United States Department of the Interior

FISH AND WILDLIFE SERVICE
Montana Ecological Services Field Office
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In Reply Refer to:
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October 2, 2020

Memorandum

To: Steve Davies, Area Manager-Montana Area Office, U.S. Bureau of Reclamation
Ted Streckfuss, Deputy District Engineer, USACE Omaha District;

From: Jodi Bush, Office Supervisor, Montana Ecological Services Office, U.S. Fish and Wildlife Service

Subject: Reinitiated consultation on effects from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project

This memorandum is in response to the U.S. Bureau of Reclamation's (Reclamation) and U.S. Army Corps of Engineers' (Corps) request to reinitiate consultation with the U.S. Fish and Wildlife Service (Service) on effects to the endangered pallid sturgeon (*Scaphirhynchus albus*) and the threatened northern long-eared bat (*Myotis septentrionalis*) from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project (Intake Project). Reclamation and the Corps' request to reinitiate consultation on the Intake Project was received by the Service via electronic mail on April 17, 2020.

Reclamation and the Corps originally requested consultation with the Service on effects to species and habitats listed under the Endangered Species Act, as amended (16 U.S.C. 1531 et seq.; Act), from the Intake Project on August 29, 2016. On November 18, 2016, the Service issued its biological opinion on effects to the pallid sturgeon from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project and a memorandum of concurrence for Reclamation and the Corps' determination that the Intake Project *may affect, but is not likely to adversely affect* the northern long-eared bat, the endangered Interior least tern (*Sterna antillarum athalassos*), and the threatened piping plover (*Charadrius melodus*).

The Intake Project (originally consulted on in 2016) is the subject of this reinitiated consultation, pursuant to Section 7 of the Act, and consists of the following four project components:

1. Operation and maintenance of the Lower Yellowstone Project prior to and during construction of the proposed bypass channel and replacement weir structure (Reclamation action);
2. Construction of a bypass channel and replacement weir structure to improve upstream and downstream fish passage at the Intake Diversion Dam (Corps action);
3. Operation and maintenance of the Lower Yellowstone Project after implementation of the Intake Project (Reclamation action);, and
4. Implementation of an adaptive management and monitoring plan (Reclamation and Corps action).

Pallid sturgeon

In April 2020, Reclamation and the Corps requested reinitiation of consultation with the Service because Intake Project modifications may affect pallid sturgeon in ways not considered in the original 2016 biological opinion. Concurrent with their request (April 17, 2020), Reclamation and the Corps provided supplemental information to the Service regarding the estimated timeline for Intake Project construction, and, on June 23, 2020, the Service received additional information from the Corps on changes to the replacement weir design and related effects to pallid sturgeon via electronic mail. Attached to this memorandum is the Service's biological opinion and incidental take statement based on our review of the Intake Project located in Dawson County, Montana, and its effects on pallid sturgeon in accordance with Section 7 of the Act. This biological opinion and incidental take statement amends and replaces the original 2016 biological opinion and incidental take statement; information presented in the original 2016 biological opinion is incorporated by reference into the attached biological opinion, and, where applicable, our approach for analyzing the effects of the Intake Project on pallid sturgeon in the attached biological opinion is consistent with the approach used in the original 2016 biological opinion, but considers information that has become available since the original consultation.

Additionally, the Service notes that the Corps' Missouri River Recovery Program has indicated that future abundance estimates for pallid sturgeon in the Missouri River between Fort Peck Dam and Lake Sakakawea and the Yellowstone River may consist of different length groups than those that were used for the 2019 preliminary abundance estimates (M. Colvin, Pallid Sturgeon Technical Team, unpublished data). Because our analysis of the effects of some aspects of the Intake Project on pallid sturgeon in the attached biological opinion and incidental take statement incorporated the 2019 preliminary abundance estimate length groups, the Service is committed to working with Reclamation and the Corps to evaluate how different abundance estimate length groups may influence our effects analysis, authorized incidental take, and incidental take monitoring requirements, should future pallid sturgeon abundance estimates utilize different length groups.

Northern long-eared bat

In April 2020, Reclamation and the Corps also requested reinitiation of consultation with the Service on effects of the Intake Project to the northern long-eared bat because new information had become available on northern long-eared bat distribution within the action area. Concurrent with their request (April 17, 2020), Reclamation and the Corps provided supplemental information on bat surveys that were conducted in the vicinity of the Intake Project construction site and elsewhere within the action area, including two surveys that resulted in the capture of northern long-eared bats in 2018. In August of 2018, bat surveys were conducted along the Yellowstone River and resulted in the capture of one post-lactating female and one non-reproductive juvenile in the vicinity of the Intake Project construction site (August 13 – 14) and one reproductive adult, and the same post-lactating female that was sampled at Intake, near Sidney, Montana (August 13 – 14; Bachen 2019).

On June 24, 2020, Reclamation and the Corps conveyed their effects analysis and determination for northern long-eared bats resulting from the Intake Project, in consideration of the new information on northern long-eared bat distribution in Montana, to the Service via electronic-mail. Therein, Reclamation and the Corps identified Intake Project elements that may affect northern long-eared bats, including tree removal and the use of pesticides associated with the long-term operation and maintenance of the Lower Yellowstone Project and the maintenance, removal, or relocation of historical buildings at Intake. Reclamation and the Corps identified the following conservation measures to reduce the potential effects of the Intake Project to northern long-eared bats:

Tree removal:

1. Limit the amount and extent of tree removal during all operation and maintenance or construction related activities.
2. Tree removal will only occur from October 1 to March 31. If trees require removal outside of these dates, Reclamation or their designated representatives will coordinate with the Service to conduct a bat survey to ensure the trees are not being utilized by northern long-eared bats as maternity roosts.
3. If northern long-eared bats are present, Reclamation will work with the Service on the best approach to minimize potential affects to this species.

Structure maintenance and relocation:

1. The historic structures will be relocated during October 1 to March 31, which is prior to the expected timeframe for maternity roosting and when northern long-eared bats would be hibernating.
2. Prior to moving the historic structures, Reclamation will conduct a bat survey to determine the presence or absence of bat species.
3. As per item 1 of this section, northern long-eared bats are not expected to be present in historic structures during the time period when they are proposed to be relocated. In the unlikely event that they are present, relocation will be delayed and the Service will be contacted. If other non-listed bats are present, Reclamation will work with

Montana Fish, Wildlife, and Parks and the Service to remove the bats prior to relocation of the buildings[1].

Based on their analysis of potential effects to northern long-eared bats resulting from the Intake Project, including the conservation measures described above, Reclamation and the Corps again determined that the Intake Project *may affect, but is not likely to adversely affect* the northern long-eared bat.

We have reviewed the information presented in Reclamation and the Corps' effects determination (June 2020) and biological assessment (Reclamation and Corps 2016), as well as other sources of information, and concur with Reclamation and the Corps' *may affect, not likely to adversely affect* determination regarding the effects of the Intake Project to northern long-eared bats.

This concludes informal consultation for northern long-eared bats pursuant to the regulations implementing section 7(a)(2) of the Act (50 CFR 402.13). Reinitiation of consultation on the proposed action may be necessary if new information reveals that the proposed action may affect listed species or designated or proposed critical habitat in a manner or to an extent not considered in this consultation, if the action is subsequently modified in a manner that causes an effect to a listed or proposed species or designated or proposed critical habitat in this consultation, or if a new species is listed or critical habitat is designated that may be affect by the proposed action.

The Service appreciates Reclamation and the Corps' continued efforts to ensure the conservation of threatened and endangered species as part of our joint responsibilities under the Endangered Species Act. If you have questions or comments related to this correspondence, please contact Austin McCullough of my staff at 406-449-5225, extension 219 or at Austin_McCullough@fws.gov.

cc: Ted Streckfuss, Deputy District Engineer, Corps Omaha District;
Steve Davies, Montana Area Office - Area Manager, U.S. Bureau of Reclamation;
Tiffany Vanosdall (Corps),
David Trimpe (Reclamation),
Erin Murphy (Corps),
Bryan Wilson (SOL),
Casey Kruse (Service-Missouri River Coordinator),
Wayne Nelson-Stastny (Service-Pallid Sturgeon Recovery Coordinator),

[1] The language presented above for Structure maintenance and relocation conservation measure 3 differs from what was proposed by the action agencies in their Northern Long-Eared Bat Analysis and Determination, dated June 2020, but was mutually agreed upon by the Service and Reclamation on September 30, 2020 (D. Trimpe, Reclamation, personal communication, September 30, 2020)

Tyson Powell (SOL)

References:

Bachen, D. 2019. Assessment of presence, range, and status of the Northern Myotis (*Myotis septentrionalis*) in the Northern Great Plains of Montana. Unpublished report prepared for the U.S. Fish and Wildlife Service, Helena, Montana.

Reclamation (U.S. Bureau of Reclamation) and Corps (U.S. Army Corps of Engineers). 2016. Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project Biological Assessment. Report submitted to the U.S. Fish and Wildlife Service in August of 2016, Billings, Montana.

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION
on
Effects to the Pallid Sturgeon
from the
Lower Yellowstone Project:
Intake Diversion Dam Fish Passage Project
2020

U.S. Fish and Wildlife Service Reference: 06E11000-2020-F-0658

Action Agency:	U.S. Bureau of Reclamation Montana Area Office U.S. Army Corps of Engineers Omaha District
Consultation Conducted by:	U.S. Fish and Wildlife Service Montana Field Office
Date Issued:	October 2, 2020

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BIOLOGICAL OPINION

LIST OF ABBREVIATIONS AND ACRONYMS

Act	Endangered Species Act
BCI	Bayesian credible intervals
BRT	Biological Review Team
C	Celsius
CLMU	Central Lowlands Management Unit
CSRP	Comprehensive Sturgeon Research Project
Corps	U.S. Army Corps of Engineers
cfs	Cubic feet per second
F	Fahrenheit
FL	Fork length
ft/s	feet per second
GPMU	Great Plains Management Unit
HOPS	Hatchery-origin pallid sturgeon
IPCC	Intergovernmental Panel on Climate Change
Intake	Intake Diversion Dam
Intake Project	Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project
IHMU	Interior Highlands Management Unit
ITS	Incidental take statement
LYP	Lower Yellowstone Project
MAMP	Monitoring and Adaptive Management Plan
MFWP	Montana Fish, Wildlife and Parks
mm	Millimeters
MRRP	Missouri River Recovery Program
NSC	Natural side channel
O&M	Operation and maintenance
PSCAP	Pallid Sturgeon Conservation Augmentation Program
PSPAP	Pallid Sturgeon Population Assessment Program
Reclamation	U.S. Bureau of Reclamation
Revised recovery plan	2014 Revised Recovery Plan for Pallid Surgeon
RPMA	Recovery priority management area
Service	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
2016 Biological Assessment	Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project Biological Assessment, August 2016
2016 Biological Opinion	Biological opinion on the effects to the pallid sturgeon from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project, November 2016
95% CI	95% confidence interval

1.0 Introduction

In 2016, the U.S. Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (Corps) proposed the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project (Intake Project) and requested consultation with the U.S. Fish and Wildlife Service (Service) on the effects of the Intake Project to pallid sturgeon (*Scaphirhynchus albus*) and other species listed under the Endangered Species Act, as amended (Act; 16 U.S.C. 1531 et seq), or their designated critical habitats, pursuant to their requirements under Section 7 of the Act. Concurrent with their request, Reclamation and the Corps jointly submitted the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project Biological Assessment (2016 Biological Assessment; Appendix A), dated August 2016, to the Service (Reclamation and Corps 2016a). The purpose of the Intake Project is to improve fish passage for pallid sturgeon and other native fish at Intake Diversion Dam[2] (Intake), continue viable and effective operation of the Lower Yellowstone Project[3] (LYP), and contribute to ecosystem restoration (Reclamation and Corps 2016a). Specifically, the Intake Project will construct a replacement weir and fish bypass channel at Intake (Reclamation and Corps 2016a). This project is considered a high priority among the suite of recovery actions that may contribute to pallid sturgeon recovery (Service 2014). On November 18, 2016, the Service issued its biological opinion on the effects to the pallid sturgeon from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project (2016 Biological Opinion; 06E00000-2017-F-0001; Appendix B) and its associated incidental take statement (ITS; Service 2016).

Reclamation and the Corps are joint leads on the Intake Project. Reclamation owns the facilities associated with the LYP and contracts their long-term operation and maintenance (O&M) to the water users, the Lower Yellowstone Irrigation Project Board of Control (Reclamation and Corps 2016a). The Corps is responsible for the design and construction of the Intake Project and awarded a contract for construction of the replacement weir and bypass channel (Reclamation and Corps 2016a). In a 2003 amended biological opinion on the effects of Corps operations on species and habitats in the Missouri and Kansas rivers that are listed under the Act, the Service recommended that the Corps work with Reclamation on a project to provide pallid sturgeon passage at the Intake (Service 2003). Accordingly, the Corps received Congressional authorization to use funds from the Missouri River Recovery and Mitigation Program for the design and construction of the Intake Project under Section 3109 of the 2007 Water Resources Development Act (Pub. L. 110-114; 121 Stat.1041; Reclamation and Corps 2016a). Reclamation and the Corps will also implement a Monitoring and Adaptive Management Plan as a structured framework for monitoring the pallid sturgeon response to the Intake Project and modifying the Intake Project, if warranted (see section 5.2.4; Reclamation and Corps 2016a).

Due to litigation and construction issues, construction of the Intake Project was delayed until July of 2019. Consequently, the estimated project construction timeline was exceeded. The delays also extended the effects from current operations on pallid sturgeon. These effects were described in the 2016 Biological Assessment, and analyzed in the 2016 Biological Opinion and

[2] The Intake Diversion Dam was constructed at river mile 73 on the Yellowstone River in 1905 to supply irrigation water to irrigation districts associated with the Lower Yellowstone Project.
[3] The Lower Yellowstone Project supplies irrigation water to Lower Yellowstone Irrigation Districts 1 and 2, Intake Irrigation District, and Savage Irrigation District (Reclamation and Corps 2016a).

ITS (2017 – 2019). Thus, Reclamation and the Corps requested to reinitiate formal consultation with the Service on the effects of the Intake Project on pallid sturgeon in a letter dated April 17, 2020.

This document transmits the Service's biological opinion and ITS based on our review of the Intake Project located in Dawson County, Montana, and its effects on pallid sturgeon in accordance with Section 7 of the Act. This biological opinion and ITS amends and replaces the 2016 Biological Opinion and ITS; information presented in the 2016 Biological Opinion is incorporated by reference into this document, and, where applicable, our approach for analyzing the effects of the proposed action on pallid sturgeon in this document is consistent with the approach used in the 2016 Biological Opinion, but considers information that has become available since the original consultation. The Reclamation and Corps letter that requested to reinitiate consultation on the effects of the Intake Project to pallid sturgeon was received by the Service via electronic mail on April 17, 2020. Concurrent with that letter, we also received supplemental information regarding the estimated timeline for Intake Project construction on April 17, 2020. On June 23, 2020, we received additional information on changes to the replacement weir design and related effects to pallid sturgeon via electronic mail (Corps in litt, 2020). This biological opinion and ITS also considered information provided in the 2016 Biological Assessment (Reclamation and Corps 2016a), 2016 Biological Opinion (Service 2016), additional information received during the consultation process, and other sources of information. A complete consultation record of this consultation is on file at the Service's Montana Ecological Services office located in Helena, Montana.

1.1 History of coordination and consultations at the Intake Diversion Dam

The Service, Reclamation, and the Corps have an extensive history of coordination and consultations related to fish passage at Intake; a comprehensive history of the coordination efforts and consultations is summarized in the 2016 Biological Assessment (Reclamation and Corps 2016a, pages 22 – 25) and 2016 Biological Opinion (Service 2016, pages 2 – 5), which are hereby incorporated by reference in their entirety. A summary of coordination, consultations, and relevant events that are specific to the Intake Project are detailed below.

On August 29, 2016, Reclamation and the Corps jointly requested consultation with the Service on the effects of the Intake Project to species and habitats listed under the Act. As part of the request, Reclamation and the Corps also submitted the 2016 Biological Assessment that determined the Intake Project may affect several listed species, including the pallid sturgeon, interior least tern (*Sterna antillarum athalossos*), piping plover (*Charadrius melodus*), and northern long-eared bat (*Myotis septentrionalis*). On November 18, 2016, consultation concluded when the Service issued the 2016 Biological Opinion and ITS on the effects of the Intake Project to pallid sturgeon and a letter of concurrence for Reclamation and the Corps' determinations that the Intake Project may affect, but is not likely to adversely affect the interior least tern, piping plover, and northern long-eared bat.

On October 30, 2017, the Corps requested consultation with the Service on the effects of the operation of the Missouri River Mainstem Reservoir System, operation and maintenance of the Missouri River Bank Stabilization and Navigation Project, operation of the Kansas River

Reservoir System, and the implementation of the Missouri River Recovery Management Plan, including the Science and Adaptive Management Plan, on species and habitats listed under the Act. Formal consultation concluded when the Service issued its biological opinion and ITS, dated April 13, 2018, on the effects of the Corps' actions on the pallid sturgeon, piping plover, and interior least tern (Missouri River Biological Opinion, Service 2018). Whereas much of this consultation was beyond the scope of what is being analyzed and discussed in this document, the Service included a conservation recommendation that the Corps continue to pursue completion of fish passage improvements at Intake, as authorized by the Water Resources Development Act in 2007.

Among other factors, the 2016 Biological Opinion analyzed the effects of construction activities and O&M of the LYP prior to and during construction of the proposed bypass channel and replacement weir on pallid sturgeon. Such O&M activities included the permitting of the interim placement of rock on the existing weir under Section 10 of the Rivers and Harbors Act of 1899 by the Corps. The timeline for completion of the fish passage improvements was specified in the 2016 Biological Assessment as up to a three year period from 2017 – 2019 (Reclamation and Corps 2016a, page 9). However, project construction was delayed by litigation (see below) until July of 2019 and is now expected to continue through 2022 or 2023 (Reclamation and Corps letter to the Service dated April 17, 2020, see below). Resultantly, construction activities and O&M of the LYP prior to and during project construction for up to an additional four years is beyond the scope of the effects of the action that were analyzed in the 2016 Biological Opinion and ITS, thus necessitating reinitiation of consultation under Section 7 of the Act.

On April 17, 2020, Reclamation and the Corps requested to reinitiate consultation with the Service on the effects of the Intake Project to pallid sturgeon. Although Reclamation and the Corps did not submit a revised biological assessment to the Service as part of this reinitiated consultation, the action agencies provided the information necessary for completing the consultation throughout the consultation process. Concurrent with their letter requesting to reinitiate consultation, Reclamation and the Corps also provided supplemental documents regarding an updated timeline for construction and new information on northern long-eared bat distribution in the vicinity of Intake. On June 23, 2020, the Corps transmitted additional information on changes to the replacement weir design and related effects to pallid sturgeon via electronic mail (Corps in litt, 2020).

In their letter dated April 17, 2020, Reclamation and the Corps stated their intent to continue Intake Project operations during the reinitiated consultation pursuant to the requirements of the 2016 Biological Opinion. Per the conservation measures described below (section 2.1), in-water construction or O&M activities are restricted during the pallid sturgeon spawning and migration periods (April 15 – July 1). Reclamation and the Corps expressed to the Service their intent to begin construction of the replacement weir on July 13, 2020, and assured the Service that such activities would not irreversibly nor irretrievably commit resources that foreclose the formulation of reasonable and prudent alternatives for the conservation of pallid sturgeon, as prohibited by Section 7(d) of the Act. Because the Intake Project is considered a high priority for pallid sturgeon recovery (Service 2014) and further delays in project construction would delay any potential benefits for pallid sturgeon resulting from the Intake Project (see section 6.1.2), the Service issued a memorandum, dated July 10, 2020, to Reclamation and the Corps in support of their decision to begin construction of the replacement weir on July 13, 2020. The 7(d) determination by Reclamation and the Corps remained in effect until this biological opinion was completed for the Intake Project.

1.2 History of litigation

A comprehensive description of the procedural history for the Intake Project is detailed in a decision from the U.S. District Court for the District of Montana in *Defenders of Wildlife v. U.S. Army Corps of Engineers*, 2018 WL 3510534 (D. Mt. 2018), which is incorporated by reference. The following summarizes the timeline for legal and procedural actions that delayed Intake Project construction.

