United States Department of the Interior

FISH AND WILDLIFE SERVICE
Louisiana Ecological Services
200 Dulles Drive
Lafayette, Louisiana 70506

December 13, 2021

Mr. Benjamin Frater
Assistant Gulf Restoration Manager
U.S. Fish and Wildlife Service
Deepwater Horizon Gulf Restoration Office
341 Greeno Rd. North, Suite A
Fairhope, Alabama 36532

Dear Mr. Frater:

This document transmits the Fish and Wildlife Service's (Service) biological opinion (enclosed), regarding the Coastal Protection and Restoration Authority's (CPRA) proposed Mid-Barataria Sediment Diversion (MBSD or project), authorized by the U.S. Army Corps of Engineers (USACE), New Orleans District, located in St. Charles Parish, Louisiana, and its potential effects on the endangered pallid sturgeon (*Scaphirhynchus albus*), the threatened West Indian manatee (*Trichechus manatus*), the threatened piping plover (*Charadrius melodus*) and its critical habitat, the threatened red knot (*Calidris canutus rufa*) and its proposed critical habitat, the threatened Eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*), and five species of sea turtles in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 United States Code [U.S.C.] 1531 *et seq*.).

The enclosed biological opinion, is based on information provided in the Louisiana Trustee Group's (LA TIG) July 2, 2021, biological assessment (BA). A complete administrative record of this consultation (Service Log No. 04EL1000-2022-F-0601) is on file at the Service's Louisiana Ecological Services Office.

The Service appreciates the *Deepwater Horizon* Gulf Restoration Office's continued cooperation in the conservation of the threatened and endangered species, and their critical habitats. If you have any questions regarding the enclosed biological opinion, please contact Ms. Amy Trahan (337-291-3126) of this office.

Sincerely,

BRIGETTE FIRMIN
Digitally signed by BRIGETTE FIRMIN
Date: 2021.12.13 14:35:54 -06'00'

Brigette D. Firmin
Acting Field Supervisor
Louisiana Ecological Services Office

Enclosure

cc (w/Enclosure): FWS, Atlanta, GA (Attn: Heath Rauschenberger)
LDWF, Natural Heritage Program, Baton Rouge, LA

Biological Opinion

Mid-Barataria Sediment Diversion

FWS Log #: 04EL1000-2022-F-0601

Prepared by:

U.S. Fish and Wildlife Service
Louisiana Ecological Services Field Office
200 Dulles Drive
Lafayette, LA 70506

December 13, 2021

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EXECUTIVE SUMMARY

This Endangered Species Act (ESA) Biological Opinion (BO) of the U.S. Fish and Wildlife Service (Service) addresses the potential effects of the Mid-Barataria Sediment Diversion (MBSD) Project being proposed by the Coastal Protection and Restoration Authority (CPRA) of Louisiana. The U.S. Army Corps of Engineers (USACE), New Orleans District is evaluating CPRA's application to construct, operate, and maintain the MBSD for a Department of the Army permit under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act and a permission request under Section 14 (33 U.S. Code [USC] 408) (Section 408) of the Rivers and Harbors Act of 1899. The MBSD is also being evaluated for funding under the Deepwater Horizon Oil Spill Final Programmatic Damages Assessment and Restoration Plan (DWH PDARP) restoration planning process by the Louisiana Trustee Implementation Group (LA TIG) which will make the final decision on funding. The LA TIG is comprised of the State of Louisiana [which includes the following state agencies: CPRA, Louisiana Department of Wildlife and Fisheries (LDWF), Louisiana Oil Spill Coordinator's Office (LOSCO), Louisiana Department of Natural Resources (LDNR), and Louisiana Department of Environmental Quality (LDEQ)], the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of the Interior (DOI), and the U.S. Department of Agriculture (USDA).

The proposed project consists of a multi-component river diversion system intended to convey sediment, freshwater, and nutrients from the Mississippi River at approximately River Mile (RM) 60.7 in the vicinity of the town of Ironton, in Plaquemines Parish, Louisiana to the mid-Barataria Basin to maintain and rebuild eroding upland and marsh habitat within the Barataria Basin. It is also intended to restore injuries to natural resources caused by the 2010 Deepwater Horizon oil spill. After passing through a proposed intake structure complex at the confluence of the Mississippi River and the proposed intake channel, the sediment-laden water would be transported through a conveyance channel to an outfall area in the mid-Barataria Basin located in Plaquemines and Jefferson Parishes. The USACE and LA TIG have determined that the Action is likely to adversely affect the pallid sturgeon (*Scaphirhynchus albus*) and requested formal consultation with the Service. The BO concludes that the Action is not likely to jeopardize the continued existence of this species. This conclusion fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, with respect to these species and designated critical habitats.

The USACE and LA TIG also determined that the Action is not likely to adversely affect the Eastern black rail (*Laterallus jamaicensis jamaicensis*), the piping plover (*Charadrius melodus*), the Rufus red knot (*Calidris canutus rufa*), the West Indian manatee (*Trichechus manatus*), Kemp's ridley sea turtle (*Lepidochelys kempii)*, and loggerhead sea turtle (*Caretta caretta*), and requested the Service's concurrence. The USACE and LA TIG also determined that the Action would have no effect on critical habitat for the piping plover or proposed critical habitat for the red knot, as well as, nesting beaches for the green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricate*), and leatherback sea turtle (*Dermochelys coriacea*). The Service concurs with that determination and provides our basis for this concurrence in section 3 of the BO. This concurrence fulfills the requirements applicable to the Action for completing consultation with respect to these species and designated critical habitats.

It is the Service's opinion that the project would not jeopardize the pallid sturgeon.

The BO includes an Incidental Take Statement that requires the USACE and the LA TIG to implement reasonable and prudent measures that the Service considers necessary or appropriate to minimize the impacts of anticipated taking on the listed species. Incidental taking of listed species that is in compliance with the terms and conditions of this statement is exempted from the prohibitions against taking under the ESA.

In the Conservation Recommendations section, the BO outlines voluntary actions that are relevant to the conservation of the listed species addressed in this BO and are consistent with the authorities of the USACE.

Reinitiating consultation is required if the USACE and LA TIG retains discretionary involvement or control over the Action (or is authorized by law) when:

(a) the amount or extent of incidental take is exceeded;
(b) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
(c) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
(d) a new species is listed or critical habitat designated that the Action may affect.

CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Louisiana Ecological Services Office.

2016-11-10 – The USACE formally requests federal, state, and tribal agencies to be cooperating or commenting agencies for National Environmental Policy Act Environmental Impact Statement (NEPA EIS) and permitting process for the Mid-Barataria Sediment Diversion Project.

2017-04-04 – The Service attends EIS kickoff meeting with other federal, state, and tribal agencies including USACE, CPRA, NOAA, etc. The Service informed the USACE of the pallid sturgeon issues for the proposed project.

2018-06-20 – Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultation kickoff meeting with representatives of the USACE, CPRA, NOAA, DOI, and Confluence Environmental Company (Confluence) to discuss the ESA section 7 and EFH consultations for the proposed project.

2018-07-20 – The Service attends a conference call with Confluence, the USACE's Engineer Research and Development Center (ERDC), and Nick Friedenberg from Applied Biomathematics regarding a pallid sturgeon population viability analysis (PVA).

2018-12-12 – Confluence provides the Service with Package 1 of the draft BA for review and comment.

2019–01-03 – The Service provides Confluence with comments on Package 1 of the draft BA.

2019–01-24 – Confluence provides the Service with Package 2 of the draft BA for review and comment.

2019–02-15 – The Service provides Confluence with comments on Package 2 of the draft BA.

2019–07-19 – The Service attends a call with the ERDC, Confluence, and Nick Friedenberg from Applied Mathematics to discuss the pallid sturgeon PVA that Applied Mathematics prepared.

2019-11-18 – Confluence provides the Service with the draft BA for review and comment; the Service provides comments on the draft BA.

2021-04-15 – The Service's DWH Gulf Restoration Office initiated, via letter, formal consultation with the Service on the proposed Mid-Barataria Sediment Diversion Project. Enclosed with the letter was a final BA.

2021-07-02 – The USACE initiated, via letter, formal consultation with the Service on the proposed Mid-Barataria Sediment Diversion Project. A link to the final BA was provided in the letter due to the size of the BA.

2021-08-02 – The Service responded, via letters, to USACE and the DWH Gulf Restoration Office providing the confirmation that the initiation package was complete and that our Biological Opinion would be issued no later than November 14, 2021. The Service's letters deeming the initiation package complete requested a determination of impacts to the red knot proposed critical habitat that was published after the final BA was received by the Service. The letter to the DWH Gulf Restoration Office stated that the Service's BO would be responding to the USACE's request but a copy of the BO would be provided to the Gulf Restoration Office and be sufficient to conclude as one consultation.

2021-10-08 – The Service requested, via electronic mail, a 30-day extension for issuance of the final BO. The USACE granted the extension on October 13, 2021.

2021-10-28 – USACE provided, via letter, a determination of impacts to the red knot proposed critical habitat.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act (ESA) of 1973, as amended, as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the proposed Mid-Barataria Sediment Diversion (MBSD) Project (the Action) being developed by the Coastal Protection and Restoration Authority (CPRA). This BO considers the effects of the Action on the pallid sturgeon (*Scaphirhynchus albus*).

The U.S. Army Corps of Engineers (USACE), New Orleans District and Louisiana Trustee Implementation Group (LA TIG) also determined that the Action is not likely to adversely affect the Eastern black rail (*Laterallus jamaicensis jamaicensis*), the piping plover (*Charadrius melodus*), the Rufus red knot (*Calidris canutus rufa*), the West Indian manatee (*Trichechus manatus*), Kemp's ridley sea turtle (*Lepidochelys kempii)*, and loggerhead sea turtle (*Caretta caretta*) and requested Service concurrence. The USACE and LA TIG also determined that the Action would have no effect on critical habitat for the piping plover or proposed critical habitat for the red knot, as well as, nesting beaches for the green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricate*), and leatherback sea turtle (*Dermochelys coriacea*). The Service concurs with these determinations for reasons we explain in section 3 of the BO.

A BO evaluates the consequences to listed species and designated critical habitat caused by a Federal action, activities that would not occur but for the Federal action, and non-Federal actions unrelated to the proposed Action that are reasonably certain to occur (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

This BO uses hierarchical numeric section headings. Primary (level-1) sections are labeled sequentially with a single digit (e.g., 2. PROPOSED ACTION). Secondary (level-2) sections within each primary section are labeled with two digits (e.g., 2.1. Action Area), and so on for level-3 sections. The basis of our opinion for each listed species and each designated critical habitat identified in the first paragraph of this introduction is wholly contained in a separate level-1 section that addresses its status, environmental baseline, effects of the Action, cumulative effects, and conclusion.

2. PROPOSED ACTION

The CPRA is proposing to construct, operate, and maintain the Mid-Barataria Sediment Diversion Project (MBSD), as authorized by USACE and being evaluated for funding by the LA TIG. The proposed project consists of a multi-component river diversion system intended to convey sediment, fresh water, and nutrients from the Mississippi River at river mile (RM) 60.7 near the town of Ironton, in Plaquemines Parish, Louisiana to the mid-Barataria Basin. After passing through a proposed intake structure complex on the Mississippi River and proposed intake channel, the sediment-laden water would be transported through a conveyance channel to an outfall area in the mid-Barataria Basin located in Plaquemines and Jefferson Parishes.

It should be noted that the specific construction details and drawings referenced in the Biological Assessment (BA) and this BO are based on the latest designs available at the time of submittal, approximately 30 percent design. As the project continues toward final design and ultimately construction, some project details are likely to be modified and refined during final design, value engineering, and other project optimization steps. Any such changes and modifications are not expected to change the mechanisms of impact to listed species and habitats discussed in the BA and this BO and therefore would not change the analyses or conclusions in this BO.

Once construction has been completed, the MBSD will be operated based on a diversion operations plan using flows measured at the Mississippi River gage at Belle Chasse. Operation of the diversion would be triggered with gates opening for flow when the Mississippi River gage at Belle Chasse reaches 450,000 cubic feet per second (cfs) and would reduce to a permanent base flow of 5,000 cfs when flow at the Belle Chasse gage falls below 450,000 cfs. When the Mississippi River flows exceed 450,000 cfs, the flow through the diversion will vary, with a maximum flow of 75,000 cfs. Flow rates through the diversion will increase proportionately to flow rates in the Mississippi River until the gage at Belle Chasse reaches 1,000,000 cfs, at which point flow through the diversion will be capped at a maximum of 75,000 cfs. At times river flows may be low and/or water levels on the basin side may be high (i.e., storm surge), which would prevent maintenance of a full 5,000 cfs base flow. Operations of the diversion will be maintained to prevent reverse flow from the Barataria Bain to the Mississippi River and operations will be suspended prior to and during major storm events.

The design elements of the proposed project are separated into 3 categories:

- Diversion Complex – The diversion complex will comprise features that form the basic structural elements for water inlet and conveyance from the Mississippi River to the basin outfall area. These features include the intake system, the gated control structure, the conveyance channel, and the guide levees.
- Basin Outfall Area – The basin side of the outfall area within the action area, where the initial delta formation is anticipated from the sediment-laden water. The features to be

constructed here are intended to increase the efficiency of water and sediment accumulation.

- Auxiliary Features – The project elements that accommodate existing or future services and infrastructure, including road, rail, and utilities and drainage systems. These features also include the placement of dredged materials in beneficial use placement areas and other mitigation measures designed to offset impacts of the construction process.

The proposed project will require 3 to 5 years of construction, depending on the extent of needed ground modifications and soil stabilization measures that may be necessary. A detailed description of the major project elements from construction through operation and maintenance are in the following section.

Site preparation for 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 of material, grading and paving, dredging, pumping of dredged material to prepared disposal site(s), installation of sediment and erosion control measures and slop protection, permanent and final stabilization, and extension of utilities to serve the proposed project operations. A more detailed description of the proposed construction plan for the proposed project is provided in Appendix B of the Biological Assessment.

Various types of equipment will be present and operating throughout the construction of the proposed project, including trucks, excavators, dozers, loaders, rollers, scrapers, cranes, pile drivers, barges, and well point drill rigs for dewatering. The means and methods implemented by the construction contractor will determine what equipment will be necessary on site. To produce the large volumes of concrete needed for the large structure, a concrete batch plant will be placed in the proposed construction footprint. On either the river or basin side of the construction area (or both), a temporary offloading facility may be constructed by the contractor to accommodate safe material transfer.

Areas associated with project construction activities will be located within the overall footprint of the construction limits (Figure 1). Staging areas and construction yards will be approximately 8 acres. The concrete batch plant will use an additional 4 acres. The final size and locations of these areas will be selected by the contractor. The staging areas will include the following:

- Haul and access roads
- A concrete batch plant
- Barge offloading facilities located on the Mississippi River and in the Barataria Basin
- A staging area for barge-delivered materials
- Construction yards
- A laydown area for drying and processing clay borrow from excavations.

