

- OPA – The Natural Resource Trustees (Trustees), with NOAA acting as the lead Federal Trustee for the LA TIG's Restoration Plan described below, must consider alternatives that are capable of meeting the requirements of OPA and its implementing regulations and that are consistent with the PDARP/PEIS for restoration of natural resources injured by the DWH oil spill. The LA TIG is responsible for making decisions related to DWH restoration actions in the mid-Barataria Basin. To help address natural resource injuries resulting from the DWH oil spill, the LA TIG issued its Final Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana (SRP/EA #3) (LA TIG 2018a). In the SRP/EA #3, the LA TIG selected the MBSD Project for further review and environmental analysis pursuant to the OPA and NEPA. The SRP/EA #3 recognized the need for an ecosystem-level perspective/approach for restoration in the Barataria Basin to address the magnitude and diversity of injuries to the nearshore environment and marshes in the Barataria Basin as a result of the DWH oil spill. The federal agencies of the LA TIG noted in that Plan that they "will, as cooperating agencies with the CEMVN for the MBSD EIS, work to ensure that any future Phase II Restoration Plan OPA/NEPA analysis takes advantage of the environmental analysis conducted in the MBSD EIS" (LA TIG 2018a). Thus, the alternatives evaluated here are the same alternatives considered under OPA in the LA TIG's Restoration Plan, which was published concurrent with the MBSD EIS. Additional detail can be found in the LA TIG's Restoration Plan, Section 3.2.4.7 explaining the LA TIG's evaluation of the range of alternatives and its identification of a Preferred Alternative (sediment diversion with variable flow up to 75,000 cfs). The LA TIG, working with CEMVN in the preparation of this MBSD EIS, is working to ensure that the OPA analysis in its LA TIG's Restoration Plan integrates and takes advantage of the environmental analysis conducted in this MBSD EIS.

- <u>Louisiana Coastal Master Plan</u> – As discussed in Section 1.2.2, the Louisiana Coastal Master Plan is the State of Louisiana's long-term comprehensive integrated coastal protection and restoration plan. The Coastal Master Plan is charged with providing a sustainable long-term solution to coastal protection and restoration. According to the Coastal Master Plan, "a sustainable system is one characterized by consistent levels of productivity and resilience" (CPRA 2017a). The Coastal Master Plan uses best available science and engineering to achieve long-term sustainability of Louisiana's coast and ecosystem, relying where possible on natural processes and cycles. The restoration strategies and specific projects identified in the Coastal Master Plan are the result of extensive public input, review, and vetting. In accordance with state law, La. R.S. 49:214.1 – 214.7, CPRA may only implement projects and programs that are consistent with the Coastal Master Plan and the annual plan.

- <u>Public and Agency Scoping Comments</u> – CEMVN and cooperating agencies identified relevant issues through public outreach during scoping and coordination with federal, state, and local agencies and Tribal Nations. Issues identified in scoping comments were used to inform the scope and development of the EIS, including alternatives analysis. Further details about scoping comments are provided in Chapter 7, Public Involvement and in the scoping report (see Appendix B).

- <u>Public and Agency Comments on the Draft EIS</u> – CEMVN and the LA TIG worked together to review, sort, and respond to comments received on the Draft EIS. Comments were first sorted into groups by topic and issue, consistent with the range of topics addressed in the Draft EIS. Comments that were identified under the alternatives topic were evaluated to determine if the comment was referring to an alternative considered in the Draft EIS or a new alternative. Suggested new alternatives were then screened against the Project purpose and need and practicability, including technical feasibility. Details regarding new alternatives suggested by Draft EIS public comments and the reasons they were considered but not carried forward for detailed review can be found in Appendix D2 Eliminated Alternatives Matrix, which was revised for the Final EIS. Further details about Draft EIS comments are provided in Chapter 7 Public Involvement and in the Public Meeting Report in Appendix B2 Draft EIS Public Review and Public Meetings, which includes all public comments and concerns (including comments and concerns regarding alternatives), along with CEMVN and/or LA TIG responses.

2.2.1 Define Project Objectives

Project objectives must be clearly defined and understood in order to develop relevant screening criteria for conducting an alternatives analysis. As explained in Chapter 1 of this EIS, the purpose and need for the proposed Project and this EIS is as follows.

Consistent with the LA TIG's SRP/EA #3 and the Louisiana Coastal Master Plan, the purpose 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 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.

As part of evaluating whether potential alternatives would meet this purpose and need, the AWG applied the following key concepts that are integral to achieving the Project's objectives:

- For this Project, "large-scale" refers to the basin-wide scale of the DWH injury and also is defined consistent with its use in the SRP/EA #3 (LA TIG 2018a), where large-scale sediment diversions are described as "designed for significant marsh creation through the transportation of large quantities of mineral sediments via high discharge volumes from the Mississippi River. As noted in the PDARP/PEIS, these types of controlled large-scale sediment diversions are distinct from the creation of small gaps or crevasses in delta distributary channel levees."

- "Deltaic processes" refers to processes such as the transport of sediment, fresh water, and nutrients from the river into the adjoining basin and the resulting deltaic sediment deposition in the basin. LA TIG considers reestablishing deltaic processes (including deltaic sediment deposition and transport of nutrients and fresh water) a critical component of sustaining and restoring wetlands, coastal, and nearshore habitats to help address ecosystem-level injuries in the Gulf of Mexico and to decrease land loss (LA TIG 2018a).

- "Sustainable" and "long-term viability" refer to restoration actions that can continue to provide benefits under existing and expected future conditions for erosion, subsidence, and sea-level rise. This requires that the Project can create and restore wetlands and also provide a mechanism to sustain wetlands that are created or restored. To achieve this objective, the sediment transported across the Barataria Basin must have an appropriate grain size distribution, considering both the relative and the absolute volumes of coarse-grained and finer-grained sediments. A range of sediment grain sizes is needed to build a sustainable delta: coarse-grained sediments/sand (greater than 63 microns) and coarse silt (32 to 63 microns) that form the foundation of new wetlands, and fine-grained sediments (less than 32 microns) to spread farther and sustain existing wetlands throughout a larger area (Allison and Meselhe 2010, CPRA 2011, Meselhe et al. 2012). To achieve these objectives, sediment diversions are located and designed to generate as high a sediment-to-water ratio (SWR) as possible, so that the diversion is as efficient as possible in transporting sediment to restore deltaic processes.

- The efficiency of sediment transport through a diversion can be measured by the SWR, which compares the ratio of sediment-to-water in the diversion to the ratio of sediment-to-water in the adjacent river. SWR values greater than 1.0 indicate that a greater concentration of sediment is diverted through the structure compared to the sediment concentration in the Mississippi River. By comparison, SWR values below 1.0 indicate that a lower concentration of sediment is diverted through the structure compared to locations in the Mississippi River upstream of the diversion intake (CPRA 2011, Meselhe et al. 2012).

- In addition to the SWR, the grain size distribution of the sediment being diverted is also an important consideration for restoring deltaic processes. Grain sizes are classified by the Wentworth scale (Wentworth 1922), with the breaks between "coarse" and "fine" particles most commonly defined by the transition from silt to sand at 63 microns. In still-water estuarine environments, however, both sand (greater than 63 microns) and coarse silt (32 to 63 microns) are able to settle out of the water column quickly to build deltaic landforms (Allison et al. 2017, Allison et al. 2014). In addition to generally having a higher SWR, larger diversions can also extract more coarse silt and sand from the river than smaller diversions (CPRA 2011, Meselhe et al. 2012).

2.2.2 Develop Screening Criteria

Based on the purpose and need and the Project objectives set forth above, the AWG identified a set of screening criteria. The screening criteria were applied to evaluate the effectiveness of different alternatives in meeting the Project purpose and need. The screening criteria were as follows:

- Criterion 1: Reconnects and reestablishes deltaic processes between the Mississippi River and the Barataria Basin to achieve Project purpose and need in a sustainable manner;

- Criterion 2: Delivers sediment, fresh water, and nutrients in a sustainable manner;

- Criterion 3: Supports the long-term viability of existing and planned coastal restoration efforts;

- Criterion 4: Helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill and is consistent with the SRP/EA #3; and

- Criterion 5: Is consistent with the Louisiana Coastal Master Plan.

Additional consideration was given to engineering and design feasibility, cost of Project implementation, and timeliness of meeting objectives.

2.2.3 Develop Additional Considerations

The formulation and evaluation of alternatives began with a large array of potential alternatives that was narrowed to more detailed design and operational alternatives after an initial process of evaluation. Consistent with CEQ guidance (CEQ 40 FAQ, Q. 2a [CEQ 1981]), the AWG attempted to select a reasonable range of operational alternatives that could be effective at meeting the Project purpose and need while enabling consideration of a range of potential environmental consequences. Evaluation of these more detailed alternatives for location, design, and operational factors required using additional more refined considerations aimed at determining the effectiveness of each alternative at meeting the Project purpose and need. Although primarily focused on factors that improve efficiency in meeting the Project purpose and need (such as the ability to capture, transfer, and distribute the appropriate types and amount of sediment to efficiently meet Project goals), these additional considerations took into account specific factors relevant to the issue being considered and therefore, varied across the different topic areas. For example, the additional considerations for evaluating maximum flow rates are different from those for evaluating operational triggers. Explanations of these additional considerations, including how they tie back to the screening criteria and the Project purpose and need, are provided in Sections 2.3 through 2.5, where these more detailed evaluations are summarized.

2.2.4 Process Used to Identify and Evaluate Alternatives to the Applicant's Preferred Alternative

To identify potential alternatives to the Applicant's Preferred Alternative and the criteria by which these alternatives should be evaluated, the AWG reviewed and considered:

- previous studies of restoration needs in the Barataria Basin (such as the LCA Ecosystem Restoration Study, Louisiana Coastal Master Plan, and others);

- NRDA restoration planning efforts, including relevant portions of the PDARP/PEIS and SRP/EA #3 documents;

- information and modeling input provided by CPRA (as the Applicant); and

- public and agency scoping comments.

The general approach used to identify and evaluate alternatives is an iterative evaluation process in which the level of detail for the alternatives increases at each step in the process. The following is a summary of the three-step iterative evaluation process for screening alternatives:

- Step 1: In Step 1, "functional alternatives" were identified – these are restoration project types (other than sediment diversions) that could potentially provide some of the same functions as the proposed Project. The functional alternatives were identified from evaluating information provided by CPRA, from previous studies, any useful restoration techniques currently available, and comments provided during scoping. The screening criteria were applied to each of the functional alternatives to evaluate the effectiveness of each at meeting the Project purpose and need and to determine which alternatives should be carried forward for further consideration. This evaluation drew upon the analysis in the SRP/EA #3, which evaluated a range of strategic restoration alternatives to restore ecosystem-level injuries in the Gulf of Mexico through restoration of critical wetlands, coastal, and nearshore habitat resources and services in the Barataria Basin. As described in Section 2.3 (see Table 2.3-1), the functional alternatives other than large-scale sediment diversion that were considered were not found to be effective at meeting the Project purpose and need, so only a large-scale sediment diversion was carried to Step 2.

- Step 2: This step involved examining different operational alternatives for a large-scale sediment diversion and developing additional considerations for evaluating the effectiveness of these potential alternatives at achieving the Project purpose and need. As explained above, these tie back to the screening criteria and provide the specificity necessary to evaluate more refined alternatives. These operational alternatives included alternative locations, alternative "triggers" for starting or stopping flow through the diversion, different capacity alternatives, and alternatives for a base flow through the diversion. As described in Section 2.4, after a thorough consideration of these factors, no additional locations, triggers, or base flow alternatives were identified to carry forward that were distinct from the Applicant's Preferred Alternative and would still be effective at meeting the Project purpose and need. However, additional capacity alternatives were retained for consideration and carried forward into Step 3.

- Step 3: This step involved examining different alternatives for the diversion outfall area and developing additional considerations for evaluating the effectiveness of these potential alternatives at achieving the Project purpose and need. For this step, the AWG asked the Applicant to closely consider potential outfall features discussed in scoping comments and evaluate a set of outfall features consistent with these scoping comments. After consideration of different potential outfall features, the Applicant proposed a specific feature for consideration by the AWG. The AWG concluded that the addition of the proposed outfall feature was effective at meeting the Project purpose and need. Thus, additional alternatives were developed that included the identified outfall feature.

At the conclusion of these steps, CEMVN identified the alternatives considered but not carried forward for detailed analysis (see Section 2.6), the No Action Alternative (see Section 2.7), and the action alternatives carried forward for detailed analysis in the Draft EIS (see Section 2.8).

After the public review of the Draft EIS, newly suggested alternatives identified in public comments were evaluated and screened against the Project purpose and need and practicability, including technical feasibility. This evaluation resulted in none of the newly suggested alternatives being carried forward for detailed review in the Final EIS. Details regarding the new alternatives that were considered and the basis for the decision not to carry them forward for detailed review can be found in Appendix D2 Eliminated Alternatives Matrix which was revised for the Final EIS.

2.3 Step 1: Evaluation of Functional Alternatives

As described above, "functional alternatives" were defined as restoration projects (in addition to sediment diversions) that could potentially provide some of the same functions as a large-scale sediment diversion and achieve all or some portion of the Project purpose and need. Project concepts identified through public and agency scoping were grouped into seven functional project types for further consideration: freshwater diversions, structural barriers, shoreline protection, barrier islands, large-scale marsh creation projects, sediment diversions supported by marsh creation, and multiple small-scale sediment diversions. Each of these potential alternatives, including large-scale sediment diversions, is described and evaluated further below, and results of the evaluation are presented in Table 2.3-1.

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Table 2.3-1
Comparison of Functional Alternatives to Screening Criteria

Functional Alternative	Criterion 1: Reconnects and reestablishes deltaic processes between the Mississippi River and the Barataria Basin to achieve Project purpose and need in a sustainable manner.	Criterion 2: Delivers sediment, fresh water, and nutrients in a sustainable manner.	Criterion 3: Supports the long-term viability of existing and planned coastal restoration efforts.	Criterion 4: Helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill and is consistent with the SRP/EA #3.	Criterion 5: Is consistent with the Louisiana Coastal Master Plan.
Large-scale Sediment Diversion into Barataria Basin	Yes – A large-scale sediment diversion into the Barataria Basin would reestablish the hydrologic connection between the Mississippi River and adjoining basin. Such diversions can reestablish deltaic processes through sediment input and nutrient cycling (LA TIG 2018a, Day et al. 2009, Kolker et al. 2012, DeLaune et al. 2013, Kemp et al. 2014, and Wang et al. 2014). The introduction of both coarse-grained and finer-grained sediment is adequate to support creating new and sustaining existing wetlands (Allison et al. 2014).	Yes – Sediment diversions are strategically located and designed to capture and deliver a combination of coarse-grained and finer-grained sediments (Allison et al. 2017, Wang et al. 2014), as well as transport fresh water and nutrients (Allison and Meselhe 2010). Sediment diversions can be operated in various ways to enable these functions in a sustainable manner through repeated input of these resources (DeLaune et al. 2013). The inherent nature of suspended materials in the Mississippi River and the strategic placement of the diversion intake also make large-scale sediment diversions a sustainable approach (Allison et al. 2014, Gaweesh and Meselhe 2015, Meselhe and Sadid 2015). See Sections 2.4.1.4 and 2.4.3.2 for additional discussion.	Yes – By reestablishing deltaic processes, a large-scale sediment diversion into the Barataria Basin could support the long-term viability of existing and planned restoration efforts. This is primarily because a large-scale sediment diversion provides a sustainable source of sediment (both coarse-grained and finer-grained) (Allison et al. 2017), fresh water, and nutrients that will support existing and newly created wetland areas (Meselhe et al. 2016a, CPRA 2017a).	Yes – The sustained introduction of sediment, fresh water, and nutrients provided by a large-scale sediment diversion into mid-Barataria Basin would reduce future land loss and create new marshes, as discussed in Chapter 5 of the PDARP/PEIS (Wang et al. 2014). Wetland maintenance will ensure the export of energy between the estuary to the near shore areas of the Gulf of Mexico.	Yes – Sediment diversions are a long-term strategy used by CPRA to address regional land loss that complements other types of projects in the Coastal Master Plan. Large-scale sediment diversion into the Barataria Basin was identified as the highest performing near-term restoration project that built and maintained wetlands and marshes in CPRA's 2017 Coastal Master Plan (CPRA 2017a).
Freshwater Diversion into Barataria Basin	No – A freshwater diversion into the Barataria Basin would reestablish the hydrologic connection between the Mississippi River and adjoining basin, but would not reestablish sustainable deltaic processes due to their design. Freshwater diversions transport primarily finer-grained suspended sediment (less than 63 microns) and are not designed to transport substantial amounts of the coarse-grained sediments (greater than 63 microns) that are associated with natural processes such as crevasse deposits or avulsions (delta-switching events during which a river abandons its existing channel and forms a new one) (CPRA 2011, Meselhe et al. 2011, Meselhe et al. 2012). A freshwater diversion would likely be designed with an intake placed higher in the water column and with smaller discharge volumes (currently constructed projects are less than 11,000 cfs) that offset the impacts of saltwater intrusion into the basin, but do not reestablish deltaic processes (CPRA 2011, Meselhe et al. 2011, Meselhe et al. 2012).	No – Design and operation of a freshwater diversion restricts it to drawing water from the upper water column near the shoreline of a river, where sediments are generally finer-grained (less than 63 microns) (Horowitz et al. 1990). Consequently, freshwater diversions do not transport significant amounts of the coarse-grained sediments (greater than 63 microns) that are necessary to build or restore large areas of wetlands. Freshwater diversions can help sustain existing and created wetlands (within their outfall areas) by reducing salinity stress, adding nutrients, and adding a limited quantity of finer-grained sediment; however, any movement of sediment during operation is of ancillary benefit. In most cases, the potential for increased wetland plant growth fueled by nutrients and fresh water provided by freshwater diversions to sustain wetlands are inadequate to balance out the erosion resulting from the combined impacts of sea-level rise, subsidence, storm surge, and other erosional factors affecting wetlands (Wheelock 2003).	No – Although, once constructed, freshwater diversions are expected to provide a continuous source of fresh water and nutrients, they do not provide a long-term sustainable source of the range of sediments necessary to restore and sustain wetlands and marshes. In addition, several freshwater diversions are currently influencing the Louisiana landscape (for example, Davis Pond, Caernarvon). Although these diversions have proven effective in addressing some causes of wetland loss (for example, saltwater intrusion), they have not demonstrated an ability to effectively offset the land loss resulting from the combined influences of erosion, subsidence, and sea-level rise, especially on a large-scale (Snedden et al. 2007, Suir et al. 2014).	No – The lack of coarse-grained sediment introduction would significantly limit the habitat and ecosystem service benefits contemplated—specifically through wetland creation—by the PDARP/PEIS. In addition, river diversions in the PDARP/PEIS are defined, generally, as diversions designed to carry sediment, fresh water, and nutrients; to build new marshes; and to increase the elevation of existing, degraded marshes. Thus, freshwater diversions may not meet the goals described in the PDARP/PEIS for the restoration approach "restore and preserve Mississippi-Atchafalaya River processes" (PDARP/PEIS, Ch. 5). The SRP/EA #3 also distinguished large-scale sediment diversions from freshwater diversions, noting that large-scale sediment diversions not only build and restore wetlands, but also restore other deltaic processes, such as continued supply of sediment for delta/marsh creation, while freshwater diversions do not restore the natural sediment deposition process (SRP/EA #3, Ch. 2.).	Yes – Freshwater diversions are included as recognized restoration techniques in the Coastal Master Plan. The Coastal Master Plan does not, however, identify a new freshwater diversion in the Barataria Basin within its 50-year plan for restoration actions.

Table 2.3-1
Comparison of Functional Alternatives to Screening Criteria

Functional Alternative	Criterion 1: Reconnects and reestablishes deltaic processes between the Mississippi River and the Barataria Basin to achieve Project purpose and need in a sustainable manner.	Criterion 2: Delivers sediment, fresh water, and nutrients in a sustainable manner.	Criterion 3: Supports the long-term viability of existing and planned coastal restoration efforts.	Criterion 4: Helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill and is consistent with the SRP/EA #3.	Criterion 5: Is consistent with the Louisiana Coastal Master Plan.
Structural Barriers	No – Designing and building structural barriers (whether rock, retaining walls, or earthen levees) would not reestablish the connection between the Mississippi River and the Barataria Basin. The Mississippi River Levee currently severs deltaic processes between river and basin (Conner and Day 1987).	No – When structural barriers are placed along or around wetlands, the barriers prevent the exchange of water and nutrients and do not allow for and can actually reduce the accumulation of sediment in wetlands (Dugan et al. 2011). Designing and building structural barriers could reduce erosional losses of wetlands in some locations, but would not create wetlands.	No – Designing and building structural barriers would not provide a long-term solution to coastal wetland erosion and subsidence in the Barataria Basin nor are they self-sustaining. Due to the impacts of subsidence, rock barriers and levees require maintenance lifts over the life of the project to maintain design elevation (Muth 2014).	No – Construction of offshore and/or nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion is a restoration technique included in the PDARP/PEIS (DWH Trustees 2016a). The SRP/EA #3 considered an alternative with shoreline protection (that is, breakwaters) but ultimately did not select that alternative as preferred because of the lesser degree of benefit that alternative provided, including benefiting fewer acres and having decreased longevity. Thus, designing and building structural barriers would not be considered consistent with the SRP/EA #3.	Yes – Designing and building structural barriers (identified as structural protection) would be consistent with the Coastal Master Plan as Louisiana is a working coast with one-quarter of the state's population residing within the boundaries of the coastal zone. However, structural protection projects are not identified as restoration techniques in the Coastal Master Plan but rather as protection techniques. Such projects reduce flood risk by acting as physical barriers against storm surge (CPRA 2017a).
Shoreline Protection	No – Designing and building shoreline protection projects would not reestablish the connection between the Mississippi River and the Barataria Basin.	No – While building shoreline protection features in the Barataria Basin may induce sediment deposition, the marsh may lose sources of sediment replenishment by limiting water exchange along the shoreline. This project type would not provide any sediment input to counteract erosive processes (Dugan et al. 2011).	No – Designing and building shoreline protection projects would not counteract subsidence or sea-level rise. Shoreline protection is not a long-term resilient or sustainable strategy for maintaining or nourishing wetlands or marshes (LA TIG 2017a).	No – As noted in the draft SRP/EA #3 (LA TIG 2018a), "shoreline protection projects can help protect existing marsh (whether natural or restored) from marsh-edge erosion and thereby extend the sustainability of the marsh. However, shoreline protection projects do not counteract impacts resulting from subsidence or sea-level rise and do not provide any input of sediment to counteract erosive processes. Depending on the location of the shoreline protection, the marsh could over time even lose some sources of sediment replenishment."	Yes – Shoreline protection is a restoration technique identified in the Coastal Master Plan. Four projects (Bayou Perot Shoreline Protection, East Snail Bay Shoreline Protection, Lake Hermitage Shoreline Protection, and West Snail Bay Shoreline Protection) are identified for implementation in the Barataria Basin over the next 50 years (CPRA 2017a; LA TIG 2017a). Designing and building shoreline protection projects would be considered consistent with the Coastal Master Plan.
Barrier Islands	No – The construction or enhancement of barrier islands does not reconnect or reestablish a deltaic connection between the Mississippi River and the Barataria Basin.	No – Construction or enhancement of beach and dune on barrier islands is accomplished through the dredging of coarse sediment, typically from offshore the barrier islands. However, this activity does not deliver fresh water and nutrients in a sustainable manner into the marsh across the Barataria Basin.	No – Barrier islands protect interior marshes by breaking energy from wind and tides. In certain circumstances, barrier islands may provide land building sediments to the interior marsh when they are eroded and breached by wave energy created by storm surge generated by tropical storms and hurricanes, if the sediments are not carried away through longshore transport. However, the construction or enhancement of barrier islands along the southern margin of the Barataria Basin would not provide a long-term sustainable outcome for the protection of interior basin marshes against subsidence and sea-level rise (Irish et al. 2010).	No – The construction or enhancement of barrier islands does restore for certain injuries in the northern Gulf of Mexico resulting from the DWH oil spill, such as by providing habitat for migratory and colonial nesting birds. Barrier island projects fall within the "create, restore, and enhance barrier and coastal islands and headlands" restoration approach of the PDARP/PEIS (DWH Trustees 2016a). However, the draft SRP/EA #3 did not include project types within this restoration approach, because the Trustees have previously restored barrier islands and headland habitat in the Barataria Basin as part of the Early Restoration Phase III Louisiana Outer Coast Restoration Program (DWH Trustees 2016b). As a result, the construction or enhancement of barrier islands would not be considered consistent with the SRP/EA #3.	Yes – The construction or enhancement of barrier islands is consistent with the goals and objectives of the Coastal Master Plan (Van Heerden and DeRouen 1997). The 2017 Coastal Master Plan recommends funding Louisiana's Barrier Island Program (CPRA 2017a), which would restore the islands as part of a regular rebuilding program.

Table 2.3-1
Comparison of Functional Alternatives to Screening Criteria

Functional Alternative	Criterion 1: Reconnects and reestablishes deltaic processes between the Mississippi River and the Barataria Basin to achieve Project purpose and need in a sustainable manner.	Criterion 2: Delivers sediment, fresh water, and nutrients in a sustainable manner.	Criterion 3: Supports the long-term viability of existing and planned coastal restoration efforts.	Criterion 4: Helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill and is consistent with the SRP/EA #3.	Criterion 5: Is consistent with the Louisiana Coastal Master Plan.
Large-scale Marsh Creation	No – With large-scale marsh creation projects, a defined amount of sediment would be pumped into the basin for the purpose of replacing eroded or subsided wetlands. This method would not deliver significant fresh water or nutrients from the Mississippi River, and consequently would not combat the causes of degradation of the estuary as wetland loss continues. Moreover, this method would not mimic the natural deltaic processes through repeated inputs of sediment, fresh water, and nutrients during times of high river flow, but instead would involve the removal of riverbed or nearshore sediment material by a dredge for transport, as a slurry via pipeline, and disposal into a mechanically created cell to a target elevation. These activities could occur at times outside of high historical inputs (such as spring floods).	No – Large-scale marsh creation projects in the Barataria Basin would increase the quantity of wetlands and marshes across the Barataria Basin by adding additional sediments required to create these wetlands. However, this alternative would not deliver fresh water and nutrients in a sustainable manner, and the majority of the benefits would be limited to the period immediately post-construction, as the sustainability of marsh creation projects is determined by the balance between forces acting against the marsh (subsidence, sea-level rise, and marsh-edge erosion) and the accretion of mineral and organic sediments that together maintain the marsh's elevation relative to the water level. Depending on the location within the Barataria Basin, marsh creation projects can be subject to high subsidence rates and high wave energy. Thus, the created marshes would not provide the sediment, fresh water, and nutrients needed for sustainability.	No – Benefits would be largely confined to the direct footprint of the project, and would not sustain existing and created wetlands (within the outfall area of a diversion project). Furthermore, CPRA has several large-scale marsh creation projects currently on the landscape and in planning or engineering and design phases that are anticipated to be on the landscape within a few years, including five proposed NRDA projects in the LA TIG First Restoration Plan. This alternative alone is not sufficient to counter land loss rates and achieve sustainability (Wiegman et al. 2017, Kemp et al. 2014, Allison and Meselhe 2010, LA TIG 2018a).	No – Marsh creation projects would help restore DWH-injured wetlands and the habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill. The SRP/EA #3 identifies a Preferred Alternative that includes large-scale sediment diversions to restore deltaic processes, marsh creation, and ridge restoration. However, the SRP/EA #3 also notes that marsh creation alone would not provide the ecosystem benefits provided by the Preferred Alternative.	Yes – Marsh creation projects are identified as a restoration strategy in the Coastal Master Plan.
Large-scale Diversion with Large-scale Marsh Creation	Yes – The diversion component of this alternative would meet this goal, as described above. The large-scale marsh creation component of this alternative can help retain the sediment being introduced into the basin at the location of the marsh creation and provide immediate project benefits. However, the containment of these marshes would not allow the transport of coarse-grained sediment from the marsh cell to other areas.	Yes – The large-scale sediment diversion component of this alternative would transport the types of sediment required to create, restore, and sustain wetlands.	Yes –The influx of sediment from the large-scale sediment diversion could help make past and planned marsh creation projects across the Barataria Basin more sustainable over the long term by providing a continuous source of sediment, fresh water, and nutrients to maintain marsh growth. However, it should be noted that created marshes require periodic lifts (addition of additional material to raise the elevation) due to subsidence and sea-level rise. As there is a limited supply of sediment in the system, this is a limiting factor and removal of sediment upstream of a diversion would limit the amount of sediment available for transport via the diversion to build and sustain wetlands.	Yes – As previously evaluated under a separate Restoration Plan and NEPA document (see the LA TIG's SRP/EA #3), the LA TIG determined that large-scale sediment diversions in coordination with other restoration types, including large-scale marsh creation, was an effective strategy in restoring for ecosystem-level injuries caused by the DWH oil spill (LA TIG 2018a). The Preferred Alternative selected by the LA TIG in the SRP/EA #3 would implement multiple strategies to work in coordination. Further planning and environmental review was completed under planning documents separate from this EIS. Additionally, CPRA and the LA TIG have already implemented multiple marsh creation projects in the Barataria Basin. As discussed in Chapter 4, Section 4.6.5.1.2.4 Land Accretion, existing wetlands that are present in the outfall area would benefit through sediment nourishment from operation of the Applicant's Preferred Alternative, which would be expected to slow or stop wetland losses in some locations.	Yes – The Coastal Master Plan includes both marsh creation projects and sediment diversion projects as components of the Coastal Master Plan with the intention that marsh creation projects, such as the Bayou Dupont projects, will benefit from planned sediment diversions. The Coastal Master Plan, however, considers these components separately (as independent projects and project types separate from the proposed MBSD Project evaluated in this EIS).