On September 4, 2015, the Montana District Court granted a motion for a preliminary injunction that prevented Reclamation and the Corps from initiating construction on the Intake Project. After an Environmental Impact Statement (Reclamation and Corps 2016b), Record of Decision (Reclamation and Corps 2016c), and the 2016 Biological Opinion were completed, the District Court dissolved the preliminary injunction on April 19, 2017.

Plaintiffs then filed an amended complaint on April 20, 2017, and, on July 5, 2017, the District Court again granted their motion for a preliminary injunction that prevented Intake Project construction. The U.S. Ninth Circuit Court of Appeals vacated the second preliminary injunction on April 4, 2018. *Defenders of Wildlife v. U.S. Army Corps of* Engineers, 730 FedAppx. 413 (9^{th} Cir. 2018). The Montana District Court subsequently denied or dismissed the remaining claims from the April 20, 2017, amended complaint on July 7, 2018. *Defenders of Wildlife v. U.S. Army Corps of Engineers*, 2018 WL 3510534 (D. Mt. 2018).

During July 2018, the Corps solicited bids for Intake Project construction and awarded the contract to the successful offeror in September of 2018. The Corps subsequently received two bid protests challenging the contract award, preventing the Corps from moving forward with the construction contract. The protests were ultimately resolved in the Corps' favor in March of 2019. Given the in-water work restrictions for the Intake Project during the pallid sturgeon spawning migration period from April 15 to July 1, project construction did not begin until July 8, 2019.

2.0 Proposed Action

2.1 Description of proposed action

The proposed action was originally described in the 2016 Biological Assessment and remains unchanged unless otherwise noted below in sections 2.1.1 – 2.1.4. Generally, the proposed action consists of the following four components (Reclamation and Corps 2016a, pages 9-21), which were further deconstructed into a total of 47 constituent elements (Reclamation and Corps 2016a, pages 58-69):

1. Operation and maintenance of the LYP prior to and during construction of the proposed bypass channel and replacement weir (Reclamation action) and permitting of the interim

placement of rock under Section 10 of the Rivers and Harbors Act of 1899 by the Corps (Corps action);
2. Construction of a bypass channel and replacement weir to improve upstream and downstream fish passage at Intake (Corps action);
3. Operation and maintenance of the LYP after implementation of the Intake Project (Reclamation action); and,
4. Implementation of an adaptive management and monitoring plan (Reclamation and Corps action).

Reclamation and the Corps identified conservation measures to minimize the effects of the proposed action on pallid sturgeon (Reclamation and Corps 2016a, page 100). Such conservation measures included (1) using a "ramp up" procedure for pile driving to allow fish in proximity to the work zone to move away before sound levels reach maximum levels; (2) restricting in-water construction or O&M activities during pallid sturgeon spawning and migration periods (April 15 – July 1); and (3) minimizing the duration that coffer dams are in place in the river.

2.1.1 Changes to the construction timeline

The anticipated timeline for construction of the Intake Project was exceeded due to litigation and constructability issues recently identified by the construction contractor. Reclamation and the Corps transmitted a new estimated timeline for construction to the Service on April 17, 2020, as supplemental information to their letter that requested to reinitiate consultation. The new construction timeline and year that the specific construction activities are expected to be completed are detailed in Table 1 but in general are expected to occur over the next five years (through 2024).

Table 1. The expected timeline for Intake Project construction and estimated year that specific construction activities will be completed.

Year	Activity
2020	- Construction of bypass channel - Construction of south half of replacement weir - Placement of rock on existing diversion structure for water diversions
2021	- Construction of the north half of the replacement weir - Placement of rock on existing diversion structure for water diversions
2022	- Removal of historic buildings, boiler, and rocking tower - Completion of bypass channel - Breach coffer dams to allow water to flow through the bypass channel - Reseeding and revegetation of bypass channel
2023	- Completion of bypass channel (if necessary due to delays) - Breach coffer dams to allow water to flow through the bypass channel (if necessary due to delays)
2024	- Bypass available for upstream pallid sturgeon migration

2.1.2 Design changes for the replacement weir

In 2019, construction of the replacement weir (under the previous 2016 Biological Opinion and ITS) began at a location approximately eight feet upstream of the existing weir. Shortly after construction began, the contractor determined that this location was unsuitable due to underwater obstructions and inadequate space to install temporary coffer dams. Resultantly, the Corps issued a contract modification to construct the replacement weir approximately 19 feet upstream from the original location. The following rationale for moving the replacement weir upstream was described in a document provided to the Service by the Corps in June 2020 as information exchanged during this reinitiated consultation (Corps in litt, 2020):

> "*In this new location, the contractor should not encounter any underwater obstructions and the contractor will have the necessary space to safely conduct in-water work. The updated design is essentially the same as what was originally awarded, only shifted upstream 19 ft. As with the awarded weir design, the fill will be sloped down from elevation 1991.0 (top of the new weir) to 1989.0 (top of existing weir), except in the notch area where the fill between the structures will be maintained at elevation 1989.0. The cross-section of the weir is increased resulting in additional stone and cobbles between the existing and new weir.*"

The Corps identified a risk for flanking around the south end of the replacement weir at the new location (Corps in litt, 2020). To mitigate this risk, 100 feet of sheet piles will be installed where the replacement weir ties into the south bank to increase stabilization. The sheet piles will be buried and protected by riprap installed at a 2:1 (rise:run) slope down to the bottom of the river channel (Corps in litt, 2020).

The 2016 Biological Opinion analyzed the effects of the replacement weir at a location approximately 40 feet upstream of the existing weir (Reclamation and Corps 2016a, page 13). The location of the weir in the awarded contract changed from what was presented in the 2016 Biological Assessment because the design was being finalized simultaneous with consultation. As such, moving the weir location upstream an additional 19 feet is closer to the location that was originally consulted on in 2016. Further, preliminary analysis by Reclamation and Corps hydrologists suggested that the replacement weir will function similarly between the original and new weir locations (Corps in litt, 2020). Specifically, hydraulic characteristics (flow depths and velocities) over the replacement weir were modelled to be the same at both locations and an improvement to conditions over the existing weir (see section 5.2.2.1; Reclamation and Corps 2016a, page 82). The proportion of water flowing in the bypass channel versus over the replacement weir is also expected to be the same at both locations (see section 5.2.2.2; Reclamation and Corps 2016a).

2.1.3 Closure of the natural side channel

Pallid sturgeon have periodically used a natural side channel (NSC) to pass upstream of the existing weir at Intake during moderate and high discharges in the Yellowstone River. As part of the proposed action, the NSC was closed to pallid sturgeon passage to facilitate construction of the new bypass channel (Reclamation and Corps 2016a). At the time of the original consultation, historical data suggested that pallid sturgeon were able to pass through the NSC at Yellowstone River discharges greater than 47,000 cubic feet per second (cfs), which would occur for at least seven days during five out of ten years (Reclamation and Corps 2016a). In their 2016 Biological Assessment, Reclamation and the Corps determined that closure of the NSC would result in short-term adverse effects to pallid sturgeon during two years of Intake Project construction until construction of the new bypass channel is completed. Because the NSC did not pass fish every year, the 2016 Biological Opinion and ITS estimated that pallid sturgeon passage through the NSC would only be blocked for one year during construction, but that these fish represented a subset of the estimated number of fish that would be blocked from passing upstream of Intake by the existing weir prior to and during construction (Service 2016).

Monitoring data from 2014 – 2018 documented that telemetered pallid sturgeon used the NSC to bypass Intake during 2014, 2015, 2017, and 2018 under Yellowstone River discharges as low as approximately 35,000 cfs (USGS 2016a; Rugg et al. 2019). Such passage mitigated the effects of blocked passage due to the existing weir prior to and during project construction. However, in 2019, a temporary road with culverts was constructed across the NSC (May), and the upstream entrance of the NSC was filled with material that was excavated for construction of the new bypass channel (July). The temporary road and fill material likely prevented pallid sturgeon from using the NSC to bypass Intake in 2019, although non-telemetered individuals may have done so without being detected. Because the NSC was closed in 2019 and construction of the bypass channel will not be completed until 2022 or 2023 (Table 1), closure of the NSC could now affect pallid sturgeon passage at Intake for up to five years (through 2023) during project construction.

2.1.4 Permitting under Section 10 of the Rivers and Harbors Act of 1899 by the Corps

The O&M of the LYP prior to and during construction of the proposed bypass channel and replacement weir (Reclamation action) and permitting of the interim placement of rock under Section 10 of the Rivers and Harbors Act of 1899 by the Corps (Corps action) was included as a component of the proposed action subject to consultation in the 2016 Biological Assessment (Reclamation and Corps 2016a). However, in 2017, Reclamation and the Corps jointly concluded that the LYP and weir structure at Intake are exempt from Section 10 of the Rivers and Harbors Act of 1899. Thus, the permitting of the periodic placement of rock at Intake by the Corps is no longer considered a component of the proposed action (as originally described in the 2016 Biological Assessment), but placement of rock at Intake will still occur during project construction as part of the proposed action (O&M of the LYP). Related effects to pallid sturgeon are analyzed and discussed below in section 5.2.1.

2.2 Action area

The Service's description of the action area in the 2016 Biological Opinion was informed by definitions of "action" and "action area" in 50 CFR 402.02. Action was defined as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies… or (d) actions directly or indirectly causing modifications to the land, water, or air" (50 CFR 402.02). Action area was defined as "all areas to be affected directly or indirectly by the Federal action and not merely in the immediate area involved in the action" (50 CFR 402.02).

After considering these definitions, the 2016 Biological Opinion concluded that the 2016 Biological Assessment's description of the action area was appropriate and incorporated it into the final document as follows:

> "*Based on the area where "modifications to the land, water, or air" (directly or indirectly) from this proposed action occur and can be perceived, the action area is described by the Assessment (p. 3) as "The lower Yellowstone River (river miles 0-77) from approximately 3 miles upstream of Intake Diversion Dam, down to the confluence with the Missouri River, and the Missouri River downstream to the headwaters of Lake Sakakawea in North Dakota. This area also includes the lands associated with the LYP canal system and lands serviced by the LYP... The Missouri River downstream of Fort Peck to the Yellowstone River confluence is not considered within the Action Area…*".

We retain the action area described in the 2016 Biological Assessment and 2016 Biological Opinion for this biological opinion and ITS. We note that modifications to land, water, or air resulting from the Intake Project may affect pallid sturgeon access to habitats upstream of Intake, including upstream of the action area, and analyze and discuss those effects in section 5.0.

3.0 Status of the Species

The status of the species section presents the biological or ecological information relevant to formulating the biological opinion. Appropriate information on the species' life history, habitat and distribution, and other data on factors necessary to its survival, is included to provide background for analyses in later sections (Service 1998, page 4-19).

Information on the habitat and distribution of the pallid sturgeon has not changed considerably since the original consultation in 2016. Detailed discussions on the status of the species can be found in the 2016 Biological Assessment (Reclamation and Corps 2016a), 2016 Biological Opinion (Service 2016), and the 2014 Revised Recovery Plan for Pallid Surgeon (Service 2014), which are incorporated by reference. The summary below highlights new information regarding pallid sturgeon life history, population dynamics, status, or distribution since the 2016 Biological Opinion was issued and reiterates information that is relevant to analyzing the effects of the proposed action on pallid sturgeon for this biological opinion and ITS. Important new information is provided by new population estimates generated since the 2016 Biological Opinion (see Table 2 and section 3.3.4, below) was issued. Similar to the 2016 Biological Opinion, the status of the species is described for pallid sturgeon throughout their range and within the Great Plains Management Unit (defined in section 3.2.2).

3.1 Introduction

In North America, the fossil record suggests that ancestral sturgeon species pre-date their contemporary counterparts by as much as 78 million years (Service 2014). However, seven out of the eight extant sturgeon species in North American are currently listed as endangered or threatened under the Act (Service 2014)). Of these, pallid sturgeon were listed as endangered throughout their range on September 6, 1990, due to habitat modification, an apparent lack of natural reproduction, commercial harvest, and hybridization in parts of their range (55 FR 36641). Dam construction was prevalent in the Missouri and Mississippi river drainages during the early- and mid-20th century to support flood control, river navigation, and agricultural production (Service 2016). Such dams have permanently or intermittently precluded pallid sturgeon from accessing spawning habitats and reduced the distance that pallid sturgeon free embryos and larvae (see life cycle discussion in section 3.2.3) are able to drift before reaching hypoxic reservoir habitats (Guy et al. 2015)—solely, or in combination, these impacts have severely or entirely limited pallid sturgeon natural recruitment for decades (Service 2014). Among these dams was the Intake Diversion Dam that was constructed at river mile 73 on the Yellowstone River in 1905 to supply irrigation water to the LYP (Reclamation and Corps 2016a).

Wild pallid sturgeon persist in the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea, including the lower Yellowstone River (Service 2014). However, natural recruitment has not been detected in this area for decades, despite extensive monitoring efforts in recent years (Braaten et al. 2012). Resultantly, the wild population is currently comprised of a limited number of adults (estimated 125 wild individuals alive in 2008; Jaeger et al. 2009) that are aging out of the population (Braaten et al. 2012). Factors that have been hypothesized to limit natural recruitment in this area include the lack of environmental spawning cues in the Missouri River due to altered flow, temperature, and sediment regimes downstream of Fort Peck Dam, blocked or severely reduced access to spawning habitats in the Yellowstone River upstream of the Intake, and inadequate drift distances for free embryos in both rivers before reaching presumed lethal conditions in Lake Sakakawea (USGS 2016a).

Since 1994, the Pallid Sturgeon Conservation Augmentation Program (PSCAP) has released hatchery-reared pallid sturgeon into portions of the Missouri, Yellowstone, and Mississippi Rivers to perpetuate wild population genetics and supplement additional year-classes in the absence of natural recruitment (Service 2016; Corps 2018). Many of the hatchery-origin pallid sturgeon (HOPS) are now reaching sexual maturity; an estimated 238 HOPS (95% confidence interval [95% CI]: 151 – 322) from 15 – 20 years of age were alive in 2016 in the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea and the lower Yellowstone River (Rotella 2017). However, natural recruitment of offspring from either wild pallid sturgeon or HOPS parents will continue to be curtailed unless the limiting factors discussed above are alleviated.

3.2 Range-wide status of the species

3.2.1 Legal status

The pallid sturgeon was listed as endangered throughout its range under the Act in 1990 (55 FR 36641). Critical habitat has not been designated for the species. A pallid sturgeon recovery plan was initially developed in 1993 (Service 1993) and later revised in 2014 (revised recovery plan; Service 2014).

3.2.2 Recovery and management

The Service's goal for pallid sturgeon is to recover the species such that listing under the Act is no longer warranted, with an interim goal to down-list the species from endangered to threatened (Service 2014). The primary strategy for recovery of pallid sturgeon is to (1) conserve the range of genetic and morphological diversity of the species across its historical range; (2) fully quantify population demographics and status within each management unit; (3) improve population size and viability within each management unit; (4) reduce threats having the greatest impact on the species within each management unit; and, (5) use artificial propagation to prevent local extirpation within management units where recruitment failure is occurring (Service 2014).

The revised recovery plan (Service 2014) consolidated the six recovery priority management areas (RPMA) that were identified in the original recovery plan (Service 1993) into four management units (Figure 1). Management unit boundaries were defined by considering (1) genetic data; (2) morphological differences in pallid sturgeon; (3) biogeography of other fish species and speciation associated with physiographic provinces; (4) common threats; and (5) the potential need and ability to implement differing management actions to address varying threats within a management unit. Descriptions of the new management units are below.

> The Great Plains Management Unit (GPMU) is defined as the Great Falls of the Missouri River, Montana to Fort Randall Dam, South Dakota. This unit includes important tributaries like the Yellowstone River, as well as the Marias and Milk rivers. The upper boundary is at the Great Falls of the Missouri River as this is a natural barrier above which pallid sturgeon could not migrate historically. The lower boundary was defined as Fort Randall Dam to ensure consistent management practices on an inter-reservoir reach of the Missouri River.
>
> The Central Lowlands Management Unit (CLMU) is defined as the Missouri River from Fort Randall Dam, South Dakota to the Grand River confluence with the Missouri River in Missouri and includes important tributaries like the lower Platte and lower Kansas rivers.
>
> The Interior Highlands Management Unit (IHMU) is defined as the Missouri River from the confluence of the Grand River to the confluence of the Mississippi River, as well as the Mississippi River from Keokuk, Iowa to the confluence of the Ohio and Mississippi rivers.
>
> The Coastal Plain Management Unit is defined as the Mississippi River from the confluence of the Ohio River downstream to the Gulf of Mexico including the Atchafalaya River distributary system.

The newly designated GPMU (Figure 2) contains former RPMA 1 (Missouri River from the mouth of the Marias River to the headwaters of Fort Peck Reservoir) and RPMA 2 (Missouri River from Fort Peck Dam to the headwaters of Lake Sakakawea, including the Yellowstone River upstream to the mouth of the Tongue River; Service 1993). The RPMA designations are retained for discussion in this biological opinion because they account for pallid sturgeon dynamics at a finer scale, including populations that are isolated by large dams. For example, pallid sturgeon populations in RPMAs 1 and 2 are both in the GPMU but are functionally disconnected by Fort Peck Dam. The proposed action and action area occur entirely in the GPMU and RPMA 2.

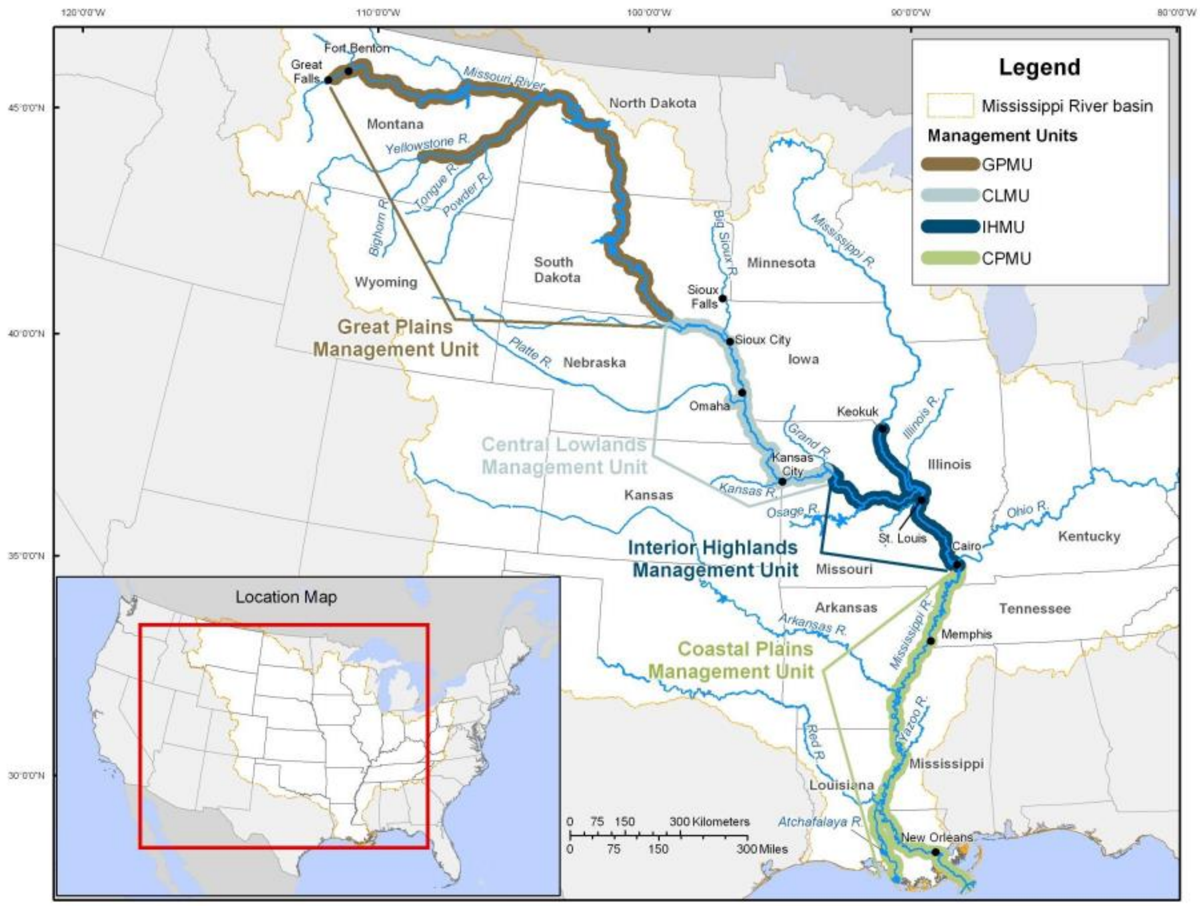

Figure 1. The location of pallid sturgeon management units in the Missouri and Mississippi river drainages (Service 2014).