To transport construction equipment and to dredge the outfall transition feature, access routes will be used within the Barataria Basin. A planned access route, from the north to the proposed outfall area, follows a route used for previous restoration projects requiring similar draft for vessels. This route can be accessed from the Gulf Intracoastal Waterway via the Barataria Bay Waterway. The Mississippi River, which is navigable by ocean-going vessels up to Baton Rouge and by barge traffic all the way to the Port of Minneapolis, Minnesota, will also be utilized by the project.

During construction of the diversion complex, a pile supported trestle with a total surface area of approximately 36,000 square feet (ft^2) would be installed just downstream of the intake along the Mississippi River for material transfer (Figure 2). The proposed construction limits for the diversion complex would be approximately 1,015.4 acres. The intake system of the diversion consists of an intake structure (with two flared training walls and an intake channel), a gated control structure, and a transition channel that will connect to the larger conveyance channel (Figure 3). The training walls will extend into the Mississippi River approximately 950 feet shoreward (west) of the Mississippi River navigation channel limits and be located on the bed slope of the river adjacent to the sand bar which occurs at approximate depth elevations of -50 feet and -70 feet.

The training walls will be to direct flow of sediment from the river into the intake and restrict riverbank soils from filling the channel. The walls will be inverted pile-founded T-walls that would gradually increase in elevation from 0.0 and -13.0 feet, respectively, in the river to approximately 16.4 feet where they would connect to the intake channel walls. To dewater the area during construction, a temporary cofferdam system would be built around the proposed training walls. Installation methods for the cofferdam system may include impact, auguring, vibrating, or other methods. Generally, upland pile driving may use either impact or vibratory pile drivers without noise attenuation. Sheet piles will be installed using vibratory methods to the extent practicable and in-water pilings may be driven with impact or vibratory pile drivers. While it is estimated that the cofferdam will remain in place for up to 3.5 years, after construction, it will be removed.

The gated control structure will consist of four 45-foot-wide steel tainter gates with a top-of-wall elevation of 16.4ft and an inverted elevation of -40ft which will regulate flow by raising or lowering the gates. The river side of the structure will tie into the current Mississippi River and Tributaries (MR&T) Project Levee alignment, with a maintenance bridge across the top and four machine rooms. Water from the gated control structure would be funneled through a U-shaped transition channel with widths increasing from the gated control structure to the trapezoidal conveyance channel. The transition wall system under consideration will be pile-supported inverted T-walls. Detailed construction methods for this gated control structure are provided in EIS Section 2.8 (CPRA 2021).

The conveyance channel will be lined with bedding stone and riprap. It will have a 300-foot bottom width with an invert elevation of -25ft, setback berms between the top of channel and toe of the guide levees, and guide levees. The total width of the conveyance channel, guide levees, and stability berms will measure 734ft and would occupy about 563 acres, including the guide levees. Detailed construction methods of the conveyance channel are provided in the EIS Section 2.8 (CPRA 2021).

Along both sides of the conveyance channel, earthen guide levees will be constructed as a linear feature designed to constrain project flows. It is anticipated that multiple lifts and construction sequences will be needed to bring the guide levees to their final design height. These levees will also serve as hurricane flood protection against storm surge and be built to an elevation of 15.6ft, which is the USACE Design Grade for the proposed upgraded New Orleans to Venice Hurricane Risk Reduction Project: Incorporation of Non-Federal Levees (NFL) from Oakville to St. Jude and New Orleans to Venice Federal Hurricane Protection Levee (NOV HPL) (collectively referred to as NOV-NFL) levee. They would include a 10-foot-wide levee crown topped with a gravel access road and will be constructed using soil material excavated for construction of the intake and conveyance channels.

The outfall area is defined as the area on the basin side of the conveyance channel that will receive fresh water, sediment, and nutrients from the Mississippi River via the conveyance channel. This area is approximately 676 acres and is delineated by Cheniere Traverse Bayou to the north, Wilkinson Canal to the south, and the Barataria Bay Waterway to the west. Currently, this area largely consists of degraded wetland, shallow open water, and oil and gas canals. It is anticipated that a delta will form in the outfall area. Further details about project-induced land building in the basin can be found in the EIS Section 4.2.

According to the modeling efforts, upon proposed project initiation, sand and coarse-grained sediments will be deposited within the outfall area in an initial delta formation with deposition of finer-grained sediment extending farther gulfward in the basin, forming a subaqueous delta just below the low-tide water level. The subaqueous delta will evolve, over time, into a subaerial delta above the low-tide water level as vegetation becomes established and encourages additional deposits of sediment. In turn this will extend the formation of new subaqueous delta farther gulfward into the basin. Fine-grained sediments transported by the diversion will travel farther from the outfall area and be dispersed throughout the proposed project area.

In the project design, the creation of an outfall transition feature (OTF) is included to increase the efficiency of water and sediment delivery. To create this feature, the receiving basin surrounding the outlet will be dredged to create a gradual gradient from the diversion channel invert elevation of -25ft (the grade elevation of the channel) to the existing bed elevation of the receiving basin (-4ft). It is designed to provide sufficient bed topography for the diversion to flow at maximum capacity, expediting initial delta formation. The OTF will be created by dredging bottom sediment from the open water area within approximately 640 acres (1 square mile) of the outfall transition walls of the structure. Dredged sediments will be place at designated beneficial use locations in the receiving basin and the bottom of the OTF will be armored with riprap.

The proposed MBSD includes a 50-year operations plan based on initial sediment transport and deposition modeling. To observe and evaluate system performance and environmental response, a monitoring and adaptive management plan will be implemented. This plan may prescribe operational changes when necessary to improve system performance or if certain threshold environmental conditions are reached.

Proposed conservation measures to be implemented during construction of the proposed project include environmental protection measures and best management practices (BMPs) to avoid or minimize potential environmental effects. CPRA will develop an Environmental Protection Plan (EPP) detailing the Best Management Practices (BMPs) and environmental protection measures

(EPMs) for the prevention and/or control of pollution and habitat disruption that may occur during construction and operations.

West Indian Manatee Protection Measures

During in-water work in areas that potentially support manatees all personnel associated with the project should be instructed about the potential presence of manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with the animal, although passively taking pictures or video would be acceptable. All on-site personnel are responsible for observing water-related activities for the presence of manatee(s). We recommend the following to minimize potential impacts to manatees in areas of their potential presence:

- All work, equipment, and vessel operation should cease if a manatee is spotted within a 50-foot radius (buffer zone) of the active work area. Once the manatee has left the buffer zone on its own accord (manatees must not be herded or harassed into leaving), or after 30 minutes have passed without additional sightings of manatee(s) in the buffer zone, in-water work can resume under careful observation for manatee(s).

- If a manatee(s) is sighted in or near the project area, all vessels associated with the project should operate at "no wake/idle" speeds within the construction area and at all times while in waters where the draft of the vessel provides less than a four-foot clearance from the bottom. Vessels should follow routes of deep water whenever possible.

- If used, siltation or turbidity barriers should be properly secured, made of material in which manatees cannot become entangled, and be monitored to avoid manatee entrapment or impeding their movement.

- Temporary signs concerning manatees should be posted prior to and during all in-water project activities and removed upon completion. Each vessel involved in construction activities should display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign at least 8½ " X 11" reading language similar to the following: "CAUTION BOATERS: MANATEE AREA/ IDLE SPEED IS REQUIRED IN CONSRUCTION AREA AND WHERE THERE IS LESS THAN FOUR FOOT BOTTOM CLEARANCE WHEN MANATEE IS PRESENT". A second temporary sign measuring 8½ " X 11" should be posted at a location prominently visible to all personnel engaged in water-related activities and should read language similar to the following: "CAUTION: MANATEE AREA/ EQUIPMENT MUST BE SHUTDOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF OPERATION".

- Collisions with, injury to, or sightings of manatees should be immediately reported to the Service's Louisiana Ecological Services Office (337-291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225-765-2821). Please provide the nature of the call (i.e., report of an incident, manatee sighting, etc.); time of incident/sighting; and the approximate location, including the latitude and longitude coordinates, if possible.

Pile Driving Noise Attenuation

A pile-driving plan to guide pile-driving operations will be developed. The plan will identify locations, approximate timing, and installation methods including any noise attenuation methods.

Stormwater Pollution Prevention Plan

The stormwater pollution prevention plan (SWPPP) will be prepared to meet National Pollutant Discharge Elimination System (NPDES) permit requirements and implemented to minimize and control pollution and erosion due to stormwater runoff. A temporary erosion and sediment control (TESC) plan is required to prevent erosive forces from damaging project sites, adjacent properties, and the environment. The TESC plan may be a component of the SWPPP.

Spill Prevention, Control and Countermeasure Plan

A spill prevention, control and countermeasure (SPCC) plan would be prepared by the contractor to prevent and minimize spills that may contaminate soil or nearby waters.

Monitoring and Adaptive Management Plan (MAMP)

A MAMP is being developed by CPRA, in association with the project, which will guide field monitoring of species, habitats, and water quality considerations during operation of the MBSD. The plan will include monitoring efforts and management actions that may affect operations based on identified thresholds and planning processes. Specific measures for monitoring project impacts on pallid sturgeon are included in the Terms and Conditions (Section 5.3) of this Opinion.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR § 402.02). The action area includes the proposed MBSD location and all surrounding areas where effects due to the sediment diversion may reasonably be expected to occur. This area includes the Barataria Basin and the Mississippi River Delta Basin (Birdfoot Delta) (Figure 4). The action area also includes the Mississippi River in the vicinity of RM 60.7 in Plaquemines Parish, Louisiana.

2.2. Non-Federal Activities caused by the Federal Action

A BO evaluates the effects of a proposed Federal action. "Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action" (50 CFR §402.02).

Activities that would not occur but for the proposed Federal action include relocation or modification of existing infrastructure within the action area (i.e., roads, railways, pipelines, utilities, levees). The auxiliary actions identified by CPRA are described in detail in the EIS Section 2.8. The proposed activities related to the construction of these features are not anticipated to impact federally listed species or designated critical habitat under the Service's jurisdiction. Therefore, these proposed activities will not be discussed further in this BO.

2.3. Tables and Figures for Proposed Action

Figure 1. Project design features and construction footprint (LA TIG 2021)

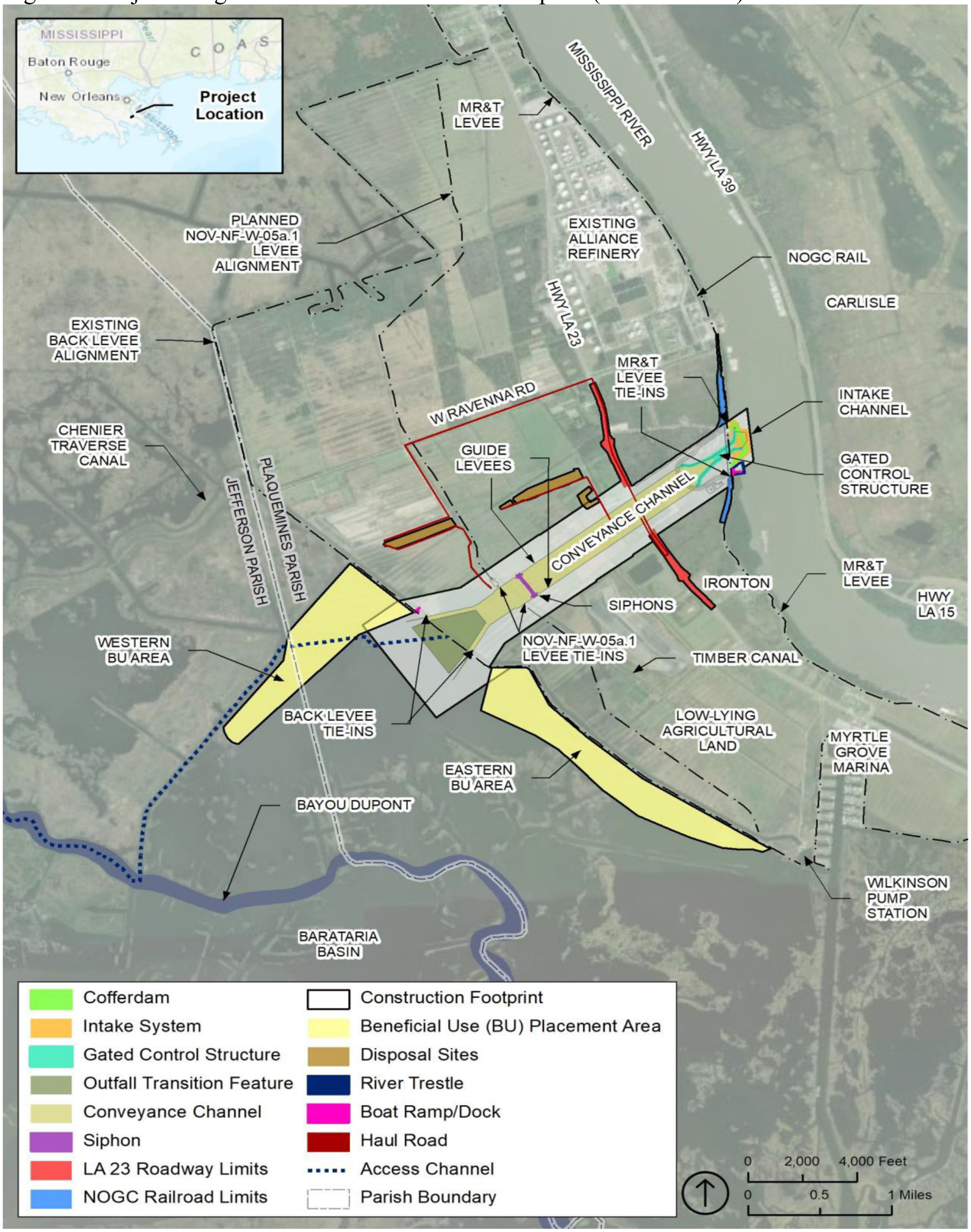


Figure 2. Proposed trestle and construction cofferdam overview. (LA TIG 2021)