Table 2.3-1
Comparison of Functional Alternatives to Screening Criteria

Functional Alternative	Criterion 1: Reconnects and reestablishes deltaic processes between the Mississippi River and the Barataria Basin to achieve Project purpose and need in a sustainable manner.	Criterion 2: Delivers sediment, fresh water, and nutrients in a sustainable manner.	Criterion 3: Supports the long-term viability of existing and planned coastal restoration efforts.	Criterion 4: Helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill and is consistent with the SRP/EA #3.	Criterion 5: Is consistent with the Louisiana Coastal Master Plan.
Smaller-scale Diversion with Marsh Creation	No – A smaller-scale diversion with marsh creation would reestablish the hydrologic connection between the Mississippi River and adjoining basin, but would not reestablish sustainable deltaic processes (see freshwater diversion and Section 2.3.7). The dedicated dredging to create new marsh provides coarse-grained sediments at the site of marsh creation; the smaller-scale diversion would transport primarily fine-grained suspended sediment. Thus, a smaller-scale diversion with marsh creation would not transport the substantial amounts of the appropriate range of sediment sizes associated with sustainable deltaic processes.	No – Although diversions are a sustainable source of sediment, freshwater, and nutrient input, a smaller-scale diversion would not provide the ongoing volumes of the appropriate range of sediment sizes that could be provided by a larger scale diversion.	No – Smaller-scale diversion would not provide range of sediment types or volumes needed to sustain existing and planned coastal restoration efforts. Marsh creation would not provide a long-term sustainable source of the range of sediments necessary to restore and sustain wetlands and marshes.	No – Although a smaller-scale diversion may help sustain DWH-injured wetlands through the delivery of fresh water and nutrients, the lack of coarse-grained sediment would significantly limit the ecosystem-level benefits contemplated by the PDARP/PEIS. The marsh creation component of this alternative would provide benefits in the specific discharge location. The smaller-scale diversion would not provide adequate additional sediments to support restoring ecosystem-level injuries in the Gulf of Mexico through restoration in the Barataria Basin, as called for in the SRP/EA #3.	Yes – Smaller-scale diversions and marsh creation are both included as recognized restoration techniques in the Coastal Master Plan. The Coastal Master Plan, however, considers these components separately (as independent project and project types separate from the proposed MBSD Project evaluated in this EIS).
Multiple Small-scale Diversions	No – A multiple small-scale diversion alternative would reestablish the hydrologic connection between the Mississippi River and adjoining basin, but would not reestablish sustainable deltaic processes (see freshwater diversions and Section 2.3.7). The smaller-scale diversions at multiple locations in the basin would transport primarily fine-grained suspended sediment (Wang et al. 2014). Thus, a multiple small-scale diversion alternative would not transport the substantial amounts of the appropriate range of sediment sizes necessary to reestablish sustainable deltaic processes and restore and sustain wetlands and marshes (Kemp et al. 2014).	No – Although diversions are a sustainable source of sediment, fresh water, and nutrient input, the alternative would not provide the ongoing volumes of the appropriate range of sediment sizes, especially coarse-grained sediments that are necessary for restoring and sustaining wetlands and marshes.	No – Multiple small-scale diversions would provide a continuous source of fresh water and nutrients at multiple points across the Barataria Basin, but they do not provide a long-term sustainable source of the range of sediments necessary to restore and sustain wetlands and marshes on a large-scale. The small-scale diversions would likely function similarly to the freshwater diversions already in place. Although these diversions have proven effective in addressing some causes of wetland loss, they have not demonstrated an ability to fully offset the land loss resulting from the combined influences of erosion, subsidence and sea-level rise, especially on a large-scale (Wang et al. 2014, Snedden et al. 2007, Wang et al. 2017, Day et al. 2000, CPRA 2012).	No – Although a multiple small-scale diversion alternative may help sustain DWH-injured wetlands through the delivery of fresh water and nutrients, the lack of coarse-grained sediment would significantly limit the ecosystem-level benefits contemplated by the PDARP/PEIS. The smaller-scale diversions would not provide adequate additional sediments to support restoring ecosystem-level injuries in the Gulf of Mexico through restoration in the Barataria Basin, as called for in the SRP/EA #3.	No – A multiple small-scale diversion alternative is recognized as a restoration technique in the Coastal Master Plan. However, CPRA eliminated this option as part of the 2017 Coastal Master Plan.

2.3.1 Freshwater Diversion into the Barataria Basin

A freshwater diversion into the Barataria Basin would move fresh water from the Mississippi River into the Barataria Basin via a human-made channel. The goal of this type of project would be to provide freshwater flow into existing, but degrading marsh systems, for the purposes of slowing wetland degradation, restoring natural wetland functions, and/or providing a mechanism to help offset the impacts of salinity intrusion.

This potential project type was evaluated against each of the screening criteria (see Table 2.3-1). While a freshwater diversion into the Barataria Basin would reestablish the hydrologic connection between the Mississippi River and adjoining basin, it would not reestablish sustainable deltaic processes due to their design. Freshwater diversions are designed to capture and transport fresh water, not sediment. As a result, a freshwater diversion would not transport the necessary volume of sediment or range of sediment types to achieve the proposed Project purpose and need.

2.3.2 Structural Barriers

One or more structural barriers such as rock barriers, retaining walls, levees, or a longer Barataria Land Bridge[6], could be designed and built to provide storm surge protection and reduce land loss or marsh erosion in the Barataria Basin. The goal of this project type would be to reduce wetland loss by restricting tidal and marine influences and reducing tidal flushing. The barriers would restrict or slow the flow of water during tidal exchange or storm events, reducing the erosive action on marsh edge, and limiting the influx of salt water. These structural barriers could also be constructed to protect residential communities or economic assets from flooding or storm surge. Structural barriers differ from shoreline protection in that they are intended to have impacts at a landscape scale instead of just protecting marsh edge from wave energy. The 2017 Coastal Master Plan includes structural and non-structural means adjacent to communities and coastal assets to reduce economic losses from storm surge flooding (CPRA 2017a).

This potential project type was evaluated against each of the screening criteria (see Table 2.3-1). Because structural barriers are not intended or designed to transport sediment, fresh water, or nutrients, they do not meet Project purpose and need.

[6] In the context of coastal protection and restoration in Louisiana, a land bridge is designed to protect a shoreline and prevent further shoreline loss. Note that construction of a longer Barataria Land Bridge would be done as a marsh creation project. The location of this marsh creation work would be designed to provide storm surge protection by protecting shoreline. Thus, the Barataria Land Bridge is included here as an example of a structural barrier.

2.3.3 Shoreline Protection

Shoreline protection consists of protecting the coastal shoreline with rock or beach nourishment for storm surge protection and to reduce land loss. One or more shoreline protection projects could be constructed in the Barataria Basin, with the goal of reducing erosion. Shoreline protection projects are an example of the "construct breakwater" restoration technique described in the PDARP/PEIS (DWH Trustees 2016a). This technique utilizes breakwaters constructed parallel to the shoreline to reduce erosion, by reducing wave energies and currents acting on shorelines, inducing sediment deposition, and providing shelter for wetland plants and shoreline habitats (Dugan et al. 2011). Breakwaters may be composed of rock riprap or concrete materials seeded with oyster spat that create a "living shoreline." In general, shoreline protection projects can be designed to protect interior marsh from further degradation; however, depending on the location and design, marsh could lose sources of sediment replenishment by limiting water exchange along the shoreline (Chasten et al. 1993, Hardaway et al. 2002, Williams and Wang 2003, Dugan et al. 2011).

This potential project type was evaluated against each of the screening criteria (see Table 2.3-1). Shoreline protection projects are not intended or designed to transport sediment, fresh water, or nutrients and, therefore, do not meet Project purpose and need.

2.3.4 Barrier Islands

Constructing or enhancing barrier islands could occur at the southern margin of the Barataria Basin, along the Gulf of Mexico. The goal of this type of project would be to create new barrier islands or enhance the longevity of existing islands to protect interior marshes by reducing wind fetch and wave energy. Barrier islands also attenuate tidal exchange and marine intrusion, helping to maintain a salinity gradient between the estuary and Gulf. Sand for island construction would be obtained by dredging coarse sediments, including sand, from borrow sources in the Mississippi River or on shoals located on the Outer Continental Shelf (OCS). Coarse sediment would be conveyed to an island via a pipeline and heavy equipment would be used to spread the material for beach or construct to the appropriate elevation for dune (Khalil et al. 2013).

This potential project type was evaluated against each of the screening criteria (see Table 2.3-1). Although barrier islands play a critical role in reducing land loss, they are not intended or designed to transport sediment, fresh water, or nutrients and, therefore, do not meet Project purpose and need.

2.3.5 Large-Scale Marsh Creation

Large-scale marsh creation projects in the Barataria Basin would involve dredging and movement of sediment from offshore or nearshore bodies of water, such as bayous, lakes, or canals, or from point bars in the Mississippi River, typically via hydraulic dredging and transporting dredged sediment via pipeline to specified locations within the basin for the purpose of replacing, creating, or maintaining eroded or subsided wetlands. As sediment is dredged from a water bottom, the dredged sediment and ambient water form a slurry which is pumped through a pipeline and placed in discrete, mechanically created marsh cells within specific areas of degraded wetlands. A perimeter retention dike around the cell may be necessary to allow construction of the marsh platform at a higher elevation than surrounding degraded wetlands or open water. Spill boxes or weirs may be constructed in the dike to allow for effluent water release from the marsh creation cell. Dredged material slurry would initially be placed to a higher elevation than the desired marsh platform; once it dewaters, it would settle to a target marsh elevation at which desired wetland plants are known to colonize and grow to form new marsh. The created marsh cells may also be planted with appropriate marsh and wetland vegetation. Once the dredged material has dewatered and settled to an appropriate marsh elevation, the retention dike may (if used) be gapped or partially degraded to allow fish and water movement.

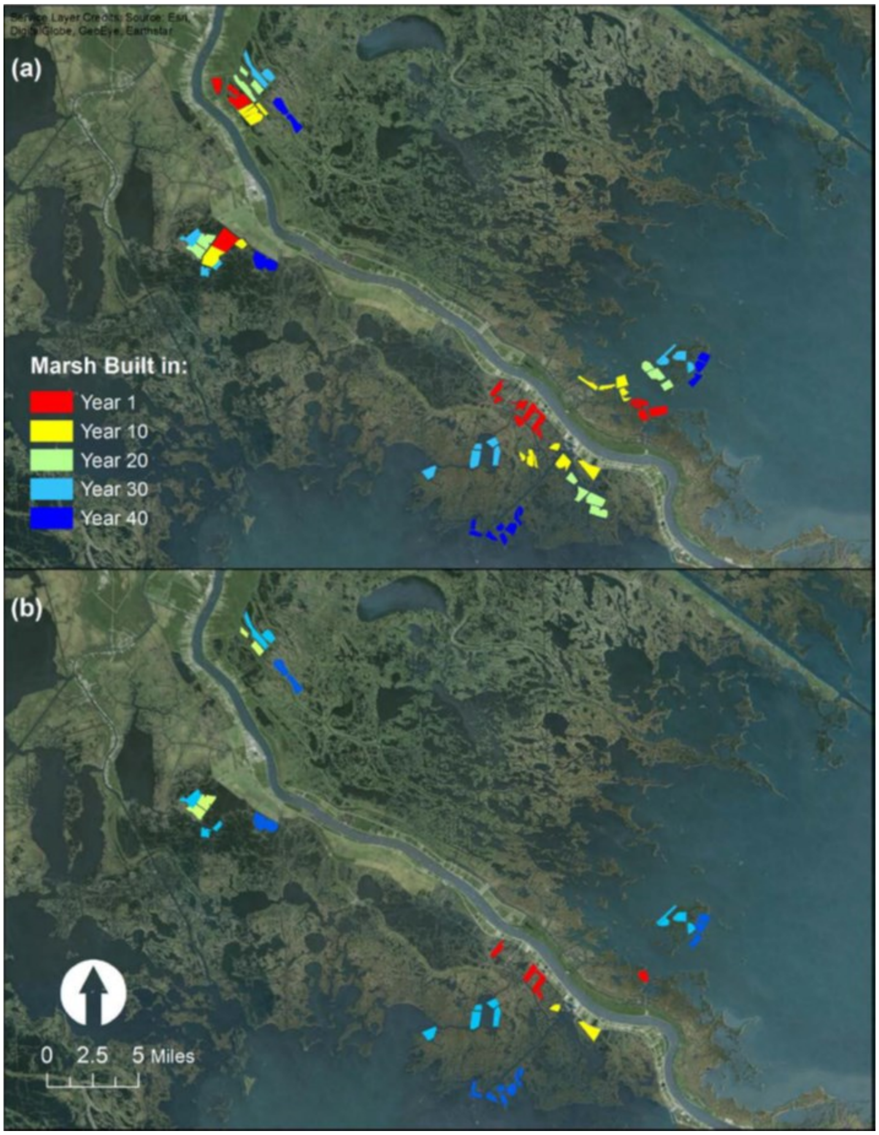
This potential project type was evaluated against each of the screening criteria (see Table 2.3-1). Large-scale marsh creation projects would increase the quantity of wetlands and marshes across the Barataria Basin by adding additional sediments required to create these wetlands. However, marsh creation projects do not convey continuous fresh water or nutrients to the containment site, and the fresh water and nutrient benefits would be confined to the discharge location. Further, marsh creation projects are subject to settlement and consolidation, as well as subsidence, sea-level rise, and erosion. Successful marsh creation projects have a limited design life in the absence of maintenance and, over the long term, require periodic maintenance or repeated “lifts” of additional sediment to maintain an elevation needed to support healthy marsh vegetation (Wiegman et al. 2017). Depending on the rate of sea-level rise, these lifts need to increase in frequency and/or volume. At the same time, the availability of sediment is dependent upon the rate at which borrow areas are replenished by the river’s sediment load; further, as water levels rise over borrow areas, sediment resources may become more difficult to access via dredging. Therefore, overall, the fill rates (cubic yards/acre) and total volumes required to sustain and build marsh, along with associated costs, are anticipated to increase significantly over time with relative sea-level rise (Khalil et al. 2018, Blum and Roberts 2009).

Recent modeling completed as part of the MRHDM Study for a marsh creation alternative using Mississippi River sand bars as the sediment source showed that without further sediment input over time, approximately half of all dredged material placed[7] in the basin would be lost by the end of a 50-year project life (Meselhe et al. 2016a).[8] The modeling projected that marsh creation would offset predicted land loss relative to a future without project scenario by 3 percent. In other words, marsh creation

[7] The modeling assumed that sand bars would be dredged and material placed in a new site to create marsh once every 10 years over the 50-year simulation period (that is, five increments, or cycles), with no maintenance lifts for previously created sites.

[8] The study by Meselhe et al. (2016a) utilized the moderate scenario from the 2012 Coastal Master Plan of subsidence and Gulf regional sea-level rise (0.25 meter by 50 years).

would only add 3 percent more land to the future without project condition (Meselhe et al. 2016a). While losses in the first two decades immediately following marsh creation were projected to be generally minor, the loss rates would increase in the last three decades due to the inability for marsh elevation to keep up with relative sea-level rise (see Figure 2.3-1).



Source: Meselhe et al. 2016a

Figure 2.3-1. Marsh Creation Cells. (a) As built (13,891 acres), and (b) remaining (7,241 acres) as subaerial marsh at target year 50.

As described above, successful large-scale marsh creation projects likely would require repeated lifts or periodic maintenance to add new dredged material within the Project area to combat sea-level rise and other coastal land loss factors (Wiegman et al. 2017). In general, the overall sustainability of large-scale marsh creation in the basin depends on the rate at which sediment in the Mississippi River borrow areas is replenished by the river's sediment load and the rate at which basin marshes degrade and require maintenance lifts. While an estimated 9 to 15 million cubic yards (mcy) of material is available for capture from the Lower Mississippi River on an annual basis, depending on river conditions (Allison et al. 2012), availability at a given borrow site is not guaranteed and sites with available sediment would need to be allocated among coastal restoration projects (Allison and Meselhe 2010, LA TIG 2020). Sediment mining from the river is only sustainable if the sediment is not removed at rates that are faster, on average, than the rates at which it is replaced (Yuill et al. 2016b). Model results using data from a borrow site located approximately 4 to 5 miles upstream of the project indicate that after sediment mining, it may take a borrow pit in the Lower Mississippi River up to 10 years to refill to pre-excavation elevations, although extrapolation from observed data suggests that refill may occur in as little as 4.4 years (Yuill et al. 2016b).

Uncertainty regarding borrow site refill rates, the potential that up to 10 years between dredging events may be required to fully recharge dredged borrow sites, and demand for sediment mining for other coastal restoration projects suggest that Mississippi River sediment borrow sites in or near the Project area may not be sufficient to support a large-scale marsh creation project.

Additionally, using sediment borrow sources farther away from areas targeted for marsh creation increases the amount of energy (fuel) required to pump the dredged material through a pipeline to the discharge site and thus increases cost (Wiegman et al. 2017, Kemp et al. 2014). Wiegman et al. (2017) modeled the impact of increasing energy costs and sea-level rise on the cost of marsh creation in the Mississippi River Delta Plain and found that sustaining marshes with hydraulic dredging resulted in declining returns on investment due to the convergence of rising energy costs and climate change. Created marsh lifespan declined with increasing sea-level rise regardless of restoration management scenario (including differing dredge volumes, fill elevations, and suspended sediment concentrations for various rates of sea-level rise). The authors concluded that the cost of creating 1 hectare (2.47 acres) of marsh could increase from $128,000 in 2016 to over $1 million by year 2100 in the event of the worst-case scenario for sea-level rise and the worst-case scenario for energy prices. Additional considerations and limitations associated with marsh creation using dredged sediment are discussed in Section 2.3.6.

Finally, substantial modeling regarding the long-term viability of marsh creation has demonstrated that marsh creation alone is not sufficient to counter land loss rates (and its associated drivers, such as sea-level rise) and achieve sustainability (Wiegman et al. 2017, Kemp et al. 2014, Allison and Meselhe 2010).

The AWG, with CEMVN concurrence, decided not to carry forward a large-scale marsh creation alternative for further consideration in this EIS. Marsh creation was eliminated from further consideration because the benefits associated with marsh creation projects are often confined to the marsh creation area and because such projects would not reestablish natural deltaic processes and thus not deliver fresh water and nutrients, and associated fine sediments, to sustain existing and created wetlands within the marsh creation area in the Barataria Basin (see Table 2.3-1). The LA TIG has funded, and will continue to fund, other types of restoration projects, including large-scale marsh creation projects, that provide ecosystem services (diverse habitat and forage for fish, birds, crustaceans and other wildlife and aquatic species) lower in the basin (for example, the Barataria Basin Ridge and Marsh Creation Project: Spanish Pass Increment, Queen Bess Island Project, and increments of the Large-Scale Barataria Marsh Creation).[9] These projects are anticipated to complement and reinforce the restoration that would be provided by the proposed MBSD Project. The marsh creation projects, particularly the Large-Scale Barataria Marsh Creation Upper Barataria project, which is within the Project area and delta formation area for the MBSD, would be able to capture the additional ongoing sediment and nutrient inputs from the Project, making them more sustainable over the long term. At the same time, marsh creation projects can help retain the sediment being introduced into the Barataria Basin by the Project (LA TIG 2018a).

Reasonably foreseeable large-scale marsh creation projects are expected to work in tandem with sediment diversions as outlined in the Louisiana Coastal Master Plan (CPRA 2017a) and are considered in the cumulative impacts section of this EIS (see Chapter 4, Section 4.25).[10]

2.3.6 Sediment Diversions with Marsh Creation

As explained in Section 2.1.1 above, sediment diversions divert sediment, fresh water, and nutrients from the Mississippi River into adjacent basins via controlled conveyance channels to reintroduce deltaic deposition of sediments and thereby create, restore, and sustain wetlands. Sediment diversions can be augmented by marsh creation features, to allow immediate recovery of former wetland areas already converted to open water.

During scoping and as part of prior studies, the possibility of constructing a sediment diversion together with marsh creation was considered as an alternative to the proposed Project. For example, the LCA Medium Diversion at Myrtle Grove with Dedicated Dredging (MDMG) study analyzed a medium-sized diversion (1,500 to 20,000 cfs) combined with dedicated dredging to create new marsh as one project. In response to comments received during the scoping process, AWG applied the screening criteria to two alternative sediment diversions augmented by marsh creation features to determine whether either would be a reasonable alternative carried forward for detailed analysis. The two alternatives are: (1) a large-scale sediment diversion with a large-scale marsh creation component; (2) a smaller-scale diversion with marsh creation.

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[9] The Large-Scale Barataria Marsh Creation: Upper Barataria Component Phase II Plan has since been completed and a design selected for implementation. In addition, a Phase II plan was completed for Spanish Pass Round 2.

[10] Existing marsh creation projects are included in existing conditions as part of Chapter 3; and planned marsh creation projects that are reasonably foreseeable are evaluated as part of the cumulative impacts analysis in Chapter 4, Section 4.25.

Although, as seen in Table 2.3-1, a large-scale sediment diversion with a large-scale marsh creation component would meet the proposed Project purpose and need the same as a large-scale diversion project alone would, combination of the two project types is not a different project from the Applicant's Preferred Alternative. Instead, it is the Applicant's Preferred Alternative combined with a large-scale marsh creation project. While it is recognized that these two project types can benefit each other, they are independent project types, with independent utility that do not rely on one another to function as intended.[11]

Further, combining analysis of a large-scale diversion with a large-scale marsh creation component into a single action would not result in an analysis of impacts different from those likely to result from the Applicant's Preferred Alternative; rather the analysis would include the impacts of the Applicant's Preferred Alternative together with the added impacts of a large-scale marsh creation project. Additionally, as previously noted, the LA TIG, including CPRA, is currently engaged in a separate, independent process of implementing a large-scale marsh creation project in the mid-Barataria Basin known as Large-scale Marsh Creation – Component E. That process is underway independent of and separate from the analysis of the Applicant's Preferred Alternative in this EIS. It is not reasonable or feasible to suspend those efforts in order to combine review of the current Project evaluated in this EIS with the Large-scale Marsh Creation – Component E. Based on the above analysis, CEMVN agreed that the combination of a large-scale sediment diversion and a large-scale marsh creation project is not a reasonable alternative for evaluation in this EIS due to independent utility.

In addition, the combination of a small-scale sediment diversion and marsh creation would not meet the proposed Project purpose and need. As described in Table 2.3-1, a smaller-scale diversion with marsh creation does reestablish the hydrologic connection between the Mississippi River and adjoining basin, but does not reestablish

[11] As part of the Restoration Plan, the LA TIG selected a large marsh creation project known as the Large-Scale Barataria Marsh Creation: Upper Barataria Component (BA-207) for further development. Although the proposed MBSD and this large-scale marsh creation project were considered together in the Restoration Plan, they are not "connected actions" as defined by CEQ's NEPA regulations (40 CFR 1508.25). Per the NEPA regulation, "connected actions" are defined as actions "that are closely related and therefore should be discussed in the same impact statement." These regulations further note that "Actions are connected if they: (i) automatically trigger other actions which may require environmental impact statements; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; [or] (iii) are interdependent parts of a larger action and depend on the larger action for their justification." None of these three factors apply to the proposed Project and a large-scale marsh creation project such as the Large-Scale Barataria Marsh Creation: Upper Barataria Component (BA-07). Neither a large-scale sediment diversion nor a large-scale marsh creation project automatically triggers the other. Neither do a large-scale sediment diversion and a large-scale marsh creation project rely on the other to proceed. Finally, although each project type would support the other (for example, created marshes would provide an immediate platform to capture and retain sediments transported to the basin by a sediment diversion), neither is dependent on the other for its utility and neither depends on the other as justification for proceeding. In other words, each project has independent utility. Therefore, NEPA does not require these project types be evaluated together within the same EIS. To the extent that the two projects may result in synergistic cumulative impacts on resources within their respective areas of influence, those cumulative impacts are discussed in Chapter 4, Section 4.25 Cumulative Impacts.

sustainable deltaic processes. As described in Section 2.3.1, smaller diversions do not effectively collect and transport the appropriate volume and types of sediment to create and sustain marshes on a large-scale. A small-scale diversion would transport primarily finer-grained suspended sediment. Thus, a small-scale diversion with marsh creation would not transport the substantial amounts of the appropriate range of sediment sizes, especially coarse-grained sediments, associated with sustainable deltaic processes. It also would not transport adequate total volume to sediments necessary to support and sustain the marsh creation area.

Further, marsh creation through dedicated dredging requires a renewable source of borrow material that does not decrease the sediment capture ability of the diversion. Logistically, there are limitations in sediment available for dedicated dredging (see Section 2.3.5). Some Mississippi River sediment sources near the Barataria Basin are already being used or are targeted for use on other restoration projects. For example, the Willis Point and Anchorage Alliance borrow sites planned to be used for the Large-Scale Barataria Marsh Creation: Upper Barataria Component are approximately 5 miles upstream of the proposed diversion location (LA TIG 2020). CPRA evaluated using material dredged from federal navigation channels (other than the Mississippi River) or privately owned canals within the Barataria Basin, but CPRA has no authority over maintenance dredging or placement of dredged material from federal navigation channels or private canals. Entities responsible for maintaining private waterways may not agree to let CPRA dredge for the material or to the use of material dredged by those entities in restoration projects. Additionally, sediment material in the private waterways may not be appropriate for use in marsh creation, as materials dredged as part of channel maintenance typically consists of very fine materials and marsh creation requires coarse-grained material. Such sources are not a reliable source of borrow material. Finally, as described in Section 2.3.5, using sediment borrow sources farther away from areas targeted for marsh creation increases the energy (fuel) required to pump the dredged material to the discharge site and increases cost (Wiegman et al. 2017, Kemp et al. 2014).

Considering this information, the AWG, with CEMVN concurrence, decided not to carry forward an alternative combining sediment diversion with marsh creation for further consideration in this EIS. Marsh creation activities have been and are likely to continue to be implemented in the basin and are reasonably foreseeable. Reasonably foreseeable marsh creation activities are considered in the cumulative impacts section of this EIS (see Chapter 4, Section 4.25).

2.3.7 Multiple Small-Scale Diversions

An alternative involving multiple small-scale diversions (5,000 to 10,000 cfs) would divert sediment, fresh water, and nutrients from the Mississippi River into adjacent basins via multiple controlled conveyance channels to reintroduce deltaic deposition of sediments and thereby create, restore and sustain wetlands. These small-scale diversions could be located in the Upper, Middle, and Lower Barataria Basin. The 2012 Coastal Master Plan considered multiple small-scale diversions into both Barataria and Breton Sound Basins.

As described in Table 2.3-1, a multiple small-scale diversion alternative would reestablish the hydrologic connection between the Mississippi River and adjoining basin, but would not reestablish sustainable deltaic processes because the appropriate volume and range of sediment needed to meet Project objectives would not be captured and/or transported into the basin. Thus, while this approach may help sustain DWH-injured wetlands by delivering fresh water and nutrients, the lack of the appropriate range of sediment sizes, especially coarse-grained sediments, would limit ecosystem benefits and sustainability. One study indicated that the most cost-effective land building projects are the smaller ones and rather than becoming more cost effective with increasing project size, the costs instead increase exponentially. However, smaller channels or diversions, although cost effective, would create wetlands at a slower rate than the larger channels (Turner and Boyer 1997). Furthermore, constructing multiple small-scale diversions would significantly increase (double or more) the total cost to achieve comparable discharge volumes into the basin. Each of those diversions would require relocating existing infrastructure; including utility, highway, and potential rail relocation, as well as alterations to one or two levee systems, depending on location. Thus, the additional cost factors associated with multiple smaller-scale diversions is not reasonable.

2.3.8 Conclusions Based on Review of Functional Alternatives

Based on the results of the evaluation, functional alternatives to a large-scale sediment diversion identified and evaluated above would not be effective in meeting the Project purpose and need and are therefore not included in the range of reasonable alternatives. While both freshwater diversions and large-scale marsh creation projects are valuable coastal restoration tools that provide benefits to the Barataria Basin, these alternatives (with the exception of large-scale sediment diversion combined with large-scale marsh creation) are not expected to fulfill the Project purpose and need with respect to restoring the deltaic processes between the Mississippi River and the adjoining Barataria Basin, as they do not provide a sustainable source of the appropriate range of sediment sizes, fresh water, and nutrients required to retain and restore wetlands over many years. Large-scale sediment diversion with large-scale marsh creation is also not a reasonable alternative; it is the combination of two independent projects, rather than an alternative to the proposed Project (see Section 2.3.6).

While large-scale marsh creation projects do restore and maintain wetlands and marshes in the basin, they are not a long-term sustainable strategy because to maintain functionality as a marsh, they require periodic maintenance through placement of additional dredged material. Maintenance is required because marsh creation projects, similar to natural marshes, suffer from edge erosion and are susceptible to inundation due to the combination of subsidence and sea-level rise. This is because large-scale marsh creation projects lack a sustainable source of sediments to replenish and support the marsh cells once placed in the basin. Freshwater diversions, by comparison, are long-term and self-sustaining, but they do not provide an adequate source of the appropriate range of sediment sizes, particularly coarse-grained sediments, necessary to create, restore, and sustain wetlands, especially at the ecosystem level.