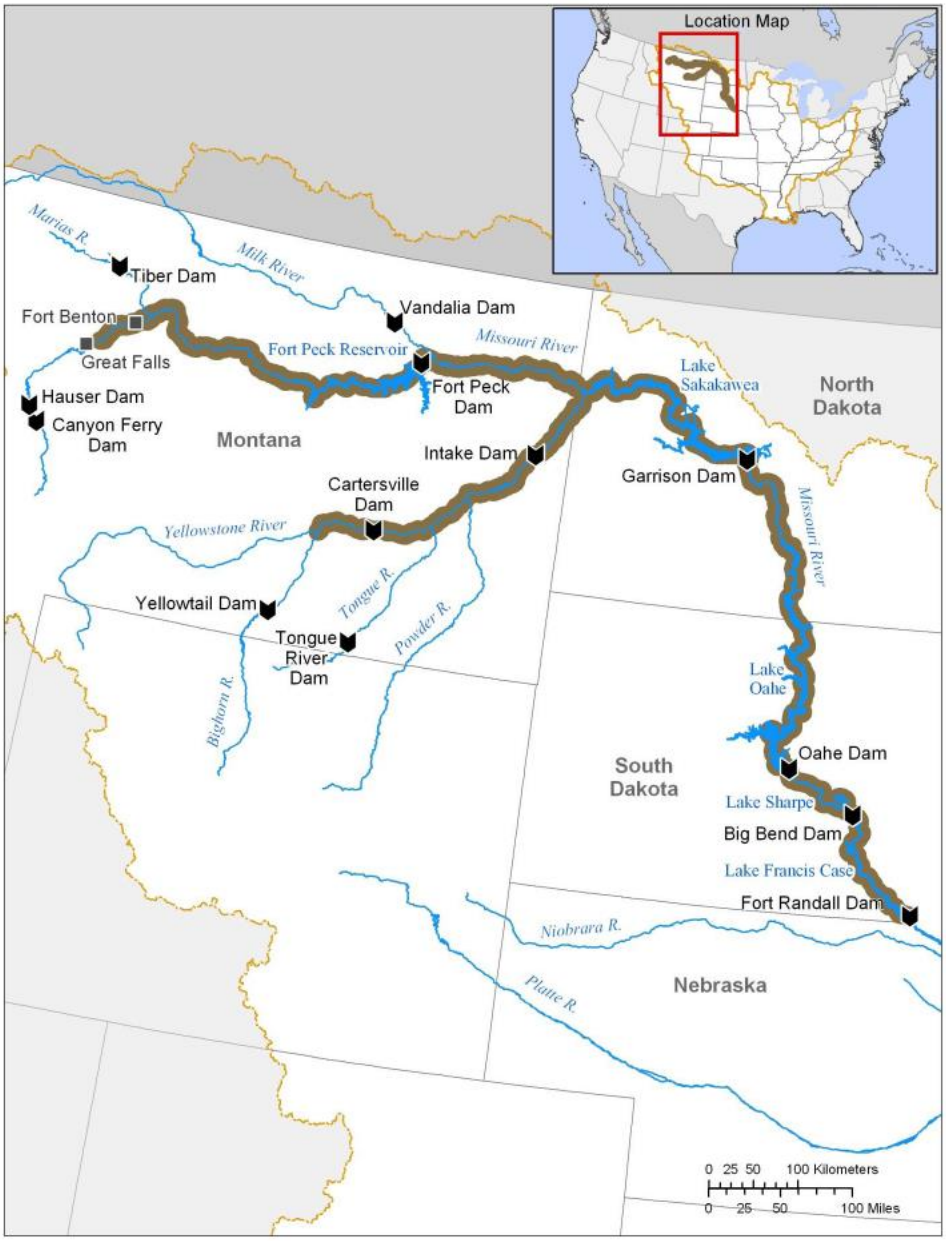

Figure 2. The location of the Great Plains Management Unit in the Missouri River drainage (Service 2014).

3.2.3 Life cycle

The estimated age at maturity for wild pallid sturgeon varies by sex, at 15 – 20 years for females and 5 years for males (Service 2014). Age at maturity for HOPS has been documented at age 7 and 9 for males and females, respectively, but appears to be older for HOPS in the northern part of their range (e.g., upper Missouri River; Service 2014). Upon reaching sexual maturity, spawning periodicity is 2 – 3 years for females and 1 – 3 years for males and appears to be similar between wild pallid sturgeon and HOPS (Service 2014; Holmquist 2017). Spawning occurs between March and July, but varies depending on latitude (Service 2014). For example, the spawning period in RPMA 2 has been reported as mid-June through early July (USGS 2016b).

Pallid sturgeon spawning has been associated with coarse substrate (e.g., boulder, cobble, or gravel) or bedrock, deeper water with relatively fast, converging flows, and environmental conditions, such as day length, water temperature, flow, or turbidity (Service 2014). Suitable spawning conditions appear to be available annually or intermittently among years in the GPMU, though conditions vary by stream and management area (RPMAs 1 and 2; USGS 2016a; Holmquist et al. 2019).

Reproductive pallid sturgeon demonstrate long upstream migrations prior to spawning (Jordan et al. 2016). Females likely spawn near the apex of their spawning migration (i.e., the furthest upstream point of a spawning migration; Jordan et al. 2016), although non-apex spawning has been observed in RPMA 2 (USGS 2016b), presumably due to altered migration pathways and environmental conditions. Males form pre-spawning aggregations at suitable spawning sites prior to female arrival (USGS 2016b); such aggregations have been observed at locations where documented spawning events subsequently occurred (USGS 2016b).

After a successful spawn occurs, pallid sturgeon undergo distinct ontogenetic phases during their first year of life. In a laboratory setting, fertilized eggs incubated 5 – 7 days before hatching, though incubation periods are temperature-dependent and may vary in the wild (Service 2014). Upon hatching, pallid sturgeon free embryos immediately enter the water column and drift predominately near the channel bottom and in the thalweg (deepest part of the river cross section) for several hundred miles (Service 2014). Total dispersal distance is regulated by water velocity and temperature (Braaten et al. 2012). Drifting free embryos subsist on a yolk sac until it is absorbed and the yolk plug is expelled (USGS 2016a). Yolk plug expulsion indicates the transition from endogenously feeding free embryos to exogenously feeding larvae (USGS 2016a). Though larvae may continue to drift, the process of settling out of the water column and into benthic habitats (i.e., drifting no longer occurs) generally coincides with the transition from free embryo to larvae (USGS 2016a).

3.2.4 Pallid sturgeon abundance

The Pallid Sturgeon Population Assessment Program (PSPAP) is a component of the Corps' Missouri River Recovery Program (MRRP) that monitors the status of pallid sturgeon in the Missouri River system below Fort Peck Dam (Corps 2018). Recently, the PSPAP was refined to better evaluate the response of pallid sturgeon populations to a suite of management actions that may be implemented through the MRRP (PSPAP v.2.0; Corps 2018). Pilot implementation of PSPAP v.2.0 began in the lower basin (Gavins Point Dam to the confluence with the Mississippi River; Corps 2018, Appendix D) in 2018 and in the upper basin (Fort Peck Dam to Lake Sakakawea; Corps 2018, Appendix D) in 2019. Although it was estimated that a minimum of three years of sampling would be necessary to provide enough data to inform population models (Corps 2018, Appendix D), preliminary pallid sturgeon abundance estimates were reported for 2019 from monitoring segments in the GPMU (segments 1 – 4), CLMU (segments 5 – 10), IHMU (segments 13 – 14; Table 2; Corps 2020 *in review*). Uncertainty associated with the preliminary abundance estimates was high (i.e., 95% CI) but is expected to improve as sampling data accumulate in the future. The PSPAP v.2.0 preliminary abundance estimates differed from previous abundance estimates by grouping wild and unknown origin pallid sturgeon (i.e., instead of wild only) or HOPS. Unknown origin pallid sturgeon included previously unsampled wild fish or HOPS that either lost their identifying tag or were not tagged (e.g., pallid sturgeon used in a larval drift study; M. Colvin, MRRP Pallid Sturgeon Technical Team, personal communication, March 24, 2020). Pending genetic identification of unknown origin fish will further refine the preliminary abundance estimates (M. Colvin, MRRP Pallid Sturgeon Technical Team, personal communication, March 24, 2020).

Table 2. 2019 preliminary abundance estimates and 95% Bayesian credible intervals for wild and unknown-origin or hatchery-origin pallid sturgeon for grouped monitoring segments within pallid sturgeon management units (Corps 2020 *in review*).

Management Unit	*Pallid sturgeon origin*	
Monitoring segments	Wild or unknown	Hatchery
Great Plains Management Unit		
Missouri River segments 1 – 4	822 (82 – 3,935)	9,808 (2,668 – 39,513)
Central Lowlands Management Unit		
Missouri River segments 5 – 10	6,803 (1,998 – 18,047)	23,270 (6,520 – 64,782)
Interior Highlands Management Unit		
Missouri River segments 13 – 14	1,921 (300 – 6,796)	9,385 (1,724 – 33,684)

The pallid sturgeon population in RPMA 1 falls outside of the scope of the MRRP. In 2007, an estimated 50 wild pallid sturgeon remained in RPMA 1 (Service 2007), although substantially fewer were assumed to be alive by 2018 (Holmquist et al. 2019). An estimated 4,109 (95% CI: 3,489-4,731) HOPS were alive in RPMA 1 in 2016 (Rotella 2017).

Estimating pallid sturgeon abundance in the middle (Missouri River confluence to the Ohio River confluence; IHMU) and lower (Ohio River confluence to the mouth; CPMU) Mississippi River has been difficult because marked individuals are recaptured infrequently during subsequent sampling events. For example, sampling in the middle and lower Mississippi River from 1997 – 2008 resulted in the capture, marking, and release of 241 pallid sturgeon but yielded no recaptures of the previously marked individuals (Friedenberg et al. 2017). Friedenberg et al. (2017) incorporated the information above into a novel modelling framework to estimate the probability that pallid sturgeon abundance in the Mississippi River exceeded a lower abundance threshold. After accounting for survival and movement, model averages estimated that the abundance of pallid sturgeon ≥ age-3 in the Mississipi River between its confluence with the Missouri River and New Orleans, Louisiana, had a 1%, 5%, and 25% chance of being less than 4,600, 7,000, and 15,000, respectively (Friedenberg et al. 2017).

3.2.5 Climate change

The effects of climate change on pallid sturgeon were analyzed and discussed in the revised recovery plan (Service 2014), 2016 Biological Assessment (Reclamation and Corps 2016a), and the 2016 Biological Opinion (Service 2016)—these documents and their supporting literature are incorporated by reference. Collectively, the documents cited predictive models from multiple sources and suggested that factors related to climate change that may impact pallid sturgeon were increasing air temperature (and thus, water temperature), a shifting hydrograph toward earlier and more variable annual runoff events, and increasing frequency and magnitude of drought conditions. For this biological opinion, we reviewed new information on the predicted climate trends at larger (e.g., North America; IPCC 2014) and local (e.g., Montana; Whitlock et al. 2017) scales.

The predicted climate scenarios for North America and Montana were similar. The Intergovernmental Panel on Climate Change (IPCC) predicted that mean annual temperatures in North America would increase by at least 2° Celsius (C) and 4°C in the mid- (2046 – 2065) and late-21st (2081 – 2100) century, respectively, relative to mean annual temperatures from 1986 – 2005 (IPCC 2014). Further, IPCC (2014) suggested a shifting hydrograph toward earlier and more variable run-off events and increased frequency of drought conditions. Similarly, mean annual temperatures in Montana under two emission scenarios (stable and increasing at the observed rate) were predicted to increase by mid-century (2040 – 2069; 4.5 – 6.0° Fahrenheit [F]) and end-of-century (2070 – 2099; 5.6 – 9.8°F) as compared to the 30-year average (1971 – 2000; Whitlock et al. 2017). Average annual precipitation was predicted to increase across Montana by mid-century and end-of-century under both emission scenarios, although the models predicted varying seasonal changes where winter, spring, and fall precipitation were expected to increase, but summer precipitation was expected to decrease (Whitlock et al. 2017). Models also predicted that the occurrence of drought would increase, although model agreement regarding drought was low relative to the other climatic factors (Whitlock et al. 2017).

Ecosystem alterations and on-going anthropogenic impacts confound the effects of climate change. For example, in the GPMU, operations at Fort Peck Dam alter the natural hydrograph by suppressing peak discharge events and supplementing base flows (Braaten et al. 2012). Further, hypolimnetic flow releases from Fort Peck dam reduce water temperature in downstream reaches (Fuller and Braaten 2012). In contrast, irrigation water withdrawals for agriculture production exacerbate the potential effects of reduced summer base flows during drought conditions.

Uncertainties regarding future climate scenarios in concert with the confounding factors make discerning the effects of climate change on pallid sturgeon difficult. Previous analyses have speculated that climate changes could limit or alter pallid sturgeon spawning behavior (Service 2014; Reclamation and the Corps 2016a), promote recruitment after successful spawning by reducing drift distances (i.e., reduced water velocities and increased water temperature; Service 2016; Reclamation and the Corps 2016a), or reduce habitat suitability during periods with low flows (Service 2014). However, we did not find substantial information at this time to support that predicted climate scenarios will impact the status of pallid sturgeon throughout their range or within the action area. Monitoring and analysis of thermal and hydrologic conditions and their confounding factors as they relate to pallid sturgeon will be critical for understanding the long-term effects of climate change on pallid sturgeon.

3.2.6 Range-wide status of the species summary

The range-wide status of pallid sturgeon has apparently stabilized since listing under the Act, primarily due to the annual stocking of HOPS through the PSCAP (Service 2014). Augmentation is critical for maintaining age-class and genetic structures within populations until natural recruitment is restored and sufficient to ensure long-term viability. Monitoring and research since listing have greatly improved our understanding of pallid sturgeon life history requirements, as well as factors that may be precluding their full life history expression. Such information has supported the implementation of management actions intended to contribute to pallid sturgeon recovery, including the Intake Project. Until such management actions restore natural processes that support pallid sturgeon viability throughout their life history, population augmentation through the PSCAP will remain in effect (Service 2014).

3.3 Status of the species in the Great Plains Management Unit

3.3.1 Introduction

As described above, the Service defined pallid sturgeon management units in its revised recovery plan (Service 2014). The proposed action and action area are entirely within the GPMU. Consistent with the 2016 Biological Opinion, we present information on pallid sturgeon in the GPMU below to describe the status of the species at an intermediate scale to that of the listed entity (Status of the Species, section 3.2) and the action area (Environmental Baseline, section 4.0). While pallid sturgeon persist in the Missouri River downstream of Garrison Dam, successful recruitment in this area is unlikely because much of the reach is impounded by reservoirs (Figure 2; Service 2014). Thus, the discussion below will be limited to RPMAs 1 and 2.

3.3.2 Life cycle

Much of the information on pallid sturgeon's life cycle described above (section 3.2.3), including wild pallid sturgeon age at maturity, spawning periodicity, spawning habitat preferences, and free embryo drift dynamics, applies to individuals in the GPMU. Age at maturity appears to be slower for HOPS in the GPMU as compared to other management units. Until recently, sexually mature HOPS had not been observed in RPMAs 1 and 2, and were predominately from the 1997 year-class (see below). The total dispersal distance required for drifting free embryos to transition to non-drifting larvae was recently estimated at 183 – 328 miles (water temperature: 16 °C; water velocity: 0.70 meters per second) in the Missouri River in RPMA 2 (Braaten et al. 2012) and hypothesized to be 311 miles in the Yellowstone River (Corps 2018).

3.3.3 Pallid sturgeon distribution

In the GPMU, pallid sturgeon are distributed in the Missouri River from Fort Benton, Montana, to the headwaters of Fort Peck Reservoir, including the Marias River downstream of the Tiber Dam; downstream of Fort Peck Dam to the headwaters of Lake Sakakawea, including the lower Yellowstone River watershed; downstream of Garrison Dam to the headwaters of Lake Oahe; and downstream of Oahe Dam to the headwaters of Lake Sharpe (Service 2014).

3.3.4 Pallid sturgeon abundance

Pallid sturgeon abundance in the GPMU has been estimated periodically since the species was listed as endangered under the Act in 1990. Generally, abundance estimates were partitioned into RPMA 1 and RPMA 2 and specific to either wild pallid sturgeon or HOPS.

The number of pallid sturgeon captured or estimated to be alive in RPMA 1 has declined through time. For example, 35 unique wild pallid sturgeon were captured during sampling from 1990 – 1995 (Gardner 1996) as compared to only three individuals from 2007 – 2013 (Service 2014). In 2007, the wild population was estimated to be 50 individuals but was assumed to be substantially smaller in 2018 (Holmquist et al. 2019). The estimated number of HOPS in RPMA 1 were 9,251 (95% CI: 6,404 – 12,104), 7,935 (95% CI: 6,231 – 9,630), and 4,109 (95% CI: 3,489 – 4,731) for 2010, 2013, and 2016, respectively (Rotella 2011, 2015, and 2017).

Similar to RPMA 1, the estimated abundance of pallid sturgeon in RPMA 2 has declined through time. An estimated 250 (95% CI: 183 – 340; Krentz 1996), 178 (95% CI: 96 – 351; Kapuscinski 2002), 150 (95% CI: 88 – 236; Kapuscinski and Baxter 2004), and 158 (95% CI: 129 – 193; Klungle and Baxter 2005) wild pallid sturgeon were alive in 1995, 2001, 2003, and 2004, respectively. Jaeger et al. (2009) used historic mark-recapture data to estimate wild pallid sturgeon abundance in RPMA 2 at 40 sampling occasions from 1988 – 2008, including that 531 (95% CI: 422 – 640) individuals were estimated to be alive in 1998 as compared to 125 (95% CI: 100 – 150) individuals in 2008. For corresponding years, abundance estimates in Jaeger et al. (2009) were consistently higher than those from previous studies, although previous estimates were near or within the 95% confidence intervals from Jaeger et al. (2009).

Survival rates for HOPS that were stocked into RPMA 2 were initially estimated in 2009 (Hadley and Rotella 2009), and subsequent addendums to the original report provided HOPS abundance estimates. The estimated number of HOPS in RPMA 2 declined through time, with estimates of 74,950 (95% CI: 37,787 – 112,141), 43,012 (95% CI: 27,214 – 58,816), and 16,444 (95% CI: 12,138 – 20,759) in 2010, 2013, and 2016, respectively (Rotella 2011, 2015, and 2017).

Several surviving HOPS have reached the age at which sexual maturity is expected (>15 years old), although pallid sturgeon in the upper Missouri River basin appear to mature slower than populations lower in the basin (Service 2014). The estimated number of HOPS that were ≥15 years old in 2016 was 143 (95% CI: 105 – 182) and 238 (95% CI: 151 – 322) for RPMA 1 and RPMA 2, respectively.

Preliminary abundance estimates for 2019 from the MRRP Missouri River monitoring segments in the GPMU are reported in Table 2 (Corps 2020 *in review*). Additionally, PSAP v.2.0 methodologies were used to estimate pallid sturgeon abundance in the Yellowstone River in 2019. Monitoring segments were established both upstream (confluence with the Powder River to Intake) and downstream (Intake to the confluence with the Missouri River) of Intake. Aggregated abundance estimates suggested that 1,281 pallid sturgeon occupied the Yellowstone River between its confluences with the Powder and Missouri rivers in 2019 (M. Colvin, Pallid Sturgeon Technical Team, unpublished data).

3.3.5 Pallid sturgeon reproduction

In the GPMU, wild pallid sturgeon declines have been attributed a lack of natural recruitment into the population and older fish aging out of the population (Braaten et al. 2009). Indeed, natural recruitment of pallid sturgeon to age-1 has not been detected in the GPMU, despite extensive monitoring efforts in recent decades (Corps 2020 *in review*). Inadequate drift distances for free embryos to transition into non-drifting larvae upstream of hypoxic (and presumably lethal) reservoir headwaters have been hypothesized as a recruitment bottleneck (Guy et al. 2015). Fort Peck Reservoir was established in 1937 and marks the lower boundary of RPMA 1, and Lake Sakakawea, established in 1953, is the lower boundary of RPMA 2 (Braaten et al. 2015).