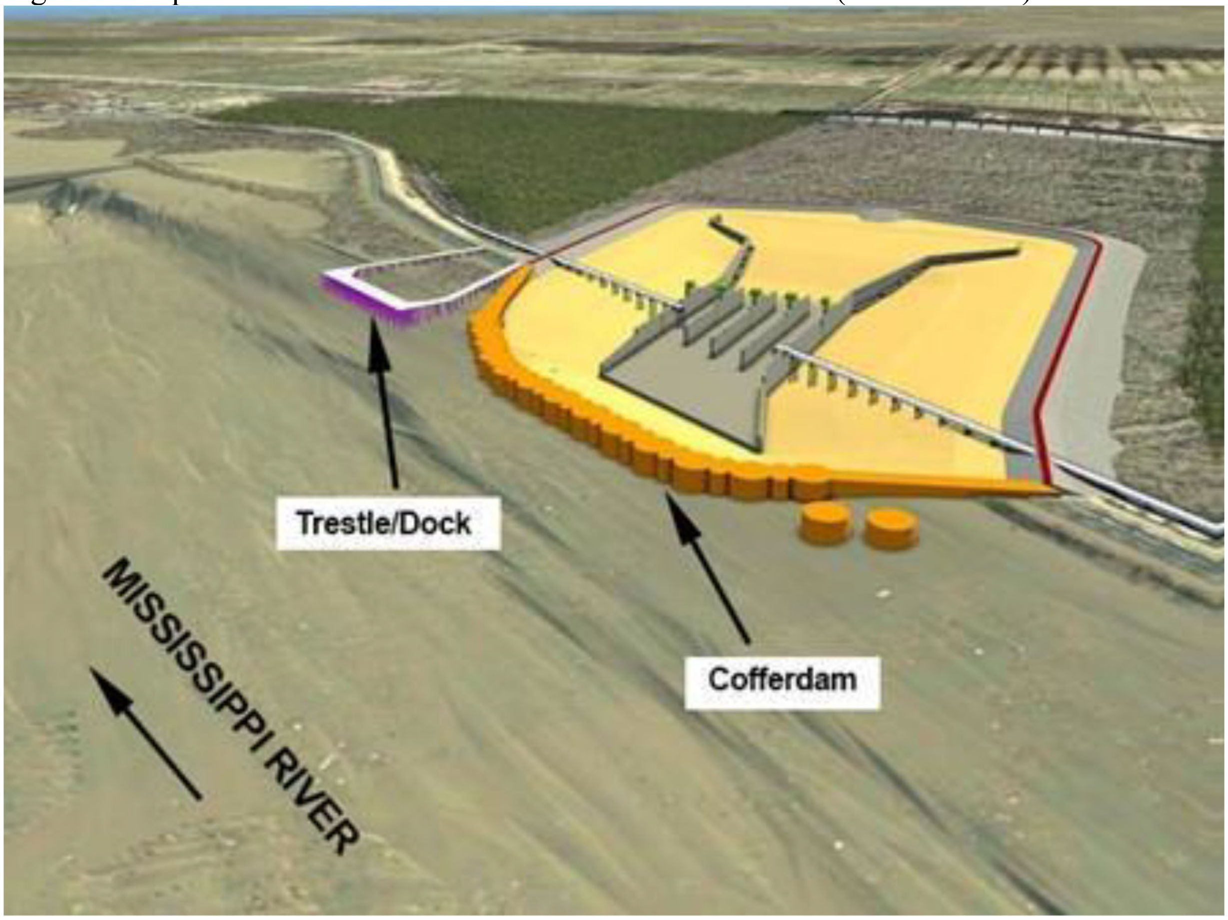


Figure 3. Proposed project design features as viewed from the Mississippi River (LA TIG 2021)

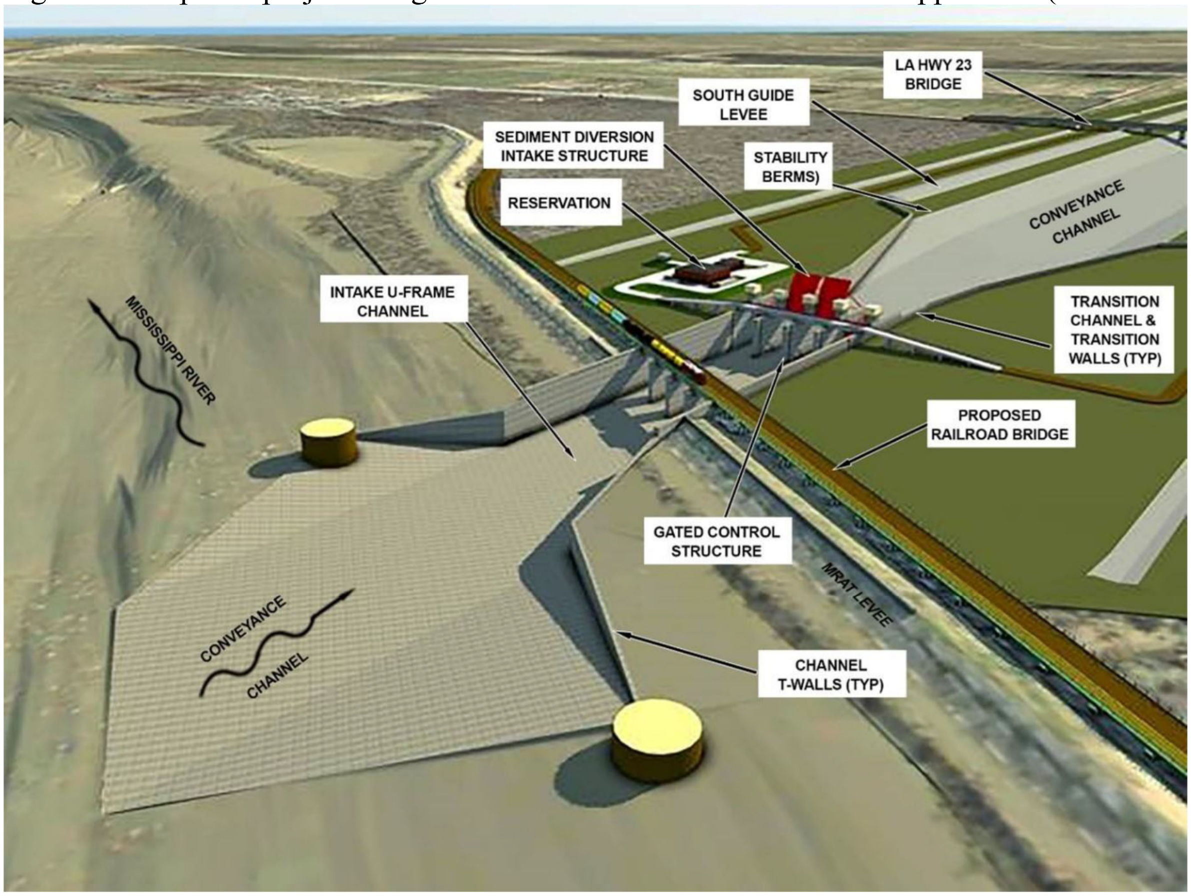
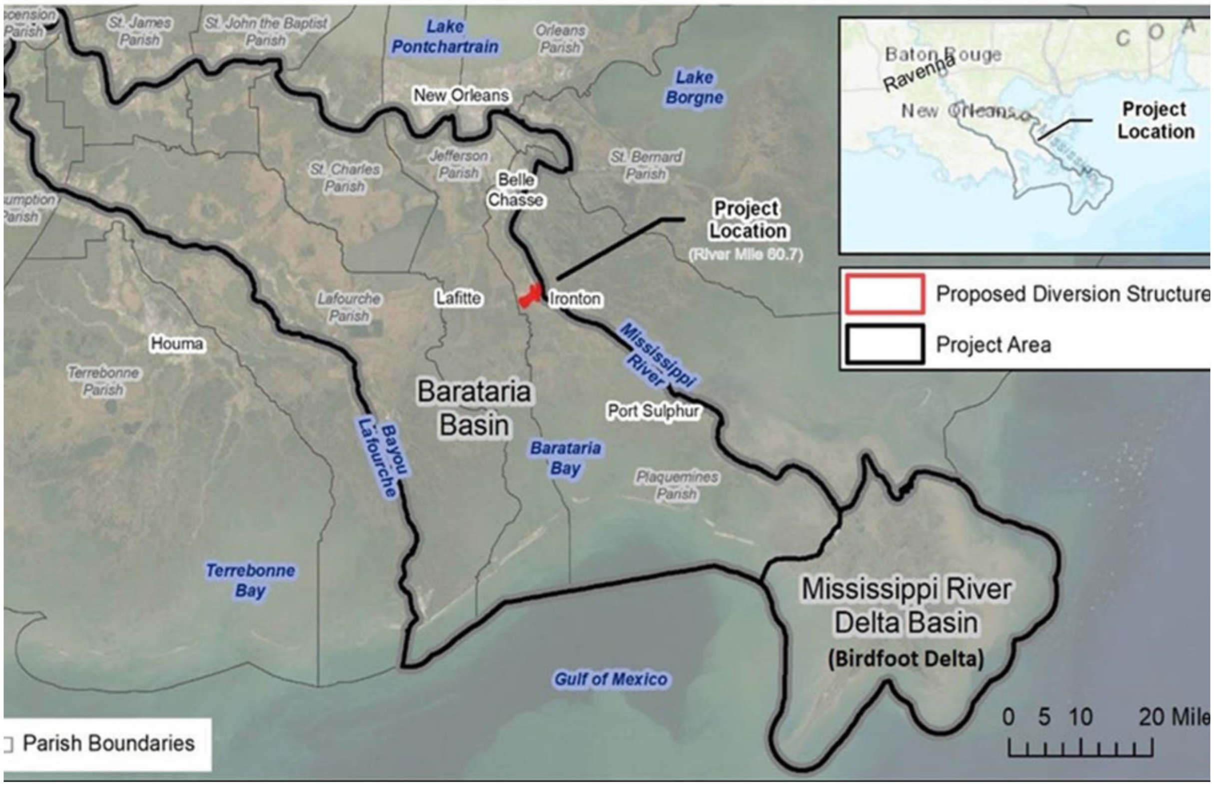


Figure 4. Project Action Area – Barataria Basin, Birdfoot Delta Basin and proposed diversion structure (LA TIG 2021).



3. CONCURRENCE

The USACE and LA TIG determined that the Action is not likely to adversely affect the Eastern black rail, piping plover, red knot, West Indian manatee, and nesting beaches for the Kemp's ridley sea turtle, and the loggerhead sea turtle. The USACE and LA TIG also determined that the Action would have no effect on critical habitat for the piping plover or proposed critical habitat for the red knot, as well as, nesting beaches for the green sea turtle, hawksbill sea turtle, and leatherback sea turtle. The Service concurs with these determinations, for reasons we explain in this section.

Eastern Black Rail

The Eastern black rail is a small, secretive marsh bird that inhabits both freshwater and saltwater marshes. The cryptic nature of this species makes accurate assessments of its range and habits difficult. A small number of observations were recorded in Louisiana between 2010 and 2017 (Service 2018). They are known to winter in the marshes of Vermilion and Cameron Parishes. There is anecdotal reports suggesting black rails may be on Grand Isle and Elmer's Island; however, surveys conducted since the Deepwater Horizon oil spill have not documented black rails there. Suitable habitat for this species is found within the project area and will be impacted, the predominantly brackish marsh in this area will transition to fresh/intermediate marsh within the mid-basin over time, and black rails are also known to utilize that marsh type. In addition, although temporary construction activities may disturb or displace the species present in the habitat near the activities, these impacts are temporary; therefore, the Service concurs with the USACE's and LA TIG's determination that the proposed project may affect, but is not likely to adversely affect the Eastern black rail.

Piping Plover and Designated Critical Habitat

The piping plover is a small (7 inches long), pale, sand-colored shorebird that winters in coastal Louisiana and may be present for 8 to 10 months annually. Piping plovers arrive from their northern breeding grounds as early as late July and remain until late March or April. They feed on polychaete marine worms, various crustaceans, insects and their larvae, and bivalve mollusks that they peck from the top of or just beneath the sand. Piping plovers forage on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation. They roost in unvegetated or sparsely vegetated areas, which may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. They also forage and roost in wrack (i.e., seaweed or other marine vegetation) deposited on beaches. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Infrequently during migration, piping plovers occur within mudflats and estuarine habitat in the Barataria Basin. Within the action area, wintering piping plovers have been documented on the barrier islands of the lower Barataria Basin including Grand Isle and Elmer's

Island as well as barrier islands adjacent to the South Pass entrance to the Mississippi River (Elliot-Smith et al. 2015).

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132); a map and descriptions of the seven critical habitat units in Louisiana can be found at https://www.fws.gov/plover/FR_notice/finalchnotice-91-95%20Louisiana.pdf. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. Designated critical habitat for wintering piping plovers in the action area include the coastal shoreline and barrier islands extending from the western edge of the action area east to the Grande Terre Islands, and certain barrier islands in the Birdfoot Delta at the mouth of the Mississippi River.

Piping plovers are not likely to occur within the construction area of the project and operation of the diversion is not likely to change the coastal processes that influence barrier island morphology. Impacts to piping plover critical habitat are not anticipated. Accordingly, the Service concurs with the USACE's and LA TIG's determination that the Action may affect, but is not likely to adversely affect the piping plover and will have no effect on piping plover critical habitat.

Red Knot and Proposed Critical Habitat

The red knot is a medium-sized shorebird about 9 to 11 inches in length with a proportionately small head, small eyes, short neck, and short legs. The red knot breeds in the central Canadian arctic but is found in Louisiana during spring and fall migrations and the winter months (generally September through early May). During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams (*Donax variabilis*), a frequent and often important food resource for red knots, are common along many gulf beaches.

On July 15, 2021, the Service proposed to designate 649,066 acres of critical habitat across 13 states for the red knot. Much of the area proposed for critical habitat in Louisiana, overlaps the designated critical habitat for piping plover.

Much like the piping plover and its designated critical habitat, red knots are not likely to occur within the construction area of the project and operation of the diversion is not likely to change the coastal processes that influence barrier island morphology. Impacts to red knot proposed critical habitat are also not anticipated. Therefore, the Service concurs with the USACE's and LA TIG's determination that the Action may affect, but is not likely to adversely affect the red knot and will have no effect on red knot proposed critical habitat.

West Indian Manatee

The West Indian manatee is a large gray or brown marine mammal known to regularly occur in Lakes Pontchartrain and Maurepas and their associated coastal waters and streams. It also can be found less regularly in other Louisiana coastal areas, most likely while the average water temperature is warm. Based on data maintained by the LDWF, there were 269 reported manatee sightings from 1990-2020 in Louisiana, 14 of which occurred within the Barataria Basin. Presence of manatee in the action area is possible; however, they are transient visitors during warmer months and are not a resident species. While construction activities may temporarily disturb or displace manatees present near construction activities, manatee protection measures identified in Section 2 are anticipated to avoid or minimize impacts to manatees. Operation of the diversion is predicted to reduce water temperatures in the Barataria Basin greatest during the winter and early spring and near the outfall site; however, manatees are present in the action area during summer months or when water temperatures are tolerable for them. Accordingly, the Service concurs with the USACE's and LA TIG's determination that the proposed project may affect, but is not likely to adversely affect the West Indian manatee.