CEMVN concurred with the AWG that these options do not meet the Project purpose and need and are not reasonable and, therefore, will not be carried forward for detailed analysis. The alternatives analysis continued to Step 2 described below.

2.4 Step 2: Evaluation of Operational Alternatives – Location, Operational Trigger, Capacity, and Base Flow

Step 2 of the alternatives evaluation process involved examining different types of “operational alternatives” for a large-scale sediment diversion, including alternative locations, alternative “triggers” for starting or stopping flow through the diversion, different maximum flow capacities, and alternatives for a base flow through the diversion. The objective of this evaluation was to identify alternatives that effectively meet the Project purpose and need, provide a range of potential environmental consequences distinct from the Applicant’s Preferred Alternative, and are practical and feasible.

Initially, different operational scenarios were reviewed using the screening criteria listed above for evaluating the functional alternatives. The AWG, however, determined that sediment diversions generally met each of the screening criteria, and consequently evaluated the operational alternatives using additional, more refined considerations aimed at determining the effectiveness of each alternative at meeting the proposed Project purpose and need. These additional considerations were developed through review of material from previous studies, input from cooperating agencies, and public input from scoping, and relate back to the screening criteria described previously. These were used to aid in an overall evaluation of how well each potential alternative operational scenario could meet the Project purpose and need. An alternative must meet the stated purpose and need to be considered a reasonable alternative. This analysis, therefore, was used to identify a range of reasonable alternatives to be carried forward for detailed evaluation in the EIS.

2.4.1 Evaluation of Location Alternatives

The process of evaluating location alternatives included identifying appropriate additional considerations and then applying them to potential location alternatives. As part of this analysis, previous studies that had evaluated potential alternative locations for a Barataria Basin diversion were reviewed.

To evaluate the location alternatives, two main considerations were identified, broken into sub-categories, and applied to the alternatives considered. The following describes the process of defining and applying the additional considerations.

2.4.1.1 Location Consideration 1: Would the location aid in the potential for accretion of sediment?

Addressing this question helps provide a more refined evaluation of Screening Criterion 1 because an alternative with a greater potential for accretion of sediment would more effectively reestablish deltaic processes such as deltaic sediment deposition. Addressing this question also helps provide a more refined evaluation of

Screening Criterion 2 because an alternative with greater effectiveness in delivering sediments and nutrients in a sustainable manner would also lead to greater effectiveness for accretion of sediment. This consideration was broken down into sub-topics that contribute to the potential for accretion of sediment, including those that address the effective capture of sediment from the Mississippi River, the amount of sediment available, and the capacity and effectiveness of the receiving area for accepting and retaining sediment and nutrients:

- Would the location allow for effective capture and distribution of finer-grained and coarse-grained sediments from the Mississippi River?
- Would capacity at the intake location be sufficient to capture needed amounts of sediment?
- Would the diversion be located in proximity to significant amounts of available sediment?
- Would the location include an outfall area that has sufficient capacity to accept the volume of water and allow for establishment of a natural system to disperse the sediment and nutrients?
- Would the outfall location be buffered from excessive erosional forces, allowing for increased sediment deposition?
- Would the outfall location have existing vegetation present that could capture sediment effectively?

2.4.1.2 Location Consideration 2: Would the location create, maintain, and sustain existing and future wetlands and marshes?

Addressing this question helps provide a more refined evaluation of Screening Criteria 3 and 4 because an alternative with a greater potential for creating, maintaining, and sustaining existing and future wetlands and marshes would also more effectively support the long-term viability of existing and planned coastal restoration efforts, and more effectively help restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill. This consideration was broken down into sub-topics that: (1) consider how a location might contribute to the potential for creating, maintaining, and sustaining existing and future wetlands and marshes; and (2) focus on whether the location addresses areas of critical need and high risk for future erosion, promotes the maintenance and sustainability of geomorphic structures and existing and future marsh, and helps prevent further saltwater intrusion. The additional considerations were:

- Would the location address an area of critical need within the Barataria Basin?

- Would the location rebuild coastal resources in areas at high risk of future loss?
- Would the location effectively contribute to preservation and maintenance of critical geomorphic structures?
- Would the location effectively promote the long-term sustainability of existing marshes, sustainability of newly created marsh, and restoration of degraded marsh?
- Would the location effectively provide protection from potential saltwater intrusion further into the basin over time?

2.4.1.3 Application of Additional Considerations to Potential Alternative Locations in Upper, Middle, or Lower Barataria Basin

As noted above, the LA TIG identified the Barataria Basin in the SRP/EA #3 as the location for the proposed restoration project because within Louisiana, the Barataria Basin suffered the most severe and persistent oiling from the DWH oil spill (LA TIG 2017a). It is also an "area of critical need" due to its significant and continuing land loss (PDARP/PEIS Chapter 4). Previous studies have considered several general locations for a sediment diversion from the Mississippi River into the Barataria Basin. These locations are expressed as RM AHP:

- Upper Barataria Basin (RM 62.5 to RM 118 [Davis Pond Freshwater Diversion Structure]);
- Middle Barataria Basin (RM 46.4 to RM 62.5); and
- Lower Barataria Basin (below RM 46.4)

Upper Barataria Basin

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 (Couvillion et al. 2016, Zou et al. 2015, Fitzgerald et al. 2006, Nelson et al. 2002). Additionally, as the most inland location, 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). Thus, while this location would be buffered from excessive erosional forces and has existing vegetation present that could capture sediment effectively, this location does not address an area of critical need within the Barataria Basin and would not be rebuilding coastal resources in areas at high risk of future loss. Also, the USACE already constructed a freshwater diversion in this area to combat saltwater intrusion (Davis Pond Freshwater Diversion) and the remainder of the Upper Barataria Basin is hydrologically constricted by US Highway 90, so this location would not effectively provide protection from potential saltwater intrusion further into the basin over time.

Finally, due to its relatively protected location, other large restoration projects are not planned for implementation until several years after Middle Barataria Basin projects (CPRA 2017a). As a result, a sediment diversion in this location would have fewer concurrent projects that could benefit from its sediment support (CPRA 2017a, LA TIG 2018a). While a project location in the Upper Barataria Basin would promote the long-term sustainability of existing marshes from the introduction of sediment, fresh water, and nutrients, overall this location would not effectively promote the sustainability of newly created marsh or restoration of degraded marsh.

Middle Barataria Basin

The marshes of Middle 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, CPRA 2017a). 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, which could help stabilize existing vegetation in degrading marshes and potentially create new wetlands in areas that are at risk of future loss due to ongoing erosion and subsidence. Moreover, the Middle Barataria Basin has large areas of shallow (0 to 3 feet) open water, often surrounded by marsh, that provide the landscape necessary to support capture and retention of sediments transported by a sediment diversion (Wang et al. 2014). The Middle Barataria Basin also has areas of largely intact wetlands (Couvillion et al. 2016) that will slow the water discharged from the diversion and provide opportunities for the depositional processes necessary for wetland (re)creation to occur. At present the Middle Barataria Basin shows lower levels of subsidence (sinking of deposited sediments) than other areas of the basin, specifically those in the Lower Barataria Basin (Reed and Yuill 2017), because of less fluid extraction and faulting. Also, as noted by Reed and Yuill (2017), "In general, subsidence ranges are lower in the northern portion of the Project area where older, thinner Holocene deposits are found, and increase towards the coast where younger, thicker deposits characterize the area. Specifically, subsidence ranges for the Upper and Middle Barataria Basin are 0.1-0.4 inch (2 to 10 mm) per year and for the Lower Barataria Basin are 0.2 to 0.8 inch (6 to 20 mm) per year."

Thus, a project in the Middle Barataria Basin would allow for capture and redistribution of fine-grained and coarse-grained sediments, is buffered from excessive erosional forces, and is protected from potential saltwater intrusion in the future.

Finally, the Middle Barataria Basin is proximate to other recently constructed and planned marsh creation projects, such as the Long Distance Sediment Pipeline marsh creation projects, and those included in the Coastal Master Plan (CPRA 2017a) and SRP/EA #3 (LA TIG 2018a). A sediment diversion in the Middle Barataria Basin would support and help sustain these projects by providing a consistent infusion of sediment and nutrients. Thus, a project in the Middle Barataria Basin has the capacity to accept and disperse sediments and nutrients and will promote the long-term sustainability of existing and newly created marshes.

Lower Barataria Basin

In contrast to the Upper and Middle Barataria Basin, the Lower Barataria Basin consists of large expanses of relatively deep open water, ranging in depth from -3 feet in parts of Barataria Bay to -80 feet at the passes between the barrier islands separating Barataria Bay from the Gulf of Mexico (see Chapter 3, Section 3.4.2.2 Bed Elevations in Surface Water and Coastal Processes), with smaller areas of highly fragmented marshes. In addition, the Lower Barataria Basin is subject to the highest rates of subsidence, compared to the Middle and Upper Barataria Basin. Thus, while the Lower Barataria Basin is an area of critical need, subsidence rates are generally higher in the lower portions of basins along the coast when compared with the middle and upper portions (Zou et al. 2015). Increases in water levels in the Lower Barataria Basin due to relative sea-level rise and the introduction of diverted riverine fresh water could result in inundation of the existing saline marshes at critical depths and durations that could lead to increased marsh mortality. This could, in turn, result in an environment more susceptible to fragmentation and loss during storm or other high energy events (DeLaune et al. 2013, Kearney et al. 2011, Turner et al. 2011). As a result, a sediment diversion located in the Lower Barataria Basin could lead to greater long-term stress on the ecosystem compared to a diversion located in the Upper and Middle Barataria Basin. 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 the proposed Project to demonstrate benefits because of the associated longer timeframes for accumulation to reach the elevation needed for wetlands to successfully establish. Consequently, 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. The deeper open-water conditions in the Lower Barataria Basin include greater erosional forces such as waves, tidal action, and storm surge, which would also reduce sediment settling and accumulation, and would erode the edges of newly created marshes (Wilson and Allison 2008), reducing long-term sustainability of existing and restored marshes. Without existing emergent wetlands to capture suspended sediment, the fine-grained sediments transported by the diversion would travel farther from the outfall, settling as a thin layer along the basin floor, rather than augmenting and supporting emergent wetlands. Thus, a project located in the Lower Barataria Basin likely has the capacity to accept the volume of water but lacks the necessary features to timely and effectively capture those sediments, rebuild or create wetlands, and the area lacks features that would protect restored marshes from erosion and saltwater intrusion over time.

Based on this evaluation, the AWG determined that potential Project alternatives in the Upper or Lower Barataria Basin would not meet the purpose and need of the proposed Project. CEMVN agreed that alternatives in the Upper and Lower Barataria

Basin were not reasonable. Thus, as a next step, alternative locations within the Middle Barataria Basin were evaluated.

2.4.1.4 Application of Additional Considerations to Potential Alternative Locations in Middle Barataria Basin

The next step in the evaluation of location considered whether there are multiple, alternative locations within the Middle Barataria Basin which would effectively meet the proposed Project purpose and need. The AWG considered the following Mississippi River location options that have been studied previously (see Figure 2.4-1):

- RM 60.1 to RM 62.5;
- RM 59.3 to RM 59.8; and
- RM 46.4 to RM 59.0.

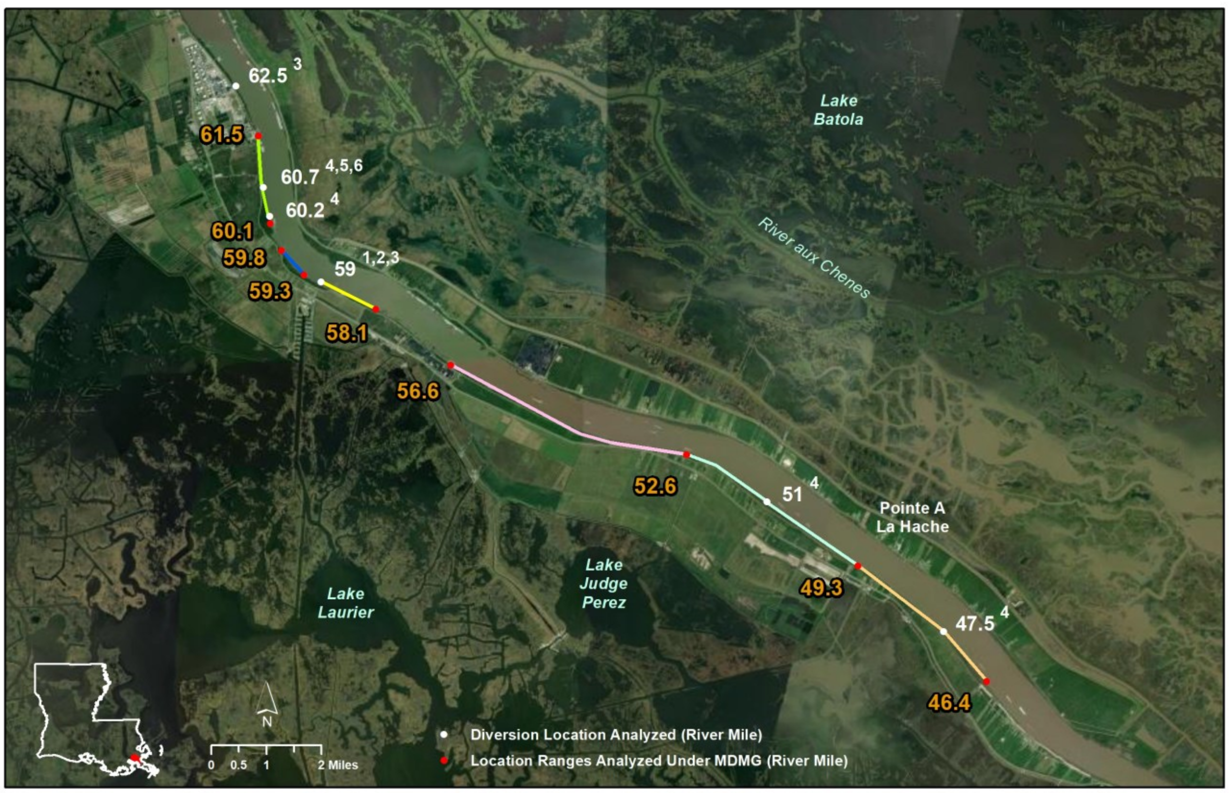


Figure 2.4-1. Locations Considered Through the Iterative Planning Process: [1] MRSNFR (CWPPRA) (USACE 2000); [2] BA-33 (CWPPRA) (LCWCRTF 2003); [3] LCA Ecosystem Restoration (USACE) (USACE 2004); [4] CPRA and non-governmental organizations (NGO) study; [5] MRHDM Study (CPRA with USACE) (USACE 2015); [6] BA-153 (Data compiled by CPRA) (CPRA 2018b).

The locations as depicted in Figure 2.4-1 were considered through the iterative planning process under previous studies. These previous studies are described in further detail in Chapter 1, Section 1.2.2.1 Previous Studies in Project History.

This location analysis took into account the same considerations as the location analysis that compared the Upper, Middle, and Lower Barataria Basin.

With regard to locations between RM 46.4 and RM 59, prior studies found that this area was most vulnerable to saltwater intrusion and relative sea-level rise with a greater proportion of saline marsh (Visser et al. 2017b). Further, due to the relatively straight nature of this segment of the river, studies concluded that this area was less likely to capture adequate sediment to support a sediment diversion. In particular, no location on this segment was adjacent to a significant source of coarse-grained sediment such as a point bar within the Mississippi River (Allison et al. 2014). Due to a combination of differing current velocities and lateral forces, rivers tend to deposit coarse-grained sediments disproportionately on the inside bend of curves in the river, and to erode areas on the outside bend (Allison and Meselhe 2010, Allison et al. 2014). By comparison, on relatively straight stretches of a river, any erosion or deposition within the river may happen more uniformly across the channel.

Without a significant source of coarse-grained sediments, it would be necessary to divert more Mississippi River water into the basin at this location to achieve the same volume of sediment transfer available from locations with more direct access to coarse-grained sediments from depositional point bars. Diversion of a larger volume of water was anticipated to have greater impacts on navigation in the river (due to reduced volume of water in the river) and greater potential adverse impacts on the basin side (due to transport of a higher total volume of fresh water into the basin). Thus, this area does not have sufficient capacity to accept the volume of water that would be needed to meet the proposed Project purpose and need.

With regard to locations between RM 59.3 and RM 59.8, studies concluded that this area would benefit from the sustained infusion of sediment, fresh water, and nutrients, but again concluded that the lack of direct access to a point bar or the depositional area adjacent to an inside bend of the river within this reach resulted in lower sediment removal efficiencies and means the area does not have sufficient amounts of available sediment. As a result, a diversion in this location would not have the capacity to capture the volume of sediment needed to build and sustain the basin side marshes and wetlands.

Based on these analyses, Project alternatives located between RM 46.4 and RM 59 or between RM 59.3 and RM 59.8 would not be as effective in meeting the proposed Project purpose and need. As noted above, sediment diversions must be located and designed to maximize the capture and transport of the appropriate range of sediment sizes, particularly coarse-grained sediments, to achieve the proposed Project purpose and need. The location identified in the Applicant's Preferred Alternative (RM 60.7) takes advantage of an existing point bar at the inside bend of the River between RM 60.7 and RM 62.5. By locating the intake at the downriver end of this existing point bar, the diversion intake could capture and divert a sufficient volume of sediment through the diversion channel. Additionally, the outfall location and receiving basin is ideally suited to gain measurable benefits from a sediment diversion. The area has natural shallow water depths and existing vegetation in the receiving basin that will support sediment accretion and promote new emergent vegetation growth. Additionally, several large-scale marsh creation and ridge restoration projects have been constructed in recent years using Mississippi River sediment to the west and north of the outfall location. The transport of additional sediment, fresh water, and nutrients through the proposed Project has the potential to benefit the long-term sustainability of some of these projects.

Further, due to the ongoing aggradation process at this point bar, a diversion at this location would have a continuous, long-term source of sediment to feed the diversion. The intake could also take advantage of fine-grained sediments that are generally suspended in the water column as well as those sizes mobilized by turbulence created during higher discharges of the river and at the diversion intake. This combination of coarse-grained sediments combined within finer-grained sediment provides sediment adequate for creating new and sustaining existing wetlands (Allison et al. 2014).

The AWG determined that Project alternatives at a river mile other than RM 60.7 at the location of the existing point bar would not be as effective in meeting the purpose and need of the proposed Project. CEMVN reviewed and agreed with this conclusion. As a next step, alternatives for operational trigger, capacity, and base flow were evaluated.

2.4.2 Evaluation of Operational Trigger

The next step in identifying potential Project alternatives involved evaluating different diversion operational scenarios that could form effective alternatives. In consideration of operational triggers during development of their proposed alternative, CPRA reviewed previous studies that looked at the appropriate Mississippi River flow for an on/off trigger to begin full diversion operation, and various options for pulsing regimes (CPRA 2011). Based on these previous studies, CPRA also conducted Project-specific modeling of various scenarios to identify operational triggers that would best meet the Project purpose and need (Liang et al. 2016a, Messina and Meselhe 2017). Results of CPRA's efforts, in addition to CEMVN's independent review of materials, were taken into consideration during the alternatives screening process, as described below.

To evaluate the operational trigger alternatives, the same overarching considerations were used for the location analysis, but with different sub-topics that focused on issues relevant to operational scenarios. All of these questions relate the analysis back to the proposed Project purpose and need:

- Would the operational scenario aid in the potential for accretion of sediment?

- Would the operational scenario allow for effective capture and distribution of fine-grained and coarse-grained sediments from the Mississippi River?
- Would the operational scenario efficiently discharge water into the basin? Otherwise stated, would the scenario provide a sufficient total volume of sediment transported at a sufficient SWR as described in Section 2.2.1?
- Would the location create, maintain, and sustain existing and future wetlands and marshes?
- Would the operational scenario effectively promote the long-term sustainability of existing marshes, sustainability of newly created marsh, and restoration of degraded marsh?
- Would the operational scenario effectively address relative sea-level rise?
- Would the operational scenario effectively promote the infilling of shallow open-water areas?

2.4.2.1 Application of Additional Considerations to On/Off Trigger Scenarios

Operation of a large-scale sediment diversion requires determining under which river conditions the diversion would be opened and allowed to flow ("turned on") and under which river conditions the diversion would be closed ("turned off"). These operational decisions are referred to as "on/off triggers."

Previous studies of the Mississippi River have documented the correlation between river discharge and sediment load, demonstrating that higher river discharge levels are generally correlated with higher sediment loads (Allison et al. 2012, Allison et al. 2014, Allison and Meselhe 2010, Meselhe et al. 2016b). As explained above, this is at least in part because at higher discharge levels, the river contains correspondingly greater energy (velocity and turbulence) that is capable of mobilizing a greater volume of sediments (both fine and coarse) into the water column and transporting those sediments downstream. Thus, using an on/off trigger can help to restore natural processes of deltaic deposition by operating the diversion at moderate to high river discharges, allowing the capture of higher sediment concentrations when the river has higher flow rates (Liang et al. 2016). Using an on/off trigger based on Mississippi River discharge also ensures that the diversion is not in full operation when the Mississippi River has low flow rates, reducing the risk of negative impacts on navigation and water supply.

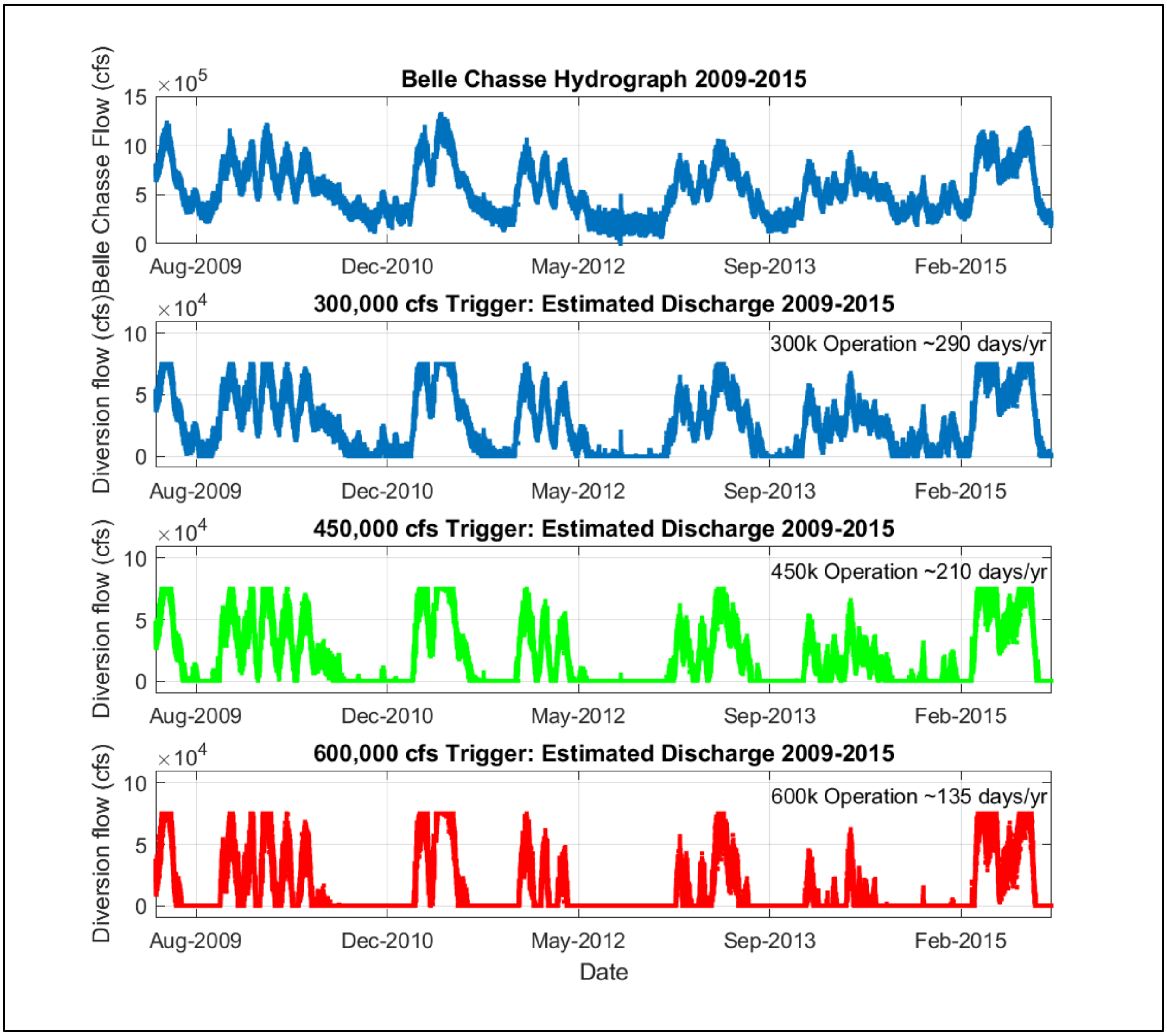
Given this strong correlation between river discharge (or flow) and sediment load, during Project development CPRA reviewed previous studies that have evaluated different diversion operation plans and conducted studies specific to Project development. Various operational trigger scenarios were reviewed and considered, such as Mississippi River sediment load discharge, salinity, turbidity, or water temperature. These scenarios were not retained for further consideration because it was determined that they were not effective at capturing and transporting appropriate amounts of sediment to meet the Project purpose and need, particularly when compared to a simple on/off trigger based primarily on river flow. This is because the monitoring data does not provide reliable real-time information regarding sediment load or turbidity in the river, and the salinity and water temperature data do not correlate to sediment availability in the Mississippi River.

CPRA also evaluated several variations of “pulsing” operations (operating the diversion only for a certain number of consecutive days at a time), as well as operating the diversion only during the rising limb (as the discharge volume in the river increased), or reducing operations during the summer. CPRA concluded that while pulsing improved sediment capture efficiency, pulsing also reduced total sediment capture, which translated into a reduction in the amount of material transported to the basin and therefore reduced wetland creation and restoration over time (Liang et al. 2016). The option with a simple on/off trigger based on Mississippi River flow showed the most effect on salinities in the basin, although the difference in salinity was not significant at most locations (Liang et al. 2016). The simple trigger option with no pulsing provided the greatest total volume of sediment.

Additional consideration was also given to operational scenarios that maintained flow rates of between 200,000 and 300,000 cfs in the Mississippi River downstream of the proposed Project location. These alternatives were not considered further due to concerns with navigation and saltwater intrusion. Thus, focus remained on simple Mississippi River flow-based on/off operational triggers.

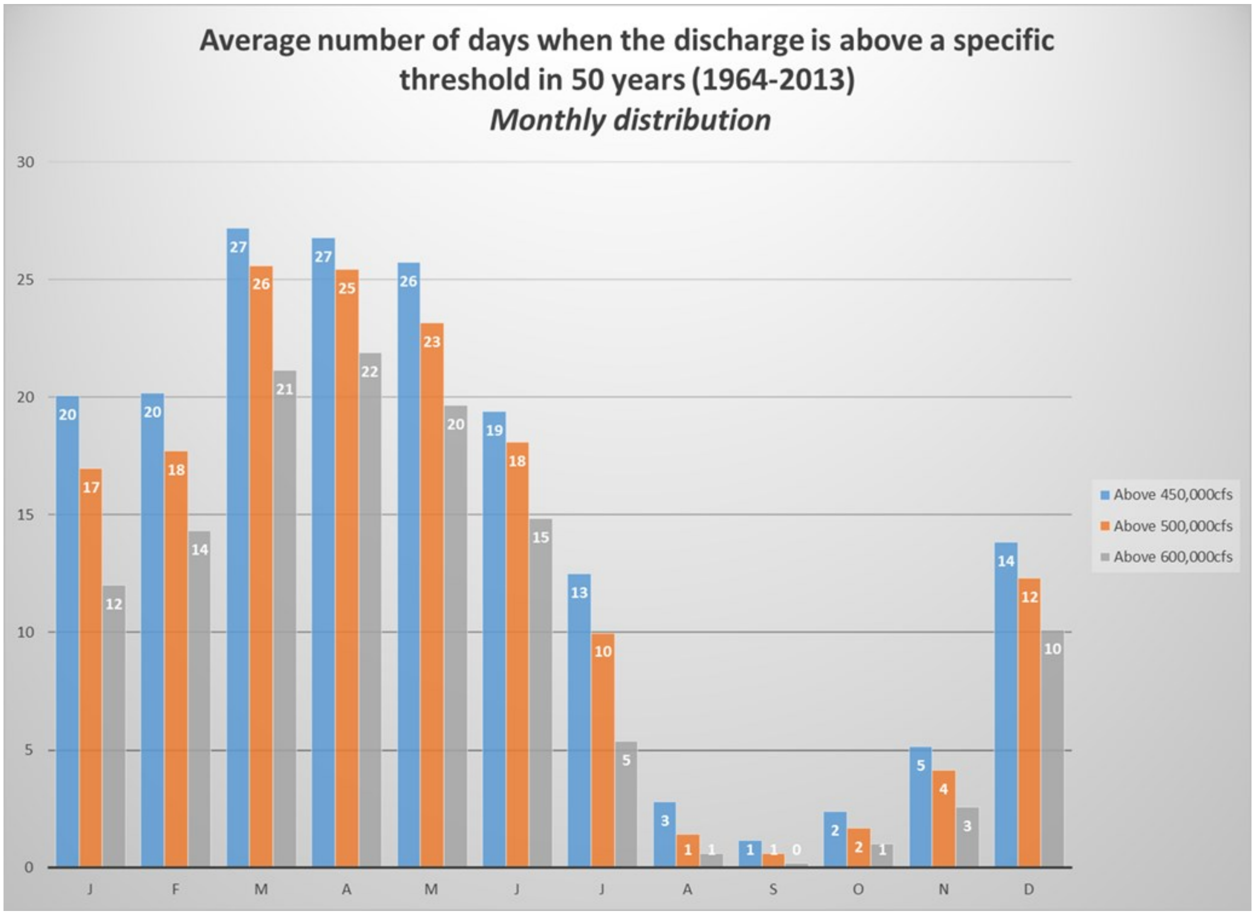
A study conducted by The Water Institute of the Gulf (Water Institute) included sensitivity testing of various triggers at 50,000 cfs increments ranging from 300,000 cfs up to 700,000 cfs (Liang et al. 2016). This study looked at impacts in the river, and also evaluated yearly-averaged diverted water volume, and diverted sediment loads. Figure 2.4-2 provides an example from this sensitivity testing that compares the flow regimes for a 75,000 cfs diversion with on/off triggers of 300,000 cfs, 450,000 cfs, and 600,000 cfs, under an assumption that in each case the flow through the diversion increases linearly from a minimum of 0 cfs at the trigger to its maximum capacity at a river discharge of 1 million cfs. Also shown on Figure 2.4-2 is the average number of days per year the diversion would be projected to operate under each trigger scenario, based on historic flow data in the Mississippi River.