In RPMA 1, considerable effort has been made toward understanding the reproductive ecology of wild pallid sturgeon and HOPS. From 2014 – 2017, reproductive males and females (wild pallid sturgeon and HOPS) were studied to investigate spawning migration dynamics, female spawning success, and to quantify spawning periodicity and age-at-first-maturity for HOPS (Holmquist 2017). Migrations were similar for reproductive wild pallid sturgeon and HOPS, but reproductively-active fish exhibited substantially greater total movements than non-reproductive fish (Holmquist 2017). Male aggregations were observed forming on the descending limb of the hydrograph during both years despite variability in the timing and magnitude of peak discharge events (Holmquist 2017). Five female pallid sturgeon (two wild and three 1997 year-class HOPS) were deemed reproductively-viable based on plasma sex steroid levels but underwent follicular atresia (i.e., degeneration of follicles; Holmquist 2017). For HOPS, the youngest reproductively-active male was 14 years old and the youngest female was 18 years old. Similar to what has been previously reported (Jordan et al. 2016), male HOPS were observed having annual and biennial reproductive cycles (Holmquist 2017).

Reproductively-active pallid sturgeon in RPMA 1 were also monitored in 2018 and 2019. Six females were reproductively active in 2018; three out of the six females and one reproductive male migrated up the Missouri River and as far as 30 miles into the Marias River. However, these pallid sturgeon exited the Marias River before spawning occurred when flow releases from the Tiber Dam were substantially reduced. Subsequent tracking and spawning assessments documented that three females had spawned in the Missouri River, while the other three females underwent follicular atresia. In 2019, two reproductive females were tracked, and both individuals successfully spawned in the Missouri River.

Recent studies in RPMA 1 offer new insight into the potential for pallid sturgeon recovery in this area and the GPMU. Monitoring efforts documented the first spawning events by any pallid sturgeon (wild or HOPS) in the Missouri River upstream of Fort Peck. Whereas the location of these spawning events are unlikely to provide enough drift distance for free embryos to develop into larvae, reproductive pallid sturgeon were detected using the Marias River for the first time—successful spawning in the Marias River may provide adequate drift distance for free embryos to become larvae before reaching Fort Peck Reservoir. All females that successfully spawned in 2018 and 2019 were HOPS from the 1997 year-class, supporting that stocked HOPS are reaching sexual maturity. Spawning migrations by two of these females were previously tracked and resulted in follicular atresia. Successful spawning during their next reproductive cycle supports the hypothesis that pallid sturgeon exhibit “dummy runs” (i.e., female pallid sturgeon that demonstrate a spawning migration but undergo follicular atresia; Holmquist 2017) during their first reproductive cycle; such “dummy runs” have potentially been observed by HOPS in the Yellowstone River.

In RPMA 2, recent monitoring has documented that pallid sturgeon spawning occurs annually in the Yellowstone River under a variety of environmental conditions (P. Braaten, U.S. Geological Survey [USGS], unpublished data); however, spawning predominately occurred at locations (lower 20 miles of the Yellowstone River) that lacked adequate drift distance for free embryos to transition to larvae before perishing in the headwaters of Lake Sakakawea (USGS 2016b). In 2011, spawning occurred in the Missouri River near its confluence with the Milk River, and a free embryo was subsequently collected downstream of the spawning site (USGS 2016b)—this was the first time spawning was detected in the Missouri River between Fort Peck Dam and Lake Sakakawea. In 2014, telemetered pallid sturgeon, including one female and two males, circumvented Intake via the NSC and migrated up the Yellowstone River and approximately 20 miles into the Powder River where spawning was presumed to occur (USGS 2016a). Most recently, in 2020, a reproductive female that was translocated upstream of Intake (see section 4.2.3.1) spawned at or near the apex of her migration in the Yellowstone River (river mile 197). Whereas multiple spawning events have been documented in RPMA 2, pallid sturgeon recruitment to age-1 has not been detected through 2019.

In RPMA 2, several HOPS have exhibited spawning behavior or reproductive physiology indicative of sexual maturity. In 2017 and 2018, HOPS (known males or of unknown sex) participated in multiple spawning aggregations in the lower Yellowstone River, including three aggregations where reproductive females were present and spawning was suspected to occur (P. Braaten, USGS, unpublished data). Though reproductive females rarely use the Missouri River, in 2018, two female HOPS (both 1997 year-class) were captured in the vicinity of the Fort Peck Dam and found to be reproductively-viable (Haddix 2019). Both females remained in the Missouri River throughout the spawning period, but spawning was not verified for either fish (Haddix 2019). Evidence that HOPS are reaching sexual maturity in RPMAs 1 and 2 continues to accumulate, suggesting that stocked individuals will be able to perpetuate these populations if limiting factors are addressed.

Telemetered wild pallid sturgeon and HOPS have made extensive migrations in the Yellowstone River watershed upstream of Intake during the spawning season. For example, pallid sturgeon have migrated up to the Cartersville Diversion Dam (river mile 234), the next potential barrier to pallid sturgeon upstream migrations, 10 miles into the Tongue River, and nearly 100-miles up the Powder River. These extensive migrations may have been reproductively-motivated because reproductive fish have been shown to migrate longer distances than non-reproductive fish during the spawning period (Holmquist 2017). Although spawning upstream of Intake has only been detected twice, spawning may have occurred by non-telemetered fish. Other plausible explanations for long spawning migrations that don’t result in successful spawning are that sufficient numbers of pallid sturgeon were not present to initiate spawning behavior (e.g., spawning aggregations) or that HOPS reaching sexual maturity were exhibiting “dummy runs”, similar to those observed in RPMA 1 (Holmquist 2017).

3.3.6 Influence of dams and reservoirs

Dams and reservoirs have altered riverine processes and habitats such that pallid sturgeon are unable to complete aspects of their life cycle. A complete discussion on the effects of dams and reservoirs on pallid sturgeon is presented in the revised recovery plan (Service 2014). The discussion below describes the effects of dams and reservoirs on pallid sturgeon recruitment to age-1. These effects have largely contributed to the presumed recruitment failure in the GPMU (Service 2014). Hypothesized factors related to dams and reservoirs that preclude natural recruitment include hypoxic conditions in reservoir headwaters, reduced drift distances available for pallid sturgeon free embryos to develop into non-drifting larvae, and altered flow, temperature, and turbidity regimes associated with spawning cues and free embryo and larval development or survival (Service 2014; Guy et al. 2015).

In the GPMU, dams have fragmented historically connected reaches of the Missouri River and its tributaries, thus isolating a pallid sturgeon metapopulation into discrete populations. On the Missouri River, Canyon Ferry Dam and seven run-of-the-river dams located near Helena (Hauser and Holter dams) or Great Falls, Montana (Black Eagle, Rainbow, Cochrane, Ryan, and Morony dams), exist upstream of contemporary pallid sturgeon distribution. Fort Peck Dam marks the boundary between RPMAs 1 and 2, and directly affects pallid sturgeon in both management areas (Figure 2). Garrison Dam impounds Lake Sakakawea and delineates the lower boundary of RPMA 2 (Figure 2). Missouri River tributaries that are occupied by pallid sturgeon and influenced by dams include the Marias River (Tiber Dam), Milk River (Vandalia Diversion Dam), and Yellowstone River (Intake and Cartersville diversion dams; Figure 2). All of the dams listed above are large in scale such that they impound water and converted former riverine habitats to reservoirs, except for the low-head diversion dams at Intake and Cartersville on the Yellowstone River and Vandalia Diversion Dam on the Milk River.

3.3.6.1 Hypoxic conditions in reservoir headwaters

Among the leading hypotheses regarding pallid sturgeon recruitment failure is that inadequate distances exist for drifting free embryos to develop into non-drifting larvae between spawning locations and reservoir headwaters (Guy et al. 2015). The transitional zone between riverine and reservoir habitats (transitional zone) is anoxic or hypoxic, and such conditions were lethal to pallid sturgeon free embryos and larvae (40-days post-hatch) in a laboratory setting (Guy et al. 2015). Resultantly, Fort Peck Reservoir in RPMA 1 and Lake Sakakawea in RPMA 2 likely act as a bottleneck for pallid sturgeon recruitment in their respective management area.

Reservoir management directly impacts the total distance that is available for free embryos or larvae to drift before reaching reservoir headwaters. For example, the transitional zone into Lake Sakakawea can vary by about 60 miles within the Missouri River channel between the historical maximum and minimum reservoir levels (Fischenich et al. 2014). Accordingly, the drawdown of Lake Sakakawea is among the suite of management actions that may be evaluated to facilitate pallid sturgeon recruitment to age-1 in RPMA 2 (Corps 2018).

3.3.6.2 Truncated pallid sturgeon drift distances

In the GPMU, dams limit or preclude access to upstream spawning habitats, thus curtailing free embryo or larval drift distances above existing reservoirs. Large dams in the Missouri River and its tributaries have permanently blocked upstream migrations and altered hundreds of miles of potential spawning habitats. For example, Fort Peck and Garrison dams have permanently blocked upstream migrations and their associated reservoirs (Fort Peck Reservoir and Lake Sakakawea) collectively inundate approximately 312 miles of former riverine habitats (Service 2016). In contrast, low-head diversion dams intermittently prevent upstream access, with passage rates depending on site-specific conditions, but have a relatively small influence on upstream habitats (i.e., don't create reservoirs).

Field studies in the Missouri River in RPMA 2 have estimated the total dispersal distance that is required for drifting free embryos and larvae to survive and recruit to the population. One study estimated that 152 and 330 miles of drift would be required at water velocities of approximately 1 foot per second and 2 feet per second, respectively (11 days of drift; Braaten et al. 2008), whereas another study estimated that 183 – 328 miles of drift distance would be required for free embryos to transition to larvae in the Missouri River between Fort Peck Dam and Lake Sakakawea at a water temperature of 16 °C (approximately 13 days of drift) and water velocity of 0.7 meters per second (Braaten et al 2012). A 5-day post-hatch free embryo that was released as part of the latter study was captured the following year during routine sampling, suggesting that adequate drift distance exists in this area for free embryos that are at least five days old (Braaten et al. 2012). Whereas these estimates informed free embryo drift requirements for the Missouri River in RPMA 2, drift requirements elsewhere (e.g., Yellowstone River) likely vary due to differing thermal, hydrologic, or physiographic characteristics.

In RPMA 1, approximately 235 and 261 miles of drift distance are available from Morony Dam (Missouri River) and Tiber Dam (Marias River), respectively, to the headwaters of Fort Peck Reservoir (Holmquist 2017; DNRC 1979). In RPMA 2, approximately 217 miles of drift distance are available in the Missouri River between Fort Peck dam and the headwaters of Lake Sakakawea (USGS 2016a), and in the Yellowstone River, approximately 250 and 260 miles of drift distance are available from the Cartersville Diversion Dam (Yellowstone River) and the furthest observed upstream pallid sturgeon migration into the Powder River, respectively, to the headwaters of Lake Sakakawea (Reclamation and Corps 2016a; P. Braaten, USGS, unpublished data). Access to reaches of the Yellowstone River watershed upstream of river mile 73 is currently limited by Intake.

3.3.6.3 Altered flow, temperature, and turbidity regimes

3.3.6.3.1 Environmental spawning cues

Dams and their operations alter environmental conditions and natural riverine processes. Flow releases from dams alter the natural hydrograph by suppressing peak flows and supplementing base flows (Braaten et al. 2012). Further, hypolimnetic dam releases substantially decrease water temperatures in downstream reaches. For example, hypolimnetic releases from Fort Peck Dam reduced water temperatures in the Missouri River for 189 miles as compared to water temperatures upstream of Fort Peck Reservoir (Fuller and Braaten 2012). Finally, dam reservoirs capture and store mobilized sediment, thus altering instream turbidity levels in stream reaches downstream of the dam. Naturally high turbidity in streams, such as the Missouri River, form instream habitat features and foster the survival of animals that have evolved in such environments.

In RPMAs 1 and 2, dam operations alter environmental factors that cue spawning behavior. Reproductive pallid sturgeon migrate upstream in the spring as flows and water temperatures increase, and males form pre-spawning aggregations on the descending limb of the hydrograph (Service 2014; Holmquist 2017). Spawning occurs when reproductive females join the aggregated males. Female reproductive-readiness (i.e., oocyte development) is hypothesized to be influenced by discharge, water temperature, and photoperiod (Service 2014).

In RPMA1, operations from Canyon Ferry Dam on the Missouri River and the Tiber Dam on the Marias River suppress peak discharge events that cue pallid sturgeon spawning migrations. Reaches of the Missouri River occupied by pallid sturgeon regain some natural river characteristics because of the distance downstream from Canyon Ferry Dam (nearly 150 miles). However, operations from Tiber Dam may have a critical role in pallid sturgeon recovery in RPMA 1. The importance of flow releases from Tiber Dam on pallid sturgeon spawning dynamics was highlighted in 2018 when reproductive pallid sturgeon (three females and one male) migrated nearly 30-miles up the Marias River when flow releases were 2,125 cfs but abruptly out-migrated when flow releases were reduced to 715 cfs (Holmquist et al. 2019).

In RPMA 2, the Yellowstone River offers a near-natural hydrograph and thermal regime, whereas Fort Peck Dam alters environmental conditions in reaches of the Missouri River between the dam and Lake Sakakawea. For example, in 2014, mean discharge (April and May) and water temperature (April 15-August 31) in the Yellowstone River was about 15,000 cfs greater and 1.5 °C warmer, respectively, than in the Missouri River below Fort Peck Dam (USGS 2016a). Telemetered wild pallid sturgeon preferentially select (60 – 90%) the near-natural conditions in the Yellowstone River over altered conditions the Missouri River for spawning migrations (Reclamation and Corps 2016a), with a higher percentage of pallid sturgeon using the Missouri River during years with relatively high discharges (>20,000 cfs).

3.3.6.3.2 Free embryo development

Dam operations influence environmental conditions that regulate the distance that drifting free embryos require to transition into non-drifting larvae. The distance that free embryos drift before transitioning into larvae is influenced by rates of free embryo development and dispersal. Free embryo developmental rate is regulated by temperature, where free embryos require approximately 200 cumulative thermal units[4] to develop into larvae (Kynard et al. 2007). Downstream dispersal rate in a given river system is largely regulated by discharge (i.e., water velocity). Dam operations can increase or decrease free embryo developmental rates relative to natural water temperatures; hypolimnetic releases are cool and slow developmental rates, whereas surface water releases (e.g., over a spillway) are warm and increase developmental rates

[4] Cumulative thermal units are a unit of measurement that describes the effects of temperature over time by calculating the sum of mean daily water temperatures for a series of days.

(Braaten et al. 2012). Similarly, flow releases from dams can increase or decrease dispersal rates relative to natural conditions depending on if the amount of water released from the dam is greater or less than the cumulative discharges entering the reservoir.

In RPMAs 1 and 2, dam operations generally decrease free embryo or larval developmental rate, but can have varying influences on dispersal rates. Hypolimnetic flow releases decrease water temperatures downstream of dams and, thus, reduce free embryo developmental rates. Dam operations may decrease or increase dispersal rates depending if flow releases are greater than or less than the cumulative discharge entering the associated reservoir. In RPMA 1, thermal effects from Canyon Ferry Dam and the seven run-of-the-river dams are somewhat normalized due to their location upstream from occupied pallid sturgeon habitats, whereas Missouri River discharges are largely influenced by operations at Canyon Ferry Dam (Holmquist et al. 2019). Tiber Dam directly influences downstream conditions in the Marias River by reducing water temperatures and altering natural flow rates (Stober 1962). In RPMA 2, hypolimnetic releases from Fort Peck Dam reduce downstream water temperatures and, thus, the rate of free embryo development. For example, average water temperature below Fort Peck Dam was 6.4°C lower than waters upstream of Fort Peck Dam from 2001 – 2009 (Fuller and Braaten 2012). Fort Peck Dam also alters natural discharge rates and, thus, dispersal rates. The Yellowstone River exhibits near-natural thermal and flow regimes, although drifting free embryos or larvae that originate in the Yellowstone River, but drift into the Missouri River are subject to the effects of Fort Peck Dam between the confluence with the Yellowstone River and the headwaters of Lake Sakakawea.

3.3.6.3.3 Turbidity

Dams reduce turbidity regimes in downstream river reaches by impounding sediment inputs. The relationship between turbidity and pallid sturgeon survival is uncertain, although it has been hypothesized that reduced turbidity levels result in increased predation on free embryos and larvae with poor mobility by reducing their concealment, thus increasing the foraging-efficiency of conspecifics (Service 2014).

3.3.7 Free embryo and larval pallid sturgeon survival

In RPMAs 1 and 2, there is strong evidence that the existence of dams and their operations directly influences the survival of pallid sturgeon free embryos and larvae. The combination of hypoxic conditions in the transitional zone, blocked access to upstream spawning habitats, reduced developmental rates, and altered dispersal rates have contributed to the presumed natural recruitment failure for pallid sturgeon in these areas.

Despite the natural recruitment failure, an unmarked pallid sturgeon (412 millimeters [mm] fork length [FL]) was captured in RPMA 2; genetic analysis assigned this individual as a HOPS that was released the previous year near the confluence of the Missouri and Milk rivers at 5-days post-hatch (Fuller and Haddix 2017). This observation supported the hypothesis that inadequate drift distances exist between spawning locations in the Missouri River and the headwaters of Lake Sakakawea to support natural recruitment, but indicated that enough drift distance is available in this area for pallid sturgeon as young as five days to recruit to the population. The

Corps is currently drafting an Environmental Impact Statement for altering flow releases from Fort Peck Dam to benefit pallid sturgeon—implementation of this action may occur as early as 2022, but is dependent on the appropriate hydrologic conditions and completion of the Environmental Impact Statement (W. Nelson-Stastny, Service, personal communication, August 10, 2020). This management action will potentially restore natural spawning cues to promote pallid sturgeon spawning in the Missouri River and reduce dispersal rates relative to conditions under existing management, such that naturally-produced free embryos will recruit to the population.

Restoring fish passage at Intake as a result of the Intake Project may increase the survival of pallid sturgeon free embryos. Pallid sturgeon have demonstrated a motivation to migrate and, on two occasions, spawn upstream of Intake. Available drift distances for free embryos between the Cartersville Diversion Dam in the Yellowstone River and the furthest observed upstream migration in the Powder River and Lake Sakakawea of 250 and 260 miles, respectively, are within the range of the distances that were predicted to be required in the Missouri River between Fort Peck Dam and Lake Sakakawea (152 – 330 miles, Braaten et al. 2008; 183 – 328 miles, Braaten et al. 2012). Whereas the distance required for drifting free embryos that originate in the Yellowstone River to transition to non-drifting larvae likely differs from the Missouri River, the Intake Project is expected to increase the likelihood for natural recruitment in RPMA 2.

In concert with the impending or potential management actions in the Missouri (Fort Peck flow releases) and Yellowstone (Intake Project) described above, drawdown of Lake Sakakawea has been hypothesized as an action that could contribute to restoration of pallid sturgeon natural recruitment in RPMA 2. This potential action and its implications on pallid sturgeon recruitment are further described in the MRRP Science and Adaptive Management Plan (Corps 2018). Reservoir levels in Lake Sakakawea can alter total drift distance available to free embryos or larvae in RPMA 2 by up to 60 miles (based on historical minimum and maximum pool levels), or approximately 1 mile per foot of reservoir elevation (Erwin et al. 2018). Indeed, modelling efforts suggested that drift periods could increase by about two days between reservoir pool levels at 5% and 95% of historical operations (Erwin et al. 2018).