Sea Turtles

There are five species of federally listed threatened or endangered sea turtles (green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle) that forage in the near shore waters, bays, and estuaries of Louisiana. The Service and National Marine Fisheries Service (NMFS) share jurisdiction over five listed sea turtle species. When sea turtles leave the marine environment and come onshore to nest, the Service is responsible for those species. Two species, the loggerhead sea turtle (*Caretta caretta*) and Kemp's ridley *(Lepidochelys kempii*) could potentially nest in Louisiana during the summer months (i.e., May through November). Historical records indicate that loggerheads nested on the Chandeleur Islands. On June 29 and July 3, 2015, two records of adult female loggerhead sea turtles nesting on Grand Isle represent the first confirmed sea turtle nesting on the coast of Louisiana for 30 years (Louisiana Sportsman 2015). The Kemp's ridley is known to nest in coastal Texas and Alabama, and nesting attempts were observed on the Chandeleur Islands of Louisiana; thus, nesting attempts could possibly occur in Louisiana as that species achieves recovery. There are no records indicating nesting of the green sea turtle, hawksbill sea turtle, or leatherback sea turtle on Louisiana beaches. Upland nesting habitat for sea turtles are not anticipated to experience impacts from the proposed project. Therefore, the Service concurs with the USACE's and LA TIG's determination that the proposed project may affect, but is not likely to adversely affect the Kemp's ridley sea turtle and loggerhead sea turtle and will have no effect on the green sea turtle, hawkbill sea turtle, and leatherback sea turtle.

This concurrence concludes consultation for the listed species and designated critical habitats named in this section, and these are not further addressed in this BO. The circumstances described in the Reinitiation Notice (Section 7) of this BO that require reinitiating consultation for the Action, except for exceeding the amount or extent of incidental take, also apply to these species and critical habitats.

4. Pallid Sturgeon

4.1. Status of Pallid Sturgeon

This section summarizes best available data about the biology and current condition of pallid sturgeon throughout its range that are relevant to formulating an opinion about the Action. The

Service published its decision to list the pallid sturgeon as endangered on October 9, 1990 (55 FR 36641-36647). The reasons for listing were habitat modification, apparent lack of natural reproduction, commercial harvest, and hybridization in parts of its range. Critical habitat has not been proposed or designated for the pallid sturgeon. The Service conducted a 5-year review of the species' status and revised the recovery plan in 2014, and determined that no status change was needed at that time. Most of the background information on pallid sturgeon biology and status presented throughout this BO is taken directly from information presented in the recently revised recovery plan (Service 2014a) and eight other BOs involving the species (Service 2009; Service 2010a; Service 2014b; Service 2018; Service 2020, Service 2021a, and Service 2021b).

4.1.1. Description of Pallid Sturgeon

The pallid sturgeon is a benthic, riverine fish that occupies the Mississippi River Basin, including the Mississippi River, Missouri River, and their major tributaries (i.e., Platte, Yellowstone, and Atchafalaya rivers) (Service 1990).

Recent studies have documented extensive hybridization between pallid sturgeon and shovelnose sturgeon in the Lower Mississippi River (Coastal Plain Management Unit) (Jordan et al., 2019). These studies also confirmed that small numbers of genetically pure pallid sturgeon continue to occupy the Lower Mississippi River; however, genetic analysis is required for their accurate identification. There is currently no official Service policy for the protection of hybrids under the Act, and the protection of hybrid progeny of endangered or threatened species is evaluated as necessary. For example, the protection of hybrids to facilitate law enforcement is recognized as appropriate under the Act (§4(3)) in cases where they are sympatric with pure species and morphologically difficult to distinguish. The duration and significance of hybridization between pallid sturgeon and shovelnose sturgeon is currently unknown, and it is not possible to visually distinguish pure pallid sturgeon from introgressed pallid sturgeon; therefore, for the purposes of management and consultation, we are considering all phenotypic pallid sturgeon as protected under the Act.

The pallid sturgeon can grow to lengths of over 6 feet (ft) (1.8 meters [m]) and weights in excess of 80 pounds (lbs) (36 kilograms [kg]) in the upper Missouri River portion of its range. In the Mississippi River, specimens seldom exceed 3 ft (1 m) in length, or 20 lbs (9 kg) in weight. Pallid sturgeon have a flattened, shovel-shaped snout, a long, slender, and completely armored caudal peduncle, and lack a spiracle (Smith 1979). As with other sturgeon, the mouth is toothless, protrusible, and ventrally positioned under the snout. The skeletal structure is primarily cartilaginous (Gilbraith et al. 1988). Pallid sturgeon are similar in appearance to the more common and darker SS, and may be visually distinguished by the proportional lengths of inner and outer barbels, mouth width, proportion of head width to head length, proportion of head length to body length, and other characteristics. As noted above, morphological pallid sturgeon require genetic analysis to determine hybridization.

4.1.2. Life History of Pallid Sturgeon

Habitat

Pallid sturgeon habitats can generally be described as large, free-flowing, warm water, turbid river habitats with a diverse assemblage of physical attributes that are in a constant state of change (Service 1993, 2014). Floodplains, backwaters, chutes, sloughs, islands, sandbars and main channel waters form the large river ecosystem that provide the macrohabitat requirements for all life stages of pallid sturgeon. Throughout its range, pallid sturgeon tend to select main channel habitats (Bramblett 1996; Sheehan et al. 1998; Service 2014a; Schramm et al. 2017); in the Lower Mississippi River (LMR), they have been found in a variety of main channel habitats, including natural and engineered habitats (Herrala et al. 2014).

Pallid sturgeon are thought to occupy the sandy main channel in the Mississippi, Missouri, and Yellowstone rivers most commonly, but also are collected over gravel substrates (Service 2014a; Bramblett and White 200l; Hurley et al. 2004; Garvey et al. 2009; Koch et al. 2012). Several studies have documented pallid sturgeon near islands and dikes, and these habitats are thought to provide a break in water velocity and an increased area of depositional substrates for foraging (Garvey et al. 2009; Koch et al. 2012). Increased use of side channel and main channel islands has been noted in spring, and it is hypothesized that these habitats may be used as refugia during periods of increased flow (Garvey et al. 2009; Koch et al. 2012; Herrala et al. 2014). Recent telemetry monitoring of adult pallid sturgeon in the LMR indicates use of most channel habitats, including dikes, revetment, islands, secondary channels, etc. (Kroboth et al. 2013; Herrala et al. 2014). Islands and secondary channels are important in recruitment of larval sturgeon in the LMR (Hartfield et al. 2013).

Pallid sturgeon occur within a variety of flow regimes (Garvey et al. 2009). In their upper range, adult pallid sturgeon are collected in depths that vary between 1.97-47.57 ft with bottom water velocities ranging from 2.20 ft/s and 2.62 ft/s (Service 2014a; Bramblett and White 2001; Gerrity 2005). Pallid sturgeon in the LMR have been collected at depths greater than 65 ft with a mean value of 32.81 ft, and water velocities greater than 5.91 ft/s with a mean value of 2.30 ft/s (ERDC unpublished data; Herrala et al. 2014). Turbidity is thought to be an important factor in habitat selection by pallid sturgeon, which have a tendency to occupy more turbid habitats than shovelnose sturgeon (Blevins 2011). In the LMR, pallid sturgeon have been collected in turbidities up to 340 Nephelometric Turbidity Units (NTU's) with a mean value of 90 NTU's (ERDC unpublished data).

Much of the natural habitat throughout the range of pallid sturgeon has been altered by humans, and this is thought to have had a negative impact on this species (Service 2014a). Habitats were once very diverse, and provided a variety of substrates and flow conditions (Baker et al. 1991; Service 1993). Extensive modification of the Missouri and Mississippi rivers over the last 100 years has drastically changed the form and function of the river (Baker et al. 1991; Prato 2003). Today, habitats are reduced and fragmented and much of the Mississippi River basin has been channelized to aid in navigation and flood control (Baker et al. 1991). The extent of impacts from range-wide habitat alteration on the pallid sturgeon is unknown, but recent studies have shown that in the unimpounded reaches (i.e., LMR), suitable habitat is available and supports a diverse aquatic community (Service 2007).

Movement

Like other sturgeon, pallid sturgeon is a migratory fish species that moves upstream annually to spawn (Koch et al. 2012). Movements are thought to be triggered by increased water temperature and flow in spring months (Garvey et al. 2009; Blevins 2011). Pallid sturgeon may remain sedentary, or remain in one area for much of the year, and then move either upstream or downstream during spring (Garvey et al. 2009; Herrala and Schramm 2017). It is possible that because movement in large, swift rivers requires a great amount of energy, this relatively inactive period may be a means to conserve energy (Garvey et al. 2009). Most active periods of movement in the upper Missouri River were between March 20 and June 20 (Bramblett and White 2001). In one study, individual fish traveled an average of 3.73 mi/day and one individual traveled over 9.94 mi/day (Garvey et al. 2009). Pallid sturgeon in the Missouri River have been reported to travel up to 5.90 mi/hour and 13.30 mi/day during active periods (Bramblett and White 2001). Based on a surrogate study that documented recaptures of shovelnose sturgeon in the Missouri River originally tagged in the LMR, pallid sturgeon may similarly undertake long-distance, multi- year upstream movements. Upstream distances approaching 1,245 mi have been recorded (ERDC unpublished data) and similar distances have been recorded for downstream movements (Service unpublished data).

Aggregations of pallid sturgeon have been reported in several locations in the middle Mississippi River, particularly around gravel bars, including one annual aggregation at the Chain of Rocks Dam, which is thought to be related to spawning activities (Garvey et al. 2009). Aggregations of pallid sturgeon in the lower 8.70 mi of the Yellowstone River are also thought to be related to spawning activities of sturgeon from the Missouri River (Bramblett and White 2001). Pallid sturgeon have been found to have active movement patterns during both the day and night, but they move mostly during the day (Bramblett and White 2001). There have been no verified spawning areas located in the LMR.

Feeding

Sturgeon are benthic feeders and are well adapted morphologically (ventral positioning of the mouth, laterally compressed body) for the benthic lifestyle (Service 1993; Findeis 1997). Adult pallid sturgeon are primarily piscivorous (but still consume invertebrates), and are thought to switch to piscivory around age 5 or 6 (Kallemeyn 1983; Carlson et al. 1985; Hoover et al. 2007; Grohs et al. 2009). In a study of pallid sturgeon in the middle and lower Mississippi River, fish were a common dietary component and were represented primarily by Cyprinidae, Sciaenidae, and Clupeidae (Hoover et al. 2007). Other important dietary items for pallid sturgeon in the Mississippi River were larval Hydropsychidae (lnsecta: Trichoptera), Ephemeridae (lnsecta: Ephemeroptera), and Chironomidae (lnsecta: Diptera) (Hoover et al. 2007). Pallid sturgeon diet varies depending on season and location, and these differences probably are related to prey availability (Hoover et al. 2007). In a Mississippi River dietary study, Trichoptera and Ephemeroptera were consumed in greater quantities in winter months in the lower Mississippi River, while the opposite trend was observed in the middle Mississippi River (Hoover et al.

2007). Hoover et al. (2007) also found that in both the middle Mississippi River and the lower Mississippi River, dietary richness is greatest in winter months.

4.1.3. Numbers, Reproduction, and Distribution of Pallid Sturgeon

Spawning

Freshwater sturgeon travel upstream to spawn between the spring equinox and summer solstice, and it is possible that either a second or an extended spawning period may occur in the fall in southern portions of the range (i.e., Mississippi River) (Service 2007; Wildhaber et al. 2007; Schramm et al. 2017). These spawning migrations are thought to be triggered by several cues, including water temperature, water velocity, photoperiod, presence of a mate, and prey availability (Keenlyne 1997; DeLonay et al. 2007; DeLonay et al. 2009; Blevins 2011). Gamete development is completed during the upstream migration and sturgeon are thought to spawn near the apex of their migration (Bemis and Kynard 1997). Data suggests that female *Scaphirhynchus* spp. do not reach sexual maturity until ages 6-17 and spawn every 2-3 years, and that males do not reach sexual maturity until ages 4-9 (Keenlyne and Jenkins 1993; Colombo et al. 2007; Stahl 2008; Divers et al. 2009). Pallid sturgeon and shovelnose sturgeon at lower latitudes (e.g., lower Mississippi River) may begin spawning at an earlier age than those in upper portions of the range (e.g., Upper and Middle Mississippi and Missouri Rivers) because they are thought to have shorter lifespans and smaller sizes (George et al. 2012). Also, LMR pallid sturgeon may be more highly fecund than those in northern portions of their range (George et al. 2012). It is thought that pallid sturgeon, like shovelnose sturgeon spawn over gravel substrates, but spawning has never been observed in this species (Service 1993; DeLonay et al. 2007; DeLonay et al. 2009).

Rearing

Pallid sturgeon hatch when they reach a total length (TL) of approximately ¼-inch. Larvae feed on yolk reserves and drift downstream for l l-17 days, until yolk reserves are depleted (Snyder 2002; Braaten et al. 2008; DeLonay et al. 2009). Length of drift and rate of yolk depletion are dependent on several factors, including water temperature, photoperiod, and water velocity (Snyder 2002; DeLonay et al. 2009). Larval drift is not completely understood and the impacts of artificial structures, as well as the role of eddies, are unknown (Kynard et al. 2007; Braaten et al. 2008). During drift, sturgeon repeat a "swim up and drift" pattern, in which they swim up in the water column from the bottom (<10 in) and then drift downstream (Kynard et al. 2002; Kynard et al. 2007). A hatchery series of shovelnose sturgeon from the Natchitoches National Fish Hatchery (NNFH) in Louisiana (J. Dean, unpublished data) reports complete yolk sac absorption at days 8-9 post-hatch, which is several days sooner than shovelnose sturgeon from Gavins Point National Fish Hatchery in South Dakota, so there could be a latitudinal difference in yolk absorption and larval maturation rates throughout the range of pallid sturgeon (Snyder 2002). The timing of exogenous feeding, which begins when yolk reserves are depleted and drifting has ceased, can differ latitudinally (DeLonay et al. 2009). The switch from endogenous to exogenous feeding is known as the “critical period", because mortality is likely if sturgeon do not find adequate food (Kynard et al. 2002; DeLonay et al. 2009). Pallid sturgeon begin exogenous feeding around 11-12 days post-hatch in upper portions of their range, but exogenous feeding was observed in fish as small as 17.82mm TL in the lower Mississippi River (Harrison et al., unpublished data), which could be as young as 6-8 days (based on unpublished age and growth data from NNFH) post-hatch (Braaten et al. 2007). The diets of young of year and juvenile pallid sturgeon and shovelnose sturgeon in upper portions of their ranges are much like those of the adult shovelnose sturgeon, and are primarily composed of aquatic insects and other benthic macroinvertebrates (Braaten et al. 2007; Wanner et al. 2007; Grohs et al. 2009; Klumb et al. 2009). Young of year and juvenile pallid sturgeon in the LMR feed primarily on Chironomidae over sand in channel habitats (Harrison et al. 2012, unpublished data). Juvenile pallid sturgeon are thought to switch to piscivory around ages 5-6 (Kallemeyn 1983; Carlson et al. 1985; Hoover et al. 2007; Grohs et al. 2009).