As shown in Figure 2.4-2, a diversion with a lower operational trigger operates more frequently and with greater total discharge than a diversion with a higher operational trigger. As a result, the diversion with the 300,000 cfs trigger operates most of the year (averaging 290 days of operation per year based on the 2009 through 2015 hydrograph at Belle Chasse), whereas the diversion with a 600,000 cfs trigger operates only 135 days/year on average. Figure 2.4-3 shows the monthly number of days (average value over 50-year data) when the Mississippi River discharge is above a specific threshold.



Source: Liang et al. 2016

Figure 2.4-2. Comparison in Diversion Flow Regimes with On/Off Triggers of 300,000 cfs, 450,000 cfs, and 600,000 cfs. (Note that the top hydrograph denotes the Mississippi River Flow at Belle Chasse between 2009 and 2015).



Source: Liang et al. 2016

Figure 2.4-3. Monthly Number of Days (Average Value over 50-year Data) when the Mississippi River Discharge is Above a Specific Threshold.

Based on this and similar analyses, CPRA determined that a low trigger (300,000 cfs) would not efficiently allow for distribution of fine-grained and coarse-grained sediments because the diversion would run at river flows that would be less effective at bringing coarse silts and sands from the riverbed into suspension and distributing those sediments into the basin. Similarly, a low trigger would result in substantial flow during times of year when sediment concentrations are low resulting in little sediment benefit.

CPRA also determined that a high trigger (600,000 cfs) would not be effective in aiding in the potential for accretion of sediment because the minimal days of operation associated with a high trigger would reduce the total volume of sediment transferred and accreted. Similarly, these minimal days of operation would also limit the effectiveness of this operational scenario in: (1) promoting the long-term sustainability of existing coastal resources that are currently degraded, (2) effectively addressing relative sea-level rise, and (3) effectively promoting the infilling of shallow open-water areas, because a lower volume of sediment would be transferred over the life of a project that is operated with a high trigger. Thus, this operational scenario would not effectively help promote long-term sustainability, address relative sea-level rise, or promote the infilling of shallow open-water areas.

In contrast, a 450,000 cfs trigger allows for diversion operations that capture the high sediment loads associated with rapidly rising river discharges and thus more effectively meets the additional considerations described above. In consideration of these concepts, CPRA's proposed on/off trigger (450,000 cfs) was carried forward for detailed analysis in this EIS. Based upon the studies outlined above, the AWG determined that the proposed 450,000 cfs operational trigger would best meet the Project purpose and need and CEMVN agreed.

2.4.3 Evaluation of Sediment Diversion Capacity Scenarios

This effort in the alternatives evaluation process involved examining different options for maximum discharge capacity, including alternatives with a smaller or larger maximum discharge capacity compared to the Applicant's Preferred Alternative (maximum discharge capacity of 75,000 cfs). As noted previously, the objective of this evaluation was to identify alternatives that effectively meet the proposed Project purpose and need and are practical and feasible.

In progressing to review these different diversion capacity scenarios, the AWG considered the degree to which the screening criteria used in the Step 1 evaluation of functional alternatives remained useful for evaluating these capacity scenarios. The AWG determined that two of the screening criteria could help determine whether the capacity alternatives effectively meet the proposed Project purpose and need. A more refined evaluation of these screening criteria was obtained by applying additional considerations to the evaluation.

2.4.3.1 Additional Considerations Applied to Capacity

To evaluate the diversion capacity alternatives, the AWG developed additional considerations relevant to Screening Criteria 1 and 2.

Screening Criteria 1: Does the alternative reconnect and reestablish deltaic processes between the Mississippi River and the Barataria Basin?

- Would the capacity alternative at this location effectively promote the long-term sustainability of existing marshes, sustainability of newly created marsh, and restoration of degraded marsh?
- Would the capacity alternative at this location allow for effective capture and distribution of fine-grained and coarse-grained sediments from the Mississippi River?
- Would the capacity alternative at this location aid in the potential for accretion of sediment?
- Would the capacity alternative provide nutrients down-basin?
- Would the capacity alternative promote the infilling of shallow open-water areas?

Screening Criteria 2: Does the alternative deliver sediment, fresh water, and nutrients in a sustainable manner?

- Would the capacity alternative improve the SWR in the diversion?
- Would the capacity at the intake location be sufficient to capture needed amounts of sediment?
- Would the capacity alternative efficiently discharge water into the basin?

2.4.3.2 Application of Additional Considerations to Capacity Alternatives

Historically, numerous studies have considered many different sizes and types of diversion structures at or near Myrtle Grove, with estimated diversion discharge capacities ranging from as low as 2,000 cfs to as high as 300,000 cfs (see Table 2.4-1). In some cases, specified diversion sizes or capacities represented a maximum flow, while in others they represented an average flow or the target flow for a particular river stage. For the sake of summarizing the outcomes of previous studies, diversion capacity sizes were grouped into four categories as follows regardless of design or how flows were designated:

- 5,000 cfs or less;
- 15,000 to 30,000 cfs;
- 35,000 to 75,000 cfs; and
- greater than 75,000 cfs.

Table 2.4-1
Diversion Sizes Considered in Previous Studies

Capacity (cfs)		Studies
≤5,000	2,000	2012 Coastal Master Plan (CPRA)
	2,100	BA-24 (CWPPRA)
	2,500	BA-33 (CWPPRA)
	5,000	MRSNFR (CWPPRA); BA-33 (CWPPRA); LCA Ecosystem Restoration (USACE); LCA MDMG (USACE); 2012 Coastal Master Plan (CPRA)
15,000 – 30,000	15,000	MRSNFR (CWPPRA); BA-33 (CWPPRA); LCA Ecosystem Restoration (USACE); CPRA and non-governmental organizations (NGO) study; LCA MDMG (USACE) 2012 Coastal Master Plan (CPRA)
	20,000	2012 Coastal Master Plan (CPRA)
	30,000	LCA MDMG (USACE)
35,000 - 75,000	38,000	LCA Ecosystem Restoration (USACE); 2012 Coastal Master Plan (CPRA)
	45,000	CPRA and NGO study; LCA MDMG (USACE)
	50,000	2012 Coastal Master Plan (CPRA)
	75,000	LCA Ecosystem Restoration (USACE); LCA MDMG (USACE); CPRA and NGO study; MRHDM Study
	75,000	2017 Coastal Master Plan (CPRA)
> 75,000	100,000	LCA MDMG (USACE)
	125,000	LCA MDMG (USACE)
	150,000	LCA Ecosystem Restoration (USACE); CPRA and NGO study
	240,000	CPRA and NGO study
	250,000	2012 Coastal Master Plan (CPRA)
	300,000	CPRA and NGO study

This collection of studies documents the importance of diversion capacity to successful sediment delivery at a particular location. CPRA reviewed and considered these studies to develop the Applicant's Preferred Alternative. Similarly, as part of its analysis, CEMVN independently reviewed and evaluated these previous studies. Based on these previous studies, in general, diversions with capacities of 5,000 cfs or less deliver fine sediment (clays and fine silts), but fail to deliver enough coarse silts and sands into the outfall (or sediment deposition) areas for delta formation (CWPRRA BA24, BA33; MRSNFR; LCA Ecosystem Restoration). Specifically, the reason for this is two-fold. With low diversion discharges, the volume of intake is not sufficient to pull water from areas away from the river shoreline. The areas close to shore do not have the depositional levels of coarse-grained sediments found in deeper portions of the Mississippi River channel (CPRA 2011, Allison 2011, Allison and Meselhe 2010, Allison et al. 2012). Second, at smaller volumes, the diversion does not generate adequate energy (in the form of turbulence) to mobilize coarse-grained sediments from the river into suspension so they can be entrained and transported into the basin. Instead, at lower discharge volumes, coarse silts and sands either fail to mobilize or fall out of suspension within the channel. At higher volumes and corresponding higher velocities, adequate turbulence is generated within the channel to mobilize and transport the heavier bedload sediments (CPRA 2011, Allison 2011, Meselhe et al. 2011, Allison and Meselhe 2010, Allison et al. 2014, Meselhe et al. 2012). Thus, lower discharge diversions (less than 15,000 cfs) have been determined to be less effective at capturing and distributing fine-grained *and* coarse-grained sediments and also do not capture needed amounts of sediment and do not promote the long-term sustainability of existing, created, restored, or degraded marshes. Without the coarse-grained sediment distribution, these diversions are unlikely to promote infilling of shallow open-water areas or capture needed amounts of sediment, or efficiently discharge water into the basin.

Flow in a sediment diversion is variable. When the diversion is operating, the flow rate through a diversion is controlled by the difference in water surface elevation between the Mississippi River and the Barataria Basin (the head differential). When the Mississippi River flow and stage are high, this high head differential would push a higher volume of water and sediment through the diversion into the Barataria Basin. When the Mississippi River flow and stage are low, there would be less energy to push water and sediment through the diversion. Thus, depending upon the flow rate in the Mississippi River and the head differential, flow in the diversion would be variable, up to a defined maximum capacity.

Together, CPRA and several non-governmental organizations (NGO) conducted a location-specific analysis (assuming an intake at RM 60.7) to determine the minimum diversion capacity necessary to mobilize sufficient coarse-grained sediments into the diversion structure, considering three diversion capacities between 15,000 cfs and 75,000 cfs maximum capacity (CPRA and NGO study; LCA MDMG). This study found that the diversion must operate above 45,000 cfs (max capacity) to effectively transport coarse-grained sediments (greater than 63 microns) from the Mississippi River (at RM 60.7) into the basin and thus function as a sediment diversion. These results are summarized in Table 2.4-2, which documents the increasing amount of total sediment diverted as well as the disproportional increase in larger grained sediments at higher capacities.

Table 2.4-2
Sediment Load Summary

	Mississippi River (Main Stem)	Diversion Channel ND-RM 60.7 15,000 cfs	Diversion Channel ND-RM 60.7 45,000 cfs	Diversion Channel ND-RM 60.7 75,000 cfs
Water Discharge (m^3/s)	19,821	361	937	1,725
Water Discharge (cfs)	700,000	12,733	33,075	60,918
Sediment Load (metric tons/day) 2-63 microns	233,539	4,189	13,819	24,789
Sediment Load (metric tons/day) 63-79 microns	10,839	188	619	1,156
Sediment Load (metric tons/day) 79-113 microns	21,816	335	1,150	2,357
Sediment Load (metric tons/day) 113-187 microns	34,437	420	1,675	3,726
Sediment Load (metric tons/day) 187-250 microns	23,460	44	528	1,607
Total Sediment Load (metric tons/day)	NA	5,176	17,791	33,636
Total 63-250 Micron Load (metric tons/day)	90,554	987	3,972	8,847
Sediment-to-Water Ratios (SWR)	--	0.60	0.93	1.12

Source: Adapted from Meselhe et al. 2011
m^3/s = cubic meters per second
ND=No Dike

As shown in Table 2.4-2, this modeling study found that over 50 years, a sediment diversion at RM 60.7 operating at a maximum capacity of 15,000 cfs diverted significantly fewer metric tons/day of sediment, including coarse-grained sediment (defined herein as sediment between “very fine sand” and “fine sand” classes, or 63 to 250 microns [Wentworth 1922]), into the basin than a diversion operating at a maximum capacity of 45,000 cfs. Of particular relevance, the study found that a sediment diversion at RM 60.7 operating at a maximum capacity of 75,000 cfs generated nearly nine times more coarse-grained sediment (63 to 250 microns) than a diversion operating at a maximum capacity of 15,000 cfs (8,847 metric tons/day as compared to 987 metric tons/day), and almost double the coarse-grained sediment than a diversion operating at a maximum capacity of 45,000 cfs (8,847 metric tons/day as compared to 3,972 metric tons/day).

In addition to the sand fraction (greater than 63 microns), the coarse silts (32 to 63 microns) are also important to the efficiency of reestablishing deltaic land building processes, for two reasons. First, as described above, both the coarse silt fraction of Mississippi River sediment and the very fine sand fraction (63 to 125 microns) are able to settle quickly in still-water environments like the outfall area in the Barataria Basin. And second, the 32- to 63-micron size increment represents the largest total volume (by weight) of sediment that is transported into the basin (Meselhe et al. 2011, Meselhe et al. 2012). The modeling study concluded that a sediment diversion at the proposed location operating at a maximum capacity of 75,000 cfs generated significantly more fine to coarse silt (2 to 63 microns) than a diversion operating at either a maximum capacity of 15,000 cfs or a maximum capacity of 45,000 cfs (see Table 2.4-2). Thus, a diversion at this location operating with a maximum capacity of 75,000 cfs is more likely to aid in potential for accretion of sediment and provide nutrients downstream than the smaller diversions evaluated in this study.

Further, this study documented the varying degrees of sediment transport efficiency for diversions of different sizes, exemplified by different SWR for each diversion capacity (see previous discussion on SWR in Section 2.2.1). Higher SWR values represent diversions that are able to transport through the diversion channel more sediment per unit volume of diverted fresh water than concentrations in the river. Thus, a higher SWR indicates enhanced benefits in terms of potential for building and sustaining wetlands and marshes relative to the potential impacts associated with removing water from the river. The CPRA/NGO study concluded that the higher the capacity of the diversion, the greater the relative volume of sediment in the diverted water. The study found that a sediment diversion operating at a maximum capacity of 75,000 cfs had the highest SWR of the alternatives considered.

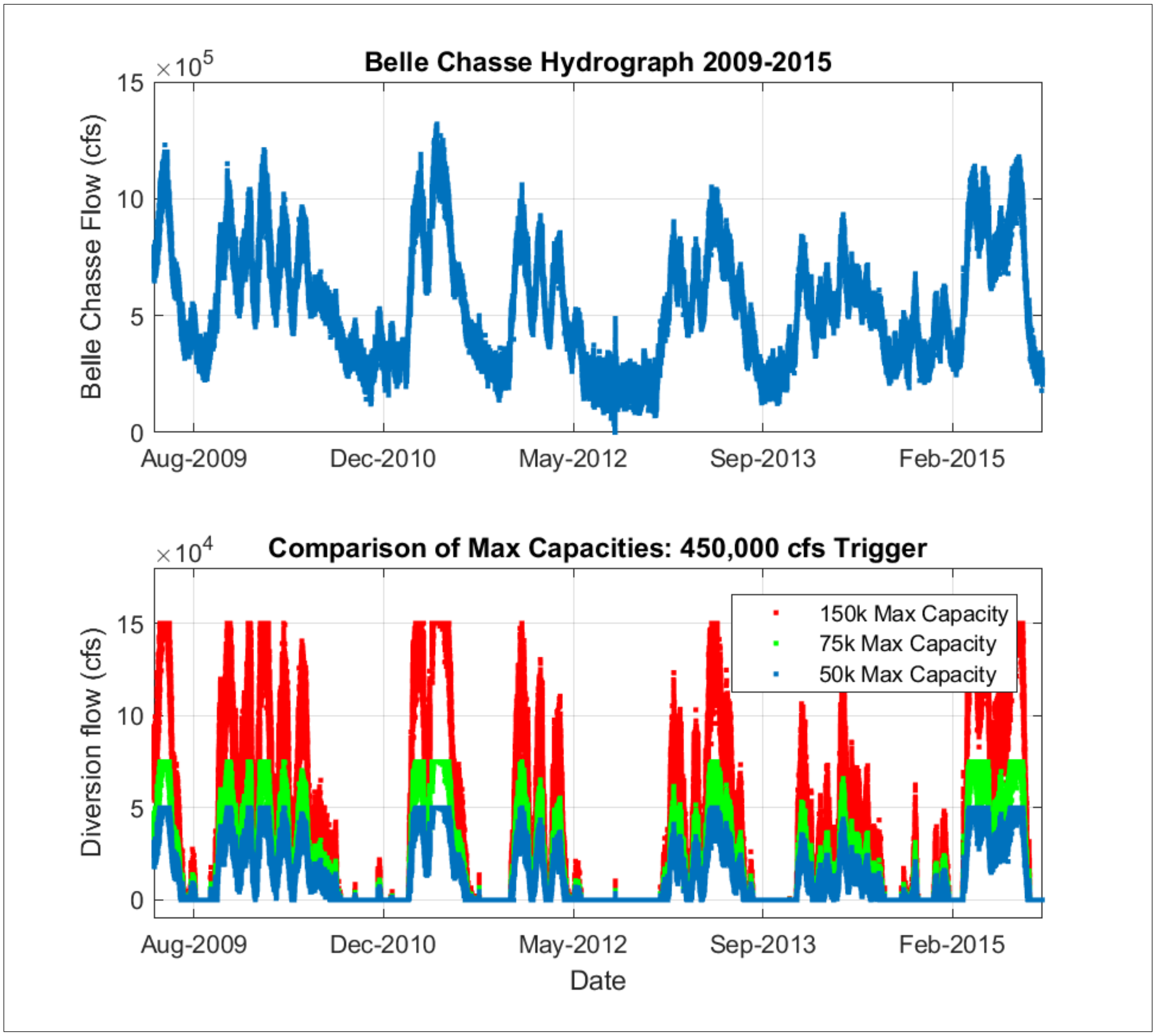
These results indicate that an intake at this location with a diversion designed to operate with a maximum capacity of 75,000 cfs allows for capture of the needed amounts of sediment, for effective distribution of fine-grained and coarse-grained sediments, and aids in potential for accretion of sediment, and thus more effectively promotes the long-term sustainability of marshes, and infilling of shallow water areas compared with the other diversion alternatives considered. Thus, based on this analysis (Gaweesh and Meselhe 2015, Meselhe and Sadid 2015), CPRA and its study partners concluded that a sediment diversion with a maximum capacity of 75,000 cfs or greater at RM 60.7 would be most effective at transporting coarse-grained sediments capable of delta building by promoting infilling of shallow open-water areas and supporting accretion of sediment in the basin. A 75,000 cfs diversion delivered more total sediment and had the relative highest SWR compared to smaller diversions (see Table 2.4-2). Additional studies have further shown that a 75,000 cfs diversion at RM 60.7 can capture larger sediments when movement of bed material is induced by high river flow (Allison and Meselhe 2010). Other studies have also shown that larger diversions are more effective at transporting sediment and building land than smaller diversions (Wang et al. 2014, Allison et al. 2014).

Upon review of these studies and subsequent CPRA conclusions, the AWG noted that these studies further demonstrated that the higher the capacity of water in the diversion channel, the greater the volume of sediment in the diverted water. Consequently, diversions with capacities higher than 75,000 cfs are projected to transport more of the materials critical to delta formation and at a higher SWR. Larger diversions may also be able to build and maintain marsh habitats under higher sea-level rise scenarios, because they are more able to provide the volume of sediment required to keep pace with faster sea-level rise (CPRA 2012, Wang et al. 2017, Allison and Meselhe 2010), thus promoting the long-term sustainability of existing, created, and restored marshes. Based on this, the AWG determined that a diversion with a maximum capacity larger than 75,000 cfs at RM 60.7 should be considered in the evaluation of alternatives. Because a 250,000 cfs diversion had been previously considered by CPRA and removed from consideration during development of their 2017 Coastal Master Plan due to potential for undesirably negative impacts associated with that size and capacity, the AWG determined that an alternative with a maximum capacity of between 75,000 cfs and 250,000 cfs should also be considered.

The studies reviewed also indicated that diversions at RM 60.7 with a maximum capacity smaller than 75,000 cfs may not be able to provide a large enough volume of sediment to build and maintain marsh habitats at a rate to keep pace with sea-level rise, and thus would not effectively promote the long-term sustainability of existing, newly created, and restored marshes. However, the AWG also noted that previous studies did not consider a diversion at RM 60.7 between 45,000 cfs and 75,000 cfs and concluded that, for comparative purposes and in order to consider a range of adverse and beneficial impacts, a smaller diversion with maximum capacity between 45,000 cfs and 75,000 cfs should also be considered in the evaluation of alternatives.

There is theoretically an infinite number of diversion capacities that could be designed for the proposed Project. In such instances, the CEQ guidance advises the lead agency to consider a reasonable range of alternatives that capture the range of potential effects that could be created by the Project consistent with the purpose and need (CEQ 40 FAQs [CEQ 1981]). Consistent with this guidance, the AWG attempted to identify a reasonable range of capacities that could be effective at meeting the Project purpose and need and capture the full range of potential environmental consequences.

Based on the above evaluation, CEMVN agreed that sediment diversion maximum capacities of 50,000 cfs, 75,000 cfs, and 150,000 cfs at RM 60.7 are the reasonable range of maximum diversion capacities to be analyzed further as Project alternatives in this EIS. Figure 2.4-4 illustrates the differences in discharge between these three diversion capacities, assuming an operational trigger of 450,000 cfs in each case (see below).



Source: USGS Belle Chasse flow gage records.

Figure 2.4-4. Differences in Discharge between Three Diversion Capacities Included in the Reasonable Range of Alternatives in this EIS.

2.4.3.3 Application of Additional Considerations to Base Flow Scenarios

Operation of a large-scale sediment diversion can also include varying the amount of base flow, which is the diversion discharge at Mississippi River flows less than the on/off trigger, although base flow will only occur when there is a sufficient head differential between the river and the receiving area (Messina and Meselhe 2017). The head differential, as previously described, is the difference in water surface elevation between the Mississippi River and the Barataria Basin. When elevations are higher in the basin than the river (during low river flow or surge in the basin) flow could actually occur backwards through the diversion channel from the basin to the river, unless the diversion gate is closed. Therefore, a base flow would only occur when the head differential was such that it allows flow into the basin, and the amount of flow would vary depending on the head differential, but would be controlled to not exceed an established maximum base flow through the diversion.

The primary purpose for the establishment of a base flow is to protect, sustain, and maintain newly vegetated or recently converted fresh, intermediate, and brackish marshes near the diversion outflow. In this step, the alternatives evaluation process conducted by CPRA and reviewed by the AWG considered whether different levels of base flow could effectively meet the proposed Project purpose and need, provide a range of potential environmental consequences distinct from the Applicant's Preferred Alternative, and are practical and feasible. The questions noted in Section 2.4.2 for consideration of trigger scenarios were also applied to the consideration of base flows during the AWG review process.

The alternatives evaluation process relied on several previous simulations of base flow options, each using historical conditions for both 2007 and 2010 in order to simulate a range in annual Mississippi River discharge, as well as environmental variables like wind and rainfall. The 0 cfs base flow scenario corresponded to the scenario with a simple trigger at 450,000 cfs (Liang et al. 2016). Other options tested included a 450,000 cfs on/off trigger plus a base flow ranging from 1,000 cfs to 10,000 cfs.

Based on the model results, a base flow with a maximum of 5,000 cfs was determined as sufficient to moderate seasonal salinities within the outfall area including immediately adjacent marshes (Messina and Meselhe 2017). The modeled base flow of 10,000 cfs showed a larger magnitude change when compared with lower base flows and was capable of reducing salinities in the extreme southern reaches of the basin. This indicates that a 10,000 cfs base flow scenario does not meet Project goals. It discharges more water than is necessary or desirable to moderate seasonal salinities within the outfall area including immediately adjacent marshes, and unintentionally freshens the basin farther from the outfall area.

A full 50-year model simulation was run with the updated Delft3D Basinwide Model for a diversion operating with a trigger of 450,000 cfs and a maximum discharge of 75,000 cfs with both a 0 cfs base flow and a 5,000 cfs base flow scenario. The model runs indicated that the operation plan with the 5,000 cfs base flow would result 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 than the operation plan with no base flow after 50 years. These results demonstrated that the 5,000 cfs base flow scenario would effectively promote the long-term sustainability of existing marshes and sustainability of newly created marsh. By comparison, a 0 cfs base flow scenario did not provide this wetland benefit, substantially reducing its effectiveness at achieving the proposed Project purpose and need. Thus, CPRA proposed a maximum 5,000 cfs base flow as part of the Applicant's Preferred Alternative.

Upon review of this information the AWG concluded that potential alternatives for different base flow values other than the proposed 5,000 cfs (considering 0 cfs and

10,000 cfs) would not be effective for meeting the proposed Project purpose and need and CEMVN agreed. As a next step, the AWG evaluated additional design considerations.

2.4.4 Evaluation of Additional Design Considerations

The AWG considered several design options raised in scoping comments, in addition to those previously considered by CPRA during development of their proposed Project. The review considered whether any of these design options could form the basis for separate alternatives that would effectively meet the Project purpose and need, provide a range of potential environmental consequences distinct from the Applicant's Preferred Alternative, and are practical and feasible. Evaluation of these options included:

- A siphon intake structure, which would involve using a siphon structure to transfer water from the Mississippi River to the Barataria Basin, instead of the proposed diversion conveyance channel.
    - This design option was not carried forward because the design of siphon structures is specific to freshwater diversions and therefore may not be feasible for capture and transport of the volume and range of sediment sizes to meet Project purpose and need.
- A "dog-leg" alignment, which would involve designing the diversion conveyance channel with two bends instead of as a straight channel.
    - This design option was not carried forward because this type of alignment can cause energy losses, which reduce water and sediment carrying capacity (CPRA 2011, Meselhe et al. 2011, Meselhe et al. 2012).
- A closed tube tunnel system for the diversion conveyance channel.
    - This design option was not carried forward because tunnel-like systems involve increased design and construction costs, along with operation and maintenance challenges. More specifically, to reach a maximum design flow of 75,000 cfs, at least two tunnels, each at least 1 mile in length, would need to be constructed in parallel, which would subsequently lead to increased maintenance difficulties.
- Piping additional sediment from a Mississippi River dredge site into the diversion conveyance channel.
    - This design option was not carried forward because it is not feasible to identify a sufficient sediment source over the life of the Project that is not already dedicated to marsh creation/enhancement projects and that would not remove upstream sediment expected to be captured by the diversion. It was also not carried forward because of logistics and cost associated

with placement and maintenance of a sediment pipeline from the source into the diversion channel.

The evaluation of these design options found that they were either not practical or feasible from a technical perspective and no more effective at meeting the purpose and need of the proposed Project. Thus, these design options were not carried forward as part of the Applicant's Preferred Alternative. The AWG reviewed these studies and conclusions and determined that these design options did not need to be carried forward as separate alternatives, and CEMVN agreed.

2.5 Step 3: Evaluation of Sediment Diversion Outfall Features

Step 3 of the alternatives evaluation process involved examining different options for features that could potentially expedite Project-related benefits in the outfall area. These features are referred to herein as "outfall features." Public scoping comments recommended constructing features in the diversion outfall area such as canals, bayous, terracing, impoundments, weirs, or chenier-like ridges to manipulate the flow of water and sediment 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. As part of the Applicant's Preferred Alternative, CPRA had incorporated features into the design of the Project to aid in expediting anticipated Project benefits (see Section 2.8.1.1). The AWG determined that additional evaluation of outfall features was necessary. As previously described, the objective of this evaluation was to identify alternatives that effectively meet the Project purpose and need, that provide a range of potential environmental consequences distinct from the Applicant's Preferred Alternative, and that are practical and feasible.

2.5.1 Additional Considerations

To evaluate these alternatives, additional considerations were applied for evaluation, similar to those applied to the operational trigger and base flow scenarios:

- Would the outfall feature aid in the potential for accretion of sediment?
- Would the outfall feature allow for effective capture and distribution of fine-grained and coarse-grained sediments from the Mississippi River?
- Would the outfall feature create, maintain, and sustain existing and future wetlands and marshes?
- Would the outfall feature effectively promote the long-term sustainability of existing marshes, sustainability of newly created marsh, and restoration of degraded marsh?
- Would the outfall feature effectively address relative sea-level rise?
- Would the outfall feature effectively promote the infilling of shallow open-water areas?

These considerations were applied to multiple potential outfall features, including those proposed during public scoping. CPRA has included two features intended to expedite near-term Project benefits in their Applicant's Preferred Alternative (see Section 2.8.1.1). These features include beneficial use of material from the diversion channel to create marsh in one of two designated areas within the outfall area but outside the area of initial delta formation, and an outfall transition feature. Creation of marsh using material left over from construction of the diversion channel in one of two designated beneficial use areas (see Figure 2.8-1) would add immediate marsh benefits within the Project vicinity. The outfall transition feature is intended to expedite formation of a delta immediately outside of the diversion outfall, within the outfall area. Features such as canals, bayous, impoundments, and weirs were removed from consideration as features within the initial delta formation area because of the potential for such features to impede the development of the delta formation. Other features considered included construction of marshes, ridges, and marsh terraces outside of the area where the delta would be expected to initially form.