3.3.8 Status of the species in the Great Plains Management Unit summary

Abundance estimates suggest that the number of pallid sturgeon present in RPMAs 1 and 2 has declined in recent years. Wild pallid sturgeon are aging out of the population (Braaten et al. 2012), whereas trends in HOPS abundance appear to coincide with stocking rates (Service 2019). The Service's Range-Wide Pallid Sturgeon Stocking Plan (2019) summarizes information that suggests stocking rates in the upper Missouri River basin during the early-2000s resulted in pallid sturgeon abundances that exceeded carrying capacity. This conclusion was supported by a recent study that suggested the abundance of HOPS exceeded that of the wild population in 1969 (Braaten et al. 2009). As a result, more conservative stocking rates have been used in recent years, which likely contributes to the observed declines in estimated HOPS abundances in RPMAs 1 and 2 (Service 2019). Abundance estimates suggest that hundreds of HOPS in both areas have reached the expected age at maturity, which was supported by field observations of HOPS spawning behavior or reproductive physiology. The presence of dams in RPMAs 1 and 2 have altered environmental conditions that influence spawning cues for reproductive pallid sturgeon and the development and survival of free embryo or larval pallid sturgeon; however, management actions are pending (i.e., Intake Project) or proposed (i.e., flow releases from Fort Peck) to support the full life history expression by the remaining wild pallid sturgeon and HOPS, as well as their progeny, in support of pallid sturgeon recovery. Such actions are expected to alleviate threats to pallid sturgeon that were identified at their listing under the Act (55 FR 36641) and in the revised recovery plan (Service 2014).

4.0 Environmental Baseline

4.1 Introduction

The Environmental Baseline section summarizes past and ongoing human and natural factors that have led to the current status of the species, its habitat, and ecosystem, within the action area (Service 1998, page 4-22). The scale of the Environmental Baseline is at the scale of the action area. The summary below highlights new information since the issuance of the 2016 Biological Opinion and ITS and reiterates information that is relevant to analyzing the effects of the proposed action on pallid sturgeon for this biological opinion.

4.2 Status of the species within the action area

4.2.1 Habitat in the action area

General descriptions of conditions in the Yellowstone River Basin and habitat in the action area are in the 2016 Biological Assessment (Reclamation and Corps 2016a) and 2016 Biological Opinion (Service 2016) and incorporated by reference.

4.2.1.1 Existing weir at Intake

The existing weir at Intake limits pallid sturgeon access to upstream reaches of the Yellowstone River and its tributaries. Although telemetered pallid sturgeon have circumvented Intake during upstream migrations through the NSC at moderate and high discharge levels in the Yellowstone River (see section 4.2.3.2 below), only one telemetered pallid sturgeon has been observed migrating upstream over the existing weir to date (Rugg et al. 2019). While the existing weir is part of the Environmental Baseline, its presence in the Yellowstone River is maintained by the annual placement of rock on the weir, which is an element of the proposed action (O&M of the LYP prior to and during construction)—we discuss the effects of the annual placement of rock on the existing weir to pallid sturgeon below in sections 5.2.1.1 and 5.2.1.2.

4.2.1.2 Fish screens at Intake

Prior to 2011, an estimated 500,000 fish of 36 species were entrained annually into the Main Canal at Intake (Reclamation and Corps 2016a). In 2011, a new headworks structure with fish screens was installed at Intake to regulate irrigation water diversions into the Main Canal and prevent the associated entrainment of fish larger than 40 mm. In the absence of pallid sturgeon screening criteria, the fish screens were designed to meet juvenile salmonid criteria (Reclamation and Corps 2016a; Figure 3). Screens include a mesh size of 1.75 mm and have a maximum approach velocity of 0.4 feet per second (Reclamation and Corps 2016a). The fish screens were mounted one meter above the channel bed to further reduce entrainment of drifting free embryos. Modeling suggested that the area influenced by the fish screens and irrigation diversions extends approximately 50 feet into the Yellowstone River at discharges ranging from 24,000 – 25,000 cfs (Reclamation and Corps 2016a). For context, the Yellowstone River at this location is approximately 700 feet wide, and the channel thalweg location is 100 – 150 feet away from the headworks structure.

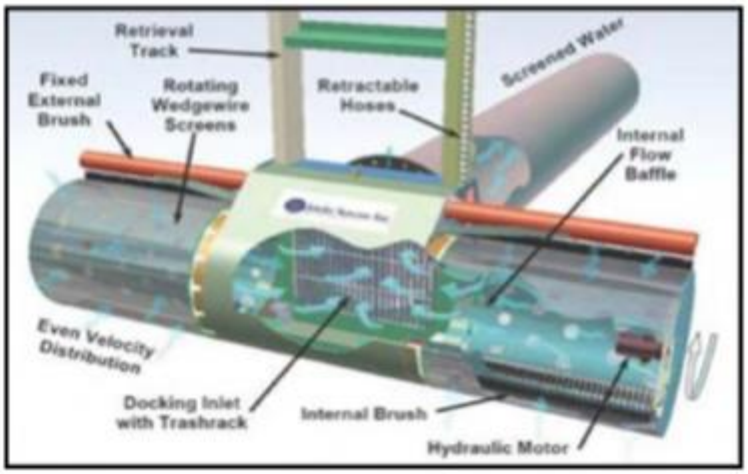

Figure 3. Representation of the fish screen design.

Monitoring data from 2012 – 2019 suggest that the fish screens have substantially reduced fish entrainment into the Main Canal. In 2012, approximately 99 percent of fish entrained into the Main Canal were from the Cyprinidae or Catostomidae families (minnows, carp, or suckers) and were typically 4 – 8 mm in length (Reclamation and Corps 2016a). Since 2012, annual entrainment monitoring has resulted in only 16 Acipenseriforme (paddlefish [*Polydon spathula*], shovelnose sturgeon [*Scaphirhynchus platorynchus*], or pallid sturgeon) being sampled in the Main Canal, of which one was unidentifiable, four were paddlefish, one was a shovelnose sturgeon, and four were sturgeon that couldn't be identified to species; genetic analysis of the six samples that were collected in 2019 is pending (D. Trimpe, Reclamation, unpublished data).

The headworks structure and fish screens have considerably reduced fish entrainment into the Main Canal, including Acipenseriformes that share early life history characteristics. Shovelnose sturgeon are prevalent in this area but have been sampled infrequently in the Main Canal since the fish screens were installed. Pallid sturgeon larger than 40 mm are expected to be screened from the Main Canal, and drifting free embryos are not likely to encounter the screens due to their placement off the channel bottom (1 meter) and away from the river thalweg; pallid sturgeon free embryo drift predominately occurs in the lower 0.5 meter of the water column (≥98%) and near the river thalweg (>95%; i.e., outside bend and mid-channel; Braaten et al. 2010). Despite these improved conditions, the potential for pallid sturgeon to be entrained into the Main Canal or impinged on the screens still exists. In their Monitoring and Adaptive Management Plan (MAMP; section 5.2.4), Reclamation and the Corps describe their commitment to monitoring the extent of such impacts and the process for implementing adaptive management measures if the anticipated amount or extent of incidental take of pallid sturgeon free embryos or larvae (incidental take statement, section 2.0) resulting from entrainment into the Main Canal or impingement on the fish screens is exceeded (Reclamation and Corps 2020 *in review*).

4.2.2 Climate change in the action area

In section 3.2.5, we discussed new information on predicted climate trends for North America and Montana and the potential for related effects to pallid sturgeon. Analysis and discussion on the effects of climate change to pallid sturgeon in the revised recovery plan (Service 2014), 2016 Biological Assessment (Reclamation and Corps 2016a), and 2016 Biological Opinion (Service 2016) were also incorporated by reference. Collectively, these analyses and discussions concluded that predicted climate scenarios toward increased water temperatures, a shifting hydrograph toward earlier and more variable run-off events, and increased frequency of drought conditions were likely; however, we did not find substantial information at this time to support that predicted climate scenarios will impact the status of pallid sturgeon within the action area.

4.2.3 Pallid sturgeon distribution

Pallid sturgeon are distributed throughout the action area, although associated densities vary seasonally and spatially. Wild pallid sturgeon and HOPS are concentrated in the lower portions of the Missouri and Yellowstone rivers in RPMA 2 from July through April (Reclamation and Corps 2016a). Migrations into upstream reaches of the Missouri and Yellowstone rivers correspond with elevated spring flows; such migrations are generally considered to be associated with spawning behavior, but non-reproductive adults and juveniles have demonstrated similar movements. Upstream migrations are dynamic as reproductive pallid sturgeon have been observed using reaches of the Missouri and Yellowstone rivers during a spawning season. For example, in 2018, a reproductive female was initially detected in the lower Yellowstone River before migrating up the Missouri River to the vicinity of Fort Peck Dam, then back into the lower Yellowstone River where spawning was suspected (P. Braaten, USGS, unpublished data). Annually, 60 – 93% of telemetered wild adults move into the Yellowstone River during the spawning period (April 15 – July 1), and, of these, 9 – 26% encounter Intake during upstream migrations (Reclamation 2020). Similarly, telemetered HOPS have been observed migrating upstream to Intake, although the distance traveled before encountering Intake has varied from relatively short to originating in the lower Yellowstone River or Missouri River (P. Braaten, USGS, unpublished data). Occasionally, telemetered pallid sturgeon have bypassed Intake during upstream migrations via translocation by Reclamation (section 4.2.3.1) or the NSC (section 4.2.3.2). These upstream migrations have persisted to the Cartersville Diversion Dam in the Yellowstone River and nearly 10 and 100 miles into the Tongue and Powder rivers, respectively (Reclamation 2018, 2019, 2020; D. Trimpe, Reclamation, unpublished data). Whereas most fish that migrate up the Yellowstone River watershed, including past Intake, return downstream to the lower Yellowstone and Missouri rivers on the descending limb of the spring-pulse hydrograph, some individuals maintain a position upstream of Intake for an extended period (Rugg et al. 2019).

4.2.3.1 Pallid sturgeon translocations above Intake

From 2017 – 2020, Reclamation translocated motivated adult and juvenile pallid sturgeon upstream of Intake, per reasonable and prudent measure #2, term and condition #1, in the 2016 ITS (Service 2016, page 65). Reclamation identified a catch zone in the Yellowstone River that spanned from below the boulder field at Intake to near the mouth of the NSC (approximately 1.25 miles); telemetered pallid sturgeon that entered the catch zone were considered motivated to migrate upstream of Intake. In 2017 and 2018, fish were allowed to utilize the NSC before being captured for translocation, whereas fish were captured below the mouth of the NSC in 2019 and 2020 because passage through the NSC was unlikely or blocked (see section 4.2.3.2).

Collectively, from 2017 – 2020, Reclamation translocated 34 pallid sturgeon upstream of Intake (Table 3), and, in doing so, substantially contributed to the overall understanding of pallid sturgeon movement, habitat utilization, and reproductively ecology in the watershed upstream of Intake (Reclamation 2018, 2019, 2020; D. Trimpe, unpublished data). Post-translocation migrations varied as some individuals held a position at their release site before returning downstream, whereas others continued upstream migrations. Notable continued upstream migrations extended to the Cartersville Diversion Dam (river mile 234) in the Yellowstone River or into the Tongue and Powder rivers (Reclamation 2018, 2019, 2020; D. Trimpe, Reclamation, unpublished data). Migrations into the Powder River were extensive at times, with recorded upstream migrations extending 48-, 82-, 87-, 88-, 89-, and 97-miles into the tributary. The Powder River is of particular interest regarding the restoration of natural recruitment in RPMA 2 because it is one of two locations where spawning has been documented upstream of Intake (2014; USGS 2016a).

Table 3. Summary of the number of wild and hatchery-origin pallid sturgeon translocated upstream of Intake by Reclamation from 2017 – 2020.

Year	Wild pallid sturgeon	Hatchery-origin pallid sturgeon	Total
2017	2	3	5
2018	3	4	7
2019	2	10	12
2020	3	7	10
Total	10	24	34

Activities by fish that were translocated in 2020 were novel as compared to recent years. A reproductive female migrated up to Yellowstone river mile 197 before returning downstream. A reproductive assessment shortly after she began moving downstream revealed that she had lost approximately 2.1 kilograms of body weight relative to a previous reproductive assessment, indicating that she had spawned near the apex of her migration. This event is the first evidence of pallid sturgeon spawning in the Yellowstone River upstream of Intake. Additionally, two pallid sturgeon migrated upstream and into the Tongue River after being translocated, which marks the first time pallid sturgeon have been detected utilizing the tributary since the 1950's (Nelson and Jaeger 2006).

4.2.3.2 Natural side channel at Intake Diversion Dam

Pallid sturgeon have used a NSC to circumvent the weir at Intake during upstream migrations under moderate to high discharge levels in the Yellowstone River (Rugg et al. 2019). The NSC diverged from the main channel approximately two miles upstream of Intake and reconnected with the main channel approximately two miles downstream of the weir. Based on the best available information at the time of the original consultation, the 2016 Biological Opinion surmised that Yellowstone River discharges of approximately 47,000 cfs or greater were required for adult pallid sturgeon to bypass Intake through the NSC during spawning migrations. Historical Yellowstone River discharge data suggested that discharges of that magnitude would occur for at least seven days during five out of every ten years (Service 2016).

Passage rates for telemetered pallid sturgeon that encountered Intake varied by life-stage and appeared to be influenced by discharge (Rugg et al. 2019). From 2014 – 2018, telemetered pallid sturgeon bypassed Intake through the NSC at Yellowstone River discharges that were lower than the minimum discharge for passage that was identified in the 2016 Biological Opinion (47,000 cfs). During this time, wild pallid sturgeon passed through the NSC every year except 2016, whereas HOPS only passed through the NSC in 2017 and 2018 (Rugg et al. 2019). For wild pallid sturgeon, passage rates were near 40% at Yellowstone River discharges greater than 45,000 cfs (range = 45,000 – 74,600 cfs), but decreased to 17% at 40,000 cfs and 0% at a maximum annual Yellowstone River discharge of 31,400 cfs in 2016 (Rugg et al. 2019; P. Braaten, USGS, unpublished data). Passage rates for HOPS (predominately juveniles or of unknown reproductive stage) were 22% at discharges ranging from 68,100 – 72,500 cfs and 15% at discharges ranging from 35,000 – 45,000 cfs (Rugg et al. 2019; P. Braaten, USGS, unpublished data).

Upstream passage through the NSC by yearling pallid sturgeon was likely limited. Hatchery-derived yearling pallid sturgeon (N = 54) were stocked in a study reach below Intake in 2015 and 2016. The percent of the research population that encountered Intake varied by year, including 18% (5 of 28 individuals) and 77% (20 of 26 individuals) of stocked individuals in 2015 and 2016, respectively. (Rugg et al. 2019). Of these, no individuals migrated upstream of Intake from mid-May through mid-July or August (Rugg et al. 2019).

In 2019, telemetered pallid sturgeon did not use the NSC, despite peak discharge in Yellowstone River reaching 46,000 cfs (Reclamation and Corps 2020 *in review*). During the spring of 2019, a temporary road with culverts was constructed across the NSC to facilitate Intake Project construction; the road was partially washed out as flows increased. In July, upper portions of the NSC were filled with material that was excavated during construction of the bypass channel. To mitigate potential impacts resulting from modifications to the NSC, in 2019 and 2020, Reclamation extended the catch zone where pallid sturgeon were targeted for translocation downstream by a half-mile (Reclamation and Corps 2020 *in review*). As such, disuse of the NSC by telemetered pallid sturgeon in 2019 was likely influenced by modifications to the NSC, increased translocation efforts, or a combination of both.

Downstream passage at Intake by telemetered pallid sturgeon has been exclusively over the weir instead of through the NSC (Rugg et al. 2019). Such downstream passage has been observed for telemetered wild pallid sturgeon, HOPS, and yearlings (Rugg et al. 2019).

4.2.4 Pallid sturgeon abundance

Because fish migrate freely between the Missouri and Yellowstone rivers, pallid sturgeon throughout RMPA 2 may utilize habitats in the action area. Historical and recent pallid sturgeon abundance estimates for RPMA 2 are detailed in section 3.3.4. Preliminary abundance estimates were that 4,658, 1,448, and 1,260 pallid sturgeon <600 mm, 600 – 800 mm, and >800 mm FL, respectively, were alive in RPMA 2 in 2019 (M. Covlin, Pallid Sturgeon Technical Team, unpublished data). Additionally, in 2016, an estimated 238 (95% CI: 151 – 322) HOPS in RPMA 2 had reached the expected age at maturity (>15 years old), and an additional 2,002 (95% CI: 1,232 – 2,777) HOPS were from 10 to 15 years old (Rotella 2017); surviving individuals from this estimate would reach the expected age at maturity by 2021.

4.2.5 Pallid sturgeon reproduction

Pallid sturgeon recovery criteria in the revised recovery plan require that a self-sustaining, genetically diverse population exists within the GPMU (Service 2014). A self-sustaining population would require that pallid sturgeon are able to complete all aspects of their life cycle, including successful recruitment to age-1. Despite accumulating evidence that pallid sturgeon spawn regularly in the Yellowstone River and intermittently in the Missouri River between Fort Peck and Lake Sakakawea and the Powder River, monitoring and research suggests a complete or severe recruitment failure for pallid sturgeon in RPMA 2 since the 1950s (Braaten et al. 2015). In the action area, pallid sturgeon spawning has been detected annually in recent years, suggesting that pallid sturgeon are motivated to spawn and suitable spawning habitat exists (USGS 2016a). However, spawning events have predominately occurred in the lower 20-miles of the Yellowstone River, which lacks adequate distance for drifting free embryos to transition to larvae before reaching Lake Sakakawea (Reclamation and Corps 2016a).

Recent spawning activity in the Yellowstone River has included both wild pallid sturgeon and HOPS. Wild fish continue to be reproductively viable but are aging out of the population (Braaten et al. 2012). In contrast, monitoring and research suggest that multiple HOPS have reached sexual maturity, and thousands more will reach the expected age at sexual maturity in the coming year (see section 3.3.4). For example, in 2017 and 2018, several HOPS (known males or of unknown sex) participated in multiple spawning aggregations in the lower Yellowstone River, including three aggregations where reproductive wild females were present and spawning was suspected (P. Braaten, USGS, unpublished data). Further, female HOPS have been predicted to be reproductive in RPMA 2, including a translocated female in 2017, and two females in the Missouri River in 2018. Observed reproductive behavior and physiology by HOPS in the action area and elsewhere in RPMA 2 suggests that this demographic will have the capacity to perpetuate the population if the factors limiting natural recruitment are addressed.

Successful spawning upstream of Intake may provide enough drift distance for pallid sturgeon free embryos and larvae to recruit to age-1. Pallid sturgeon have demonstrated the motivation to migrate up to and past Intake. Spawning at the apex of previously observed pallid sturgeon migrations in the Yellowstone (river mile 234) and Powder rivers (river mile 97) would provide 250 and 260 miles of drift, respectively, before reaching Lake Sakakawea. Braaten et al. (2012) predicted that free embryos that develop in 16°C water temperature would drift for 13 days and total dispersal distance at a mean water column velocity 0.70 meters per second would range from 183 – 328 miles. Yellowstone River water temperatures likely exceed 16°C during the period of free embryo drift, thus increasing free embryo development rate and reducing the required drift distance for survival; median water temperature (2002 – 2012) during late-May to October was 20.0°C, with median water temperatures approaching 16°C and 20°C by June 1 and July 1, respectively (USGS 2016b). However, channel slope, and thus dispersal velocity, is higher in the Yellowstone River (slope = 0.04 – 0.07 near Intake; Reclamation and Corps 2016a) than the reach of the Missouri River studied by Braaten et al. (2012; slope = 0.0002). Differing thermal, hydrologic, or physiographic characteristics between the Missouri and Yellowstone rivers, and their associated influence on free embryo dispersal, highlights the need to develop drift/dispersal models specific to the Yellowstone River.

Pallid sturgeon spawning upstream of Intake has been detected twice in recent years (Powder River mile 20 in 2014; Yellowstone River mile 197 in 2020). While these observations are encouraging toward the potential for successful spawning upstream of Intake, the associated drift distances were near the lower end of the estimated range for free embryo survival in the Missouri River in RPMA 2. Based on presumed spawning locations, the total drift distance upstream of Lake Sakakawea was 183 and 213 miles for locations in the Powder River (2014) and Yellowstone River (2020), respectively. Evidence of natural recruitment resulting from spawning in the Powder River in 2014 has not been reported.