Kynard et al. (2002) found larval pallid sturgeon to be photopositive and showed little preference to substrate color, except for a slight preference for light substrates when exogenous feeding began. It is thought that pallid sturgeon become increasingly photonegative starting around day 11 post-hatch (Kynard et al. 2002). In this same study, larval sturgeon swam in open habitats, seeking no cover under rocks in the swimming tube, and aggregated in small groups around days 3-5 post-hatch (Kynard et al. 2002). The black tail phenotype of these young sturgeon is thought to aid in recognition and aggregation (Kynard et al. 2002). Pallid sturgeon have been observed swimming and drifting at a wide range (2-118 in) above the bottom depending on water velocities (although most fish are thought to stay in the lower 20 in of the water column), and drift velocities are thought to range from 0.98-2.29 ft/s (Kynard et al. 2002; Kynard et al. 2007; Braaten et al. 2008). Drift distance of larval sturgeon is thought to be between 85.75-329.33 mi (Kynard et al. 2007; Braaten et al. 2008). Juvenile pallid sturgeon have been found in water depths ranging from an average of 7.58-8.14 ft in the upper Missouri River (Gerrity 2005). Maximum critical swimming speeds for juvenile pallid sturgeon range from 0.32 ft/s to 0.82 ft/s, depending on size, with larger juveniles (6-8 in TL) able to withstand higher water velocities than their smaller counterparts (5-6 in TL) (Adams et al. 1999). In the Lower Mississippi River, larval sturgeon collections are associated with flooded sand bars in secondary channels and sand/gravel reefs in the main channel (Hartfield et al. 2013; Schramm et al 2017).

Distribution and Abundance

Pallid sturgeon occur in parts of the Mississippi River Basin, including the Mississippi River below the confluence of the Missouri River, and its distributary, the Atchafalaya River; and the Missouri River and its tributaries the Yellowstone and Platte Rivers (Kallemeyn 1983; Killgore et al. 2007). Recovery efforts have divided the extensive range of pallid sturgeon into four management units (Service 2013b) based on population variation (i.e., morphological, genetic) and habitat differences (i.e., physiographic regions, impounded, unimpounded reaches) throughout the extensive range of the pallid sturgeon (Service 2013b). These are:

> *Great Plains Management Unit (GPMU)*: The GPMU extends from Great Falls of the Missouri River, Montana, to Fort Randall Dam, South Dakota, and includes the Yellowstone, Marias, and Milk Rivers.
>
> *Central Lowlands Management Unit (CLMU)*: The CLMU includes the Missouri River from Fort Randall Dam, South Dakota, to the confluence of the Grand River, Missouri, and includes the lower Platte and lower Kansas Rivers.

Interior Highlands Management Unit (IHMU): The IHMU includes the Missouri River from the confluence of the Grand River, Missouri, to the confluence of the Mississippi River, Missouri, and the Mississippi River from Keokuk, Iowa, to the confluence of the Ohio River, Illinois.

Coastal Plain Management Unit (CPMU): The CPMU includes the LMR from the confluence of the Ohio River, Illinois, to the Gulf of Mexico, Louisiana (the action area of this consultation), and the Atchafalaya River distributary system, Louisiana.

To date, more than 1,100 pallid sturgeon have been captured in the CPMU since listing (more than 500 pallid sturgeon from the LMR, and more than 600 from the Atchafalaya River) (Killgore et al. 2007; Service database 2018), exceeding capture numbers from all other management units combined. Pallid to shovelnose ratios range between 1:6 to l:3 in the LMR, depending upon river reach, and 1:6 in the Atchafalaya River (Killgore et al. 2007; Service 2007). The ratio of pallid to shovelnose sturgeon in the lower Mississippi River reach where the BCS is located is typically 1:3 (ERDC 2013). Age-0 pallid sturgeon have been captured in both the LMR and the Atchafalaya, although it is unclear exactly where and when spawning occurs (ERDC, unpublished data; Hartfield et al. 2013). Age-0 and immature pallid sturgeon are difficult to distinguish from shovelnose sturgeon (Hartfield et al. 2013); however, capture data indicates annual recruitment of immature pallid sturgeon since 1991 (Service database 2013). The occurrence of *Scaphirhynchus* was extended from River Mile 85 downstream 50 miles to River Mile 33, when ERDC collected two young-of-year *Scaphirhynchus* sturgeon with a trawl in the lower Mississippi River in November of 2016 (USACE 2017).

4.1.4. Conservation Needs of and Threats to Pallid Sturgeon

Much of the following information is taken from Service documents (Service 2000, 2007, 2014b, 2018). The pallid sturgeon was listed due to the apparent lack of recruitment for over 15 years, and the habitat threats existing at the time of listing. Destruction and alteration of habitats by human modification of the river system is believed to be the primary cause of declines in reproduction, growth, and survival of the pallid sturgeon. The historic range of pallid sturgeon as described by Bailey and Cross (1954) encompassed the middle and lower Mississippi River, the Missouri River, and the lower reaches of the Platte, Kansas, and Yellowstone Rivers. Bailey and Cross (1954) noted a pallid sturgeon was captured at Keokuk, Iowa, at the Iowa and Missouri state border. Duffy et al. (1996) stated that the historic range of pallid sturgeon once included the Mississippi River upstream to Keokuk , Iowa, before that reach of the river was converted into a series of locks and dams for commercial navigation (Coker 1930).

Habitat destruction/modification and the curtailment of range were primarily attributed to the construction and operation of dams on the upper Missouri River and modification of riverine habitat by channelization of the lower main stems of the Missouri and Mississippi Rivers. Dams substantially fragmented pallid sturgeon range in the upper Missouri River. However, free-flowing riverine conditions currently exist throughout the lower 2,000 mi (3,218 km) (60 percent) of the pallid sturgeon historical range. Although the lower Missouri River continues to be impacted by regulated flows and modified habitats, actions have been developed and are being implemented to address habitat issues. Recent studies and data from the Mississippi River suggests that riverine habitats are less degraded than previously believed, and that they continue to support diverse and productive aquatic communities, including pallid sturgeon. Although there are ongoing programs to protect and improve habitat conditions in the four management units, positive effects from these programs on pallid sturgeon have not been quantified.

Carlson and Pflieger (1981) stated that pallid sturgeon are rare but widely distributed in both the Missouri River and in the Mississippi River downstream from the mouth of the Missouri River. A comparison of pallid sturgeon and shovelnose sturgeon catch records provides an indication of the rarity of pallid sturgeon. At the time of their original description, pallid sturgeon composed 1 in 500 river sturgeon captured in the Mississippi River at Grafton, Illinois (Forbes and Richardson 1905). Pallid sturgeon were more abundant in the lower Missouri River near West Alton, Missouri, representing one-fifth of the river sturgeon captured (Forbes and Richardson 1905). Carlson et al. (1985) captured 4,355 river sturgeon in 12 sampling stations on the Missouri and Mississippi Rivers. Field identification revealed 11 (0.25 percent) pallid sturgeon. Grady et al. (2001) collected 4,435 river sturgeon in the lower 850 mi (1,367 km) of the Missouri River and 100 mi (161 km) of the middle Mississippi River from November 1997 to April 2000. Field identification revealed nine wild (0.20 percent) and nine hatchery-origin pallid sturgeon.

Today, pallid sturgeon, although variable in abundance, are ubiquitous throughout most of the free flowing Mississippi River. When the pallid sturgeon was listed as endangered they were only occasionally found in the following areas; from the Missouri River: 1) between the Marias River and Fort Peck Reservoir in Montana; 2) between Fort Peck Dam and Lake Sakakawea (near Williston, North Dakota); 3) within the lower 70 mi (113 km) of the Yellowstone River downstream of Fallon, Montana; 4) in the headwaters of Lake Sharpe in South Dakota; 5) near the mouth of the Platte River near Plattsmouth, Nebraska; and, 6) below River Mile 218 to the mouth in the State of Missouri.

Keenlyne (1989) updated previously published and unpublished information on distribution and abundance of pallid sturgeon. He reported pre-1980 catch records for the Mississippi River from its mouth upstream to its confluence with the Missouri River, a length of 1,153 mi (1,857 km); in the lower 35 mi (56 km) of the Yazoo/Big Sunflower and St. Francis Rivers (tributaries to the Mississippi); in the Missouri River from its mouth to Fort Benton, Montana, a length of 2,063 mi (3,323 km); and, in the lower 40 mi (64 km) of the Kansas River, the lower 21 mi (34 km) of the Platte River, and the lower 200 mi (322 km) of the Yellowstone River (tributaries to the Missouri River). The total range is approximately 3,500 mi (5,635 km) of river.

Currently, the Missouri River (1,154 mi) (1,857 km) has been modified significantly with approximately 36 percent of the riverine habitat inundated by reservoirs, 40 percent channelized, and the remaining 24 percent altered due to dam operations (Service 1993). Most of the major tributaries of the Missouri and Mississippi Rivers have also been altered to various degrees by dams, water depletions, channelization, and riparian corridor modifications.

The middle Mississippi River, from the mouth of the Missouri River to the mouth of the Ohio River, is principally channelized with few remaining secondary channels, sand bars, islands and abandoned channels. The middle Mississippi River has been extensively diked; navigation channels and flood control levees have reduced the size of the floodplain by 39 percent.

Levee construction along the lower Mississippi River, from the Ohio River to the Gulf, has eliminated major natural floodways and reduced the land area of the floodplain by more than 90 percent (Fremling et al. 1989). Fremling et al. (1989) also report that levee construction isolated many floodplain lakes and raised river banks. As a result of levee construction, 15 meander loops were severed between 1933 and 1942.

Destruction and alteration of big-river ecological functions and habitats once provided by the Missouri and Mississippi Rivers were believed to be the primary cause of declines in reproduction, growth, and survival of pallid sturgeon (Service 2014a). The physical and chemical elements of channel morphology, flow regime, water temperature, sediment transport, turbidity, and nutrient inputs once functioned within the big-river ecosystem to provide habitat for pallid sturgeon and other native species. On the main stem of the Missouri River today, approximately 36 percent of riverine habitat within the pallid sturgeon range has been transformed from river to lake by construction of six massive earthen dams by the USACE between 1926 and 1952 (Service 1993). Another 40 percent of the river downstream of the dams has been channelized. The remaining 24 percent of river habitat has been altered by changes in water temperature and flow caused by dam operations.

The channelized reach of the Missouri River downstream of Ponca, Nebraska, once a diverse assemblage of braided channels, sandbars, and backwaters, is now confined within a narrow channel of rather uniform width and swift current. Morris et al. (1968) found that channelization of the Missouri River reduced the surface area by approximately 67 percent. Funk and Robinson (1974) calculated that, following channelization, the length of the Missouri River between Rulo, Nebraska, and its mouth (~500 river miles) (310 km) had been reduced by 8 percent, and the water surface area had been reduced by 50 percent.

Missouri River aquatic habitat between and downstream of main stem dams has been altered by reductions in sediment and organic matter transport/deposition, flow modification, hypolimnetic releases, and narrowing of the river through channel degradation. Those activities have adversely impacted the natural river dynamics by reducing the diversity of bottom contours and substrates, slowing accumulation of organic matter, reducing overbank flooding, changing seasonal patterns, severing flows to backwater areas, and reducing turbidity and water temperature (Hesse 1987). The Missouri River dams also are believed to have adversely affected pallid sturgeon by blocking migration routes and fragmenting habitats (Service 2014a).

The pattern of flow velocity, volume, and timing of the pre-development rivers provided the essential life requirements of native large-river fishes like the pallid sturgeon and paddlefish. Hesse and Mestl (1993) found a significant relationship between the density of paddlefish larvae and two indices (timing and volume) of discharge from Fort Randall Dam. They concluded that when dam operations caused discharge to fluctuate widely during spring spawning, the density of drifting larvae was lower, and when annual runoff volume was highest, paddlefish larval density was highest. Hesse and Mestl (1987) also modeled these same two indices of discharge from Fort Randall Dam with an index of year-class strength. They demonstrated significant negative relationships between artificial flow fluctuations in the spring and poor year-class development for several native and introduced fish species including river carpsucker, shorthead redhorse, channel catfish, flathead catfish, sauger, smallmouth buffalo, and bigmouth buffalo. The sample size of sturgeon was too small to model in that study; however, a clear relationship existed between poor year-class development in most native species studied and the artificial hydrograph.

Modde and Schmulbach (1973) found that during periods of low dam releases, the secondary subsidiary channels, which normally feed into the river channel, become exposed to the atmosphere and thus cease to contribute littoral benthic organisms into the drift. Schmulbach (1974) states that use of sandbar habitats were second only to cattail marsh habitats as nursery ground for immature fishes of many species.

Even though extensive flood control, water supply, and navigation projects constrict and control the Missouri and Mississippi Rivers with reservoirs, stabilized banks, jetties, dikes, levees, and revetments, relatively unaltered remnant reaches of the Missouri River and the Mississippi River from the Missouri River confluence to the Gulf of Mexico still provide habitat useable by pallid sturgeon. However, anthropogenic alterations (i.e., levee construction) effectively increased river stage and velocities at higher discharges by preventing overbank flows on the adjacent floodplains (Baker et al. 1991).

The upper ends of the reservoirs in the upper basin may be influencing the recruitment of larval sturgeon. Both shovelnose sturgeon and pallid sturgeon larvae have a propensity to drift after hatching (Kynard et al. 1998a, 1998b). Bramblett (1996) found that the pallid sturgeon may be spawning in the Yellowstone River between River Mile 9 and River Rile 20 upriver, and that from historic catch records, there is some evidence to indicate that the occurrence of pallid sturgeon catches coincide with the spring spawning at the mouth of the Tongue River (Service 2000). Shovelnose sturgeon have been found to spawn in the tributaries of the Yellowstone River as well as such areas as the Marias, Teton, Powder and Tongue Rivers (Service 2000). Shovelnose sturgeon are successfully recruiting and reproducing in the river stretches in the upper basin and this may be directly related to the amount of larval and juvenile habitat they have available downstream of the spawning sites.

Early indications in culturing pallid sturgeon indicate that sturgeon larvae will not survive in a silty substrate. In 1998, most of the larval sturgeon held in tanks at Gavins Point National Fish Hatchery (NFH), experienced high mortality when the water supply contained a large amount of silt which settled on the bottom of the tanks. Migration routes to spawning sites on the lower Yellowstone River have been fragmented by low-head dams used for water supply intakes. Such habitat fragmentation has forced pallid sturgeon to spawn closer to reservoir habitats and reduced the distance larval sturgeon can drift after hatching.

Historically, pallid, shovelnose, and lake sturgeon were commercially harvested in all States on the Missouri and Mississippi Rivers (Helms 1974). The larger lake sturgeon and pallid sturgeon were sought for their eggs which were sold as caviar, whereas shovelnose sturgeon were historically destroyed as bycatch. Commercial harvest of all sturgeon has declined substantially since record-keeping began in the late 1800s. Most commercial catch records for sturgeon have not differentiated between species and combined harvests as high as 430,889 lb (195,450 kg) were recorded in the Mississippi River in the early 1890s, but had declined to less than 20,061 lb (9,100 kg) by 1950 (Carlander 1954). Lower harvests reflected a decline in shovelnose sturgeon abundance since the early 1900s (Pflieger 1975). Today, commercial harvest of SS is still allowed in 5 of the 13 states where pallid sturgeon occur.