In consideration of public scoping comments, and because of the possibility of expediting anticipated Project-related benefits, while not interfering with the proposed Project's purpose, two types of outfall features (in addition to construction of the outfall transition feature and beneficial use of material from the diversion channel, discussed above and in Section 2.8.1.1) were reviewed for further consideration.

First, construction of a low ridge west of and running parallel to the northern terminus of Wilkinson Canal and its intersection with Round Lake was considered. The purpose of this feature would be to prevent the deposition of sediment into Wilkinson Canal and to promote deposition within the shallower adjacent waters and wetlands. Ridge creation has become an established restoration technique in Louisiana (CPRA 2017a). This technique not only reestablishes important habitats for wildlife species but also provides important erosion protection and wind fetch reduction in immediate areas.

The second feature considered was the construction of marsh terraces or similar sediment retention features within the Outfall South beneficial use placement area identified in Figure 2.8-1, adjacent to Wilkinson Canal. Marsh terracing has been promoted as a means of enhancing deposition and retention of suspended sediments, reducing turbidity, increasing marsh-edge habitat, increasing overall primary and secondary productivity, and maximizing access for marine and estuarine organisms (Rozas and Minello 2001).

After analyzing these two potential outfall features, CPRA chose to propose marsh terracing as an alternative Project feature in the range of alternatives to be analyzed further in the EIS. These features are most often used to reduce wave energy within an area, protect eroding or recently restored shorelines, or to promote sediment deposition and resultant benefits, all of which is intended for this effort. Terraces are intended to increase immediate benefit within the outfall area and nearer to the diversion point of discharge. They could also function to reduce sediment transport into Wilkinson Canal by promoting deposition nearer to the diversion. The marsh terracing alternative could also allow for strategic placement of features designed to aid in the retention of sediment while maintaining the capacity of the system to convey initial flows and establish a delta and distributary channels within the outfall area. Additionally, these features can be constructed with a wide range of available borrow material and would not be constrained by typical marsh creation specifications. Each of the federal agencies represented on the LA TIG and CWPPRA Task Force have utilized or endorsed the use of marsh terraces.

CEMVN agreed that marsh terracing is appropriate to include as an outfall feature in the reasonable range of alternatives. In order to determine how the proposed marsh terracing might perform at each of the three maximum diversion capacities carried forward for further consideration (50,000 cfs, 75,000 cfs, and 150,000 cfs; see Section 2.4.3), each capacity is considered both with and without the proposed terrace features. The proposed marsh terrace features are described further in Section 2.8.2.

2.6 Summary of Alternatives Considered but Eliminated from Detailed Analysis

Table 2.6-1 provides a summary of the alternatives considered in this analysis but eliminated from detailed analysis. The explanations for why each alternative was eliminated from detailed analysis are provided throughout this chapter in the section noted in Table 2.6-1.

Table 2.6-1
Summary of Alternatives Considered but Eliminated

Alternative Name	Description	Section
Step 1: Evaluation of Functional Alternatives		
Freshwater Diversion	Divert water from the Mississippi River into the Barataria Basin via a human-made channel	2.3.1
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 in the Barataria Basin	2.3.2
Shoreline Protection	Protect the coastal shoreline utilizing breakwaters constructed parallel to the shoreline to reduce erosion	2.3.3
Barrier Islands	Construct or enhance barrier islands at the southern margin of the Barataria Basin	2.3.4
Large-scale Marsh Creation	Marsh creation through Mississippi River dredging/pipeline sediment delivery	2.3.5
Sediment Diversions with Marsh Creation	Large-scale sediment diversion operating in conjunction with a large-scale marsh creation component	2.3.6
	Smaller-scale diversion with marsh creation, either through traditional dredge and fill within a specified marsh creation cell or through piping of dredged material into the Barataria Basin on a continuing basis	2.3.6
Multiple Small-scale Diversions Along the Mississippi River	Multiple diversions (5,000 to 10,000 cfs) located in the Upper, Middle, and Lower Barataria Basin	2.3.7
Step 2: Evaluation of Operational Alternatives – Location, Operational Trigger, Capacity, Base Flow, and Additional Design Considerations		
Location	Upper Barataria Basin – (RM 62.5 to RM 118)	2.4.1.3
	Mid-Barataria Basin (RM 46.4 to RM 62.5) – Specific study of reaches or sites to include RMs 47.5, 51, 59, 60.2, 60.7, 60.8, 61.3 and 62.7	2.4.1.3
	Lower Barataria Basin – (below RM 46.4)	2.4.1.3

Table 2.6-1 Summary of Alternatives Considered but Eliminated		
Alternative Name	**Description**	**Section**
Operational Triggers	Alternatives with 300,000 cfs to 700,000 cfs trigger, including more detailed analysis of 300,000 cfs and 600,000 cfs and variations of simple on/off flow-based trigger (pulsing, rising limb, and seasonal) and alternative triggers (sediment load, salinity, and water temperature)	2.4.2
Maximum Operational Flow Rates	Diversion capacity alternatives of 2,000 to 300,000 cfs considered through review of previous studies and modeling efforts	2.4.3
Base Flow	No base flow	2.4.3.3
	Different base flow scenarios (1,000 to 10,000 cfs from CPRA modeling efforts)	2.4.3.3
Construction and Design Features	Pipe additional sediment from a Mississippi River dredge site into the diversion conveyance channel	2.4.4
	Use of a siphon intake structure	2.4.4
	"Dog-leg" alignment, which would involve designing the diversion conveyance channel with two bends instead of as a straight channel	2.4.4
	Closed "tunnel-like" system for the diversion conveyance channel	2.4.4
Step 3: Evaluation of Sediment Diversion Outfall Features		
Outfall Features	Construct canals, bayous, 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. (Note that marsh terracing is carried forward for further analysis)	2.5

Appendix D2 Eliminated Alternatives Matrix provides information on other alternatives that were considered but not detailed in Chapter 2. Appendix D2 was revised for the Final EIS to include details regarding alternatives received from public comments on the Draft EIS that were considered but eliminated/not carried forward for detailed review.

2.7 No Action Alternative

The EIS must include "No Action" as an alternative to the proposed Project (40 CFR §1502.14(d)). The USACE Regulatory Program's NEPA implementing regulations define the No Action Alternative as follows:

> The "no action" alternative is one which results in no construction requiring a USACE permit. It may be brought by (1) the applicant electing to modify his proposal to eliminate a work under the jurisdiction of the USACE or (2) by denial of the permit. District Engineers, when evaluating this alternative, should discuss, when appropriate, the consequences of other likely uses of a project site, should the permit be denied. 33 CFR Part 325, Appendix B, ¶9.b.(5)(b).

Although the No Action Alternative does not meet the purpose and need of the proposed Project, it is carried forward in this EIS to provide a means by which to compare the potential future impacts of not proceeding with the Applicant's Preferred

Alternative or the other action alternatives. It enables a comparison of the potential environmental impacts of the future *without* the Project to the effects of the future *with* the Project. Thus, under the No Action Alternative, CPRA's requested 10/404 permit would not be approved and/or the LA TIG would not approve funding for construction of the Applicant's Preferred Alternative or the other action alternatives. As a result, the proposed large-scale sediment diversion would not be constructed, nor would any of the other alternatives that are considered. In addition, potential impacts (both beneficial and detrimental to resources within the Project area) described for the considered action alternatives would not occur.

Existing projects and operations in and around the Project area would be expected to continue. For example, CEMVN would continue managing the Mississippi River for navigation under the current dredging operations plan. Sediment carried in the river would continue to be deposited within the channel or would discharge directly into the Gulf of Mexico.

Multiple coastal restoration and hurricane risk reduction projects occur or are currently being constructed within the Project area including local, state, and federally funded efforts such as marsh creation, terracing, barrier and shoreline restoration, dune and ridge restoration, and various levee system projects. Under the No Action Alternative, it is assumed these projects would continue under current operation and maintenance plans. For example, Davis Pond Freshwater Diversion would continue to operate as authorized to meet salinity targets in the Barataria Basin. (The Davis Pond Freshwater Diversion Operations Plan can be found at http://coastal.la.gov/diversion-operations/.) A full list of such projects included in modeling used to aid in impact assessment for the No Action Alternative can be found in Appendix E.

It is anticipated that implementation of other future restoration projects would continue. For example, the CWPPRA program would continue funding coastal restoration projects in the Barataria Basin; CPRA would continue to construct coastal restoration and protection projects identified in the Coastal Master Plan in high-priority locations in the Barataria Basin; and the LA TIG would fund increments of the Large-scale Barataria Marsh Creation Project. Although it is reasonably foreseeable that these restoration projects would occur, irrespective of the decision by CEMVN and the LA TIG on the Applicant's Preferred Alternative, permits and funding have not yet been obtained for all such projects. Future restoration actions such as these are characterized as reasonably foreseeable future actions and these actions are assessed in Chapter 4, Section 4.25 Cumulative Impacts.

Existing agricultural, industrial, and commercial land use trends would continue in the location of the proposed diversion complex. Due to the presence of wetland areas at the proposed Project location between the NOV-NF-W-05a.1 levee reach and Mississippi River Levee, this EIS assumes that any other development in this area could require a Section 404 permit and/or Section 408 authorization. In consideration of current, ongoing, and planned developments in the area and the access that the location of the proposed Project provides to the Mississippi River, it is reasonable to expect that under the No Action Alternative, at some future point, the area could be developed for industrial or commercial purposes. However, it would be speculative to guess what exactly the development might be. It is reasonable to assume that any future man-made development would be required to comply with applicable local, state and federal environmental standards, including state and federal permitting requirements.

2.8 Action Alternatives Carried Forward for Detailed Analysis

Given the analyses described above, the CEMVN has identified a reasonable range of alternatives to be carried forward for detailed analysis in this EIS, including:

- Alternative 1: variable flow up to 75,000 cfs maximum sediment diversion (Applicant's Preferred Alternative);
- Alternative 2: variable flow up to 75,000 cfs maximum sediment diversion including marsh terracing outfall feature;
- Alternative 3: variable flow up to 50,000 cfs maximum sediment diversion;
- Alternative 4: variable flow up to 50,000 cfs maximum sediment diversion including marsh terracing outfall feature;
- Alternative 5: variable flow up to 150,000 cfs maximum sediment diversion; and
- Alternative 6: variable flow up to 150,000 cfs maximum sediment diversion including marsh terracing outfall feature.

Each of the alternatives are large-scale sediment diversion projects. These alternatives are carried forward for further analysis under the Section 10/404 permit review by USACE and under OPA by the LA TIG who are also cooperating agencies for the EIS. Results of the impact analyses showed mainly negligible to minor differences in impacts when terrace features were compared to the alternatives without terrace features. Therefore, the impacts of all the terrace alternatives are described under the "Terrace Alternatives" heading within each resource section in Chapter 4, Environmental Consequences. In the instances that the terrace impacts with more than minor differences are notably different from the other alternatives, those differences are explicitly stated within the Chapter 4 resource sections.

The following sections describe the range of alternatives identified by CEMVN for further evaluation in this EIS, in addition to the No Action Alternative.

2.8.1 Alternative 1: Variable Flow up to 75,000 cfs Maximum Sediment Diversion (Applicant's Preferred Alternative)

The Applicant's Preferred Alternative consists of a diversion complex in Plaquemines Parish on the right descending bank of the Mississippi River at RM 60.7, with a conveyance system that would discharge sediment, fresh water, and nutrients from the Mississippi River into an outfall area within the mid-Barataria Basin in Plaquemines and Jefferson Parishes. The conveyance system would cross a portion of LA 23 and the NOGC Railroad, and alter a portion of the MR&T Levee and the NOV-NF-WF-05a.1 levee reach. Notably, the NOV-NF-W-05a.1 levee reach is an improvement to the level of risk reduction provided by the existing non-Federal levee between Le Reussite and Myrtle Grove. As discussed in Chapter 1, Section 1.5.4, Congress authorized and funded USACE to improve and incorporate portions of the Plaquemines Parish non-Federal levee into the federal NOV Project. USACE began construction in 2022 on the approximately 6 miles of the planned NOV-NF-W-05a.1 levee reach on the alignment shown in Figure 2.8-1 below. The design of the diversion structure includes tie-ins to both the NOV-NF-W-05a.1 levee reach and the existing Plaquemines Parish back levee, which will remain in place. Rather than siting the improved NOV-NFL levee on the same alignment as the existing non-Federal back levee, the location of some reaches has been adjusted. In those instances, the existing back levee will not be degraded.

If a DA permit is issued for the proposed MBSD Project, the construction of the NOV-NF-W-05a.1 levee reach by USACE is anticipated to occur prior to or concurrent with construction of the Applicant's Preferred Alternative. Therefore, the existence of the back levee and the NOV-NF-W-05a.1 levee reach are considered as a baseline condition for the impact analyses in this EIS (unless otherwise specified), and consideration is given to the potential cumulative impacts associated with concurrent construction of the NOV-NFL levee improvements and the action alternatives.

2.8.1.1 Project Design Features

The proposed Project is a sediment delivery system that consists of several elements or hydraulic structures/features. The design elements of the proposed Project for all six action alternatives are separated into three categories:

- **diversion complex**: the basic structural elements that control water intake and conveyance from the Mississippi River to the basin outfall area;
- **outfall area**: the area in the Barataria Basin where sediment, fresh water, and nutrients from the Mississippi River would be dispersed via the conveyance channel during operations; includes features the Applicant has determined would increase the efficiency of water and sediment accumulation; and
- **auxiliary structures**: Project elements that accommodate existing or future services and infrastructure, including road, rail, utilities, and drainage systems.

The engineering and design (E&D) progressed from the 30 percent E&D phase to the 60 percent E&D phase between the Draft EIS and Final EIS. Notable updates include the addition of two additional excess material disposal areas in the uplands, additional siphon and interior drainage path right-of-way, revised sizes/dimensions of the beneficial use areas in the Barataria Basin, and updated barge/vessel access route alignment in the Barataria Basin. The design elements of the Applicant's Preferred Alternative in this Final EIS have been updated and are based on the 60 percent E&D phase for the proposed Project and are listed in Table 2.8-1 and illustrated in Figure 2.8-1. The design elements are applicable to all six action alternatives, with the exception of the terraces (see Figure 2.8-1). Terraces would only be constructed under the three terrace alternatives (see Sections 2.8.2, 2.8.4, and 2.8.6 for more information about the terrace alternatives). Concurrent with the development of this EIS, the Applicant is continuing to evaluate and refine the E&D effort for the proposed Project. The Applicant has provided sufficient details on the proposed design, construction, and operational components of its proposed Project in order to ensure that this EIS provides decision makers and the public with accurate information regarding the potential environmental impacts of the proposed Project.

Table 2.8-1 **Project Design Elements**

The diversion complex (sometimes referred to generally as diversion structure) includes the following:
• Intake system (or headworks) which includes:
  o Intake structure (or channel)
  o Flared training walls in the Mississippi River
  o Gated control (or gate) structure
  o Transition channel
• Conveyance channel which includes:
  o Guide levees
  o Stability berms

The outfall area is where sediment, fresh water, and nutrients would be dispersed into the Barataria Basin during Project operations.
• The immediate outfall area includes the following design elements:
  o Outfall transition feature
  o Basin access channel
  o Beneficial use placement areas (Outfall South 1 and 2 and Outfall North)
  o Marsh terraces (for three of the action alternatives)

Auxiliary features are Project elements that accommodate existing or future services and infrastructure.
• Auxiliary features include the following:
  o Permanent site features including reservation site, administration building, access roads, boat ramps
  o Drainage system/inverted siphon
  o LA Hwy 23 modifications
  o NOGC railroad modifications
  o Utility relocations

Temporary features are Project elements that would be necessary during construction but would be removed or restored once construction is complete.
• Temporary features during construction include the following:
  o Cofferdam
  o Concrete manufacturing plant
  o Contractor yards (or staging areas)
  o Haul roads
  o Excess material stockpile/disposal areas
  o River trestle/dock

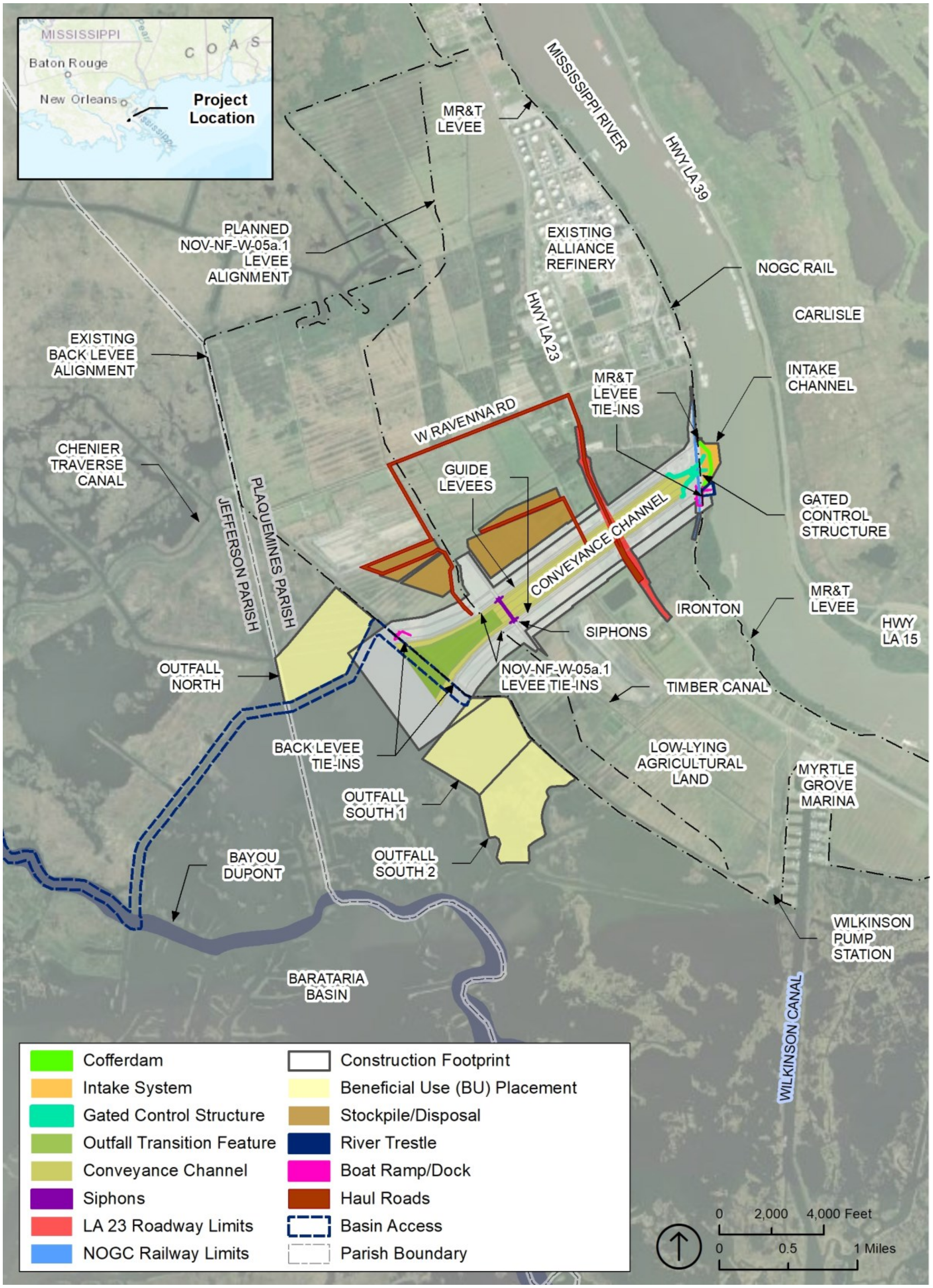


Figure 2.8-1. Project Design Features and Construction Footprint. Note that the terraces shown in the figure would only be constructed for the three terrace alternatives.

As shown in Table 2.8-2 below, the proposed Project construction footprint would encompass up to approximately 1,376 acres. This includes the proposed Project operational footprint (793 acres), plus temporary construction features that would not be required or maintained during Project operations (see Table 2.8-2). Additionally, approximately 467 acres of open water and eroding marsh would be restored to wetlands and/or shallow water aquatic habitat in three beneficial use placement areas in the immediate outfall area, depending on the availability of suitable material generated from dredging operations during construction.

Table 2.8-2
Project Construction and Operational Footprint Acreages (60 percent design)[a]

Project Features		Acres
Permanent (Remains for Operation of Project)	Diversion Complex Area[b]	793
Temporary (Construction Only)	Work Areas (adjacent to the channel)	81 [c]
	Basin Access Channel Right-of-Way	369[c]
	River Trestle/Dock	3[c]
	Stockpile / Disposal Areas	177[c]
	Haul Roads	19[c]
Total Construction Acres		**1,376[d]**
Beneficial Use Placement Areas		467[c]

[a] The numbers in this table have been rounded for presentation purposes.
[b] This includes associated Project components including the intake system, conveyance channel, outfall transition feature, permanent site features, modifications to LA 23 and the NOGC Railroad.
[c] Many of these features overlap, using the same land area for more than one purpose. The purpose of these rows is to provide the acreage of each Project feature regardless of overlap.
[d] This total does not reflect the sum of the rows above because certain Project features overlap, and the overlap has been accounted for in this row to avoid double counting.

Diversion Complex

The diversion complex consists of the following features: intake structure (headworks), conveyance channel, conveyance channel guide levees, and stability berms (see Figure 2.8-2). These features would be designed to convey sediment, fresh water, and nutrients from the Mississippi River to the Barataria Basin by way of a gated control structure.

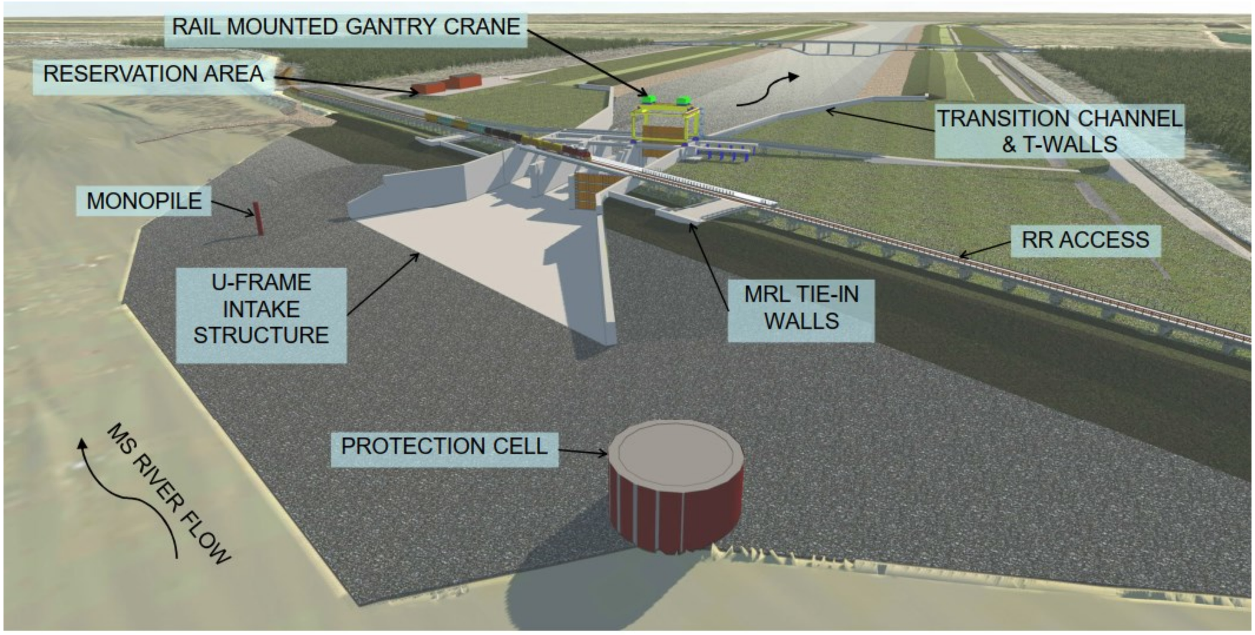


Figure 2.8-2. Proposed Project Design Features as Viewed from the Mississippi River.

Headworks/Intake System

The headworks, also referred to as the intake system, consists of three main features: an intake structure (or channel), a gated control structure (or gate structure), and a transition channel that would connect to the conveyance channel.

Intake Structure

The intake structure would consist of a U-frame concrete intake channel with an invert (bottom) elevation of approximately -25 feet, a width of approximately 220 feet, and a length of approximately 550 feet from the river, including the gated control structure (described below). The intake channel is sited at a sand point bar to facilitate the capture of sand. Construction of the intake channel would require removing a portion of the existing MR&T Levee and replacing it with floodwalls (T-walls) that will tie into the existing levee at each end. The Applicant's intake structure design reduces head loss and optimizes the SWR of the river water coming into the channel.

A protection cell designed to resist barge traffic would be located upstream of the intake structure. A downstream monopile would accommodate aids to navigation. The navigation channel would be approximately 1,200 feet from the nearest diversion structure. The top elevations of the intake structure walls would be sloped toward the river channel and set as low as possible to allow sediment to flow over the walls during high river conditions. The wall structures are pile founded U-frame walls that also act to retain the river embankment. To construct the intake and gated control structure in the Mississippi River, a temporary cofferdam system would be built around the proposed intake system to dewater the area during construction. After construction, the cofferdam system would be removed.

Gated Control Structure

The gated control structure would consist of three approximately 66-foot wide gate bays with an invert elevation of -25 feet and a top-of-wall elevation of 20.35 feet. The rate of flow of the diverted Mississippi River water into the conveyance channel would be controlled through the partial or complete raising or lowering of the gates. The structure would include operator platforms with gate operation components, crane platforms, and a maintenance bridge crossing. The gates would be operated with commercial power and diesel generators would be used for back-up power. For seepage control, subsurface cutoff walls and drainage systems would be incorporated.

Transition Channel

From the gated control structure, water would transition into the trapezoidal conveyance channel at a channel invert elevation of -25 feet. The transition wall system under consideration would be pile-supported inverted T-walls located on both sides of the conveyance channel from the gated control structure to the guide levees.

Conveyance Channel

The conveyance channel would be approximately 2 miles long and fully armored and lined with bedding stone and riprap. It would convey sediment-laden river water from the gated control structure and transition channel to the Barataria Basin. The conveyance channel would have an approximate 250-foot bottom width with an invert elevation of -25 feet and 7:1 side slopes to an approximate elevation of 2 feet or lower at the toe of the stability berm. The channel would cut through a complex geologic environment that includes point bar deposits, marsh deposits, and abandoned distributary channels.

Guide Levees and Stability Berms

Earthen guide levees would be constructed along both sides of the conveyance channel as a linear feature designed to constrain Project flows (see Figure 2.8-3). Wick drain systems would be incorporated into the levees to expedite settlement or soil consolidation. It is anticipated that multiple lifts and construction sequences would be needed to bring the guide levees to their final design height. The guide levees on the protected side of the NOV-NF-W-05a.1 levee reach would also serve as hurricane and storm damage risk reduction against storm surges and would be built to an elevation of approximately 15.85 feet, which exceeds the USACE design grade for the NOV-NFL levee. The guide levees on the basin side of the NOV-NF-W-05a.1 levee reach would not be considered part of the HSDRRS and would transition to an elevation of 8.2 feet at the outfall transition feature. The guide levees would include a 10-foot wide levee crown topped with a gravel access road. The levees would be constructed from soil material excavated for construction of the intake system and conveyance channel. The total width of the conveyance channel, stability berms, and guide levees would measure approximately 1,000 feet.

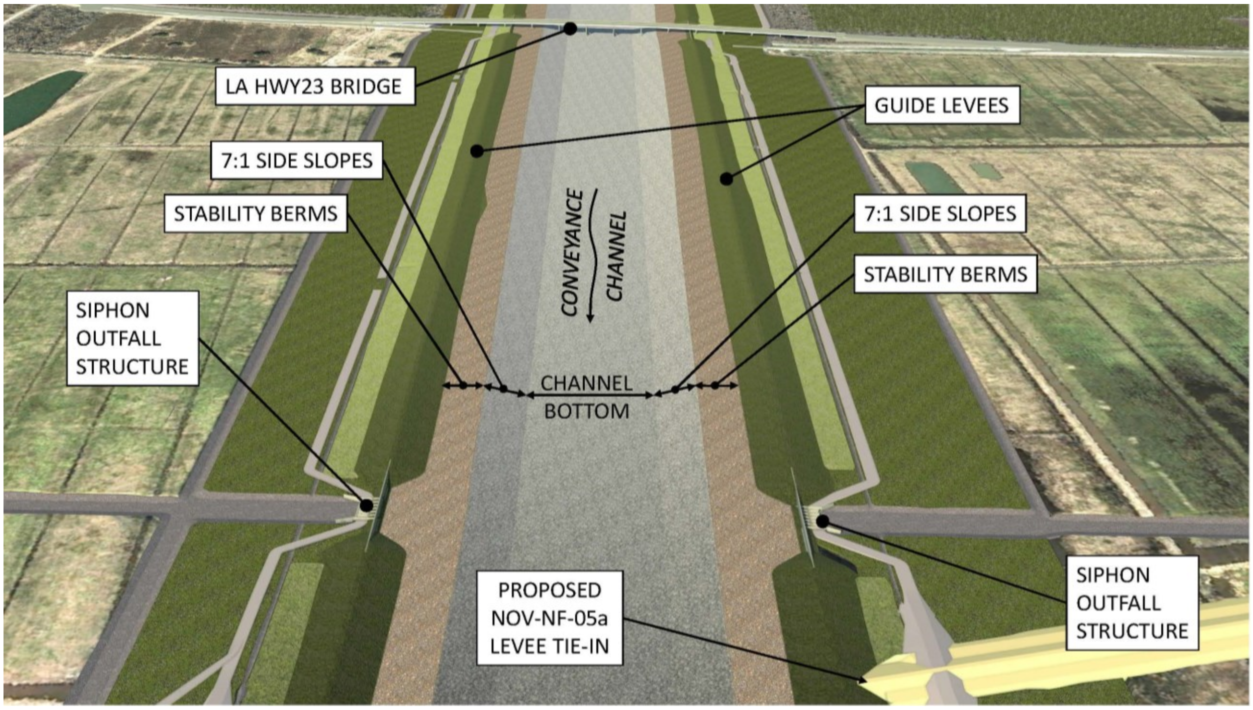


Figure 2.8-3. Upstream View of the Proposed Conveyance Channel, Guide Levees, Stability Berms, and Siphon.