4.2.6 Status of the species in the action area summary

Preliminary abundance estimates were that 4,658, 1,448, and 1,260 pallid sturgeon <600 mm, 600 – 800 mm, and >800 mm FL, respectively, were alive in RPMA 2 in 2019 (M. Colvin, Pallid Sturgeon Technical Team, unpublished data). All of these fish have access to the action area as pallid sturgeon have been observed throughout the Yellowstone River downstream of the Cartersville Diversion Dam, portions of the Powder and Tongue rivers, and the Missouri River between its confluence with the Yellowstone River and Lake Sakakawea. The remaining wild pallid sturgeon are sexually viable, whereas thousands of HOPS have already, or will soon reach, sexual maturity. Spawning occurs annually in lower portions of the Yellowstone River and has been detected twice upstream of Intake in recent years. Whereas spawning locations below Intake lack adequate drift distances upstream of hypoxic conditions in the Lake Sakakawea headwaters, locations upstream of Intake may provide enough drift distance to support free embryo survival. Access to spawning habitats upstream of Intake have been mostly precluded by Intake, as only a small number of individuals have bypassed Intake through the NSC or translocation efforts by Reclamation. Upstream migrations after passing Intake have been expansive and included two Yellowstone River tributaries, the Powder and Tongue rivers. Free embryos that originate in these upstream reaches will encounter Intake during their downstream drift; while the potential for adverse effects to drifting free embryos at Intake exists, Reclamation greatly reduced the potential for their entrainment into the Main Canal by installing the headworks structure with fish screens in 2011.

5.0 Effects of the Action

Effects of the action is defined as all consequences to a 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 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).

The Service's analysis of the effects of the proposed action to pallid sturgeon in this biological opinion considered the best information available, including scientific literature, unpublished agency reports, and the professional judgement of biologists familiar with pallid sturgeon biology and ecology, and information provided to the Service from Reclamation and the Corps during the consultation process (April 17 and June 23, 2020; see section 2.1). The Service also reviewed Reclamation and the Corps' analysis and discussion of how the proposed action may affect pallid sturgeon in the 2016 Biological Assessment (Reclamation and Corps 2016a), in consideration of new information that has become available since the original consultation and changes to the construction timeline and replacement weir design.

5.1 Analysis

Effects of the proposed action to pallid sturgeon were evaluated using a pathway that considered the species' exposure, response, and resulting biological effect (if any) to each Intake Project element. The proposed action is comprised of four primary components (described previously in 2.1 Proposed Action and summarized here), which were further deconstructed into a total of 47 constituent elements (Reclamation and Corps 2016a). Intake Project components are as follows:

1. Operation and maintenance of the LYP prior to and during construction of the proposed fish passage improvements;
2. Construction of replacement weir and bypass channel for fish passage;
3. Future operation and maintenance of the LYP; and
4. Monitoring and adaptive management.

Reclamation and the Corps analyzed the potential effects of the Intake Project to multiple pallid sturgeon life stages (egg, free embryo/larvae, juvenile, adult; Reclamation and Corps 2016a). Potential effects to each pallid sturgeon life stage were detailed for each project element, including the rationale for exposure and mechanism of exposure, and categorized as beneficial effect, no effect, insignificant effect, discountable effect or adverse effect (Reclamation and Corps 2016a).

Intake Project elements that were determined to have an insignificant or discountable effect to pallid sturgeon in Reclamation and the Corps' effects analysis are incorporated by reference into this effects of the action section, but will not be discussed further in this biological opinion (Reclamation and Corps 2016a). Those effects were related to noise, turbidity, disturbance, pumps, and temporary increases in water velocity due to coffer dams (Reclamation and Corps 2016a). The remaining project elements and associated effects to pallid sturgeon will be discussed below; these project elements include (1) the O&M of the LYP during Intake Project construction, including the annual placement of rock on the existing weir, irrigation diversions, and fish screen operation; (2) construction of the bypass channel and replacement weir, including the physical presence of the weir and closure of the NSC; (3) future O&M of the LYP, including irrigation diversions and fish screen operation; and (4) monitoring and adaptive management.

5.2 Components and elements that are likely to adversely affect pallid sturgeon

5.2.1 Operation and maintenance of Lower Yellowstone Project during Intake Project construction

5.2.1.1 Effects of the annual placement of rock on the existing weir on upstream pallid sturgeon migrations

The existing weir at Intake serves to divert irrigation water to the irrigation districts associated with the LYP. Whereas the presence of the existing Intake weir is not part of the proposed action, annual placement of rock on the existing weir to maintain a weir elevation that is sufficient to divert the full LYP water right of 1,374 cfs is part of the proposed action. Such placement of rock maintains the presence of the existing weir that would otherwise diminish through time due to the gradual displacement of rock by natural causes (e.g., elevated stream flows, ice, etc.) and will continue until construction of the replacement weir is completed. Reclamation and the Corps estimate that project construction will continue through 2022, but may extend to the end of calendar year 2023.

The 2016 Biological Opinion and ITS concluded that effects to pallid sturgeon resulting from blocked upstream passage by the annual placement of rock on the existing weir during project construction would be specific to wild adult pallid sturgeon and in the form of reproductive impairment (Service 2016, pages 37 – 38, 60). However, monitoring data since the original consultation suggest that non-reproductive pallid sturgeon are also motivated to access and utilize habitats upstream of Intake. Non-reproductive individuals, including both sexually mature fish that are not reproductive in a given year and juveniles, have made extensive upstream migrations after passing Intake via the NSC or translocation and for extended periods of time. For example, non-reproductive individuals have migrated to the vicinity of Cartersville Diversion Dam in the Yellowstone River (2018, Reclamation 2019; 2019, Reclamation and Corps 2020 in review) or more than 80 miles up the Powder River (2017; Reclamation 2019). Further, many of the telemetered fish that bypass Intake remain in upstream habitats through autumn or over the winter; in 2019, six of the twelve translocated individuals remained upstream through September, including five HOPS and one wild male, and five of these fish, including the wild male, remained in upstream habitats through the winter.

The motivations for pallid sturgeon to migrate upstream of Intake and resulting effects from blocked passage by the annual placement of rock on the existing weir may vary by reproductive state, but can be difficult to discern. Among the goals of the Intake Project is to provide fish passage at Intake such that reproductive pallid sturgeon can access suitable spawning habitats in upstream reaches of the Yellowstone River and its tributaries. Successful spawning in these upstream reaches will increase the total distance available to drifting free embryos between the spawning location and Lake Sakakawea relative to existing conditions, thus increasing the likelihood that natural recruitment will occur. Thus, reproductive individuals that are blocked from accessing upstream habitats due to the annual placement of rock on the existing weir are subject to harm in the form of reproductive impairment. The effects to non-reproductive individuals resulting from blocked upstream passage at Intake are less clear. Given the observed propensity for non-reproductive individuals to utilize habitats upstream of Intake for extended periods of time, we conclude that blocked upstream passage at Intake impairs the ability of non-reproductive individuals to access feeding and sheltering habitats that would otherwise be selected for. Therefore, reproductive and non-reproductive pallid sturgeon that are motivated to pass upstream of Intake but are blocked from doing so by the annual placement of rock on the existing weir will be adversely affected during project construction (up to four years or through 2023).

Information on movement patterns by pallid sturgeon < 600 mm FL is sparse and has been generated from stocked HOPS in the absence of natural recruitment. In RPMA 2, individuals <600 mm FL were up to age-9, based on Missouri River sampling data collected from 1998 – 2007 (Shuman et al. 2011), and were likely not sexually mature as the shortest observed reproductive individual in RPMA 2 to date was 773 mm FL (M. Webb, Service, unpublished data). Post-stocking movements by HOPS have been inconsistent as studies have reported downstream migrations, a maintained position in the stocking area, or a combination of upstream and downstream migrations (Jordan et al. 2016). However, the observed post-stocking movements by HOPS are likely confounded by variables related to stocking (e.g., age and size, location, acclimation period; Jordan et al. 2016) and natural conditions (e.g., temperature, discharge, habitat; Jordan et al. 2016; Rugg et al. 2019). Sampling data from the Missouri River in RPMA 2 suggested that stocked HOPS tend towards downstream migration as more individuals were captured in downstream reaches than in reaches near their release location, though both scenarios exist (Jordan et al. 2016). In 2015 and 2016, yearling HOPS (314 – 415 mm FL) were released in test (below Intake) and control reaches (open river system) to evaluate subsequent movement patterns, including the influence of the existing weir on upstream passage at Intake (Rugg et al. 2019). The NSC was available to yearling HOPS for upstream passage during both years of the study (Rugg et al. 2019). Similar to previous studies, stocked HOPS demonstrated contrasting tendencies to migrate upstream or downstream during subsequent years; in 2015, most fish in both the control and test reaches moved downstream, whereas, in 2016, most fish held their position in both reaches or moved upstream in the control reach (Rugg et al. 2019). The number of yearling HOPS that encountered Intake varied by year (5 in 2015 and 20 in 2016), but no individuals passed upstream of Intake during this study, suggesting that the existing weir acts as a barrier to upstream passage by relatively small individuals (Rugg et al. 2019). Because stocked HOPS < 600 mm FL tend toward downstream migrations and naturally produced pallid sturgeon < 600 mm FL will lack the ability to migrate volitionally until reaching the lower-most portions of RPMA 2 due to the required drift distance, the majority of pallid sturgeon < 600 mm FL would have to make substantial upstream migrations in the Yellowstone River to encounter Intake, and such migrations have not been documented. Further, we have no evidence that blocked access to upstream reaches of the Yellowstone River by the annual placement of rock on the existing weir would result in adverse effects to pallid sturgeon < 600 mm FL by impairing behavioral patterns related to feeding or sheltering. Thus, based on information available at this time, we conclude that the annual placement of rock on the existing weir is not likely to adversely affect pallid sturgeon < 600 mm FL.

Effects to pallid sturgeon 600 – 800 mm and >800 mm FL that are blocked from accessing upstream habitats by the annual placement of rock on the existing weir may vary depending on reproductive state and length. Pallid sturgeon >800 mm FL may be reproductive or non-reproductive in a given year, whereas individuals 600 – 800 mm FL are likely non-reproductive. Based on data from 2009 – 2019, the majority of reproductive pallid sturgeon in RPMAs 1 and 2 were >800 mm FL, with only 6% of reproductive females (2 out of 36) and 1% of reproductive males (1 out of 73) being <800 mm FL (M. Webb, Service, unpublished data). However, mature individuals >800 mm FL will not be reproductive every year due to pallid sturgeon spawning periodicities of 1 – 3 years for males and 2 – 3 year for females (Service 2014). Reproductive assessments that predict an individual's reproductive state for a given year require physically handling the fish and have some associated uncertainty (M. Webb, Service, personal communication, June 10, 2020). For example, reproductively-classified females are vitellogenic (producing or stimulating the formation of an egg) and may spawn during the upcoming or next spawning period (M. Webb, Service, personal communication, June 10, 2020). Because reproductive assessments require handling each fish and the results have some uncertainty, we did not distinguish between effect types in quantifying the effects to pallid sturgeon resulting from blocked upstream passage by the annual placement of rock on the existing weir but instead estimated the total number of fish in each length group (600 – 800 mm or >800 mm FL) that would be impacted as a result of impaired behavioral patterns related to breeding, feeding, or sheltering.

The Comprehensive Sturgeon Research Project (CSRP) is a collaborative research program among various State and Federal agencies that is designed to improve the fundamental understanding of pallid sturgeon reproductive ecology and population dynamics (USGS 2016a). Among other research objectives, the CSRP tracks pallid sturgeon movement dynamics in RPMA 2 using telemetry equipment; telemetry radio tags with unique identifying codes are surgically implanted into individuals and subsequent movements are recorded at stationary antennas or using boat-mounted mobile antennas. The number of pallid sturgeon carrying telemetry tags has varied among years, and tagged fish were categorized as wild pallid sturgeon or HOPS (Table 4). For this biological opinion, we calculated the total number of telemetered individuals in RPMA 2 for wild pallid sturgeon by relating the number of fish observed in the Yellowstone River from 2015 – 2017 (Rugg et al. 2019) to the maximum observed percentage of wild telemetered population that used the Yellowstone River in the same year (P. Braaten, USGS, unpublished data). For example, Rugg et al. (2019) reported that 56 telemetered wild pallid sturgeon were in the Yellowstone River in 2016, and during the same year, the maximum occupancy occurred when 82.5% of the telemetered wild pallid sturgeon population used the Yellowstone River (P. Braaten, USGS, unpublished data); thus, we calculated that a total of 68 wild pallid sturgeon were carrying telemetry tags in 2016 (56/82.5% = 67.9). The Service manages a database that records the number of individual HOPS that are implanted with a radio tag annually (R. Wilson, Service, unpublished data); we used this database to estimate the number of HOPS that carried telemetry tags annually from 2015 – 2018 by adding the cumulative number of tags that had been inserted into HOPS up to the specified year (Table 4).

Table 4. Summary of the number of telemetered wild pallid sturgeon and HOPS that were in RPMA 2, Yellowstone River, encountered Intake, and passed Intake via the NSC or over the weir from 2015 – 2018).

	Number of telemetered fish			
Pallid sturgeon origin Year	RPMA 2	Yellowstone River	Encountered Intake	Volitionally passed upstream of Intake
Wild				
2015	62[1]	48[2] (77.4%)	6[2] (9.7%)	1[2] (1.6%)
2016	68[1]	56[2] (82.4%)	7[2] (10.3%)	0[2] (0%)
2017	76[1]	69[2] (90.8%)	7[2] (9.2%)	2[2] (2.6%)
2018	*	52[2] (NA)	8[2] (NA)	2[2] (NA)
Hatchery				
2015	106[3]	34[2] (32.1%)	3[2] (2.8%)	0[2] (0%)
2016	125[3]	51[2] (40.8%)	9[2] (7.2%)	0[2] (0%)
2017	143[3]	83[2] (58.0%)	16[2] (11.2%)	2[2] (1.4%)
2018	154[3]	99[2] (64.3%)	13[2] (8.4%)	3[2] (1 over dam; 1.9%)

[1] P. Braaten, USGS, unpublished data
[2] Rugg et al. 2019
[3] R. Wilson, Service, unpublished data
* The total number of telemetered wild pallid sturgeon in 2018 was unknown due to several radio tags expiring before the expected expiration date (P. Braaten, USGS, personal communication, April 17, 2020).

Whereas additional information is available regarding wild pallid sturgeon and HOPS movement patterns in the Yellowstone River, reports detailing such information lack pallid sturgeon length data that are needed for relating the percentage of fish that encounter Intake to recent preliminary abundance estimate length groups (600 – 800 mm and >800 mm FL; M. Colvin, Pallid Sturgeon Technical Team, unpublished data). Rugg et al. (2019) reported length (FL) at the most recent capture for pallid sturgeon that were studied to evaluate pre-construction passage rates at Intake over a four-year period (2015 – 2018). We, therefore, used unpublished data from the Pallid Sturgeon Technical Team (Table 5) and information from Rugg et al. (2019) to estimate the number of pallid sturgeon in each length group that would encounter the existing weir during upstream migrations. For this biological opinion, we concluded that fish that pass upstream of the land-based telemetry station located one mile downstream of the bypass channel[5] have encountered the area affected by Intake and possess the motivation to continue migrating upstream (Braaten et al. 2015).

Preliminary pallid sturgeon abundance estimates were that 1,448 and 1,260 pallid sturgeon 600 – 800 mm and >800 mm, respectively, existed in RPMA 2 in 2019 (Table 5; M. Colvin, Pallid Sturgeon Technical Team, unpublished data). We note that the 95% Bayesian credible intervals associated with these abundance estimates are high but are expected to improve in both accuracy and precision as more sampling data are collected. Nonetheless, the preliminary abundance estimates represent the best available information at this time. We also note that the number of pallid sturgeon that were estimated to be alive in RPMA 2 by the most recent abundance estimates is substantially less than previous abundance estimates. For example, recent

[5] The land-based telemetry station located one mile downstream of the bypass channel is included as a component of Reclamation and the Corps' Monitoring and Adaptive Management Plan—see section 5.2.4.

preliminary estimates were that a total of 7,366 pallid sturgeon were alive in 2019 (all length groups; M. Colvin, Pallid Sturgeon Technical Team, unpublished data) as compared to an estimate that 125 wild pallid sturgeon were alive in 2008 and 16,444 HOPS were alive in 2016 (Rotella 2017). However, reduced abundance, as estimated by the Pallid Sturgeon Technical Team, is consistent with previously observed declines through time in the estimated number of pallid sturgeon alive in RPMA 2 (See section 3.3.4 Pallid sturgeon abundance).

Table 5. 2019 preliminary pallid sturgeon abundance estimates with 95% Bayesian credible intervals (BCI) for HOPS, wild or unknown pallid sturgeon, or all pallid sturgeon by length groups (600 – 800 mm or >800 mm FL) in the Missouri and Yellowstone rivers in RPMA 2 (M. Colvin, Pallid Sturgeon Technical Team, unpublished data).

River	Origin	Length group (mm)	Estimate	95% BCI
Missouri River[1]	Hatchery	600 – 800	1,217	116 – 34,017
	Wild/unknown	600 – 800	0	0
	Hatchery	>800	875	121 – 9,628
	Wild/unknown	>800	107	4 – 4,693
Yellowstone River[2]	All	600 – 800	231	116 – 511
	All	>800	278	144 – 553
RPMA 2[3]	All	600 – 800	1,448	--
	All	>800	1,260	--

[1]Missouri River abundance estimates are specific to the reach of river between Fort Peck Dam and the headwaters of Lake Sakakawea.
[2]Yellowstone River abundance estimates are specific to the reach of river between the mouth and its confluence with the Powder River (river mile 148).
[3]Abundance estimates for RPMA 2 were calculated by adding those from the Missouri and Yellowstone rivers for each size class. Thus, 95% Bayesian credible intervals were not reported.

Wild pallid sturgeon observed by Rugg et al. (2019) exceeded 800 mm FL, based on the most recent physical recapture (N = 75; range 826 – 1630 mm FL; Rugg et al. 2019). Data from 2018 were omitted from our analysis because the total number of telemetered wild fish in RPMA 2 was unknown due to the batteries in several radio tags expiring before their expected date (P. Braaten, USGS, personal communication, April 17, 2020). From 2015 – 2017, the annual percent of the telemetered wild pallid sturgeon population in RPMA 2 that encountered Intake ranged from 9.2 – 10.3% (Table 4; Rugg et al. 2019). Although the percentage of wild telemetered fish that encountered Intake during this study was consistent with previous years, it was near the lower end of the observed range from 2011 – 2018 (9 – 26%; Reclamation 2019).

Of the 124 individual HOPS that were encountered by Rugg et al. (2019) from 2015 – 2018, 27.4% (N = 34) were 600 – 800 mm FL and 72.6% (N = 90) were > 800 mm FL. The percentage telemetered HOPS 600 – 800 mm FL and > 800 mm FL that encountered Intake during this study was similar at 28.9% (N = 13) and 71.1% (N = 32), respectively (Rugg et al. 2019). Agreement on the percent of telemetered HOPS in each length group for the broader population (i.e., the telemetered population) versus those that encountered Intake suggests that the likelihood of HOPS to encounter Intake is not influenced by size.

We estimated the number of pallid sturgeon that would be adversely affected due to blocked upstream passage by the annual placement of rock on the existing weir by extrapolating the percent of the telemetered population that encountered Intake from 2015 – 2018 (both wild- and hatchery-origin pallid sturgeon) by length group (600 – 800 mm and > 800 mm FL; Rugg et al. 2019) to recent preliminary pallid sturgeon abundance estimates (M. Colvin, Pallid Sturgeon Technical Team, unpublished data). On average, the percent of telemetered populations that encountered Intake during upstream migrations was similar for wild pallid sturgeon (9.7%; range: 9.2 – 10.3%; 2015 – 2017), HOPS (7.4%; range: 2.8 – 11.2%; 2015 – 2018), and pallid sturgeon >800 mm FL, including both wild pallid sturgeon and HOPS (8.3%; range: 5.9 – 10.4%; 2015 – 2017). The maximum percentage of a telemetered population to encounter Intake from 2015 – 2018 was 11.2% by telemetered HOPS in 2017 (Rugg et al. 2019). Given the consistency in the percentage of each telemetered population that encountered Intake during upstream migrations from 2015 – 2018, we assumed that up to 11.2% of pallid sturgeon from 600 – 800 mm FL and >800 mm FL would be adversely affected annually from placement of rock on the existing weir blocking upstream passage. Thus, we estimate that upstream passage for up to 162 (i.e., 1,488 pallid sturgeon [600 – 800 mm FL] x 11.2 % = 162.2) and 141 (i.e., 1,260 pallid sturgeon [>800 mm FL] x 11.2% = 141.1) pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, may be blocked annually by the placement of rock on the existing weir during project construction.