Mortality of pallid sturgeon occurs as a result of illegal and incidental harvest from both sport and commercial fishing activities (Service 2000). Sturgeon species, in general, are highly vulnerable to impacts from fishing mortality due to unusual combinations of morphology, habits, and life history characteristics (Boreman 1997). In 1990, the head of a pallid sturgeon was found at a sport-fish cleaning station in South Dakota, and in 1992 a pallid sturgeon was found dead in a commercial fisherman's hoop net in Louisiana. In 1997, four pallid sturgeon were found in an Illinois fish market (Sheehan et al. 1997). It is probable that pallid sturgeon are affected by the illegal take of eggs for the caviar market. In 1999, a pallid sturgeon that was part of a movement and habitat study on the lower Platte River was harvested by a recreational angler (Service 2000). Bettoli et al. (2008) found 1.8 percent of the total sturgeon catch in Tennessee caviar harvest were composed of pallid sturgeon. In addition, such illegal and incidental harvest may skew pallid sturgeon sex ratios such that hybridization with shovelnose is exacerbated. Killgore et al. (2007) indicated that higher mortality rates for pallid sturgeon in the Middle Mississippi River may be a result of habitat limitation and incidental take by the commercial shovelnose fishery.

Currently, only a sport and/or aboriginal fishery exist for lake sturgeon, due to such low population levels (Todd 1998). SS are commercially harvested in eight states and a sport fishing season exists in a number of states (Mosher 1998). Although information on the commercial harvest of shovelnose sturgeon is limited, Illinois reported the commercial harvest of shovelnose sturgeon was 43,406 lbs (19,689 kg) of flesh and 233 lbs (106 kg) of eggs in 1997 and Missouri reported a 52-year mean annual harvest of 8,157 lbs (3,700 kg) of flesh (Todd 1998) and an unknown quantity of eggs for 1998. Missouri also has a sport fishery for shovelnose sturgeon but has limited data on the quantities harvested (Mosher 1998).

The previous lack of genetic information on the pallid sturgeon and shovelnose sturgeon led to a hybridization debate. In recent years, however, several studies have increased our knowledge of the genetic, morphological, and habitat differences of those two species. Campton et al. (1995) collected data that support the hypothesis that pallid sturgeon and shovelnose sturgeon are reproductively isolated in less altered habitats, such as the upper Missouri River. Campton et al. (2000) suggested that natural hybridization, backcrossing, and genetic introgression between pallid sturgeon and shovelnose sturgeon may be reducing the genetic divergence between those species. Sheehan has identified 86 separate loci for microsatellite analysis that are being used to differentiate between pallid sturgeon, shovelnose sturgeon, and suspected hybrid sturgeon (Service 2000).

Bramblett (1996) found substantial differences in habitat use and movements between adult pallid sturgeon and shovelnose sturgeon in less altered habitats. Presumably, the loss of habitat diversity caused by human-induced environmental changes inhibits naturally occurring reproductive isolating mechanisms. Campton et al. (1995) and Sheehan et al. (1997) note that hybridization suggests that similar areas are currently being used by both species for spawning.

Carlson et al. (1985) studied morphological characteristics of 4,332 sturgeon from the Missouri and middle Mississippi Rivers. Of that group, they identified 11 pallid sturgeon and 12 pallid sturgeon /shovelnose sturgeon hybrids. Suspected hybrids have recently been observed in commercial fish catches on the lower Missouri and the middle and lower Mississippi Rivers (Service 2000). Bailey and Cross (1954) did not report hybrids, which may indicate that hybridization is a recent phenomenon resulting from environmental changes caused by human-induced reductions in habitat diversity and measurable changes in environmental variables such as turbidity, flow regimes, and substrate types (Carlson et al. 1985). A study by Keenlyne et al. (1994) concluded that hybridization may be occurring in half the river reaches within the range of pallid sturgeon and that hybrids may represent a high proportion of remaining sturgeon stocks. Hartfield and Kuhajda (2009) stated that hybridization rates in the Mississippi River have been overestimated, and there is no direct evidence linking the morphological or genetic variation defined as hybridization between pallid sturgeon and shovelnose sturgeon in the lower Missouri, Mississippi, or Atchafalaya Rivers with recent anthropogenic activities. Hybridization could present a threat to the survival of pallid sturgeon through genetic swamping if the hybrids are fertile, and through competition for limited habitat (Carlson et al. 1985). Keenlyne et al. (1994) noted few hybrids showing intermediacy in all characteristics as would be expected in a first generation cross, indicating the hybrids are fertile and reproducing.

Hubbs (1955) indicated that the frequency of natural hybridization in fish was a function of the environment, and the seriousness of the consequences of hybridization depends on hybrid viability. Hybridization can occur in fish if spawning habitat is limited, if many individuals of one potential parent species lives in proximity to a limited number of the other parent species, if spawning habitat is modified and rendered intermediate, if spawning seasons overlap, or where movement to reach suitable spawning habitat is limited (Hubbs 1955). Any of those conditions, or a combination of them, could be causing the apparent breakdown of isolating mechanisms that prevented hybridization between these species in the past (Keenlyne et al. 1994). Hartfield and Kuhajada (2009) examined three of the five original specimens used to describe the pallid sturgeon and found that the character indices currently used to distinguish the fish identify some of the type specimens as hybrids. In conclusion, they stated they found no evidence directly linking habitat modification and hybridization particularly in the Mississippi River and no evidence that hybridization constitutes an anthropogenic threat to the pallid sturgeon.

More recent studies have documented extensive hybridization between pallid sturgeon and shovelnose sturgeon in the Lower Mississippi River (Coastal Plain Management Unit) (Jordan et al. 2019). These studies also confirmed that small numbers of genetically pure pallid sturgeon continue to occupy the Lower Mississippi River; however, genetic analysis is required for their accurate identification. Please refer to Section 3.1 Species Description for an explanation of why we consider all phenotypic pallid sturgeon as protected under the Act for the purposes of management and consultation.

Although more information is needed, pollution is also likely an exacerbating threat to the species over much of its range. Pollution of the Missouri River by organic wastes from towns, packing houses, and stockyards was evident by the early 1900s and continued to increase as populations grew and additional industries were established along the river. Due to the presence of a variety of pollutants, numerous fish-harvest and consumption advisories have been issued over the last decade or two from Kansas City, Missouri, to the mouth of the Mississippi River. That distance represents about 45 percent of the pallid sturgeon total range. Currently there are no advisories listed by the U.S. Environmental Protection Agency (EPA) south of Tennessee (approximately 710 miles).

Polychlorinated biphenyls (PCBs), cadmium, mercury, and selenium have been detected at elevated, but far below lethal, concentrations in tissue of three pallid sturgeon collected from the Missouri River in North Dakota and Nebraska. Detectable concentrations of chlordane, dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyltrichloroethane (DDT), and dieldrin also were found (Ruelle and Keenlyne 1994). The prolonged egg maturation cycle of pallid sturgeon, combined with bioaccumulation of certain contaminants in eggs, could make contaminants a likely agent adversely affecting eggs and embryos, as well as development or survival of fry, thereby reducing reproductive success.

In examining the similarities and differences between shovelnose sturgeon and pallid sturgeon, Ruelle and Keenlyne (1994) concluded that, while the shovelnose sturgeon may not meet all the traits desired for a surrogate, it may be the best available for contaminant studies. Conzelmann et al. (1997) reported that trace element concentrations in Old River Control Complex (ORCC) shovelnose sturgeon in Louisiana were generally higher than in shovelnose sturgeon from other areas. Certain trace elements can adversely affect reproduction, development, and may ultimately be lethal if concentrations are excessive. Most trace element levels were unremarkable; however, cadmium, copper, lead, and selenium concentrations were elevated in ORCC samples and may warrant concern (Conzelmann et al. 1997).

Conzelmann et al. (1997) also reported that organochlorine (OC) pesticide concentrations are the main environmental concern in Louisiana's shovelnose sturgeon, and consequently, in the pallid sturgeon. Shovelnose sturgeon OC concentrations were generally greater than were observed in fishes from other areas, and ORCC shovelnose sturgeon toxaphene levels were elevated compared to the National Contaminants Biomonitoring Program. Toxaphene possesses known carcinogenic, teratogenic, xenotoxic, and mutagenic properties; can cause suppression of the immune system; and may function as an endocrine system imitator, blocker, or disrupter (Colburn and Clements 1992). Those factors make toxaphene the greatest OC concern in ORCC SS and, by extension, the ORCC pallid sturgeon (Conzelmann et al. 1997). Further investigations are needed to identify contaminant sources in the Mississippi and Atchafalaya Rivers and to assess the role, if any, of contaminants in the decline of pallid sturgeon populations.

Another issue that is negatively impacting pallid sturgeon throughout its range is entrainment. The loss of pallid sturgeon associated with water intake structures has not been accurately quantified. The EPA published final regulations on Cooling Water Intake Structures for Existing Facilities per requirements of Section 316(b) of the Clean Water Act. The rule making was divided into three phases. However, only Phase I and II appear applicable to inland facilities; Phase III applies to coastal and offshore cooling intake structures associated with coastal and offshore oil and gas extraction facilities. The following rule summaries are based on information found at https://www.epa.gov/cooling-water-intakes. Phase I rules, completed in 2001, require permit holders to develop and implement techniques that will minimize impingement mortality and entrainment. Phase II, completed in 2004, covers existing power generation facilities that are designed to withdraw 50 million gallons per day or more with 25 percent of that water used for cooling purposes only. Phase II and the existing facility portion of Phase III were remanded to EPA for reconsideration and a final rule combined the remands into one rule in 2014. This rule, implemented through National Pollutant Discharge Elimination System permits, is intended to minimize negative effects associated with water cooling structures.

Section 316(b) of the Clean Water Act requires the EPA to insure that aquatic organisms are protected from impingement or entrainment. As part of the Phase II ruling, some power plants have begun conducting required entrainment studies. Preliminary data on the Missouri River suggests that entrainment may be a serious threat that warrants more investigation. Initial results from work conducted by Mid-America at their Neal Smith power facilities found hatchery-reared pallid sturgeon were being entrained (Jordan in litt. 2006; Ledwin in litt. 2006; Williams in litt. 2006). Over a 5-month period, four known hatchery-reared pallid sturgeon have been entrained, of which two were released alive and two were found dead. Ongoing entrainment studies required by the Clean Water Act will provide more data on the effects of entrainment. However, addressing entrainment issues may not occur immediately and continued take of hatchery reared or wild pallid sturgeon will limit the effectiveness of recovery efforts. In addition to cooling intake structures for power facilities, concerns have been raised regarding entrainment associated with dredge operations and irrigation diversions. Currently little data are available regarding the effects of dredge operations. However, the USACE St. Louis District, and the Dredging Operations and Environmental Research Program have initiated work to assess dredge entrainment of fish species and the potential effects that these operations may have on larval and juvenile *Scaphirhynchus*. Data for escape speed, station-holding ability, rheotaxis and response to noise, and dredge flow fields are being used to develop a risk assessment model for entrainment of sturgeon by dredges. Entrainment has been documented in the irrigation canal supplied by the Intake Dam on the Yellowstone River (Jaeger et al. 2004). Given that entrainment has been documented to occur in the few instances it has been studied, further evaluation of entrainment at other water withdrawal points is warranted across the pallid sturgeon range to adequately evaluate this threat. Entrainment of pallid sturgeon stocked in the Mississippi River into the Atchafalaya River via the ORCC has been documented by the capture of a tagged stocked sturgeon that was released into the Mississippi River.

BOs which allow the take of pallid sturgeon also represent a factor that should be considered when examining factors that could have an influence on the pallid sturgeon population. The table below (Table 1) presents all completed BOs for the LMR.

4.1.5. Tables and Figures for Status of Pallid Sturgeon

Table 1. BOs conducted for actions occurring on the Lower Mississippi River that impacted pallid sturgeon. Critical habitat is not designated for this species; thus, none is included here.

BOs (year)	Action Affecting PALLID STURGEON	Authorized Take	Take Reported
2003	BO addressing the Natchitoches National Fish Hatchery's Collection of Endangered Pallid Sturgeon from Louisiana Waters for Propagation and Research	90 adults/season for 5 season (harassment) 8 adults/season for 5 seasons (death)	23 harassment (2003)
2004	Modification to revise 2003 IT estimates for BO (4-7-3-702) on Natchitoches National Fish Hatchery's Activities	120 adults/season for 5 (harassment) 14 adults/season for (death) potential	329 (Atchafalaya) harassment (through 2010) 7 dead (2004)
2004	Programmatic BO addressing the effects of the Southeast region's Section 10(a)(1)(A) Permitting on the pallid sturgeon (5-years)	28 adults in captive propagation/year (death) 2,500 to 15,000 captive year-class 90 days old or older (one-time loss-death) 200 larval/juvenile/year sampling (death) 3, 5-inch or greater fish/year netting (death or injury) 3 fish/year external tagging (death or injury) 1 fish/year transport (death) 5 fish/year radio-tracking (death or injury)	461 (LMR) harassment (through 2012) 1 dead (2006) 2 dead (2007) 1 dead (2009)
2005	Modification 2 – adding new forms of take to the 2004 revised Incidental Take Statement (4-7-04-734) for the 2003 BO (4-7-03-702) on Natchitoches National Fish Hatchery's Activities	14 wild pallid sturgeon/season (death) 15,000 hatchery-reared pallid sturgeon/season (death)	NA
2009	BO addressing the 2008 Emergency Opening of Bonnet Carré Spillway, USACE	14 adults (harassment) 92 adults (death)	14 adult harassment Unknown deaths
2010	BO addressing the Medium White Ditch Diversion	23 adults/year (death) potential	0
2010	BO addressing the small diversion at Convent/Blind River	7 adults/year (death) potential	0
2010	BO addressing the Taxonomic ID study	100 adults (death)	76
2013	Modification of the Programmatic BO	21 adults/year(death) potential	0
2013	BO addressing the USACE CIP	Unspecified	0
2014	BO addressing the USACE Permits for Sand and Gravel Mining in the Lower Mississippi River	Unspecified	NA
2018	BO addressing the Bonnet Carré Spillway 2011 and 2016 Emergency Operations	2011 – 20 adults (harassment) 82 adults (death) 2016 – 26 adults (death)	2011 – 20 adults Unknown deaths 2016 – N/A Unknown deaths
2020	BO addressing the Bonnet Carré Spillway 2018 Emergency Operation	14 adults (death) 2 adults (harassment)	4 adults – 2 harassment, 2 dead
2021	BO addressing the Bonnet Carré Spillway 2019 Emergency Operations	83 adults (death) 18 adults (harassment)	19 adults – 18 harassment, 1 dead
2021	BO addressing the Bonnet Carré Spillway 2020 Emergency Operations	9 adults (death) 9 adults (harassment)	12 adults – 9 harassment, 3 dead
Total[1]		160 adults/year (harassment) 397 adults (death) 14-28/year (potential death) 200 larval fish/year (potential death) 2,500-15,000 year-class 90 days old or older (one-time loss-death)	867 adult harassment 90 adult known dead Unknown <200/year larvae collected

4.2. Environmental Baseline

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the pallid sturgeon, its habitat, and ecosystem within the Action Area. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR §402.02).