Basin Outfall Area and Delta Formation Area

The Applicant has defined the outfall area as the area in the Barataria Basin where sediment, fresh water, and nutrients from the Mississippi River would be dispersed via the conveyance channel during operations. The immediate outfall area is defined as the area of the Barataria Basin that encompasses the outfall transition feature, barge access channel for delivery of construction materials, beneficial use placement areas, and marsh terrace outfall features.

It is anticipated that a delta would form in the outfall area (see Chapter 4, Section 4.2 Geology and Soils for more details about Project-induced land building in the basin). Modeling efforts indicate that upon Project initiation, sand and coarse-grained sediments would be deposited within the outfall area in an initial delta formation area, with finer-grained sediment being deposited farther gulfward in the basin, forming a subaqueous delta just below the low-tide water level. Over time, the delta would expand to form a subaerial delta above the low-tide water level, thus expanding the subaqueous delta farther gulfward into the basin. Fine-grained sediments transported by the diversion would travel farther from the outfall area and be dispersed throughout the Project area. The delta formation area would expand over time to occupy approximately 20 square miles in the vicinity of the conveyance channel by 2070 (see Chapter 4, Section 4.2 Geology and Soils for details about the delta formation process and maps portraying the projected delta formation area).

Outfall Transition Feature

The Applicant proposes to include the creation of an approximately 2,600-foot-long outfall transition feature to transition the conveyance channel into the outfall area of the basin. The outfall transition feature would increase the efficiency of water and sediment delivery between the conveyance channel and the natural ground within the basin (see Figure 2.8-4). To create the outfall transition feature, a gradual gradient would be dredged from the diversion channel invert elevation of -25 feet to the bottom elevation of the receiving basin at approximately -4 feet and armoring it with riprap. The outfall transition feature would establish this gradient from the discharge end of the conveyance channel starting where it crosses the NOV-NFL levee, tapering to the surrounding bottom elevation in the basin with a sheet pile end wall and riprap armoring for toe protection against scour. The riprap armoring will extend 100 feet past the toe wall. Braced sheet pile walls would be located at the end of the outfall transition feature flares into the basin.

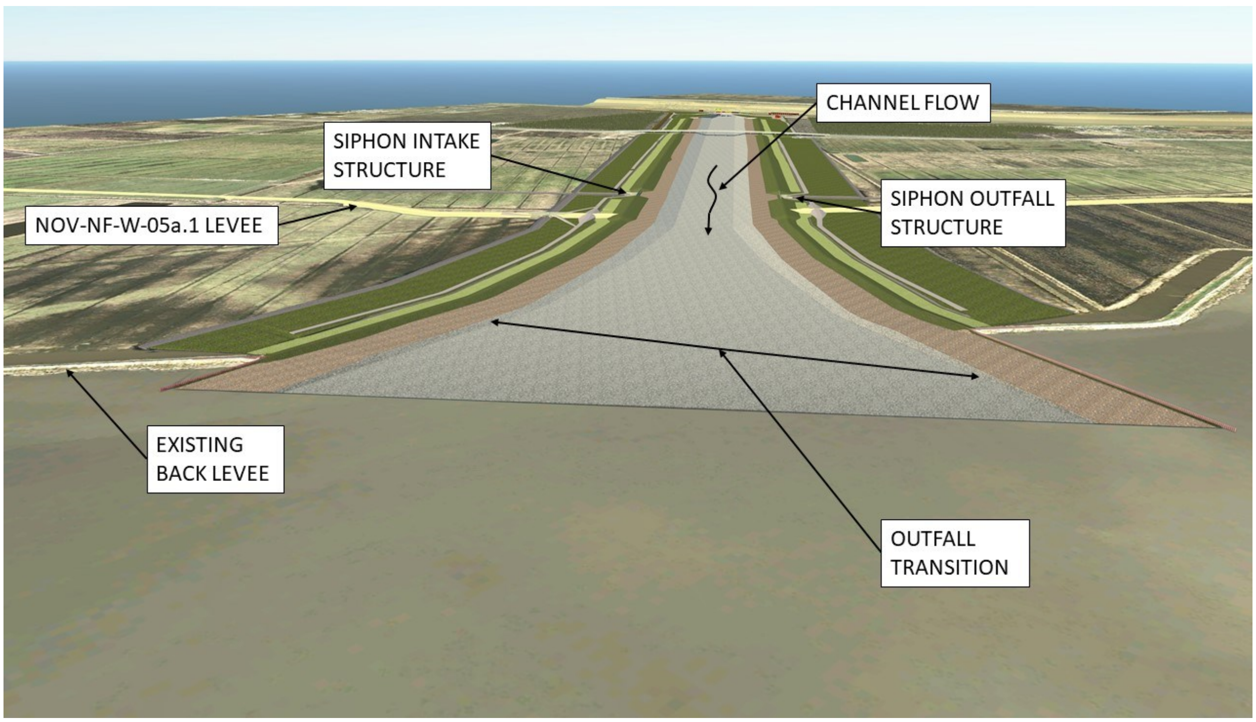


Figure 2.8-4. Proposed Project Outfall Transition Feature in the Barataria Basin.

The Applicant determined that this outfall transition feature would be needed to improve initial efficiency of the diversion because the existing topography would impede the ability of the diversion to flow at maximum capacity. During the operational life of the Project, it is anticipated that maintenance dredging in the diversion complex and basin would be needed to maintain optimal discharge and delta development. The timing and locations for maintenance dredging are uncertain. Future maintenance dredging and placement of dredged material in the basin would be done in a manner that takes into consideration habitat creation and delta development. It is anticipated that the outfall transition feature would expedite development of the initial delta formation area and that after several years of operation, the diversion discharge would eventually erode a channel into the basin.

Basin Access Channel

A basin access channel would be used by barges for delivery of construction materials through the Barataria Basin. Slight modifications to the alignment of the basin vessel access route were made largely in the area of the approach to the outfall transition feature and the connection to the Barataria Bay Waterway. The channel was chosen based on assessments of suitability of vessel access, navigation safety, and minimization of hazards and resource impacts. The selected access channel (shown in Figure 2.8-1) follows a route used by previous restoration projects that similarly required a deeper draft to allow for booster pumps and other work barges. Dredging of the basin access channel would occur in a section of Bayou Dupont where it crosses the Pen in the immediate outfall area. Dredging would be performed by a clam shell rig and the dredged material would be placed adjacent to the access channel in open-water bottoms. The placement areas would be gapped where navigable or significant tidal channels occur to avoid hydrologic impoundment, maintain organismal ingress and egress, and maintain existing landowner or recreational access. The required excavation depth elevation would be -9 ft (NAVD88) and the channel width would be a base of 50 feet. The typical deposition placement areas would have a base of 50 to 60 feet and a height commensurate with the excavation depth needed within the given reach. The excavation volume for the dredged reaches is approximately 303,000 cubic yards.

Beneficial Use Placement Areas

The Applicant's Preferred Alternative also includes beneficial use placement areas that total 467 acres in the basin to the northwest and southeast of the proposed diversion (see Figure 2.8-1). Material excavated for construction of the conveyance channel and the outfall transition feature would, if suitable, first be used for construction of Project components. Any remaining excavated or dredged material would be used beneficially within the proposed beneficial use areas or disposed of in the designated upland disposal locations on private property. The beneficial use areas are referred to as the Outfall North and Outfall South (1 and 2) beneficial use areas. CPRA estimates that approximately 2.0 mcy of excess dredged material generated during Project construction would benefit 467 acres in these areas through the creation of 375 acres of emergent marsh and the nourishment of 92 acres of existing marsh and terrace habitat. The beneficial use areas depicted in Figure 2.8-1 were chosen by the Applicant, in part, due to the proximity to the source of material, the general absence of existing oil and gas infrastructure in the vicinity, and to minimize risk of interfering with the initial delta formation. The size of the beneficial use areas decreased from 484 acres to 467 acres from the 30 percent and 60 percent designs, respectively, due to adjustments to the beneficial use boundaries based on design and the estimated quantity of material for placement during construction. The Outfall South beneficial use cells were re-designed (multiple cells with containment) to improve sediment retention and phasing of wetland creation and nourishment. The sequence of filling would begin at the Outfall North cell, then proceed to Outfall South cells 1 and 2. An additional area near Outfall South cells 1 and 2 would be available for the beneficial use of material should excess dredged material during construction and operations exceed 2.0 mcy.

Existing natural or artificial features (for example, canal spoil banks and marsh edge) would be used to retain pumped sediments. The construction of containment dikes from in-situ water bottom sediments would be necessary to limit sediment loss. Upon completion of filling, dikes may be gapped to maintain tidal exchange.

Auxiliary Features

Permanent Site Features

The proposed Project would require physical plant facilities for personnel to operate and maintain the diversion structure. Support buildings and structures would be located in a reservation site on the south side of the diversion structure within security fencing. The reservation site will include an administration, operation, and maintenance building, an equipment storage building, and a sewage treatment plant; the buildings would be on pile-supported slabs. Concrete boat ramps would be constructed along the Mississippi River bank and Barataria Basin bank from the back levee. Timber piles would be used to construct the boat ramp on the basin side. Other permanent features include access roads from LA 23 and a maintenance access bridge over the intake channel adjacent to the gated control structure.

Drainage System

The location of the proposed Project is within a drainage basin with forced drainage which flows to the Wilkinson Canal Pump Station where it is pumped out to the Barataria Basin. Construction of the Applicant's Preferred Alternative would bisect the existing drainage system and disrupt existing drainage patterns; thus, the Applicant would construct an inverted siphon that would cross beneath the proposed conveyance channel near Timber Canal (see Figure 2.8-5). The drainage system would be designed for a 10-year, 24-hour rainfall event. The inverted siphon would convey drainage from the northern drainage area to the southern drainage area, and ultimately to the existing Wilkinson Canal Pump Station. The inverted siphon would consist of six 96-inch diameter pipes and inlet and outlet structures with sluice gates on the inlet structure for each siphon pipe, stop logs, and access decks. The inverted siphon pipes would slope from the inlet and outlet structures to an approximate invert elevation of –37 feet beneath the conveyance channel. Two ditches on either side of the conveyance channel guide levees that will flow to and from the inlet and outlet structures will be included in the drainage system. For the agricultural polder (or impoundment area) between the NOV-NFL levee and the back levee (that is, the polder located north of the conveyance channel), there will be a drainage ditch from the back levee canal that connects to a sluice gate drainage structure that will be constructed within the NOV-NFL levee. The system will allow drainage from the polder to the siphons and finally to the Wilkinson Canal Pump Station (see Figure 2.8-6).

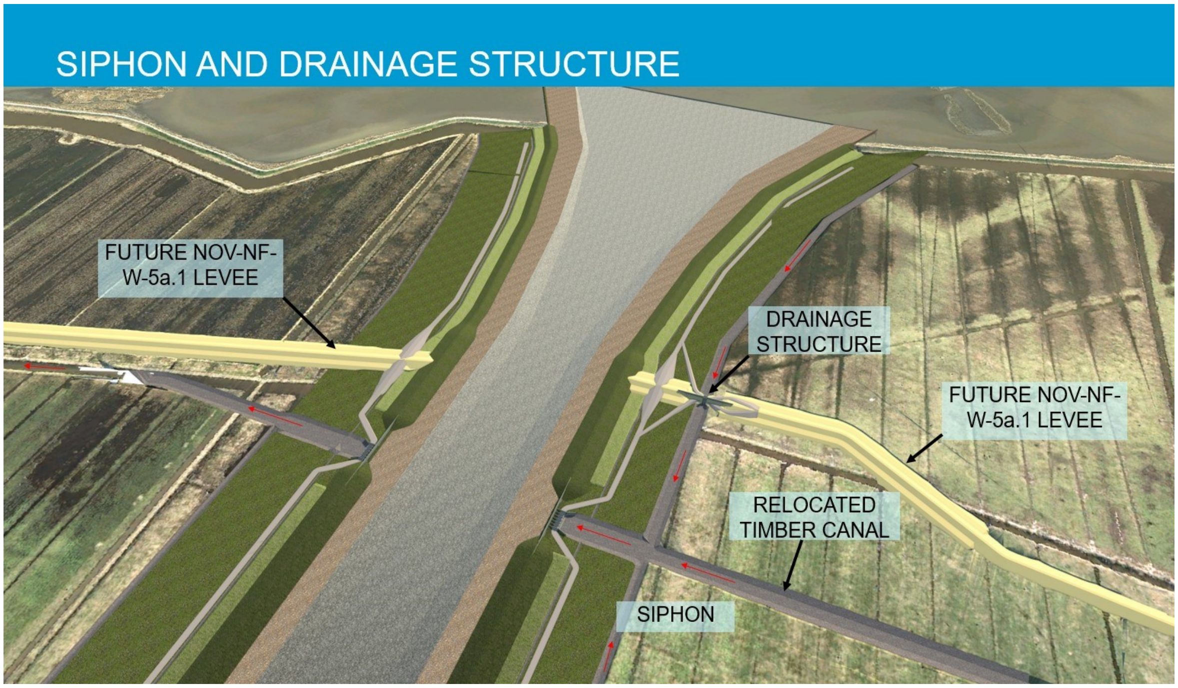


Figure 2.8-5. Proposed Project Siphon and Drainage Structure.

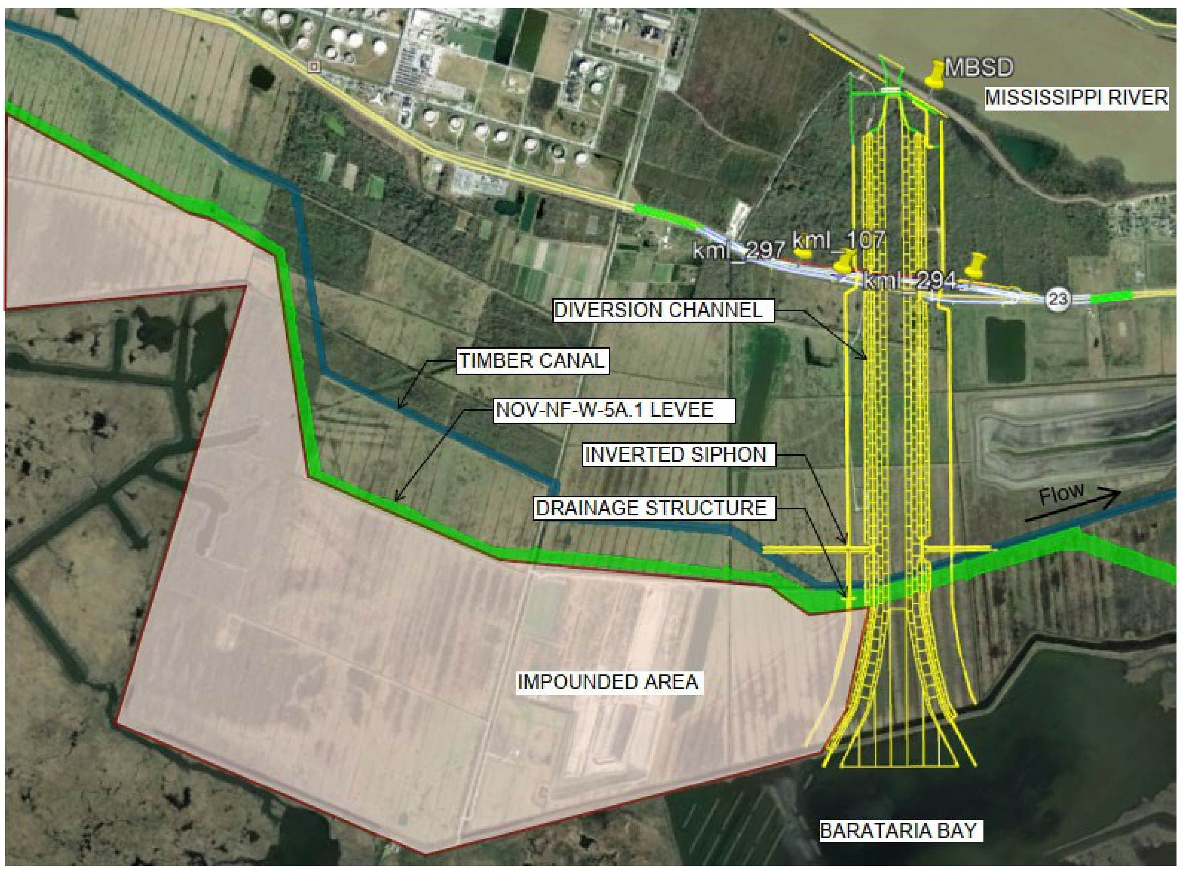


Figure 2.8-6. Proposed Project Drainage Structure and Location of Impounded Area (Polder).

Linear Infrastructure (Road, Rail, and Utilities)

Construction of the conveyance channel would require that a portion of the NOGC Railroad right-of-way be raised and relocated over the intake channel (see Figure 2.8-2). The proposed railroad modifications include maintaining the existing railroad alignment, constructing a bridge over the intake structure with a deck elevation of 20.35 feet to clear the intake walls, and extending the track by approximately 600 feet to comply with bridge approach design standards.

Construction of the conveyance channel would also require that LA 23 be raised and relocated over the conveyance channel. The proposed bridge structure would span the conveyance channel and guide levees. The bridge would have a length of approximately 2,200 feet with at least 5 feet of clearance over the top of the conveyance channel guide levees.

A number of other public and private facilities and utilities would require relocation due to the construction, operation, and maintenance of the Applicant's Preferred Alternative. The LA 23 corridor contains power, fiber optic, and water utilities. Major utilities requiring relocation prior to construction are Entergy's electrical distribution and transmission infrastructure, Plaquemines Parish Government's water line, and Shell Oil Company's crude oil pipeline. The Entergy transmission line is located within the proposed conveyance channel right-of-way and the distribution line is located with the proposed conveyance channel and LA 23 right-of-way. The parish water line is located within the LA 23 right-of-way. The Shell crude oil pipeline is a shallow, buried 20-inch-diameter pipeline located within the proposed outfall transition feature right-of-way. The relocation of the crude oil pipeline would be accomplished by horizontal directional drilling and subsequent pipeline replacement below the outfall transition feature sheet pile walls and potential scour area. The proposed basin access channel would be used to access the pipeline relocation area.

2.8.1.2 Property Acquisition to Support Project

USACE regulations provide that an applicant's signature on a permit application is affirmation that the applicant possesses or will possess the requisite property interests to undertake the activity proposed in the application. USACE does not verify an applicant's property rights as part of the permitting process. A DA permit does not authorize any injury to property or invasion of rights or any infringement of federal, state, or local laws or regulations.

Although not part of CEMVN's permit review process, the Applicant and TIG agencies requested the inclusion of the Applicant's property acquisition plan, as follows:

Prior to construction, the Applicant would acquire property interests from owners of land within the footprint of the diversion, as well as temporary servitude rights for any construction staging areas. The acquisition of these property interests would not in themselves result in any environmental impacts. Any potential environmental impacts on these property interests would be associated with the land use and activities that would occur within the acquired area, which are evaluated in this EIS.

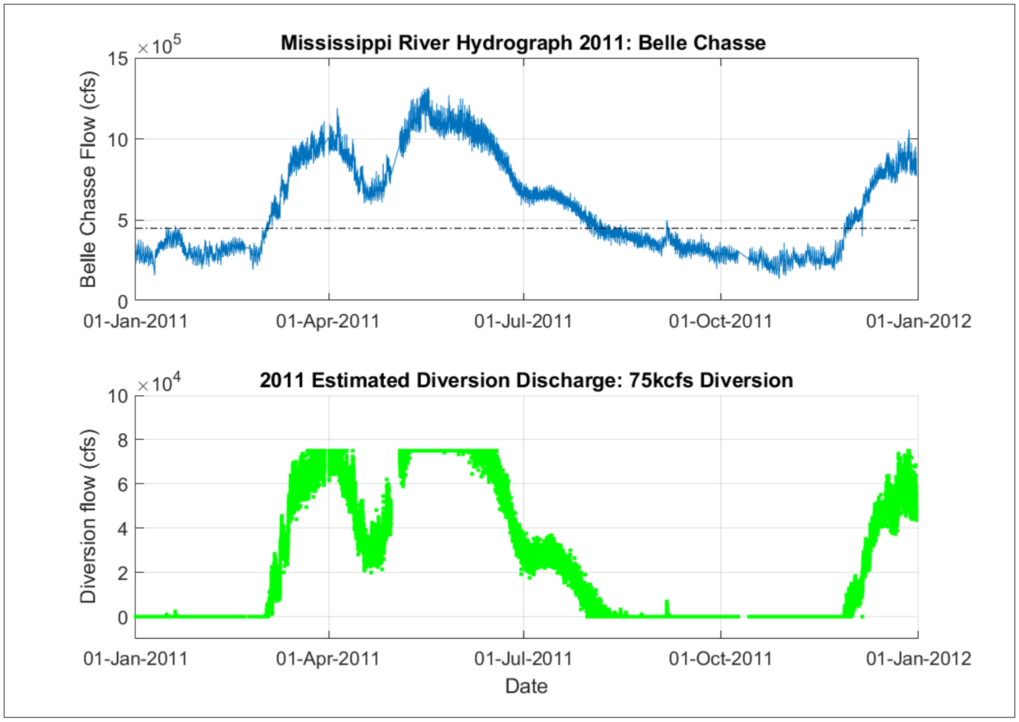
The Applicant's preferred means of property acquisition is through a negotiated sale wherein the Applicant pays a negotiated amount of compensation to landowners in exchange for the property interests needed for the Project. However, if the Applicant is unable to acquire the necessary property interests from a landowner through a negotiated agreement, the Applicant may, in appropriate circumstances, exercise the state's eminent domain authority to acquire the needed real estate interests. CPRA would compensate those landowners for the value of any property interest acquired. Real estate acquisition by CPRA is governed generally by state law in accord with La. Const. Article 1, Section 4(F), La. R.S. 49:214.1 *et seq.*, La. R.S. 49:214.5.5, La. R.S. 49:214.5.6, and La. R.S. 49:214.6.1(A)(1)).

In addition, Chapter 4, Section 4.20 Public Health and Safety, Including Flood and Storm Hazard Risk Reduction of this EIS, explains that the Project is projected to increase flooding in several communities located outside of flood protection that range from within 10 miles north to approximately 20 miles south of the immediate outfall area. The Applicant anticipates that it would acquire property interests from property owners within the communities south of the diversion to address the increased flood impacts on their properties due to the Project. As with the acquisitions for the Project footprint and construction staging areas, the Applicant would first attempt to acquire any such servitudes through a voluntary negotiation process by offering compensation to landowners in exchange for the property interests requested by the Applicant. If that voluntary process is not successful, the Applicant may, in appropriate circumstances, exercise the state's eminent domain authority to acquire the affected property interests, if necessary. CPRA would compensate those landowners for the value of any property interest acquired. Real estate acquisition by CPRA is governed generally by state law in accord with La. Const. Article 1, Section 4(F), La. R.S. 49:214.1 *et seq*., La. R.S. 49:214.5.5, La. R.S. 49:214.5.6, and La. R.S. 49:214.6.1(A)(1)). See Section 4.27 and Appendix R1 for additional details regarding the Mitigation and Stewardship Plan.

2.8.1.3 Project Operations

The proposed Project includes a diversion Operations Plan (see Appendix F2). When operational, the standard operations trigger for the diversion structure gates to open for flow (above the base flow) is when the Mississippi River gauge in Belle Chasse exceeds 450,000 cfs. When flow at the Belle Chasse gauge falls below 450,000 cfs, the diversion structure would be operated to reduce flow down to a not-to-exceed base flow of 5,000 cfs, to the extent practicable.

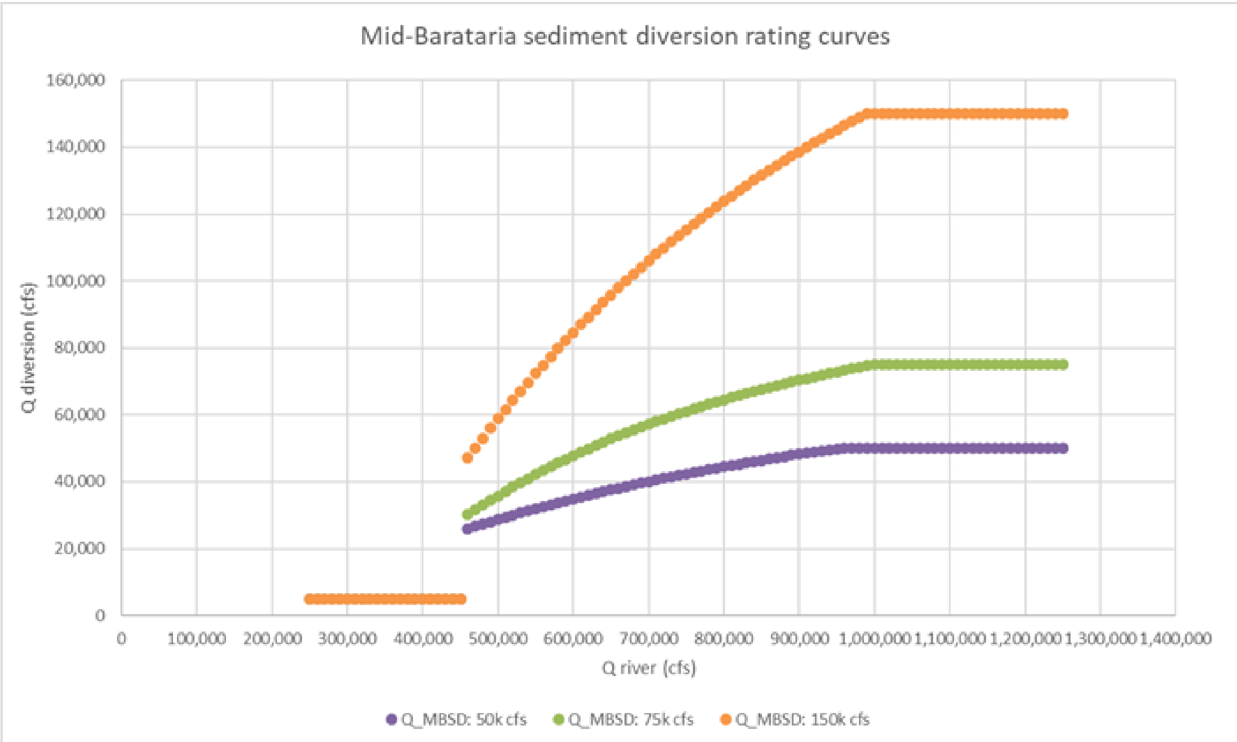
For the Applicant's Preferred Alternative, flow through the diversion would be variable, with a maximum diversion flow of 75,000 cfs when the river flow reaches approximately 1 million cfs or higher. When the diversion is operating above base flow, the flow rate would be controlled by the difference in water surface elevation between the Mississippi River and the Barataria Basin (the "head differential"). When the Mississippi River flow and stage are high, this high head differential would push a higher volume of water and sediment through the diversion into the Barataria Basin. When the Mississippi River flow and stage are low, there would be less energy to push water and sediment through the diversion. Figure 2.8-7 illustrates this variable flow rate for a representative Mississippi River hydrograph from 2011 (data derived from Yuill et al. 2013).



Source: Yuill et al. 2013

Figure 2.8-7. Illustration of Variable Flow for 75,000 (75k) cfs Diversions (bottom plot) Driven by 2011 Mississippi River Discharge (top plot) with a 450,000 cfs Operational Trigger in the Mississippi River. Note: This figure is not intended to depict base flow.

Figure 2.8.8 illustrates the "jump" between the 5,000 cfs base flow depicted by the orange flat line and variable flow capacity rates when the diversion gates are fully opened starting at the 450,000 cfs trigger in the Mississippi River. When the Mississippi River flows exceed 450,000 cfs and the diversion gates are opened fully, the diversion flow would increase to approximately 25,000 cfs, and thereafter flows would increase proportionally as the river flow increases up to maximum diversion capacity flow of 75,000 cfs when the river reaches a flow of 1 million cfs. Whenever the flow rate through the diversion structure exceeds approximately 75,000 cfs, this would be the trigger to partially close the gates to maintain the maximum flow of 75,000 cfs through the diversion.



Source: Water Institute

Figure 2.8-8. Illustration of Base Flow (5,000 cfs) and Variable Capacity Flow for 75,000 (75k) cfs, 50,000 (50k) cfs, and 150,000 (150k) cfs Diversions in Relation to the Mississippi River Discharge with a 450,000 cfs Operational Trigger in the Mississippi River. Note: The 5,000 cfs base flow is denoted by the flat orange line.