There is some uncertainty regarding the number of telemetered fish that represent the total population because the batteries in several implanted radio tags have recently expired before their expected date (P. Braaten, USGS, personal communication, April 17, 2020). The most recent year with a reliable estimate of the number of pallid sturgeon from 600 – 800 mm FL that carried a radio tag was 2018, when approximately 3% (42 out of 1,448) of individuals were telemetered (R. Wilson, Service, unpublished data). This suggests that up to 5 telemetered pallid sturgeon from 600 – 800 mm FL will encounter Intake and possess the motivation to migrate upstream in any given year (i.e., 162 pallid sturgeon [600 – 800 mm FL] x 3% = 4.9). Similarly, 2017 was the most recent year with a reliable estimate of the number of pallid sturgeon >800 mm FL carrying radio tags, when approximately 14% of individuals were telemetered (176 out 1,260). This suggests that, in any given year, up to 20 telemetered individuals >800 mm FL may encounter the existing weir (i.e., 141 pallid sturgeon [>800 mm FL] x 14% = 19.7). By comparison, from 2015 – 2018, the greatest annual total number of telemetered pallid sturgeon to encounter Intake was 23 in 2017 (Rugg et al. 2019).

5.2.1.2 Effects of the annual placement of rock on the existing weir on downstream pallid sturgeon migrations

During project construction, the annual placement of rock on the existing weir at Intake may adversely affect pallid sturgeon during downstream passage at Intake. Water velocities over the weir are relatively high at approximately 8 and 10 feet per second at Yellowstone River discharges of 15,000 cfs and 30,000 cfs, respectively, and water over the dam spills into a boulder field that extends approximately 300 feet downstream of the weir (Reclamation and Corps 2016a). By comparison, mean water velocities in the Yellowstone River upstream of Intake (Lockwood, Montana to Glendive, Montana) was 2.8 feet per second (USGS 2009). Such conditions may be hazardous to juvenile or adult pallid sturgeon that volitionally migrate downstream over the weir, as well as to free embryos that drift over the weir.

Downstream passage at Intake by telemetered juvenile and adult pallid sturgeon from 2014 – 2019 occurred exclusively over the existing weir, as opposed to through the NSC (Rugg et al. 2019; Reclamation and Corps 2020 *in review*; USGS 2016a). Telemetered fish generally passed downstream over the weir during the descending limb of the spring-pulse hydrograph or summer base-flows with no evidence of injuries or mortalities during downstream passage. Although downstream passage at Intake to date has not resulted in known injuries or mortalities to the relatively small number of juvenile or adult telemetered pallid sturgeon that have been observed, the potential for such effects to pallid sturgeon exists. The Service's Biological Review Team (BRT) recommended biological success criteria for downstream passage over the replacement weir, including that annual mortality of adult pallid sturgeon would not exceed 1% (Service letter to D. Epperley, Reclamation, undated). We extended the BRT criteria in estimating the potential effects of downstream passage over the existing weir, with rocking, during project construction such that the rate of annual mortality or injury to adult and juvenile pallid sturgeon is not expected to exceed 1% of individuals. Such effects will be quantified using telemetered pallid sturgeon, where the annual rate of injury or mortality to telemetered pallid sturgeon during downstream passage is not expected to exceed 1% of telemetered individuals or one individual, whichever number is greater for a given year.

Drifting free embryos are likely the most vulnerable pallid sturgeon life-stage to adverse effects related to downstream passage over the existing weir. Relatively high water velocities over the existing weir and turbulent conditions through the adjacent boulder field resulting from the annual placement of rock on the weir pose a risk of injury or mortality for the weak-swimming free embryos. However, free embryo exposure to such conditions during project construction is dependent on reproductive pallid sturgeon bypassing the existing weir (via translocation or swimming over the weir), successful spawning, and survival of the fertilized eggs to hatch. To date, pallid sturgeon spawning in the Yellowstone River watershed upstream of Intake has only been documented twice (Powder River 2014; Yellowstone River 2020). Subsequent sampling for drifting free embryos in areas downstream from the suspected spawning locations did not yield pallid sturgeon in 2014, whereas results are still pending for sampling in 2020. Nonetheless, the potential for free embryos to be killed or injured while drifting over the existing weir and adjacent boulder field still exists.

Information to support quantifying such effects is sparse; Reclamation has sampled for drifting free embryos above and below the existing weir at Intake, pursuant to reasonable and prudent measure #1, term and condition #1, in the 2016 ITS (Service 2016, page 64). To date, such monitoring has yielded only five Acipenseriforme samples (4 eggs, 1 larva) that were collected in 2019; genetic identification of these samples is pending (D. Trimpe, Reclamation, unpublished data). We note sampling for drifting free embryos in the Yellowstone River has been difficult due to high water velocities, debris, and turbulent conditions and that Reclamation is coordinating with other agencies to improve their sampling methodology at Intake. We discuss quantifying the effects of the existing weir on drifting free embryos further in section 5.2.5.

5.2.1.3 Irrigation diversions and operation and maintenance of the fish screens

Irrigation water is delivered to the LYP by diverting up to 1,374 cfs into the Main Canal through a headworks structure located immediately upstream of the existing weir. In 2011, a new headworks structure was installed that incorporated fish screens to prevent fish greater than 40 mm in length from being entrained into the Main Canal. Irrigation diversions into the Main Canal and O&M of the headworks structure, including the fish screens, have the potential to adversely affect pallid sturgeon, both during Intake Project construction and after construction is completed.

The 2016 Biological Assessment (Reclamation and Corps 2016a, pages 54 – 55, 72 – 75) and 2016 Biological Opinion (Service 2016) detail the potential for adverse effects to various pallid sturgeon life-stages resulting from irrigation diversions into the Main Canal or O&M of the fish screens and are incorporated by reference. In summary, juvenile and adult pallid sturgeon are unlikely to be adversely affected by irrigation diversions into the Main Canal because their swimming capabilities exceed the approach and sweep velocities at the fish screens, and they are too large to be entrained through the screens. Drifting free embryos are the most vulnerable pallid sturgeon life-stage to adverse effects resulting from irrigation withdrawals through the fish screens as a result of being impinged on the fish screen or entrained into the Main Canal. As described above, these adverse effects to free embryos are dependent on reproductive pallid sturgeon bypassing Intake, successful spawning, and survival of the fertilized eggs to hatch. In the event that these conditions occur, free embryo exposure to the headworks structure and Main Canal is expected to be minimal because the area of influence for water withdrawals into the Main Canal is approximately 50 feet of the 700 foot-wide river channel, and drifting free embryos will be concentrated in the river thalweg (Braaten et al. 2010), which is located approximately 100 – 150 feet away from the headworks structure. Thus, while the potential for drifting free embryos to encounter the headworks structure is low and the proportion of individuals that would be impacted by water withdrawals into the Main Canal relative to the number of individuals in the Yellowstone River minimal, the potential for their exposure and the related adverse effects still exists.

Information available to support estimating the number of free embryos that will be impinged on the fish screens or entrained into the Main Canal if they encounter Intake is limited. From 2012 – 2019, Reclamation has monitored the Main Canal for free embryo or larval fish entrainment (D. Trimpe, Reclamation, unpublished data); from 2012 – 2017, only one Acipenseriforme larvae was captured, but could not be genetically identified. In 2018, nine Acipenseriforme larvae were captured, of which, genetic analysis identified four as paddlefish, one as a shovelnose sturgeon, and four were determined to be sturgeon, but couldn’t be identified to species (i.e., either pallid or shovelnose sturgeon). In 2019, Reclamation sampled six Acipenseriforme (five eggs and 1 larvae) and genetic analysis of these samples is pending. We discuss quantifying the effects of irrigation diversions and the fish screens on drifting free embryos further in section 5.2.5.

5.2.1.4 Effects of the operation and maintenance of the Lower Yellowstone Project during project construction on wild pallid sturgeon

Operation and maintenance of the LYP during the extended Intake Project construction period (up to four years or through 2023) may result in additional adverse effects to the wild population relative to those that were analyzed and described in the 2016 Biological Opinion. Because natural recruitment has not occurred for decades in RPMA 2, the remaining wild pallid sturgeon are nearing the end of their expected lifespan (Braaten et al. 2009). In 2008, 125 (95% CI: 100 – 150) wild individuals were estimated to be alive in RPMA 2 (Jaeger et al. 2009), and the annual mortality rate for wild pallid sturgeon in RPMA 2 has been estimated at 5% (Braaten et al. 2009). Although we are unable to accurately estimate a specific number, we do conclude that an unknown number of wild pallid sturgeon are likely to die during the extended construction period. These wild pallid sturgeon are expected to die naturally (not be killed as a result of the project), but their opportunity to reproduce in habitats upstream of Intake would be lost due to the annual placement of rock on the existing weir (see section 5.2.1.1) and closure of the NSC in 2019 (see section 5.2.2.3). The Service notes that such effects to wild pallid sturgeon during the construction period are expected to be minimized by future translocation efforts, whereby wild pallid sturgeon that are apparently motivated to migrated upstream past Intake, but are blocked from doing so, will be captured, transported, and released upstream of Intake by Reclamation (see reasonable and prudent measure 2, term and condition 1, in the incidental take statement, section 4.0).

The PSCAP (Pallid Sturgeon Conservation Augmentation Program) was established to perpetuate the pallid sturgeon population in RPMA 2 and elsewhere in their range. Through the PSCAP, propagated HOPS are derived from wild pallid sturgeon and strategically stocked into the management units to maintain viable populations (abundance, age-class structure, and genetic structure) until the threats to pallid sturgeon recovery are addressed (Service 2014, 2019). Because HOPS in RPMA 2 are currently at an abundance that likely exceeds the historical population abundance (Braaten et al. 2009), comprised of multiple age-classes, and representative of the wild population genetics structure, additional natural mortality to wild individuals during the extended construction period is not expected to limit the potential for pallid sturgeon recovery in RPMA 2 or for the species as a whole.

5.2.2 Construction of the replacement weir and bypass channel

5.2.2.1 Physical presence of the replacement weir

The replacement weir will consist of a cantilevered structure, supported by driven piles, that spans the entire main channel of the Yellowstone River (approximately 700 ft in length; Figure 4; Reclamation and Corps 2016a). Gaps between the driven piles will be filled with cobbles and riprap, and the piles and fill will be capped with concrete for reinforcement and to ensure that water, ice, and debris pass smoothly over the structure (Reclamation and Corps 2016a). The elevation of the replacement weir will be 1,991.0 feet, with the exception of a low flow notch at an elevation of 1,989.0 feet. The low flow notch will have a top width of 125 feet and bottom width of 85 feet and will be located approximately 100 – 150 feet out from the river-left bank to align with the river thalweg (Figures 5 and 6; Reclamation and Corps 2016a). The low flow notch is designed to facilitate downstream passage by all pallid sturgeon life stages, particularly drifting free embryos that concentrate in the river thalweg (Braaten et al. 2012; Reclamation and Corps 2016).

Figure 4. Conceptual model of the replacement weir design in relation to the existing weir (Reclamation and Corps 2016a).

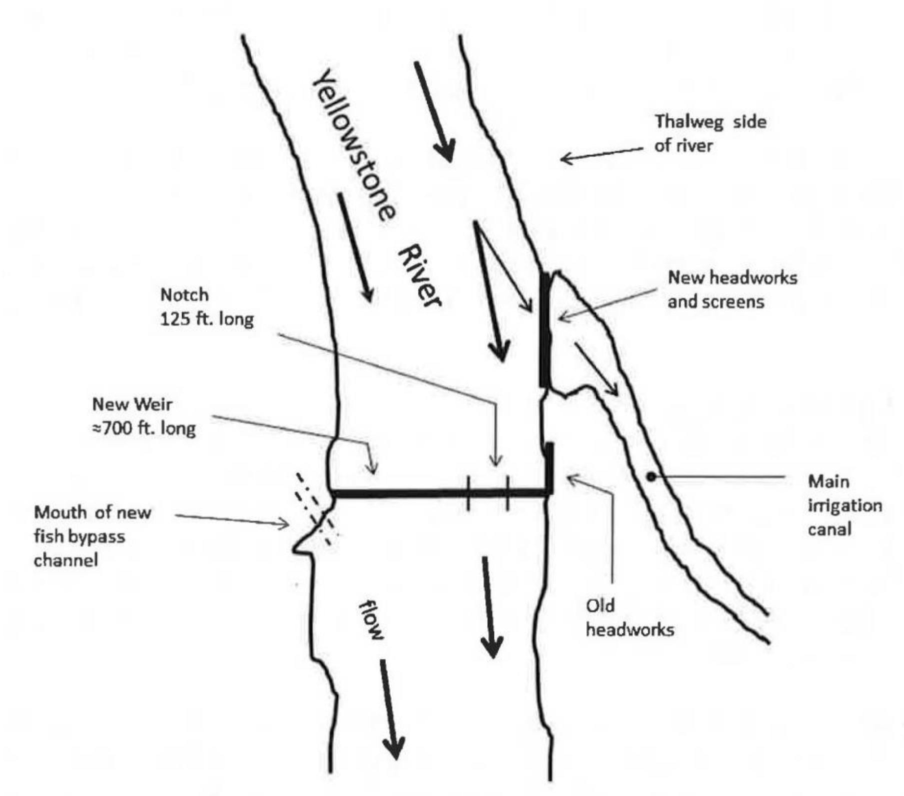

Figure 5. Representation of the replacement weir, low flow notch, and headworks structure with fish screens in the Yellowstone River (Reclamation and Corps 2016).

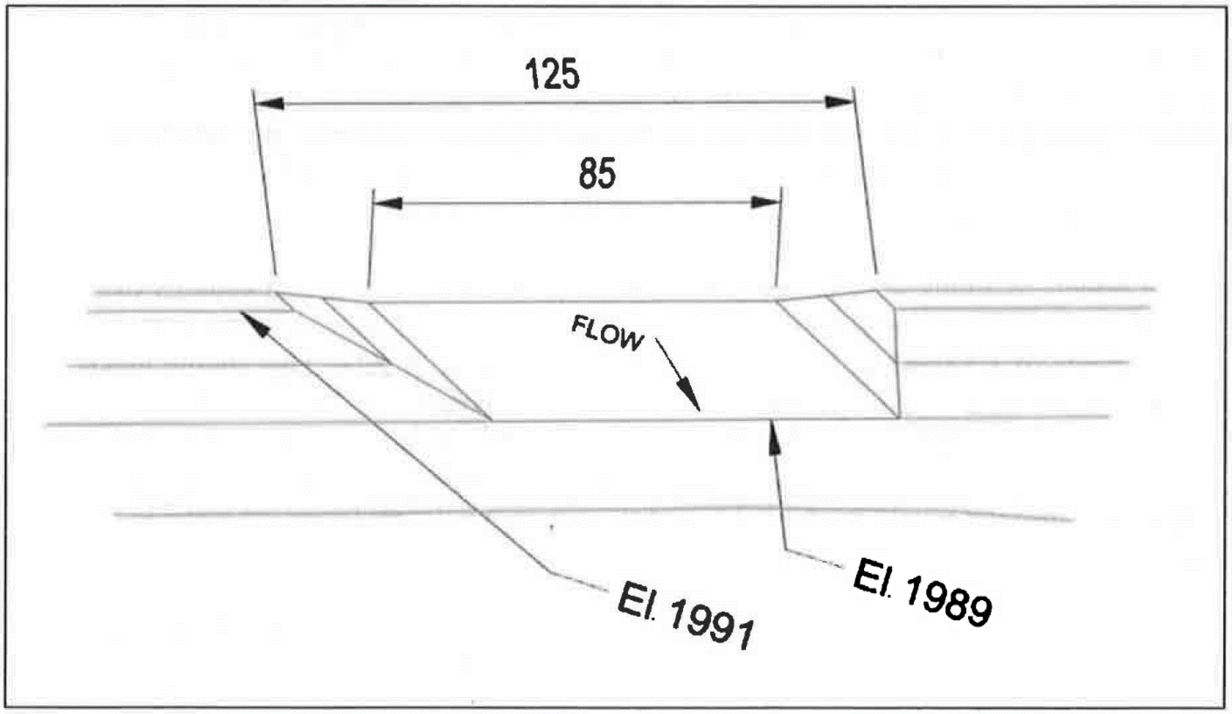

Figure 6. Representation of the low flow notch in the replacement weir design with dimensions and elevation (both in feet).

In 2019, construction of the replacement weir began at a location approximately eight feet upstream of the existing weir, but this location was deemed unsuitable shortly after construction began. The replacement weir will now be constructed approximately 27 feet upstream of the existing weir (Corps in litt, 2020). The new location will slightly increase the replacement weir's footprint in the Yellowstone River because additional fill will be required for a smooth transition between the replacement weir and existing weir, which will remain in place to provide added stability. Due to the new location, additional riprap and sheet piles will also be used where the replacement weir ties into the south bank of the Yellowstone River to prevent flanking (Corps in litt, 2020).

Analysis by Reclamation and Corps hydrologists suggested that the replacement weir at the new location and with the slightly modified design will function the same hydraulically as was expected at the original location, which will be an improvement as compared to hydraulic conditions over the existing weir (Table 5; Corps in litt, 2020). Further, Reclamation and the Corps' analysis suggested that no additional effects to pallid sturgeon beyond those that were analyzed in the 2016 Biological Assessment are expected at the new weir location (Corps in litt, 2020).

Table 5. Comparison of flow depths and velocities over the existing and replacement weir at the new location at 15,000 cubic feet per second (cfs) and 30,000 cfs in the Yellowstone River.

	15,000 cfs	30,000 cfs
Structure	Flow depth and velocity	Flow depth and velocity
Existing weir	2.1-2.9 feet, 8 ft/sec	4 feet, 10 ft/sec
Replacement weir notch	3.5 feet, 5 ft/sec	5.4 feet, 6.8 ft/sec

The ongoing presence of the replacement weir in the Yellowstone River may adversely affect pallid sturgeon at multiple life stages during upstream or downstream migrations. In section 5.2.1.1, we describe the effects to reproductive and non-reproductive (mature individuals that are not reproductive in a given year and juveniles) pallid sturgeon resulting from blocked upstream passage due to the annual placement of rock on the existing weir. Therein, we concluded that blocked upstream passage at Intake was not likely to adversely affect pallid sturgeon <600 mm FL, but would adversely affect reproductive and non-reproductive pallid sturgeon 600 – 800 mm and > 800 mm FL by impairing behavioral patterns related to breeding, feeding, or sheltering. We conclude that pallid sturgeon will be subject to the same effects resulting from blocked upstream passage by the replacement weir as those described in section 5.2.1.1 resulting from blocked upstream passage by the annual placement of rock on the existing weir.

We estimated that annually up to 162 and 141 pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, would encounter the existing weir during upstream migrations. Our estimate of the annual number of pallid sturgeon that will encounter the replacement weir for each length group is the same; however, pallid sturgeon that encounter the replacement weir will be able to pass upstream of Intake through the new bypass channel once it is constructed. We estimate the combined effects of the presence of the replacement weir and bypass channel on upstream migrations by pallid sturgeon 600 – 800 mm and > 800 mm FL in section 5.2.2.2.

Downstream passage at Intake by telemetered pallid sturgeon has been exclusively over the existing weir and adjacent boulder field, as opposed to through the NSC (Rugg et al. 2019). Mortalities or injuries resultant from downstream passage in this area have not been reported for the limited number of telemetered individuals that have been observed (Rugg et al. 2019). Existing conditions over the weir and boulder field are volatile in comparison to reaches of the Yellowstone River in this area, primarily due to the almost annual placement of rock on the existing weir structure to maintain a sufficient surface water elevation to divert the full LYP water right (1,374 cfs) into the Main Canal and subsequent downstream displacement of rock from the weir to the adjacent boulder field (Reclamation and Corps 2016a). Currently, water velocity and depth over the weir vary depending on Yellowstone River discharge level (Table 5), and flows over the weir and boulder field are turbulent due to large rock that has been introduced to the system over the past century (Reclamation and Corps 2016a).