4.2.1. Action Area Numbers, Reproduction, and Distribution

The Action under consultation occurs within the LMR area of the Coastal Plains Management Area. The range-wide status of the pallid sturgeon within the action area is discussed within the STATUS OF THE SPECIES/CRITICAL HABITAT section above. As noted in that section, the abundance of pallid sturgeon in the Mississippi River is not precisely known; however, collection efforts show the species is widespread and not uncommon in the LMR. There is an estimated 95 percent probability that the population has more than four age 3+ pallid sturgeon per 6.44 RM (Friedenberg et al. 2018). Pallid sturgeon have been documented as occurring in the LMR adjacent to the Barataria Basin (LDWF 2014). While evidence of the abundance and age structure of the pallid sturgeon population downstream of New Orleans is scarce, two young-of-year *Scaphirhynchus spps.* were collected at RM 33, well below the proposed location of the Action, and the farthest downstream a mature individual has been captured was at RM 95 near New Orleans (Friedenberg and Siegrist 2019). The low numbers detected south of RM 85 could be due to low abundance of the species; however, it could also be attributed to the limited sampling effort in that area (J. Kilgore, personal communication, 2018).

Three potential density scenarios were used to estimate abundance of pallid sturgeon in the action area (Friedenberg and Siegrist 2019). These estimates were calculated on the local level, the LMR from the location of the sand weir to the Atchafalaya River at RM 312, as well as on the a scale occupying the entire LMR up to RM 953 at the confluence of the Ohio River (Table 2) The population density scenarios used to estimate pallid sturgeon population size are described as follows:

- **50% population density** – The assumption that pallid sturgeon population density falls by half downstream of New Orleans. The scenarios assumed there were 3.22 age 3+ pallid sturgeon/RM in the 45 RM between the sand weir and New Orleans, and for the 217 RM upstream to the Atchafalaya River, there were 6.44 age 3+ pallid sturgeon/RM.
- **10% population density** – Due to general agreement that pallid sturgeon population density decreases in the lower reaches of the LMR, it assumed a population density of 0.644 age 3+ pallid sturgeon/RM downstream of New Orleans.

- **Juveniles only** – Assumed the pallid sturgeon population in the vicinity of the diversion only included juveniles

The hard substrates that act as natural spawning habitat for pallid sturgeon are lacking in the LMR; therefore, spawning is assumed not to occur in this reach of the river (Baker et al. 1991, Dryer and Sandvol 1993, Friedenberg and Siegrist 2019).

4.2.2. Action Area Conservation Needs of and Threats

The action area conservation needs and threats would be among those previously discussed under STATUS OF THE SPECIES/CRITICAL HABITAT, but would include only those pertaining to the southern portion (LMR) of the species' range as previously described. This section of the river has been heavily modified for the purposes of navigation and has few remaining natural features necessary for the pallid sturgeon. Contaminants in water, sediments, or prey species could float down river and be in the vicinity of the action area which could affect any pallid sturgeon present.

While the Action Area would occur at RM 60.7 of the Mississippi River, north of this area other diversion structures are in operation that either are known to (Old River Control Complex and Bonnet Carré Spillway) or are suspected to (Caernarvon and Davis Pond) entrain pallid sturgeon. Since the pallid sturgeon has been listed, the Bonnet Carré Spillway has been opened nine times (1994, 1997, 2008, 2011, 2016, 2018, twice in 2019, and 2020). Entrainment rates of pallid sturgeon through the Bonnet Carré Spillway depend on water volume and velocity through structure, length of operation, and time of year of operation. At RM 50, below the Action Area, the USACE constructs a temporary sand weir using dredge material during low water months to manage salinity. It is believed that individuals below the temporary weir may be lost from the population due to low quality habitat as well as seasonal inhibition to upstream movement due to the weir.

4.2.3. Tables and Figures for Environmental Baseline

Table 2. Abundance of age 1+ pallid sturgeon used to calculate entrainment mortality at the scale of the local population and the LMR (Friedenberg and Siegrist 2019).

Age Structure	Pallid Sturgeon Abundance	
	Local Population	Lower Mississippi River Population
50% Density	1,954	7,177
10% Density	1,806	7,031
Juveniles Only	1,769	6,994
Source: Friedenberg et al. 2018		

4.3. Effects of the Action

This section analyzes the effects of the Action on the pallid sturgeon. Effects of the Action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action (50 CFR §402.02). Our analyses are organized according to the description of the Action and the defined Action Area in Section 2 of this BO.

4.3.1. Effects of Project Construction

Pallid sturgeon are known to occur within the Mississippi River near the diversion. During construction activities in the Mississippi River, such as dredging, vessel operations, pile driving and pier construction, there is a potential to disturb or injure pallid sturgeon near the action area. These sounds would be added to the baseline sound conditions of the Mississippi River. Noises from natural sources, such as wind-driven waves, storms, fish, currents, and vocalizing marine mammals are represented as ambient underwater sound levels. Underwater noise levels increase when anthropogenic sources are added to ambient noises. Anthropogenic underwater sound in the Mississippi River could be generated by fishing and recreational vessels, large commercial vessels, pile-driving, and dredging.

Collaboratively, NOAA, the Service, and the U.S. Federal Highway Administration established underwater sound levels for noise thresholds for fish behavior disruption and injury shown in Table 3 (WSDOT 2008). "Effective quiet" or safe exposure levels recognized by the National Marine Fisheries Service (NMFS) are as low as 150 decibels (dB); therefore, sounds below that level of effective quiet will not harass fish (NMFS 2016b). In-water construction and maintenance activities that could potentially increase underwater sound levels are described in Table 5.3.8-1 of the BA (LA TIG 2021). Vibratory pile driving generates generally 10 dBA to 20 dBA (A-weighted decibel scale) lower than impact driving; thus, the proposed project intends to use vibratory pile driving hammers where possible (WSDOT 2019). However, while quieter than impact pile driving, vibratory pile driving can still result in a cumulative sound energy effect. While vessel operations that occur in the river could produce in-water noise disturbance, those noise levels are less than the injury effects threshold (i.e., 206 dB_{PEAK}) and are composed of a different sound signature than pile driving activities.

Underwater noise calculations for impact pile driving in the Mississippi River are expected to produce underwater sound levels of up to 208 dB_{Peak}, 190 dB_{RMS}, and 180 dB SEL, while vibratory pile driving is expected to produce underwater sounds levels of 182 dB_{Peak}, 165 dB_{Rms}, and 165 dB SEL (NOAA 2018). Over a duration of 1 to 2 months, a total of 132, 30- to 36-inch-diameter pilings are proposed to be installed in the river using impact pile driving. Vibratory pile driving is anticipated to occur for 5 to 10 months in the river cofferdam vicinity.

Underwater sounds would be generated from impact pile driving activities to construct a pier and the cofferdam may be encountered by sturgeon within 3,281ft of these activities which could potentially injure those sturgeon, while behavioral impacts could extend to approximately 15,230 ft. The sounds from the impact pile driving activities would be the loudest underwater sound the species will encounter. These activities will be located along the western bank of the Mississippi River, where the river is approximately one-half mile wide near RM 60.7, which might not allow for unobstructed passage by fish through the areas of higher noise. Barotraumas (injuries caused by pressure waves, such as hemorrhage and rupture of internal organs), temporary stunning, and alterations in behavior are known to be caused by high underwater sound pressure levels (SPL) which can injure and/or kill fish (Turnpenny et al. 1994, Turnpenny and Nedwell 1994, Popper 2003, Hastings and Popper 2005). Sturgeon have swim bladders which makes them more susceptible to barotraumas from impulsive sounds than fish without swim bladders. Juvenile white sturgeon have been found to be more susceptible to barotrauma after initial feeding due to the potential for herniation in their intestines. While the swim bladders partially inflate later in development because of the physiology of the swim bladder in sturgeon, gas transfers from the swim bladder can be released through the sturgeon's mouth (Brown et al. 2013).

Although behavioral responses in fish due to elevated underwater sound are not well understood, the responses could include a startle response, delayed foraging, or avoidance of the area. Feist et al. (1992) found that broad-band pulsed noise, such as impact pile driving noise, rather than continuous, pure tone noise like vibratory pile driving were more effective at altering fish behavior. Studies found that juvenile salmonids (40- to 60-millimeter in length) exhibit a startle response followed by an adjustment to low frequency noise in the 7 to 14 hertz (Hz) range (Knudsen et al. 1992 and 1994, Mueller et al. 1998). Those same studies also showed that noise intensity level must be 70 dB to 80 dB above the hearing threshold of 150 Hz to achieve a behavior response. To produce a behavioral response in herring, Olsen (1969) found ambient sound must be at least 24 dB less than the minimum audible field of the fish, and pile driving noise levels have to be 20 dB to 30 dB higher than sound levels. Juvenile sturgeon and herring are of similar size; therefore, herring can serve as a surrogate. Behavioral responses of pallid sturgeon are expected to be short-term and intermittent while construction is being conducted (approximately 8-12 hours/day).

A cofferdam with about 60-foot-wide cells supported by a stability berm, would be constructed to isolate approximately 9.25 acres of the Mississippi River of which about 8 acres of the isolated area will be excavated for the intake structure development. The isolated area of the river using the cofferdam could reduce habitat available to sturgeon, and any fish within the cofferdam area during installation may be lost. Temporary construction activities of the MBSD could potentially alter pallid sturgeon habitat downstream, such as scour holes, sandbars, and flow refugia, due to the alteration of the Mississippi River flow volumes downstream of the construction area; however, because of the dynamic system of the river these alterations are not likely to be significant. Habitats used by larvae, juveniles, or migrating adults could be altered but spawning habitat for pallid sturgeon is not known to occur in the area of the river near the proposed project area so spawning habitat will not be altered.

Studies have collected pallid sturgeon from a range of turbidity conditions, including highly altered areas with consistently low turbidities (i.e., 5-100 nephelometric turbidity units (NTU)) to comparatively natural systems such as the Yellowstone River that has seasonally high turbidity levels (>1,000 NTU) (Braaten and Fuller 2002, 2003; Erickson 1992, Jordan et al. 2006, Peters and Parham 2008). Highly turbid river systems such as the Mississippi River are components of natural ecological processes in which pallid sturgeon evolved. Therefore, increased turbidity in the river from the construction activities is not anticipated to directly impact the pallid sturgeon.

Table 3. Guidance on Fish Underwater Noise Thresholds.

Functional Hearing Group	Noise Thresholds	
	Behavioral Disruption Threshold	Injury Threshold
Fish > 2 grams Fish < 2 grams Fish all sizes	150 dB RMS	187 dB Cumulative SEL 183 dB Cumulative SEL Peak 206 dB
SEL = sound exposure level = 1 dB re 1 μPa2 -sec RMS = For pile driving, this is the square root of the mean square of a single pile driving impulse pressure event Source: WSDOT 2018, NMFS 2018		

4.3.2. Effects of Diversion Operation

Depths utilized by pallid sturgeon have been reported throughout its range; however, because of the varying total depth of the rivers throughout its range this information may have limited applicability to the LMR, unless depth is expressed as a percent of the total river depth. Water depth elevations in the Mississippi River where the training walls and intake channel of the structure occur are approximately -50 feet to -70 feet North American Vertical Datum (NAVD) (LA TIG 2021). The calculated percent of total river depth utilized by pallid sturgeon is approximately 70ft (Bramblett 1996 cited in Constant et al. 1997; Constant et al. 1997). Using that percentage compared to water depths during the diversion would indicate that pallid sturgeon should not be found in the batture in front of the structure during its operation. However, the usage of this habitat has never been quantified (incidental usage or actively used) or documented in literature. Incomplete knowledge of pallid sturgeon life history, especially in the LMR, does not preclude high water usage of the batture as feeding habitat or velocity refugia.

Depending on annual flow cycles, the MBSD is anticipated to operate at high-flow of 75,000 cfs for an average of 9 months out of the year for the first few decades and is anticipated to slowly increase peak flow operations to a maximum of 11 months out of the year by 2070. Base flow operations would keep a flow of 5,000 cfs through the MBSD. Past operations of the Bonnet Carré Spillway (at RM 133) have various numbers of pallid sturgeon entrained depending on factors such as flow, length of opening, and temperature (Service 2021a). During the 2011 emergency operation of the Bonnet Carré Spillway, which had a maximum flow of 315,930 cfs, entrainment of 20 pallid sturgeon was recorded compared to the entrainment one pallid sturgeon recorded after the emergency operations in 2020 with a maximum flow of 90,000 cfs (Service 2021b). Schultz (2013) found that small numbers of pallid sturgeon were entrained by the Davis Pond Freshwater Diversion (RM 119) while no pallid sturgeon were detected at smaller diversions that were sampled (at RM 83.8, 81.5, 64.5, and 63.9).

The Pallid Sturgeon Lower Basin Recovery Workgroup (Workgroup) has identified information gaps essential to the consultation and recovery processes in the Lower Mississippi River Basin. These include the following: relative abundance of pallid sturgeon, demographics, feeding habits, habitat use, hybridization ratios, presence of fish diseases in the wild, population anomalies, and reliable separation and identification of pallid sturgeon, shovelnose sturgeon, and hybrids. A more recent information gap identified by the Workgroup is the entrainment of adult and juvenile pallid sturgeon through the ORCC and potential entrainment through the existing coastal wetland restoration diversions. The implications of the MBSD operations on sturgeon populations within the LMR can be better understood due to the completion of the "Entrainment Studies of Pallid Sturgeon Associated with Water Diversions in the Lower Mississippi River" (ERDC 2013), although some data gaps remain. ERDC is currently conducting sturgeon entrainment studies at the ORCC, and has documented entrainment of sonic-tagged pallid sturgeon and shovelnose sturgeon. While the specific reasons for sturgeon entrainment are unknown, researchers hypothesize one or more of the following reasons: (1) sturgeon located near the structure during the opening are immediately entrained; (2) sturgeon actively swim into the structure to obtain refuge or prey, or to move into a perceived transit path; or, (3) sturgeon are entrained passively or actively during down-river migration (Service 2018d). Pallid sturgeon, as well as other sturgeon species, have positive rheotaxis and will orient into the direction of water flow (Hoover et al. 2011). Based on past collections of pallid sturgeon after Bonnet Carré Spillway emergency operations, near the spillway structure and in the depression being dewatered after closure of the spillway, it is possible pallid sturgeon would be found near the MBSD when it transitions from peak to base flow.

There are no known topographic or hydrographic features (apart from current) that would appear to attract the sturgeon to the vicinity of the MBSD.