Although the base flow is proposed to operate at a maximum of 5,000 cfs, base flow would also be variable and would depend in large part on the head differential between the Mississippi River and the Barataria Basin. In cases of extremely low Mississippi River flow and/or high water levels in the Barataria Basin, the head differential could be negative, creating the potential for reverse flow from the basin into the river. The Applicant proposes to maintain a base flow up to 5,000 cfs, utilizing diversion gates or alternate methods to ensure that base flow magnitude and flow direction from the Mississippi River into the Barataria Basin can be appropriately controlled.

Throughout this EIS, the term “base flow” is used to refer to flows through the diversion of up to 5,000 cfs. The terms “open” or “operating above base flow” are used to refer to flows through the diversion beginning at approximately 25,000 cfs when the Mississippi River is flowing at 450,000 cfs at Belle Chasse up to the maximum capacity of the diversion (50,000 cfs, 75,000 cfs, or 150,000 cfs, depending on the alternative) when the Mississippi River reaches approximately 1 million cfs at Belle Chasse.

The diversion would be operated in a manner that would prevent flow from the Barataria Basin towards the Mississippi River. The diversion structure would be closed when the relationship between the water levels in the Mississippi River and the

Barataria Basin would create a reverse flow or when other stop triggers or "Emergency Operations" are met, including spills and other hazardous discharges, navigation impediments, climatic conditions such as tropical depressions or named storms, diversion structure damage or emergency, and public safety as described in the Applicant's Preliminary Operations Plan (see Appendix F2).

2.8.1.4 Project Construction Activities

The proposed Project would require approximately 5 years of construction, depending on the extent of needed ground modifications and soil stabilization measures. Construction would likely occur in several phases.

Construction of the major Project features includes clearing and grubbing, stockpiling and placement of material, excavating and constructing haul roads (including drainage channels, cross drain structures, and access fencing), hauling material, grading and paving, dredging, pumping of dredged material to prepared disposal site(s), installation of sediment and erosion control measures and slope protection, permanent and final stabilization, and extension of utilities to serve the proposed Project. Many of these features would be temporary and would be removed after construction is complete.

Construction of the conveyance channel would include clearing and grubbing of the site. The wooded area east of LA 23 would be cleared of trees, since these are not permitted near levees or stability berms. A majority of the conveyance channel levee alignment construction would use wick drains to stage and/or preload with excess fill to allow soils to gain strength while consolidating to support the side slopes. Mechanical and hydraulic excavation methods would be used to excavate the channel. Channel excavation would provide the volume necessary for embankment construction, such that outside sources of material would not need to be imported to the site for the embankments. Laydown areas would be needed to dry and treat wet clays before placing as fill material; these temporary stockpile locations would be within the construction footprint and temporary right-of-way. Beneficial use areas in the basin would receive excess soil for wetland habitat creation.

If necessary, the stockpiling and/or disposal of excess excavated soils not required for construction and not used beneficially would occur in the designated upland disposal locations on private property. Existing borrow pits adjacent to the construction site would also be used to dispose of native soil that is not suitable for levee construction or beneficial use. With the 60 percent design, there were additional areas (in addition to the existing borrow pits that were previously identified in the 30 percent design) to receive excess soil during channel excavation (see Figure 2.8-1). The layout of the disposal areas was designed to avoid wetland impacts. Material would be stockpiled to a height of about 5 feet above grade. Access and disposal would be voluntary with a landowner-granted right-of-entry.

The intake system would be constructed using "in-the-dry" methods by installing an enclosed temporary dewatering cofferdam in the Mississippi River. The temporary cofferdam consists of a steel combi-wall cofferdam system (pipe and sheet pile) in the Mississippi River and on the river batture. The cofferdam system would tie into an interim levee that will provide the main line of flood risk reduction until construction of the gated control structure is completed (see Figure 2.8-9). The navigation channel would be approximately 1,000 feet from the temporary cofferdam. For the duration of construction, the cofferdam would be maintained at or above an elevation of 16.4 feet to match the elevation of the Mississippi River Levee plus freeboard. The dewatering system consisting of deep pumped wells and shallow wellpoints would be used to draw down the water table to maintain a dry excavation bottom. Work barges and tugboats would be used for ancillary equipment. The temporary cofferdam would be removed after construction is complete. It is estimated that the cofferdam would be in place for a minimum of approximately 3 years.

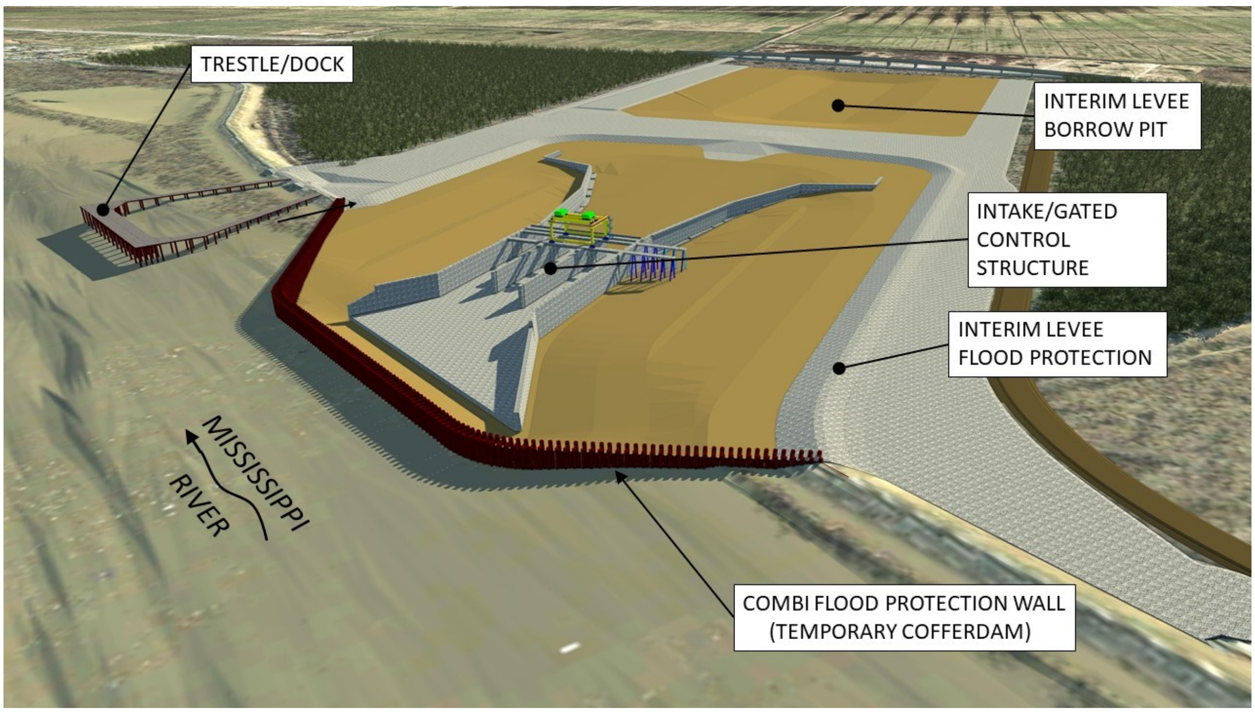


Figure 2.8-9. Proposed Temporary Cofferdam and Trestle/Dock as Viewed from the Mississippi River.

Additional activities that may be required for construction of the gated control structure include the construction of subsurface cutoff walls and drainage systems.

For the construction of the outfall transition feature and conveyance channel, after the guide levees are constructed and are able to provide an equivalent level of risk reduction as the NOV-NFL levee, approximately 2,500 feet of the NOV-NFL levees would be removed. The proposed Project guide levees would tie-in to the back levee and the NOV-NFL levees at the points where the two levees intersect along both sides of the conveyance channel. The Project would maintain the current level of risk reduction matching the NOV-NFL levee.

Various types of equipment would be present and operating throughout the construction of the Applicant's Preferred Alternative. Types of equipment to be used include excavators, trucks, loaders, dozers, rollers, scrapers, pile drivers, cranes, barges, and well point drill rigs for dewatering. The means and methods of the construction contractor will determine what equipment would be on-site. A concrete manufacturing plant will be placed in the proposed construction footprint to produce the volumes of concrete needed for the large structures (see Figure 2.8-1). Deliveries of raw and plant-fabricated construction materials would be made by vehicle transport via LA 23, or by barge transport either from the Mississippi River or through the Barataria Bay Waterway and Bayou Dupont with additional dredging. A temporary offloading facility (trestle/dock) with pipe piles and a levee ramp would be constructed in the Mississippi River to accommodate materials and equipment transfer from barges on the Mississippi River (see Figure 2.8-9). A more detailed description of the construction sequencing and methods for the proposed Project is provided in Appendix F.

2.8.2 Alternative 2: Variable Flow up to 75,000 cfs Maximum Sediment Diversion Including Marsh Terrace Outfall Features

Alternative 2 consists of a large-scale sediment diversion as described in Alternative 1. The only difference is that Alternative 2 would include construction of marsh terrace features intended to expedite the near-term benefits of the Project (see Section 2.5.1). The marsh terraces are proposed to be located in the diversion outfall area near the location of the proposed Outfall South beneficial use placement area (see Figure 2.8-1). This is seen as a feasible location to construct these marsh terrace features to aid in overall sediment retention, help protect newly deposited sediment from erosion, and avoid interfering with the ability of the system to convey diversion flows. Terraces are typically designed to be site-specific allowing for characteristics of borrow material, wind/wave energy within the system, currents, and other relevant factors. In this case, anticipating both increased currents and water levels, a design was chosen that has initial elevations somewhat higher than typical target marsh elevations. The reason for this is to avoid or minimize frequency of overtopping of the terraces and to avoid scour. Should scour occur, it is anticipated that the terraces would eventually reach an elevation to support marsh vegetation. The terraces would be oriented into the discharge current from the diversion (see Figure 2.8-1). Specifications for individual terraces include:

- overall elevation: +4.75 feet NAVD88;
- bottom width: 75 feet;
- top width: 15 feet;
- total length of each feature: 1,000 feet;
- total length of outfall terrace: 18,000 linear feet or about 31 acres of water bottom covered; and

- anticipated side slope: 5 foot vertical to 1 foot horizontal.

It is anticipated that the source of material for terrace creation would come from the creation of the outfall transition feature either through hydraulic dredge and placement or by mechanically removing and placing the material. In the unlikely event that additional material is needed, the source could be material excavated for the diversion conveyance channel or other local source.

2.8.3 Alternative 3: Variable Flow up to 50,000 cfs Maximum Sediment Diversion

Alternative 3 consists of a large-scale sediment diversion as described for Alternative 1. However, this alternative would be designed for a maximum operational flow of 50,000 cfs. Although this alternative would have a smaller maximum capacity, the general construction footprint and design features would be similar to that described for Alternative 1, except that the intake channel and conveyance channel would be narrower (approximately 100 feet and 135 feet narrower, respectively) as compared to Alternative 1, and the construction timeframe would be shorter in duration than that of Alternative 1 by several months. The narrower intake channel would require less construction material to be excavated and would have less construction traffic as compared to Alternative 1.

During operations, Alternative 3 would have different impacts on the quality of the human environment as compared to the higher-maximum flow alternatives. For example, due to lower maximum flows, this alternative would have decreased impacts on water elevations and salinity, and the geographic area of land building would be smaller than that of Alternative 1. Chapter 4 discusses the differences in impacts among the alternatives in detail.

2.8.4 Alternative 4: Variable Flow up to 50,000 cfs Maximum Sediment Diversion Including Marsh Terrace Outfall Features

Alternative 4 consists of a large-scale sediment diversion the same as described in Alternative 3 and includes the marsh terracing described for Alternative 2.

2.8.5 Alternative 5: Variable Flow up to 150,000 cfs Maximum Sediment Diversion

Alternative 5 consists of a large-scale sediment diversion the same as described in Alternative 1 except that it would be designed for a maximum flow of 150,000 cfs. The general construction footprint and design would be similar to that described for Alternative 1, except that the intake channel and conveyance channel would be wider (approximately 100 feet and 330 feet wider, respectively) and the outfall transition feature would be larger (approximately 140 acres wider) as compared to Alternative 1. In addition, the construction timeframe would be longer by several months. The wider intake channel, conveyance channel, and outfall transition feature would require more material to be excavated and an increase in construction traffic.

During operations, this 150,000 cfs Alternative would have different impacts on the quality of the human environment as compared to the 50,000 cfs and 75,000 cfs alternatives. For example, due to a higher-maximum flow capacity, this alternative would have increased impacts on water elevations and salinity, and the geographic area of land building would be larger than that of Alternatives 1, 2, 3, and 4. Chapter 4 discusses the differences in impacts among the alternatives in detail.

2.8.6 Alternative 6: Variable Flow up to 150,000 cfs Maximum Sediment Diversion Including Marsh Terrace Outfall Features

Alternative 6 consists of a large-scale sediment diversion as described for Alternative 5 and includes the marsh terracing described for Alternatives 2 and 4.

2.9 Summary of Environmental Consequences Under Each Alternative

Table 2.9-1 summarizes the construction and operational impacts of each alternative on the Project area's resources (corresponding Chapter 4 sections are noted within parentheses under each resource). As described in Chapter 4, Environmental Consequences, construction impacts are those impacts resulting from construction activities over the anticipated 5-year construction period; operational impacts are those resulting from operation and maintenance of the alternatives during the 50-year analysis period. The No Action Alternative is compared to existing conditions to understand the anticipated changes in the environment that would occur irrespective of the proposed Project. Thereafter, the anticipated environmental consequences of the Project action alternatives are compared to the results of the No Action Alternative analysis. The results of these analyses are summarized below in Table 2.9-1. A detailed discussion of these impacts under all the alternatives is provided in Chapter 4, Environmental Consequences.

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Table 2.9-1
Comparative Summary of Potential MBSD Impacts Under Each Alternative (as Compared to the No Action Alternative unless Otherwise Stated)

Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
Geology and Soils (Section 4.2)	• Continued land loss in the Barataria Basin and birdfoot delta would cause major, permanent, and adverse impacts due to subsidence and sea-level rise.	Construction: • Moderate, permanent, adverse impacts on the existing topography, geology, and geomorphology of the construction footprint from excavation, dredging, compaction, grading, or filling. • Moderate, permanent, beneficial and adverse impacts on the geology and geomorphology of the open-water, shallow-bay bottom, and emergent marshes in the Project outfall area from the emplacement of dredged material for beneficial use and from access dredging, respectively. • Moderate, permanent, adverse impacts on soils present in the construction footprint, including prime farmland soils. • Minor, temporary, adverse impacts on the extraction of mineral resources due to the relocation of infrastructure or temporary, minor delays during transport. Operational: • Major, permanent, beneficial impacts on land building in the Barataria Basin due to the diversion of flow and sediment load into the Barataria Basin. Approximately 17,300 acres of wetland are projected to be created and sustained in the Barataria Basin by 2050 (third decade of operations), decreasing to 13,400 acres of wetlands by 2070 due to the ongoing effects of sea-level rise and subsidence. Modeled land areas and changes presented in this table have been rounded to three significant digits. Land areas are considered accurate to within plus or minus 200 acres. • Moderate, permanent, adverse impacts on land building in the birdfoot delta due to the diversion of flow and sediment load into the Barataria Basin that would otherwise be transported downstream. Wetlands in the birdfoot delta would be reduced by 3,000 acres by 2070. • Moderate, short-term to permanent adverse and beneficial impacts on soils in the outfall area. • Minor, long-term to permanent, adverse and beneficial impacts on mineral resources due to deposition of sediment that may prevent access to oil and gas extraction infrastructure (adverse impact) and protect pipelines from wave and collision exposure (beneficial impact).	• Impacts would be similar to the Applicant's Preferred Alternative. • 9,660 acres of wetlands would be created and sustained in the Barataria Basin by 2070. • Wetlands in the birdfoot delta would be reduced by 2,820 acres by 2070.	• Impacts would be similar to the Applicant's Preferred Alternative. • 29,200 acres of wetlands would be created and sustained in the Barataria Basin by 2070. • Wetlands in the birdfoot delta would be reduced by 2,820 acres by 2070.	Construction: • As compared to the No Action Alternative, the terrace alternatives would cause additional construction impacts, both adverse and beneficial, as compared with the corresponding capacity alternatives without terraces) in that they would modify the existing natural topography (adverse) but result in emergent uplands with higher ecological value (beneficial). Operational: • The presence of terraces would yield only slight increases in land building in the Barataria Basin and slight decreases in land loss in the birdfoot delta as compared with the corresponding capacity alternatives without terraces. These differences would vary from decade to decade. Otherwise, these alternatives are substantially similar to the corresponding capacity alternatives without terraces.
Groundwater (Section 4.3)	• Existing agricultural, industrial, and commercial land use trends would continue in the location of the proposed diversion complex, where shallow groundwater flow and depths have historically been and would continue to be altered through the operation of drainage canals and pumping to reduce flooding. Use of the groundwater from the deeper aquifer systems underlying the Project area for irrigation or other purposes would remain restricted. • Current trends in saltwater intrusion and water well use would continue.	Construction: • Temporary, minor, adverse impacts on overland water flow, groundwater flow direction, and local water table elevations of shallow aquifers would be caused by clearing, grading, dewatering, and near-surface soil compaction of the work areas. • Negligible impacts on the Mississippi River Alluvial Aquifer and the Chicot Equivalent Aquifer System. • Temporary and negligible to long-term and moderate adverse impacts on groundwater quality depending on the severity of potential spills and leaks of hazardous materials and the effectiveness of the spill response action. Impacts would be negligible with the implementation of an effective Project Spill Prevention, Control, and Countermeasure Plan (SPCC Plan). Operational: • Permanent, minor, adverse impacts on shallow groundwater elevations and flow direction in surficial aquifers due to the presence of Project structures and modifications to existing drainage channels and forced drainage pumping. • Negligible impacts on groundwater use. • Minor short- and long-term impacts on shallow groundwater quality due to the introduction of fresh water in the outfall area during operations. These	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

Table 2.9-1
Comparative Summary of Potential MBSD Impacts Under Each Alternative (as Compared to the No Action Alternative unless Otherwise Stated)

Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
		impacts may be either beneficial or adverse depending on the nature of the chemical changes and their indirect impacts on vegetation and aquatic life. Although saltwater intrusion would continue to impact groundwater in the Project area, the freshwater inputs may temporarily reduce shallow groundwater salinity and specific conductance in the outfall area.			
Surface Water and Coastal Processes (Section 4.4)	• Continued processes of land subsidence and sea-level rise leading to major, permanent, adverse impacts by lowering bed elevations and increasing water levels. • Moderate, permanent, adverse trends in tidal influence extending farther northward into the basin and circulation patterns changing, as sea level continues to increase.	Construction: • Minor, temporary, adverse impacts on water flows and sediment transport in the Mississippi River due to the presence of the cofferdam, including localized increases in water velocity, scouring near the cofferdam, and deposition downstream of the cofferdam. • Moderate, short-term, adverse impacts on existing bed elevations in the basin due to dredging and the placement of material for beneficial use compared to the No Action Alternative with impacts becoming beneficial over the long term as wetlands are created and sustained in the beneficial use areas. Operational: • Major to minor, permanent, beneficial impacts in Barataria Basin bed elevations and land building from the influx of sediments (~275 million tons over 50 years) with impacts decreasing with distance from the diversion structure (maximum increase of 3.7 feet in the immediate outfall area by 2070). • Moderate, permanent, adverse impacts on bed elevations and land building in the birdfoot delta from the diversion of water and sediment out of the river. • Major to minor, permanent, adverse impacts on water levels in the basin from the input of fresh water, with impacts decreasing with distance from the diversion structure (maximum increase of 1.0 foot in the immediate outfall area). • Major to minor, permanent, adverse impacts on the speed and direction of currents and flows in the Barataria Basin and moderate, permanent, adverse impacts on water levels and flows in the Mississippi River near the intake structure. • Minor, intermittent, beneficial impacts on water levels in the Mississippi River, with local reductions of up to 1.0 foot during maximum Project operations. • Moderate, permanent, and adverse impacts on currents and flow in the Mississippi River due to the creation of a cross-stream (perpendicular to the existing general downstream flow) velocity component near the proposed diversion site. • Negligible impacts on stormwater management and drainage in the land between the levees where the diversion structure would be located; minor, permanent, adverse impacts on stormwater management and drainage in the immediate outfall area due to increased water levels and head differential between the basin and protected side of levees, requiring increased pumping.	• Major to minor, permanent, beneficial impacts in Barataria Basin bed elevations and land building from the influx of sediments (~190 million tons over 50 years) with impacts decreasing with distance from the diversion structure (maximum increase of 2.9 feet in the immediate outfall area by 2070). • Major to minor, permanent, adverse impacts on water levels in the basin from the input of fresh water, with impacts decreasing with distance from the diversion structure (maximum increase of 0.7 foot in the immediate outfall area). • All other impacts would be similar to the Applicant's Preferred Alternative.	• Minor, intermittent, beneficial impacts on water levels in the Mississippi River, with local reductions of up to 1.0 foot during maximum Project operations. • Major to minor, permanent, beneficial impacts in Barataria Basin bed elevations and land building from the influx of sediments (~525 million tons over 50 years) with impacts decreasing with distance from the diversion structure (maximum increase of 5.9 feet in the immediate outfall area by 2070). • Major to minor, permanent, adverse impacts on water levels in the basin from the input of fresh water, with impacts decreasing with distance from the diversion structure (maximum increase of 2.0 feet in the immediate outfall area). • All other impacts would be similar to the Applicant's Preferred Alternative.	Construction: • As compared to the No Action Alternative, the terrace alternatives would have substantially similar impacts as the corresponding alternatives without terraces, plus additional minor, short-term, adverse construction impacts on local hydrology and bed elevations in the immediate outfall area. Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding alternatives without terraces, plus, additional minor impacts on diversion-induced deposition patterns resulting in less sediment accretion and land building in the vicinity of the terraces, and greater sediment accretion and land building to the northwest and west of the terraces.
Surface Water and Sediment Quality (Section 4.5)	• No construction related impacts would occur. • Land subsidence and sea-level rise would continue, resulting in permanent elevated salinity, total suspended sediments (TSS), and sulfate throughout the basin. • Minor permanent increases in average minimum water temperatures in the basin. • Basin subsegments impaired by fecal coliforms would remain impaired.	Construction: • Temporary, minor or moderate adverse construction impacts on water quality would result from the resuspension of fine sediments into the water column from in-water activities or runoff of sediment from adjacent work zones, resulting in increased turbidity and suspended sediments. • Construction activities associated with the use of heavy equipment would create the potential for inadvertent releases of contaminants (fuel, oil, and other construction materials) to surface water in both the Mississippi River and the Barataria Basin. These impacts would be temporary and minor and mitigated by the implementation of SPCC Plan and Stormwater Pollution Prevention Plan (SWPPP).	Construction: • Impacts would be similar to the Applicant's Preferred Alternative. Operational: • Minor to moderately elevated (slightly less elevated than Applicant's Preferred Alternative) TN and TP concentrations throughout the basin. • Negligible to moderate decrease (slightly less decreased than Applicant's Preferred Alternative) in average sulfate concentrations in the basin.	Construction: • Impacts would be similar to the Applicant's Preferred Alternative. Operational: • Minor to moderately elevated (slightly more elevated than Applicant's Preferred Alternative) TN and TP concentrations throughout the basin. • Permanent, minor to moderate increase (slightly more elevated than Applicant's Preferred Alternative) in TSS concentrations throughout the basin; negligible to	Construction: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs). Operational: • Each terrace alternative generally would have the same impacts as listed for

Table 2.9-1
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Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
	• Sediment quality in the Mississippi River and the basin would remain similar to current conditions.	Operational: • Permanent, minor to moderate decreases in salinity in the basin; minor increases in salinity in the birdfoot delta. • Permanent, minor decrease in basin water temperatures corresponding to diversion opening (flowing greater than the 5,000 cfs base flow). • Permanent, minor to moderately elevated total nitrogen (TN) and total phosphorus (TP) concentrations throughout the basin. • Impacts on DO would vary throughout the basin, but overall minor to moderate, permanent impacts. • Permanent, minor to moderate increase in TSS concentrations throughout the basin; negligible to minor increases in TSS in the birdfoot delta; seasonal shift in TSS trends in the northern basin. • Permanent minor to moderate decrease in average sulfate concentrations in the basin. • Permanent, major adverse impacts caused by elevated fecal coliform concentrations in the basin possibly causing an oyster propagation use impairment. • Movement of sediment from Mississippi River to basin is not expected to result in measurable impacts on sediment quality in the basin.	• Permanent, minor to moderate increase (slightly less elevated than Applicant's Preferred Alternative) in TSS concentrations throughout the basin; negligible to minor increases in TSS in the birdfoot delta; seasonal shift in TSS trends in the northern basin. • All other impacts would be similar to the Applicant's Preferred Alternative.	minor increases in TSS in the birdfoot delta; seasonal shift in TSS trends in the northern basin. • Negligible to moderate decrease (slightly more decreased than Applicant's Preferred Alternative) in average sulfate concentrations in the basin. • All other impacts would be similar to the Applicant's Preferred Alternative.	each corresponding capacity flow alternative without terraces (50,000, 75,000, and 150,000 cfs) with some noted differences in fecal coliform and other parameters.
Wetlands (Section 4.6)	• Major, permanent, adverse impacts due to the continued loss or conversion of wetlands in the Barataria Basin and birdfoot delta. • By year 2070, total wetland acres would be 72,800 in the Barataria Basin and 6,410 acres in the birdfoot delta. • Invasive plant species would continue to persist and the net impact on invasive plants would be minor, permanent, and adverse.	Construction: • Minor to moderate, adverse impacts due to dredging and filling wetlands to construct the Project features. • Moderate, permanent, beneficial impacts in beneficial use areas due to creation and enhancement of wetlands. • Minor, temporary, adverse, localized impacts on wetlands adjacent to construction footprint due to sedimentation and contaminants from runoff during construction. • Minor, permanent, localized beneficial impacts in the Project construction footprint due to invasive species mortality during excavation activities and minor to moderate, long-term, adverse impacts in the event that construction results in the spread of invasive species. Operational: • Major, permanent, beneficial impacts on wetlands in the delta formation area and new marsh/marsh creation projects in the diversion outfall area that would be sustained or created by the diversion of sediment and fresh water. By year 2070, total wetland acres would be 85,500 and wetland losses would be 17.4 percent less than the No Action Alternative. • Moderate, permanent, adverse impacts on wetlands in the birdfoot delta. By year 2070, total wetland acres would be reduced to 3,510 acres. • Negligible impacts on wetlands outside of the delta formation area. • Moderate, short-term, adverse impacts due to erosion and loss of some emergent wetlands near the immediate outfall area, which would be offset when total wetland impacts are considered over the 50-year analysis period. • Minor to moderate, permanent, adverse impacts by increasing the spread of invasive species in the Barataria Basin. • Negligible to minor, permanent, beneficial impacts by decreasing the spread of invasive species in the birdfoot delta.	• Major, permanent, beneficial impacts on wetlands in the delta formation area and new marsh/marsh creation projects in the diversion outfall area that would be sustained or created by the diversion of sediment and fresh water. By year 2070, total wetland acres would be 82,000 and wetland losses would be 12.7 percent less than the No Action Alternative. • Moderate, permanent, adverse impacts on wetlands in the birdfoot delta. By year 2070, total wetland acres would be reduced to 3,680. • All other impacts would be similar to the Applicant's Preferred Alternative.	• Major, permanent, beneficial impacts on wetlands in the delta formation area and new marsh/marsh creation projects in the diversion outfall area that would be sustained or created by the diversion of sediment and fresh water. By year 2070, total wetland acres would be 98,600 and wetland losses would be 35.4 percent less than the No Action Alternative. • Moderate, permanent, adverse impacts on wetlands in the birdfoot delta. By year 2070, total wetland acres would be reduced to 3,710. • All other impacts would be similar to the Applicant's Preferred Alternative.	Construction • As compared to the No Action Alternative, terrace alternatives would have substantially similar construction impacts as that of corresponding capacity flow alternatives without terraces, except that terrace construction would cause additional minor, short-term, adverse impacts on existing wetlands due to potential vegetation mortality from material placement. Operational • As compared to the No Action Alternative, terrace alternatives would have substantially similar impacts as those listed for the corresponding capacity flow alternatives without terraces, except that they would cause a negligible increase in wetland loss in the birdfoot delta.
Air Quality (Section 4.7)	• Continued loss of wetlands in the Barataria Basin via conversion to open water would release methane and CO_2 trapped in plant biomass and marsh sediments, contributing to increased.	Construction: • Minor, direct, temporary, adverse impacts on air quality would occur during construction due to emissions from combustion-powered equipment. • Minor to moderate, direct temporary, adverse impacts on air quality due to emissions from fugitive dust, including during operation of the on-site concrete manufacturing plant.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the