Effects of the action on larval, fry, and juvenile fish

The presence of two larval *Scaphirhynchus* collected at RM 33, well below the proposed location of the MBSD, provided evidence for the presence of early life stages in the proposed project area (Friedenberg and Siegrist 2019). The methods to collect larval and young-of-year (YOY) *Scaphirhynchus* have been refined during the past decade; therefore, the numbers of larval *Scaphirhynchus* collected within the Mississippi River have increased (Herzog et al. 2005; Hrabik et al. 2007; Phelps et al. 2010). In 1985, a shovelnose sturgeon larva was collected at White Castle (River Mile 193) (Constant et al. 1997). Larval shovelnose sturgeon have also been collected near Vicksburg, Mississippi, (River Mile 435) approximately 374 miles upstream of the proposed MBSD (Constant et al. 1997; Hartfield et al. 2013; Schramm et al. 2017). Kynard et al. (2002) and Braaten et al. (2008) reported longer larval drift times; thus, greater distances were traveled by pallid sturgeon larva when compared to shovelnose sturgeon larva. Pallid sturgeon larvae were determined to travel at approximately the mean river velocity for the first 11 days after hatching and then slightly slower for the next 6 days because of the sturgeon's transition to a benthic life stage. Distances covered during larval drift are affected by water velocity; however, water temperature can affect larval/fry development rates (warmer temperatures increase development rates) which would also affect drift distances. Higher water velocities occur with larger flood events (USACE 2009). Water velocities in the Mississippi River south of Baton Rouge (River Mile 231) have been documented to range from 4.4 feet per second (fps) to 1.5 fps depending on the discharge. South of Baton Rouge the river channel is larger and the slope of the river decreases; thus, velocities are slower than those above Baton Rouge (Wells 1980). Surface water velocities measured north of Baton Rouge range from 2.9 fps to 5.6 fps for discharges of 200,000 cubic feet per second (cfs) to l million cfs, respectively.

Three surface velocity cross-sections taken south of Baton Rouge at discharges of 350,000, 460,000, and 470,000 cfs never had velocities greater than 4 fps, but a surface velocity cross-section taken north of Baton Rouge measured velocities in excess of 5 fps for a discharge of 310,000 cfs (Wells 1980). The MBSD operation plan calls for initial opening of the diversion gates when the Mississippi River gage in Belle Chasse reaches 450,000 cfs and maximum flow (75,000 cfs) through the structure will occur when the Belle Chasse gage exceeds 1,000,000 cfs. The most southern pallid sturgeon spawning sites are unknown; however, potential gravel bar spawning sites occur at various locations between Baton Rouge, Louisiana, and Vicksburg, Mississippi, (River Mile 435) approximately 374 miles upstream of the MBSD. If a mean water velocity of 5.9 fps (4 miles per hour) is assumed to have occurred from Vicksburg to the MBSD, larvae could travel as much as 96 miles per day, barring entrainment into the eddies, the batture, and other areas.

One seven-day and one nine-day post-hatch larval sturgeon were collected near Vicksburg, Mississippi, on May 20, which indicated that hatching occurred on the 13 and 11 of May, respectively. The previously mentioned larval sturgeon captured at White Castle was collected on May 15. Other larval sturgeon recently captured between Greenville and Vicksburg, Mississippi, (approximate Rivers Miles 540 and 440, respectively) would indicate hatching occurred in early to mid-May (Schramm et al. 2017). Although there could be limited spawning as early as late March, most spawning in the LMR occurs during late April through mid-May.

Effects of the action on sub-adult and adult

Hoover et al. (2005) examined swimming performance of juvenile pallid sturgeon (maximum size 6.3 inches) at different velocities. Minimum escape speeds for pallid sturgeon ranged from 1.6 to 1.7 fps and burst speeds were determined to range from 1.7 to 2.95 fps; however, because they frequently failed to exhibit rheotaxis, their ability to avoid entrainment based on swimming performance was determined to be relatively low. Overall, approximately 18 percent were not positively rheotatic; however, Adams et al. (1999) found only 7 percent were non-rheotatic. White and Mefford (2002) examined swimming behavior and performance of shovelnose sturgeon ranging from 25.2 to 31.5 inches in length. Their ability to navigate the length of the test flume was best (60 to 90 percent) over a smooth bottom followed by coarse sand, gravel, and then cobble, but the small sample size and large variability precluded this from being a definitive conclusion. The greatest success at negotiating the flume was determined to occur between the range of 2 and 4 fps; however, success at greater velocities (6 fps) did occur. Approximately 30 percent failed to exhibit rheotactic behavior at velocities below 1.6 fps. Conversely, Adams et al. (1997) found all adult shovelnose to be positively rheotactic. Pallid sturgeon are believed to avoid areas that have very little or no water velocity (DeLonay and Little 2002, cited in Quist 2004; Erickson 1992 cited in Service, no date) and leave areas that no longer have flows (Backes et al. 1992; Constant et al. 1997).

The timing of pallid sturgeon movements and migration in the LMR may differ from that of other rivers and other portions of the Mississippi River (Constant et al. 1997). Migrations and movement in the Atchafalaya River was associated with water temperatures between 14 and 21 degrees Celsius (ºC) (Constant et al. 1997) and spring and early summer seasons (Schramm and Dunn 2008). During winter months, when water temperatures fall below 12ºC, pallid sturgeon have been caught in deeper water and reduced growth and survival of juvenile *Scaphyrynchus spp.* was noted; therefore, pallid sturgeon may be at a lower entrainment risk during winter (DeVries et al. 2015, Kappenman et al. 2009, Friedenberg and Siegrist 2019). This is supported by the observation of few pallid sturgeon entrained through the Bonnet Carré Spillway during the January emergency operation in 2016 (Service 2018).

4.3.3 Summary of Effects of the Action

An estimate for the entrainment risk associated with the MBSD was developed using entrainment risk as a function of the abundance of pallid sturgeon present in the action area and the likelihood of entrainment during operations (Friedenberg and Siegrist 2019). Three potential density scenarios were evaluated based on a conservative estimate of the abundance of pallid sturgeon in the system, to estimate the abundance of pallid sturgeon in the action area (Friedenberg 2018). The three density scenarios are provided in Section 4.2.1 (50% population density below New Orleans, 10% population density below New Orleans, and only juveniles below New Orleans) and abundance estimates are shown in Table 2. Entrainment estimates are based on predicted number of fish present per volume of water which characterizes the greatest potential effect from entrainment losses to the population, essentially overestimating the effect of a level of entrainment on the population.

The combination of population estimate with entrainment risk assumes that fish are evenly distributed and so are proportional to the volume of Mississippi River water diverted. Friedenberg and Siegrist (2019) based volumetric entrainment rates on either Service-derived rates (Service 2018) or a mark-recapture rate (Schultz 2013) predicted or observed in diversions, and then applied the rates to generate annual volumetric estimates (Table 4). The projected mean annual entrainment estimates were applied to simulations of future flows over the next 50 years to estimate predicted mean total entrainment over the MBSD operational period (Table 5). Based on these calculations, annual entrainment of pallid sturgeon through the MBSD could range from 7 to 58 sturgeon per year while the MBSD could entrain between 350 and 2,403 pallid sturgeon over the MBSD operational period of 50 years. Depending on the entrainment scenario, a reduction of 0.07 to 0.43 percent in the annual population growth rates of sturgeon, with the 50 percent densities resulting in the greatest potential effect to population growth and the juvenile only scenario resulting in the least potential effect. Due to insufficient data on pallid sturgeon to determine which scenario best represents expected conditions, the conservative assumption of the 50 percent density scenario represents the maximum number of entrainment of pallid sturgeon through the MBSD per year and total over the 50 year analysis period as well as the population effects from the proposed project. Therefore, entrainment of pallid sturgeon from the MBSD would be 58 individuals per year and 2,403 sturgeon over 50 years, and there would be an estimated 0.43 percent reduction in the annual population growth rate for the species.

Table 4. Projected mean annual pallid sturgeon entrainment through MBSD (LA TIG 2021).

Age Structure	Ages Entrained	Mean Annual Entrainment Estimates	
		FWS 2018 Capture Rate* mean (SD)	Mark-Recapture Rate** mean (SD)
50% Density	Age 1+	58.0 (19.1)	34.8 (11.5)
10% Density	Age 1+	11.6 (3.8)	7.0 (2.3)
Juveniles Only	Age 1-2	20.2 (6.7)	12.1 (4.0)
*USFWS 2018 methods; **Schultz 2013 methods SD = standard deviation Sources: Schultz 2013, LWFD 2018, Friedenberg 2019			

Table 5. Predicted mean total pallid sturgeon entrainment through the MBSD over 50 years (LA TIG 2021).

Age Structure	Mean Total Entrainment Over 50 Years Estimates	
	FWS 2018 Capture Rate* mean (SD)	Mark-Recapture Rate** mean (SD)
50% Density	2,403 (292)	1,561 (186)
10% Density	515 (62)	350 (47)
Juveniles Only	1,020 (281)	647 (191)
*USFWS 2018 methods; **Schultz 2013 methods SD = standard deviation Sources: Schultz 2013, LWFD 2018, Friedenberg 2019		

4.4. Cumulative Effects

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

We know that the Mid-Breton Sediment Diversion and Maurepas Diversion Projects are reasonably certain to be implemented upstream of the MBSD. However, those projects are federal actions that will require separate consultation under ESA §7. We are not aware of any non-federal actions in the action area that may affect the pallid sturgeon. Therefore, cumulative effects did not alter the conclusion reached in this BO for the action.

4.5. Conclusion

In this section, we summarize and interpret the findings of the previous sections for the pallid sturgeon (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or

b) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

The proposed project would involve construction, operation, and maintenance of the MBSD to discharge sediment, fresh water, and nutrients from the Mississippi River to an outfall area within the mid-Barataria Basin. Construction activities on the river side would include pile driving as well as the isolation and dewatering (using a cofferdam) of approximately 9.25 acres in within the Mississippi River. Construction activities are estimated to take 3 to 5 years, in which pile driving activities would occur from one to five months in the river. Both vibratory and impact pile driving will be used on the river side; however, when possible vibratory pile driving will be used to minimize impacts to sturgeon. Pallid sturgeon near this area of construction are anticipated to avoid the area during in-water pile driving activities due to increased underwater noise but would likely return to the area once noise returns to ambient levels. Any pallid sturgeon isolated in the cofferdam area may be lost.

Operation of the MBSD poses the risk of entrainment of all life stages of pallid sturgeon present in the area near the structure. Base flow of the MBSD would be 5,000 cfs while maximum flow would be capped at 75,000 cfs when the Mississippi River gage at Belle Chasse reaches 1,000,000 cfs. While the MBSD has a different purpose and design compared to other diversions located north of the proposed MBSD, impacts of entrained pallid sturgeon would be similar. A maximum of 48 sturgeon per year and 2,403 sturgeon over 50 years are estimated to be entrained through the MBSD, and therefore, be lost to the population. The estimated maximum reduction in annual population growth for pallid sturgeon is 0.43 percent. Our analysis indicates that while the proposed MBSD would have a negative effect on pallid sturgeon, such effects to annual population growth would not be appreciable for the survival and recovery of the pallid sturgeon.

After reviewing the current status of the pallid sturgeon, the estimated effects of the construction, operation, and maintenance of the MBSD, and the cumulative effects, it is the Service's biological opinion that the MBSD is not likely to jeopardize the continued existence of the species.

5. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3). In regulations at 50 CFR §17.3, the Service further defines:

- "harass" as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;"

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" and
- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the USACE and the LA TIG must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. The USACE has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the USACE and the LA TIG fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the USACE must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

5.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section(s) of this BO. We reference, but do not repeat, these analyses here.

The Service estimated incidental loss (by death or serious injury) of 48 pallid sturgeon per year and 2,403 over the 50 years. The pallid sturgeon estimated as incidental loss are those anticipated to be entrained through the MBSD.

5.2. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary or appropriate to minimize the impact of incidental take caused by the Action on listed wildlife species. RPMs are described for each listed wildlife species in the subsections below.

RPM 1. Gate operation that would significantly increase or decrease the velocity through the structure should be implemented over several hours to allow fish sufficient time to migrate back to the river or swim away from the structure.

RPM 2. The CPRA and the USACE will coordinate with the Service to develop a Fish Monitoring and Removal Plan for pallid sturgeon. This plan will need to be completed and Service approved prior to the construction of the cofferdam.

RPM 3. Dredging (cutterhead/suction) in the Mississippi River would be conducted using dredge operational parameters coordinated with the Service.

RPM 4: Ensure that the terms and conditions are accomplished and completed as detailed in this incidental take statement including the completion of reporting requirements.

5.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the USACE and the LA TIG must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the USACE and the LA TIG must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that are added to the permit, contract, or grant document.

T&C 1. RPM 1. The Service's Louisiana Ecological Services Office (337-291-3126) should be notified of any proposed changes to the proposed action described in the biological opinion, so that re-initiation of consultation under Section 7 of the ESA can proceed as quickly and efficiently as possible.

T&C 2. RPM 2. Develop a plan to be implemented for the proposed MBSD that identifies potential avoidance and minimization measures for pallid sturgeon. Live sturgeon captured in the structure or the cofferdam area should be tagged and returned to the river.

T&C 3. RPM 3. Should dredging (cutterhead/suction dredge) activities be necessary in the Mississippi River, the following operational parameters would be included as conditions of the permit and in the design of the project:

1) The cutterhead must remain completely buried in the bottom material during dredging operation. If pumping water through the cutterhead is necessary to dislodge material or to clean the pumps or cutterhead, etc., the pumping rate will be reduced to the lowest rate possible until the cutterhead is at mid-depth, where the pumping rate can then be increased.
2) During dredging, the pumping rates will be reduced to the slowest speed possible while the cutterhead is descending to the channel bottom.

T&C 4. RPM 4. Upon locating a dead, injured, or sick individual of an endangered or threatened species, CPRA must notify the Louisiana Ecological Services Office at Lafayette, Louisiana at (337) 291-3100 and the USACE within 48 hours. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

T&C 5. RPM 4. A report describing the actions taken to implement the terms and conditions of this ITS shall be submitted to the Project Leader, U.S. Fish and Wildlife Service, 200 Dulles Drive, Lafayette, LA 70506, within 60 days of the completion of project construction. This report shall include the dates of work, assessment, and actions taken to address impacts to the pallid sturgeon, if they occurred.

5.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the USACE must report the progress of the Action and its impact on the species to the Service as specified in the ITS (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R). As necessary and appropriate to fulfill this responsibility, the USACE must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the USACE and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

M&R 1- Monitoring of the diversion structure for the entrainment of pallid sturgeon should be conducted, once the diversion is in operation. This monitoring should be conducted yearly, once flows through the MBSD revert to base flow after maximum flow conditions. This report should include the amount of pallid sturgeon captured in the diversion structure throughout the year, time of year they were captured, flow volumes, and how the captures coincides with the flow.

M&R 2- A monitoring report will be submitted to the Service after maximum flow conditions have occurred. This report should include any data sheets, maps, and the findings of the pallid sturgeon monitoring efforts.

6. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the USACE and the LA TIG.

- Support pallid sturgeon monitoring and studies throughout the Lower Mississippi River to aid in the determination of future diversion impacts to the pallid sturgeon population, as well as, to improve our understanding the species.

7. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the USACE retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the USACE is required to immediately request a reinitiation of formal consultation.

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