Table 2.9-1
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Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
	atmospheric greenhouse gases (GHGs).	Operational: • Negligible impacts on air quality due to operations. • Minor, indirect, permanent, beneficial impacts on carbon sequestration and atmospheric GHG concentrations due to wetland creation and restoration within the Barataria Basin.			corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Noise (Section 4.8)	• No impacts on noise levels from construction, operation, or maintenance of the Project would occur.	Construction: • Temporary, direct, minor to moderate, adverse noise impacts during construction of the Project, due to operation of combustion-powered construction equipment and pile driving. Operational: • Negligible airborne noise impacts due to operations and maintenance during active maintenance activities, diversion gate operation, and water flow through the diversion. • Impacts on marine and aquatic species due to noise from maintenance dredging would be intermittent and limited to maintenance dredging activities (see Section 4.10 Aquatic Resources, Section 4.11 Marine Mammals, and Section 4.12 Threatened and Endangered Species for specific noise impacts on species).	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Terrestrial Wildlife and Habitat (Section 4.9)	• Major, permanent, adverse impacts on terrestrial wildlife due to the continued loss or conversion of wetlands. • Minor to moderate, short-term to permanent, adverse impacts on upland vegetation due decreased presence of wetlands and storm surge protection. • Major, permanent, adverse impacts on modeled species (green-winged teal, mottled duck, and alligator) from a model-projected decrease in habitat suitability; negligible to minor permanent, adverse impact on gadwall.	Construction: • Minor to moderate, temporary to permanent, adverse impacts on upland vegetation due to clearing associated with Project construction. • Negligible to moderate, temporary to permanent adverse impacts on wildlife from habitat clearing and construction disturbance. Operational: • Negligible to minor, permanent, direct and indirect, adverse impacts on terrestrial species from operational noise and lighting, and potential impacts on migration/movement. • Minor to major, permanent, beneficial impacts on wildlife using wetland habitat from the creation of wetland in the basin by year 2070. • Moderate, permanent, adverse impacts on wildlife in the birdfoot delta through the loss of wetlands by year 2070. • Minor to moderate, permanent beneficial impacts on green-winged teal, mottled duck, and alligators; negligible impacts on gadwall. • Moderate to major, permanent, adverse impacts on species that predominantly use higher salinity marsh such as diamondback terrapin. • Negligible to minor, permanent, adverse impacts on upland vegetation and minor, permanent, adverse impacts on wildlife and wildlife habitat from the potential spread of invasive plants and animals.	• Moderate, permanent, direct and indirect, beneficial impacts on green-winged teal, mottled duck, and alligators from increased habitat suitability near the immediate outfall area; negligible impacts on the gadwall due to overall low habitat suitability in the Project area. • All other impacts would be similar to the Applicant's Preferred Alternative.	• Moderate to major, permanent, direct and indirect, beneficial impacts on green-winged teal, mottled duck, and alligators from increased habitat suitability near the immediate outfall area; negligible impacts on the gadwall due to overall low habitat suitability in the Project area. • All other impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Aquatic Resources (Section 4.10)	• Moderate, permanent, indirect, adverse impacts on SAV. • Major, permanent, direct and indirect adverse impacts on benthic resources and essential fish habitat (EFH) and managed species. • Habitat suitability for key species decreases overtime with changing salinity and marsh loss. • Continued trend of invasive species expansion or maintenance.	Construction: • Minor, temporary to permanent, direct and indirect, adverse impacts on SAV. • Minor to moderate, short-term to permanent, direct and indirect impacts on benthic resources. • Negligible to minor, temporary to permanent, direct and indirect, adverse impacts on EFH and managed species. • Minor to moderate, adverse, temporary to permanent impacts on aquatic invasive plants and animals. Operational: • SAV: Major, temporary, indirect, adverse impact through the initial and immediate change in salinity in the Barataria Basin, followed by major, permanent, indirect, beneficial impacts. Permanent, adverse, indirect, and negligible impacts in the birdfoot delta from increasing salinity. • Benthic resources: Minor to moderate, permanent, direct and indirect impacts in the Barataria Basin (beneficial or adverse, depending on species).	• Impacts would be similar to the Applicant's Preferred Alternative. • Key species: Generally consistent with Applicant's Preferred Alternative but with slight decreases in benefits due to smaller increases in marsh, slight decreases in adverse impacts from the smaller area of disrupted larval transport, and incremental changes in either beneficial or adverse impacts associated with the decreased area of salinity modification (depending on species preferences).	• Impacts would be similar to the Applicant's Preferred Alternative. • Key species: Generally consistent with Applicant's Preferred Alternative but with slight increases due to larger increases in marsh, slight increases in adverse impacts from the larger area of disrupted larval transport, and incremental changes in either beneficial or adverse impacts associated with the expanded area of salinity modification (depending on species preferences).	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

Table 2.9-1 Comparative Summary of Potential MBSD Impacts Under Each Alternative (as Compared to the No Action Alternative unless Otherwise Stated)					
Resource	**No Action Alternative**	**75,000 cfs Alternative (Applicant's Preferred)**	**50,000 cfs Alternative**	**150,000 cfs Alternative**	**Terrace Alternatives**
	• Key Species ○ Brown shrimp – Major, adverse, indirect, permanent impacts. ○ White shrimp – Major, adverse, indirect, permanent impacts. ○ Blue crab – Moderate, adverse, indirect, permanent impacts. ○ Bay anchovy – Negligible, indirect, permanent impacts. ○ Gulf menhaden – Negligible, indirect, permanent impacts. ○ Red drum – Minor, adverse, indirect, permanent impacts. ○ Spotted seatrout – Minor, adverse, indirect, permanent impacts. ○ Atlantic croaker – Minor, adverse, indirect, permanent impacts. ○ Southern flounder – Negligible, indirect, permanent impacts. ○ Largemouth bass – Major, adverse, indirect, permanent impacts. ○ Eastern oyster – Major, adverse, indirect, permanent impacts.	Moderate, permanent, and adverse impact in the birdfoot delta from marsh loss. • EFH: Major, permanent, direct and indirect, beneficial changes. Moderate, permanent, adverse impacts in the birdfoot delta from loss of marsh habitat. • Managed species: Negligible impacts on coastal migratory pelagics and highly migratory species due to predominant use of nearshore and offshore waters. Minor, adverse, indirect, and permanent impacts on reef fish from changes in prey species (gray snapper) or salinity and nursery habitat (lane snapper). • Habitats impacts range from major beneficial to major adverse. • Key species: ○ Brown shrimp – Major, adverse, direct and indirect, permanent impact to species with major decrease in abundance earlier in analysis period than No Action; impact continues through the analysis period. ○ White shrimp – Negligible to minor, beneficial, direct and indirect, permanent impact to species with potentially greater abundance than under No Action. ○ Blue crab – Negligible to minor, beneficial, direct and indirect, permanent impact to species with potentially greater abundance than under No Action. ○ Bay anchovy – Minor, beneficial, direct and indirect, permanent impact to species with slightly greater abundance than under No Action. ○ Gulf menhaden – Moderate, beneficial, direct and indirect, permanent impact to species with greater abundance than under No Action. ○ Red drum – Moderate, beneficial, indirect permanent impact to species with greater abundance than under No Action. ○ Spotted seatrout – Minor, adverse, direct and indirect permanent impact to species with a slightly lower abundance than under No Action. ○ Atlantic croaker – Negligible, direct and indirect, permanent impact with no measurable basin-wide change in abundance over time as compared to No Action. ○ Southern flounder – Negligible to minor, adverse, direct and indirect, permanent impact to species with potentially lower abundance than under No Action. ○ Largemouth bass – Moderate, beneficial, direct and indirect, permanent impact to species with greater abundance than under No Action. ○ Eastern oyster – Major, adverse, direct and indirect, permanent impact to species with major decrease in abundance earlier in analysis period than No Action and continues over time. ○ Freshwater fishes – Moderate, beneficial, direct and indirect, permanent impact to freshwater fish introduced into basin with greater abundance than under No Action. ○ Minor to moderate, permanent, indirect, adverse impacts on aquatic invasive plants and animals.			
Marine Mammals (Section 4.11)	• Gradually increasing minor, permanent, adverse impacts on Barataria Bay Estuarine System (BBES) dolphins.	Construction: • Negligible to minor, temporary, indirect, and adverse impacts on bottlenose dolphins from construction noise and dredging. Operational: • Major adverse impacts on BBES dolphins and dolphin habitat (due mostly to salinity) that would continue throughout the lifetime of the Project. Immediate decreases in salinity levels within the BBES Stock area, which would persist throughout the analysis period, would cause permanent, major adverse impacts on BBES dolphin health, survival, and reproduction. Dolphins north of the Barrier Islands would be especially adversely impacted, while Barrier Island-associated dolphins would be less-adversely impacted; however, all	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

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Comparative Summary of Potential MBSD Impacts Under Each Alternative (as Compared to the No Action Alternative unless Otherwise Stated)

Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
		groups would be more adversely impacted than compared to conditions under the No Action Alternative. • Based on the projected decreases in survival rates due to prolonged low-salinity exposure, there would be a substantial reduction in population numbers.			
Threatened and Endangered Species (Section 4.12)	• No impact on the West Indian manatee, hawksbill and leatherback sea turtle, pallid sturgeon, and giant manta ray. • Minor adverse impact on the loggerhead and green sea turtles, and saltmarsh topminnow. • Negligible impact on the black rail and bald eagle. • Minor to moderate adverse impact on Kemp's ridley sea turtle, piping plover (and critical habitat), and red knot (and proposed critical habitat).	Construction: • No effect (no impact) on loggerhead sea turtle critical habitat, five species of sea turtles on nesting beaches, and designated (piping plover) or proposed (red knot) critical habitat. • Likely to adversely affect (minor adverse impact on) pallid sturgeon due to construction noise. • Not likely to adversely affect (negligible to minor impact on) West Indian manatee, piping plover, red knot, five species of sea turtles in marine environments, black rail, and giant manta ray. • Minor, temporary, adverse, and direct/indirect impacts on saltmarsh topminnow. • Negligible impact on bald eagles from loss of potential nesting trees and indirect disturbances from construction activities. Operational: • No effect (no impact) on four species of sea turtles on nesting beaches, or loggerhead or designated (piping plover) or proposed (red knot) critical habitat (compared to the No Action Alternative). • Not likely to adversely affect (negligible to minor adverse impact on) West Indian manatee; hawksbill and leatherback sea turtles in marine environments; the loggerhead sea turtle on nesting beaches; piping plover; red knot; black rail, and giant manta ray. • Likely to adversely affect (minor to moderate adverse impact on) the Kemp's ridley, loggerhead, and green sea turtles and pallid sturgeon. • Minor to moderate, permanent, direct and indirect, beneficial impacts on the saltmarsh topminnow. • Negligible to moderate, permanent, indirect, and adverse impacts on bald eagle from potential contaminant uptake.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Socioeconomics (Section 4.13)	• Economy, Employment, Businesses, and Industrial Activity: General trend continues: moderate to major, permanent, adverse impacts on economic activities. • Population: Major, permanent, adverse impacts on population outmigration. • Housing and Property Values: Negligible (inside flood protection) to major (outside flood protection), permanent, adverse impacts on property values. • Tax Revenue: Minor to moderate permanent, adverse impacts on sales and use revenues in the Project area. Impacts on property taxes are expected to be negligible for areas inside of flood protection, while for areas outside of flood protection, where	Construction: • Economy, Employment, Businesses, and Industrial Activity: Moderate to major, temporary, beneficial impacts from job creation and increased economic activity in the Project area. Short-term, minor to moderate, adverse impacts on some businesses located in the direct vicinity of construction activities associated with increased traffic, noise, and dust during construction. Minor, permanent, adverse impacts on agricultural outputs and employment in areas in and near the proposed Project footprint. • Population: Negligible impacts on population in the Project area. • Housing and Property Values: Minor, short-term, adverse impacts on properties within the construction footprint as well as properties within approximately 0.5-mile around the footprint. Minor to moderate, temporary, adverse direct construction impacts would occur on lands within the construction footprint, as well as adjacent lands, including nearby residences and businesses. • Tax Revenue: Minor to moderate, short-term, beneficial impacts on sales and use and income taxes across the State of Louisiana and local jurisdictions associated with construction spending, particularly in Plaquemines Parish. Minor, permanent, adverse impacts on property taxes receipts in Plaquemines Parish associated with reduced housing and property values. • Public Services and Utilities: Minor short-term benefits to public services associated with increased sales tax receipts, primarily in Plaquemines Parish.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Economy, Employment, Businesses, and Industrial Activity: Each terrace alternative would have similar construction impacts as listed for each corresponding flow capacity alternative without terraces (50,000, 75,000, and 150,000 cfs). Inclusion of spending on marsh terraces under any of the capacity alternatives would slightly increase the regional economic benefits of these alternatives as compared to the flow capacity alternatives. • All Other Socioeconomic Activities: Each terrace alternative would have the same impacts as listed for each corresponding

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	populations are generally smaller, moderate to major, permanent, adverse impacts are expected. • Public Services and Utilities: Moderate to major, permanent, adverse impacts. Current trends of closures and decreases in public services in expected to continue. • Community Cohesion: Moderate permanent, adverse impacts on community cohesion. • Protection of Children**:** Minor, permanent, adverse impacts on the welfare of children.	Minor short-term adverse impacts on public services associated with reduced property taxes. Negligible impacts on utilities. • Community Cohesion: Negligible impacts on community cohesion. • Protection of Children: Negligible impacts on protection of children. Operational: • Economy, Employment, Businesses, and Industrial Activity, Negligible to minor, permanent, beneficial impacts on businesses and industrial activity in the west bank New Orleans area north of the diversion. Minor permanent, adverse impacts on the regional economy, employment, businesses, and industrial activity as a result of increased tidal flooding and storm surge in areas outside flood protection in the Barataria Basin, particularly in the 2030s to 2050s in areas near (within 10 miles north or 20 miles south) the immediate outfall area. Depending on the degree of flood impact, CPRA plans to acquire Project servitudes on affected properties within communities to compensate property owners for the impact of diversion-induced flooding on the value of their properties. • Population: Minor to moderate, permanent, adverse impacts on communities near the immediate outfall area (within 10 miles north or 20 miles south) outside of flood protection due to increased tidal flooding and associated outmigration. Depending on the degree of flood impact, CPRA plans to acquire Project servitudes on affected properties within communities to compensate property owners for the impacts of diversion-induced flooding on the value of their properties. Long-term, negligible to minor, beneficial impacts due to additional storm surge protection for the west bank New Orleans area north of the diversion. • Housing and Property Values: In the west bank New Orleans area north of the diversion, the Project would be expected to have minor, permanent, beneficial impacts on housing and property values as the land gained as a result of the proposed Project would decrease the risks of storm hazards. Minor to moderate, permanent, adverse impacts on housing and property values would occur in communities near the immediate outfall area (within 10 miles north or 20 miles south) outside of flood protection. Negligible to minor impacts for areas inside flood protection and for areas further (more than 20 miles) south of the diversion. • Tax Revenue: Minor to moderate, permanent, beneficial impacts on property tax revenues in the west bank New Orleans area north of the diversion. Minor, permanent, adverse impacts in areas outside of flood protection near the immediate outfall area (within 10 miles north or 20 miles south); negligible impacts expected in areas further from the immediate outfall area. Negligible impacts for areas inside flood protection. • Public Services and Utilities: Minor, permanent, beneficial impacts on public service facilities and delivery in the west bank New Orleans area due to decreased storm hazard risks and increased tax revenue. Public services and utilities infrastructure located outside of federal flood protection near (within 10 miles north or 20 miles south) the immediate outfall area would experience direct adverse impacts. Decreased tax revenues in Plaquemines and Jefferson Parishes would reduce funding for public services. Overall minor, permanent, adverse impacts on delivery of public services in Plaquemines and Jefferson Parishes. • Community Cohesion: Minor to moderate, permanent, adverse impacts on community cohesion in communities near the immediate outfall area (within 10 miles north or 20 miles south) outside of flood protection related to outmigration. • Protection of Children: Minor, permanent, adverse impacts on children in communities near the immediate outfall area (within 10 miles north or 20 miles			capacity flow alternative without terraces (50,000, 75,000, and 150,000 cfs) and would be similar to the Applicant's Preferred Alternative.

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Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
		south) outside of flood protection. Minor, permanent, beneficial impacts on children in the in the west bank New Orleans area north of the diversion.			
Commercial Fisheries (Section 4.14)	• Adverse impacts on the commercial shrimp fishery due to decrease in shrimp abundance from reduced marsh habitat and increased salinity over time. • Adverse impacts on the commercial oyster industry due to salinity shift over time, particularly after 2050. • Adverse impacts on commercial crab fishery due to decrease in blue crab abundance from reduced marsh habitat over time. • Adverse impacts on commercial fisheries for spotted seatrout, Atlantic croaker, and largemouth bass (proxy for freshwater species) as abundance declines in the long term due to reduced marsh habitat and increased salinity and water depth. • No or negligible impacts anticipated for southern flounder, Gulf menhaden, and bay anchovy commercial fisheries due to negligible impacts on species abundance over time.	Construction: • Minor, adverse, temporary impacts on commercial fishing during construction due to delays in accessing areas used for fishing as compared to No Action Alternative. Operational: • Moderate to major, permanent, adverse impacts on shrimp fisheries associated with adverse impacts on brown shrimp abundance over time. Impacts would further encourage fishers to exit from the industry. • Major, permanent, adverse impacts on eastern oyster fisheries due to adverse impacts on eastern oyster abundance. • Negligible to minor, permanent, beneficial impacts on blue crab fishery would be anticipated due to changes in species abundance. • A range of impacts on finfish fisheries would be expected. Decreases in species abundance in the Project area would cause direct reductions in commercial catch, discourage entrants into the fishery, and encourage exits, while the converse would be true where increases in abundance and catch would be anticipated. Specifically, as compared to the No Action Alternative: ○ Moderate, permanent, beneficial impacts on Gulf menhaden; ○ Minor, permanent, beneficial impacts on bay anchovy; ○ Negligible, impacts on Atlantic croaker; ○ Negligible to minor, permanent, adverse impacts on southern flounder; ○ Minor, permanent, adverse impacts on spotted seatrout; and ○ Moderate, permanent, beneficial impacts on freshwater finfish fisheries.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Environmental Justice (Section 4.15)	• Major, permanent, adverse impacts on low-income and minority populations. Environmental changes may impact low-income and minority populations more intensely than general population due to social and economic vulnerabilities, ties to traditional lands and lifeways, and dependence on commercial and subsistence fisheries that would be expected to decline over time.	Construction: • Minor to moderate, temporary, adverse impacts on low-income and minority populations within 0.5-mile of the construction footprint. Construction impacts on minority and low-income populations, including the population of Ironton, could be disproportionately high and adverse depending on the unique vulnerabilities within that community. Operational: • May have disproportionately high and adverse, long-term impacts on some low-income and minority populations in communities located near the immediate outfall area (within 10 miles north and 20 miles south) and outside of federal levee protection including populations within Myrtle Grove, Woodpark, Suzie Bayou, Hermitage, Grand Bayou, and Happy Jack due to increased tidal flooding and storm hazards, to the extent that such populations are uniquely vulnerable to tidal flooding and storm hazard impacts. In addition, negligible to minor increase in risk of levee overtopping in communities gulfward of the immediate outfall area during certain 1 percent (100 year) storms could result in disproportionately high and adverse impacts on low-income and minority populations in Ironton to the extent that overtopping leads to flooding in that community. To a lesser extent, tidal flooding could increase in the Lafitte area, which includes multiple communities with varying levels of existing non-federal flood protection. May have disproportionately high and adverse impacts on low-income and minority populations engaged in commercial and subsistence fishing and dependent on adversely impacted fisheries in the Barataria Basin; disproportionate impacts may vary according to levels of engagement and dependence. • For low-income or minority populations located in areas inside the federal levee system, or farther than 10 miles north and 20 miles south of the	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

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Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
		immediate outfall area, impacts from increased tidal flooding and storm surge caused by operation of the Project are expected to be negligible. Impacts on low-income and minority populations in these areas would not be disproportionate. For low-income or minority populations located in areas north of the diversion, some beneficial impacts related to additional protection from storm hazards due to reduced storm surge and wave heights as a result of land building may occur relative to the No Action Alternative.			
Recreation and Tourism (Section 4.16)	• No impacts on recreation and tourism from construction of the proposed Project would occur. Ongoing trends would continue. • Negligible (early decades) to major (later decades) declines in recreation site accessibility. • Minor, permanent decreases in the abundance and recreational fishing of spotted seatrout and red drum. • Moderate, permanent, decreases in site accessibility for recreational boating. • Adverse impacts on hunting and wildlife watching. • Major, permanent adverse impacts on visitation to privately-managed recreation areas. • Recreational expenditures in the region and the associated economic impacts would decrease over time.	Construction: • Temporary, minor, localized, adverse impacts from construction due to traffic, increased dust, and noise impacts which may contribute to delays in accessing sites. Water-based construction traffic in the Mississippi River and Barataria Basin may also have minor impacts on recreational site access for recreational users. Operational: • Long-term to permanent, minor to moderate, adverse impacts on site accessibility, recreational boating, and boat-based recreational fishing due to tidal flooding, sedimentation, and expansion of invasive plant species. • Minor, permanent, adverse impacts on recreational fishing for spotted seatrout. • Moderate, permanent, beneficial impacts on recreational fishing for red drum. • Minor to moderate, permanent, beneficial impacts on hunting and wildlife watching due to increases in wetland habitat. • Minor, permanent, adverse or beneficial impacts on the regional economy associated with recreational expenditures in the region.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Public Lands (Section 4.17)	• Major, permanent, and adverse impacts on public lands due to decreases in wetland habitat availability for fish and wildlife and adverse impacts on visitation accessibility.	Construction: • Temporary, minor, adverse impacts from construction due to temporary and localized traffic congestion from the mobilization of crews and equipment, which may contribute to delays in accessing public lands. Operational: • Negligible to minor, adverse, permanent impacts on public lands in the Barataria Basin due to negligible to minor, adverse impacts on wetland habitat at these sites. • Minor to moderate, adverse, permanent impacts on the Pass A Loutre Wildlife Management Area (WMA) and Delta National Wildlife Refuge (NWR) in the birdfoot delta due to projected decreases in wetland habitat. • Long-term, minor to moderate, adverse direct and indirect impacts on site accessibility due to increased tidal flooding at public lands and private recreation sites (or roads leading to those sites).	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Land Use and Land Cover (Section 4.18)	• No impacts on land use from construction of the proposed Project would occur. • Any future impacts would be required to comply with applicable permits and laws. • Major, permanent, adverse impacts due to continued land loss in the Barataria Basin and birdfoot delta.	Construction: • Moderate, temporary and short-term, adverse impacts due to vegetation clearing, ground disturbance, and fill placement. Operational: • Moderate, permanent impacts on existing land use. • Major, permanent beneficial impacts in the Barataria Basin due to lands that are sustained or created (13,400 acres by year 2070). • Moderate, permanent, adverse or beneficial (depending on the user) impacts on wetland land loss in the birdfoot delta (an additional 3,000 acres lost by 2070).	• Major, permanent beneficial impacts in the Barataria Basin due to lands that are sustained or created (9,660 acres by year 2070). • Moderate, permanent, adverse or beneficial (depending on the user) impacts on wetland land loss in the birdfoot delta (an additional 2,820 acres lost by 2070).	• Major, permanent beneficial impacts in the Barataria Basin due to lands that are sustained or created (29,200 acres by year 2070). • Moderate, permanent, adverse or beneficial (depending on the user) impacts on wetland land loss in the birdfoot delta (an additional 2,820 acres lost by 2070).	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

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Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
			• All other impacts would be similar to the Applicant's Preferred Alternative.	• All other impacts would be similar to the Applicant's Preferred Alternative.	
Aesthetic and Visual Resources (Section 4.19)	• No impacts on aesthetic and visual resources from construction of the proposed Project would occur. • Any future impacts would be required to comply with applicable permits and laws. • Minor to major, adverse to beneficial, permanent impacts on aesthetic and visual resources depending on type and scope of potential future development.	Construction: • Temporary, minor, adverse impacts on visual resources during construction of the Project. Operational: • Permanent, moderate, adverse impacts on visual resources from operation of the Project due to presence of aboveground structures. • During operations, permanent, minor, beneficial changes in the existing viewshed within the Barataria Basin due to wetland creation and restoration.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Public Health & Safety, Including Flood and Storm Hazard Risk Reduction (Section 4.20)	• Minor to major, permanent, adverse impacts from increase in frequency and severity of non-storm and storm related flooding inside and outside federal levee systems.	Construction: • Minimized risk of inadvertent releases of contaminants which could cause temporary, adverse impacts that range from no impact to moderate, depending on nature of release. • Minimized risk of storm events which could cause construction equipment and material related impacts which could have short-term, adverse impacts that range from minor to moderate impact. Operational: • Minor to major, adverse, long-term impacts on public health and safety due to increased tidal flooding in the Barataria Basin communities near the immediate outfall area not protected by federal levees. • Minor to moderate, beneficial, permanent impacts on public health and safety associated with storm hazards in communities outside of federal levee systems north of the immediate outfall area. • Minor to moderate, adverse, permanent impacts on public health and safety risks associated with storm hazards in communities outside of federal levee systems south of the immediate outfall area. • Negligible to minor, beneficial, permanent impacts on decreasing levee overtopping north of the immediate outfall area and permanent, negligible to minor, adverse impacts on increasing levee overtopping immediate outfall area.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Similar impacts as Applicant's Preferred Alternative, with greater major intensity of impact on public health and safety than the Applicant's Preferred Alternative during the first 20 years of the analysis period, particularly in communities outside the federal levee system closer to the immediate outfall area.	Construction • Construction of terraces would alter approximately 88 additional acres of 100-year floodplains than the corresponding capacity flow alternative without terraces (50,000, 75,000, and 150,000 cfs) Alternative, but no impacts on public health and safety. Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Navigation (Section 4.21)	• Cargo tonnages and marine vessels transiting the Lower Mississippi River, GIWW, Barataria Bay Waterway, and Bayou Lafourche would continue to show little or no growth. • Existing dredging trends would continue.	Construction: • Minor, temporary, adverse impacts on traffic capacity in the Lower Mississippi River and the Barataria Basin federal navigation channels due to 10 monthly barge deliveries of construction materials via both the Mississippi River and Barataria Basin channels during the construction period. • Minor, temporary, adverse impacts on safety and efficiency of shallow-draft vessels transiting past the proposed Project site in the Mississippi River during construction due to waterway obstructions associated with the proposed cofferdam for the 3.5-year construction timeframe of the river intake system. Operational: • Moderate, intermittent but permanent, adverse impacts on marine traffic efficiency and safety for shallow-draft vessels in the Mississippi River during operations due to cross-currents extending into the channel from the proposed intake structure. Some congestion may be unavoidable and could cause transit delays. • Minor, permanent, adverse impacts on maintenance dredging between the proposed intake structure (RM 60.7 AHP) and Venice (RM 13 AHP) in the	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

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Comparative Summary of Potential MBSD Impacts Under Each Alternative (as Compared to the No Action Alternative unless Otherwise Stated)

Resource	No Action Alternative	75,000 cfs Alternative (Applicant's Preferred)	50,000 cfs Alternative	150,000 cfs Alternative	Terrace Alternatives
		Mississippi River due to changes in typical shoaling patterns and locations and minor increases in dredging quantities if new point bar growth intrudes into the navigation channel. • Moderate, permanent, adverse impacts on maintenance dredging in the Mississippi River from Venice to the Gulf, including Head of Passes and in Southwest Pass, and in other passes carrying flow to the Gulf (for example, South Pass, Tiger Pass). • Minor, permanent, indirect impacts on marine traffic in the Barataria Basin navigation channels due to increased dredging frequencies (dredging activities may cause delays for marine traffic). • Moderate, permanent, adverse impacts on maintenance dredging in the Barataria Bay Waterway due to increased sedimentation. • Minor, permanent, adverse impacts on maintenance dredging in Bayou Lafourche due to increased sedimentation.			
Land-Based Transportation (Section 4.22)	• Future increases in LA 23 traffic volumes of 2.2 percent annually. • NOGC train traffic expected to remain at current levels. • Future industrial and commercial development in vicinity of the Project site may induce increases in roadway and railroad traffic volumes, which may result in congestion and delays for motorists.	Construction: • Temporary, moderate, adverse impacts on roadway traffic delays and congestion from construction-generated traffic and reduced roadway capacity for southbound traffic on LA 23. • Temporary, minor, adverse impacts on increased NOGC train traffic from rail deliveries of construction materials. Operational: • Permanent, minor, adverse impacts on LA 23 traffic access due to closure of two median cross-over locations. • Permanent, minor, beneficial impacts on LA 23 traffic safety due to limited wildlife access on proposed LA 23 bridge.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Hazardous, Toxic, and Radioactive Waste (Section 4.23)	• Only limited impacts on hazardous, toxic, and radioactive waste (HTRW) are expected to occur during the 5-year analysis period (the period that would otherwise be required for construction of the proposed Project); therefore, there would likely be only negligible HTRW impacts during that timeframe. Existing HTRW within the basin and the birdfoot delta could be impacted as a result of future development or ongoing processes, potentially resulting in minor to major, permanent adverse impacts over time, depending on the type of future developments or events.	Construction: • Temporary, minor to moderate, adverse impacts due to potential unexpected discovery of and exposure to existing contaminated sites. Operational: • Short- to long-term, minor to major adverse impacts resulting from the transport and use of potentially harmful chemicals and fuels needed for general equipment maintenance and operation and increased water flow and sedimentation.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).
Cultural Resources (Section 4.24)	• Existing and future trends, including subsidence and erosion, within the Operational Impacts Area of Potential Effects (APE) would continue.	Construction: • USACE determined that the undertaking will have an adverse effect on one (1) historic property (archaeological site, 16PL107) within the Construction Impacts APE. Operational: • USACE determined the undertaking will have an adverse effect on 5 historic properties (archaeological sites) within the Operational Impacts APE.	• Impacts would be similar to the Applicant's Preferred Alternative.	• Impacts would be similar to the Applicant's Preferred Alternative.	Construction and Operational: • As compared to the No Action Alternative, the three terrace alternatives would have substantially similar impacts as the corresponding capacity flow alternatives without terraces (50,000, 75,000, and 150,000 cfs).

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