The replacement weir was designed to improve downstream passage for pallid sturgeon at all life stages (Reclamation and Corps 2016a). Pallid sturgeon < 600 mm, 600 – 800mm, and > 800 mm FL have passed downstream of the existing weir and boulder field with no indication of adverse effects (Rugg et al. 2019). The replacement weir will improve upon existing passage conditions related to water velocity, depth, and turbulence across the entire weir (Table 5), and these conditions will be further improved through the low flow notch (Reclamation and Corps 2016a). Although infrequent placement of rock at the replacement weir may continue to be necessary, turbulent conditions over the boulder field are expected to subside through time as natural causes (e.g., high flows, ice, debris) continue to disperse previously placed rock further downstream. Further, the new bypass channel, which mimics the characteristics of a natural side channel in the Yellowstone River and will be accessible to pallid sturgeon under a broader range of discharges than the NSC, will provide an alternative route for pallid sturgeon to migrate downstream at Intake.

In section 5.2.1.2, we described the potential effects to juvenile and adult pallid sturgeon during downstream passage over the existing weir. The effects to juvenile and adult pallid sturgeon during downstream passage over the replacement weir are expected to be similar; however, the replacement weir represents a substantial change with unknown effects to fish passage (Rugg et al. 2019) and the new bypass channel will also be available to pallid sturgeon for downstream passage. Because the Service does not expect additional adverse effects during downstream passage over the replacement weir beyond those that were described for the annual placement of rock on the existing weir, we again extend the BRT criteria for successful adult pallid sturgeon downstream passage at Intake in estimating the effects to adult and juvenile pallid sturgeon during downstream passage over the replacement weir; we expect that the annual rate of mortality or injury to adult and juvenile pallid sturgeon will not exceed 1% of individuals that pass downstream over the replacement weir. These effects will be quantified using telemetered pallid sturgeon such that the annual rate of injury or mortality to telemetered pallid sturgeon during downstream passage at Intake is not expected to exceed 1% of telemetered individuals or one individual, whichever number is greater for a given year.

Free embryos will encounter the replacement weir during their downstream drift if pallid sturgeon successfully spawn upstream of Intake and the fertilized eggs survive to hatch. Free embryos enter the water column immediately upon hatch and are weak swimmers throughout their ontogenetic development to becoming larvae (Kynard et al. 2007; Braaten et al. 2012). Free embryo drift velocity upon entering the water column is slightly less than the water velocity and gradually declines during the drift period (Braaten et al. 2012). Drift predominately occurs in the lower 0.5 meters of the water column (≥98%) and near the river thalweg (>95%; i.e., outside bend and mid-channel; Braaten et al. 2010).

The replacement weir was designed to facilitate downstream passage at Intake by drifting free embryos and larvae. Water depth and velocity over the replacement weir will vary with Yellowstone River discharge, but will improve (i.e., deeper with lower velocity) upon current conditions over the existing weir (Table 5; Reclamation and Corps 2016a). Turbulence over the replacement weir will be minimized by contouring fill upstream of the replacement weir and between the replacement and existing weirs, as well as by the smooth concrete cap on top of the replacement weir. While turbulence over the downstream boulder field will persist, these conditions are expected to gradually reduce through time as previously placed rock continues to disperse downstream. The low flow notch will further improve water depth, velocity, and turbulence over the replacement weir and will be aligned with the river thalweg where drifting free embryos are concentrated (Braaten et al. 2010). Conditions over the replacement weir, existing weir, and boulder field are expected to be similar to bluff pools and rapids that occur in the Yellowstone River and are naturally encountered by drifting free embryos (Reclamation and Corps 2016a). Reclamation and the Corps (2016a) noted that a laboratory study on the effects of riprap to white sturgeon (*Acipenser transmontanus*) larvae found no differences in the survival of or injury to fish drifting past riprap in comparison to a control group (Kynard et al. 2014), though the two sturgeon species exhibit differing behavioral and drift-dispersal characteristics at early life stages. Though the replacement weir was designed to facilitate free embryo downstream passage at Intake and improve on conditions for passage relative to existing conditions, the potential for adverse effects to free embryos that drift over the replacement weir, existing weir, and boulder field still exists. Increased velocities and turbulence coincident with the prevalence of large rock in this area poses the risk for drifting free embryos to be injured or killed during their downstream passage. However, information to quantify those effects is sparse. We discuss quantifying the effects of the replacement weir on drifting free embryos further in section 5.2.5.

5.2.2.2 Physical presence of the bypass channel

A bypass channel is currently being constructed on the south side of the replacement and existing weirs to facilitate fish passage around Intake. The bypass channel will diverge from the mainstem Yellowstone River at the location of the upstream entrance to the NSC, approximately 9,200 feet upstream of the replacement weir, and reconnect approximately 500 feet downstream of the boulder field tailout below the existing weir, totaling approximately 11,150 feet (2.1 miles) in length (Figure 7). Design and construction of such a bypass channel that is suitable for pallid sturgeon passage is unique, and information regarding the bypass channel design criteria were lacking. Accordingly, the BRT recommended physical and biological criteria to aid in developing bypass channel design criteria and evaluate project success (Reclamation and Corps 2016a).

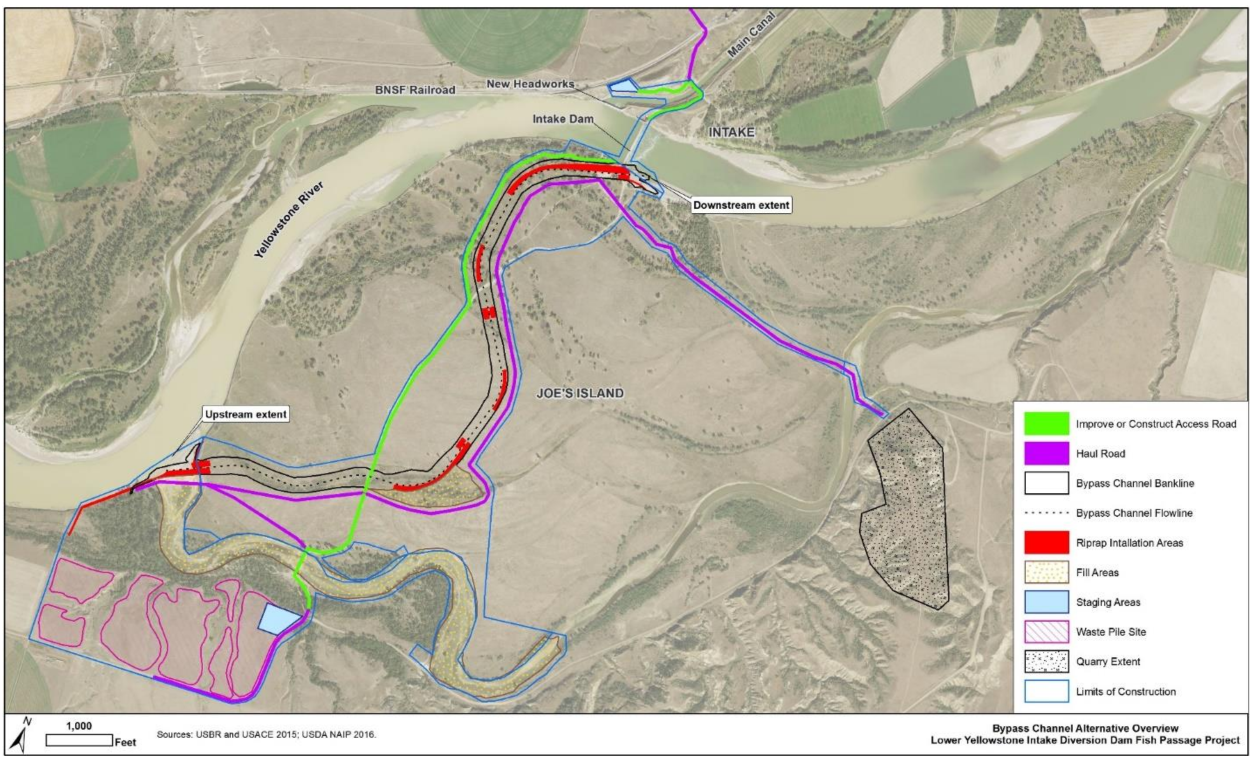

Figure 7. Bypass channel planform and design features (Reclamation and Corps 2016a).

The BRT considered that best available science regarding pallid sturgeon swimming capabilities and habitat preferences and recommended physical criteria for the bypass channel under two Yellowstone River discharge scenarios (7,000 – 14,999 cfs and 15,000 – 63,000 cfs; Table 6; Reclamation and Corps 2016a). Physical criteria considered the percent of the total Yellowstone River discharge that flows into the bypass channel, bypass channel mean column velocity, minimum bypass channel cross-sectional depth for 30 contiguous feet, and mean column velocities at the bypass channel entrance and exit (Reclamation and Corps 2016a).

The bypass channel was designed to meet BRT recommendations regarding physical criteria (Table 6). Within the scope of this design, the bypass channel longitudinal profile will have a similar range of slopes (0.02 – 0.07%) as compared to the Yellowstone River in this area (0.04 – 0.07%; Reclamation and Corps 2016a). Large gravel and cobble will be used to line the channel for protection against vertical erosion, and grade control structures will be placed at the bypass channel entrance and exit, as well as at two intermediate locations within the channel for added vertical stability. The bypass channel cross-section will have a bottom width of 40 feet and side slopes with a rise-to-run ratio ranging from 1:4 – 1:8, resulting in a top width of 150 – 250 feet (Reclamation and Corps 2016a). Bypass channel planform will consist of two large meander bends, and riprap will be installed on four outside bends with a higher potential for lateral erosion (Figure 7).

Table 6. Summary of Biological Review Team (BRT) physical criteria recommendations and modeled physical criteria for the bypass channel (Reclamation and Corps 2016a).

	Yellowstone River discharge[1]			
	7,000 – 14,999 cfs		15,000 – 63,000 cfs	
Physical criteria	BRT recommendation	Bypass channel[2]	BRT recommendation	Bypass channel[2]
Flow split[3]	840 – 1,800 cfs (≥ 12%)	940 – 1,950 cfs	1,950 – 9,450 cfs (13 – ≥ 15%)	1,950 – 8,610 cfs
Water velocity[4]				
In-channel	2.0 – 6.0 ft/s	2.8 – 3.5 ft/s	2.4 – 6.0 ft/s	3.5 – 5.2 cfs
Entrance	2.0 – 6.0 ft/s	3.1 – 3.8 ft/s	2.4 – 6.0 ft/s	3.8 – 5.8 ft/s
Exit	≤ 6.0 ft/s	3.3 – 3.5 ft/s	≤ 6.0 ft/s	3.5 – 5.0 ft/s
Water depth[5]	≥ 4.0 ft	4.5 – 6.3 ft	≥ 6.0 ft	6.3 – 12.6 ft

[1]Measured at the USGS gage at Sidney, Montana.
[2]Modeled results for the bypass channel design (Reclamation and Corps 2016a).
[3] Percent of the total Yellowstone River discharge that flows into the bypass channel.
[4] Mean water column velocity.
[5] Minimum cross-sectional depth across 30 contiguous feet.

A scour hole currently exists on the southern portion of the Yellowstone River immediately downstream of the rock field and causes a large eddy to form where the new bypass channel will converge with the mainstem Yellowstone River (Reclamation and Corps 2016a). The presence of this eddy may reduce flow velocities from the bypass channel and into the river such that pallid sturgeon are less likely to be attracted into the bypass channel during upstream migrations. To increase the likelihood that pallid sturgeon detect the bypass channel entrance, this area will be filled and contoured to direct bypass channel flows into the main channel more effectively.

The new bypass channel is expected to pass pallid sturgeon in all years by conveying an adequate amount of water for pallid sturgeon passage at all discharge levels in the Yellowstone River (Table 7). By comparison, passage through the NSC was only observed at a Yellowstone River discharge greater than approximately 35,000 cfs, and passage rates through the NSC increased with Yellowstone River discharge (Rugg et al. 2019). Additionally, year-round access to the bypass channel will likely naturalize the timing of passage at Intake, as well as subsequent migrations and spawning activity, in relation to the Yellowstone River hydrograph and water temperatures. For example, in 2017 and 2018, Reclamation targeted pallid sturgeon for translocation upstream of Intake upon their entry into a specified “catch zone” that spanned from just downstream of the boulder field to the downstream entrance of the NSC; this “catch zone” was selected to target fish that migrated up to the existing weir but still allowed for the opportunity to utilize the NSC to circumvent Intake (Reclamation 2019, 2020). Translocated fish that utilized the Powder River in 2017 and 2018 had reached the apex of their ascent around the time that other pallid sturgeon were bypassing Intake via the NSC (Reclamation 2019). Reclamation (2019) also noted that the translocated fish migrated further up the Powder River (river miles 87, 88, 89, and 97) in 2017 and 2018 than the pallid sturgeon that utilized the Powder River in 2014 (river miles 5, 8, 20) after bypassing Intake via the NSC and hypothesized that earlier access to upstream reaches may result in longer upstream migrations and preferential selection of suitable spawning habitats (Reclamation 2019). Such conditions, which would also be provided by early passage through the new bypass channel, would support natural recruitment by increasing free embryo drift distances and pallid sturgeon spawning success.

Table 7. Expected flow conditions in the bypass channel at various Yellowstone River discharges (Reclamation and Corps 2016a).

Yellowstone River Discharge[1] (cfs)	Flow in bypass channel (cfs)	Flow in main channel (cfs)	Percent of total flow in bypass channel (%)	BRT criteria (%)
7,000	1,100	5,900	16	≥12
15,000	2,200	12,800	15	13 – ≥15
30,000	4,100	25,900	14	13 – ≥15
54,200[2]	7,500	46,700	14	13 – ≥15
63,000	8,700	54,300	14	13 – ≥15
74,400[3,6]	10,700	54,700	14	N/A
87,600[4,6]	12,900	74,700	15	N/A
128,300[5,6]	20,000	108,300	16	N/A

[1]Measured at the USGS gage at Sidney, Montana.
[2]2-year flow event.
[3]5-year flow event.
[4]10-year flow event.
[5]100-year flow event.
[6]Yellowstone River discharge exceeds amount with BRT recommended criteria.

As described in sections 5.2.1.1 and 5.2.2.1, we estimate that annually up to 11.2% or 162 and 141 pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, will encounter the replacement weir during upstream migrations. Pallid sturgeon that encounter Intake but do not pass upstream through the bypass channel will be subject to adverse effects resulting from blocked upstream passage by the replacement weir (section 5.2.2.1).

Information to support estimating the number of pallid sturgeon that will pass through the new bypass channel during upstream migrations is limited. The BRT recommended biological success criteria for adult pallid sturgeon upstream passage at Intake (85%), but no criteria were provided for juveniles (Reclamation and Corps 2016a). Reclamation and the Corps adopted the BRT criteria for adult pallid sturgeon upstream passage at Intake into their MAMP (section 5.2.4), which provides a framework toward meeting the criteria if upstream adult passage is less than 85%. The MAMP also describes the need to develop upstream passage criteria for juveniles.

While the Service anticipates that pallid sturgeon upstream passage through the NSC will meet or exceed the BRT recommended success criteria (85%), we reviewed the best available information on upstream passage at Intake to analyze the effects of the replacement weir and bypass channel on upstream passage by juvenile and adult pallid sturgeon. Thus, the Service expects that, due to an increased percentage of Yellowstone River flow into the bypass channel as compared to the NSC, annual passage rates will meet or exceed the observed passage rates through the NSC under optimal conditions (i.e., elevated Yellowstone River discharges). Passage rates through the NSC for wild pallid sturgeon were near 40% at discharges greater than 45,000 cfs and for HOPS were 33% at discharges greater than 68,000 cfs (Rugg et al. 2019; P. Braaten, USGS, unpublished data).

We estimated the percent of pallid sturgeon 600 – 800 mm and >800 mm FL that will pass upstream of Intake annually through the bypass channel to account for changing demographic characteristics through time as HOPS grow and reach sexual maturity. Rugg et al. (2019) observed wild pallid sturgeon (N = 75) and HOPS (N = 124) from 2015 – 2018. Of these pallid sturgeon, all wild fish were >800 mm FL, whereas 72.6% of HOPS (N = 90) were >800 mm FL. Thus, 45.5% (wild) and 54.5% (HOPS) of pallid sturgeon >800 mm FL are expected to pass upstream of Intake through the bypass channel at passage rates of 40% and 33%, respectively. As such, we weight-averaged the expected passage rates for wild pallid sturgeon and HOPS to estimate that annually a minimum of 36% of pallid sturgeon >800 mm FL that encounter Intake will pass through the bypass channel ([45.5% wild pallid sturgeon x 40% passage rate] + [54.5% HOPS x 33% passage rate] = 36.2%). Passage rates for pallid sturgeon 600 – 800 mm FL, all of which were HOPS, is expected to be at least 33%. In relation to the estimated annual number of pallid sturgeon 600 – 800 mm (N = 162) and >800 mm FL (N = 141) that will encounter Intake, we estimate that annually a minimum of 53 and 51 individuals, respectively, will pass upstream of Intake. While the estimated passage rates for each length group are low in comparison to the BRT recommended criteria, these passage rates represent an improvement relative to passage rates through the NSC.

5.2.2.3 Closure of the natural side channel

In 2019, flow into the natural side channel (NSC) was disconnected when a coffer dam was placed at the upstream entrance of the channel and material that was excavated during construction of the new bypass channel was used to fill the upper portions of the NSC. While this activity was a component of the originally proposed action (Reclamation and Corps 2016a) and occurred while the 2016 Biological Opinion and ITS were still in effect, the period between when the NSC was closed and new bypass channel becomes available for pallid sturgeon passage will be longer than expected. As originally proposed (Reclamation and Corps 2016a), the NSC would have been closed for a 2 – 3 year period during project construction before alternative upstream passage would be provided by the newly constructed bypass channel. Given that the estimated timeline for project construction has been extended through 2022 or 2023, the NSC will now be closed for up to five years before the new bypass channel is connected to the Yellowstone River and accessible to pallid sturgeon.

From 2014 – 2018, telemetered pallid sturgeon used the NSC to pass upstream of Intake more than was anticipated in the 2016 Biological Assessment and 2016 Biological Opinion and ITS, including under a broader range of Yellowstone River discharges. The 2016 Biological Opinion and ITS concluded that Yellowstone River discharges of approximately 47,000 cfs would be needed to pass adult pallid sturgeon through the NSC, based on limited information that was available at the time of consultation. Because historical data suggested that discharges of that magnitude would only occur for seven days during five out of ten years, it was assumed that closing the NSC would only impact adult pallid sturgeon upstream migrations during one year of the 2 – 3 years during Intake Project construction (Service 2016).

However, movement data (2014 – 2018) documented that pallid sturgeon were able to pass through the NSC under lower Yellowstone River discharges than was expected and that both adult and juvenile pallid sturgeon used the NSC to circumvent Intake during upstream migrations. From 2014 – 2018, wild pallid sturgeon passed through the NSC every year except 2016 and at Yellowstone River discharges that ranged from approximately 40,000 – 74,600 cfs (Rugg et al. 2019). During the same time period, HOPS passed through the NSC in 2017 and 2018 under Yellowstone River discharges that ranged from approximately 35,000 – 72,500 cfs (Rugg et al. 2019). Although the effects to pallid sturgeon resulting from the closure of the NSC were underestimated in the 2016 Biological Opinion and ITS because pallid sturgeon, including juveniles, used the NSC to pass upstream of Intake more frequently than expected, the affected fish were considered a subset of those impacted by the presence of the existing weir during project construction. Specifically, an estimated 5 – 16 adult pallid sturgeon (41%; Service 2016, page 41), representing a subset of the estimated 15 – 32 adult wild fish that would encounter Intake and be adversely affected by the existing weir, would be impacted by the closure of the NSC (Service 2016, pages 38 and 41). Whereas the total number of pallid sturgeon that have encountered Intake since the 2016 Biological Opinion and ITS were issued is unknown because movements are only documented for telemetered fish, an annual maximum of eight telemetered adult wild fish encountered Intake in 2018. The 2016 Biological Opinion cited information on the percentage of the telemetered wild population that encountered Intake during upstream migrations and its relationship to the estimated wild population abundance to estimate that one telemetered wild adult pallid sturgeon also represents two non-telemetered adult wild individuals (Service 2016, page 38). Thus, the maximum annual number of telemetered wild individuals that encountered Intake in 2018 (N = 8) likely represented a total of 24 adult wild fish (8 telemetered and 16 non-telemetered); of these telemetered pallid sturgeon, five fish (two through the NSC and three via translocation) passed upstream of Intake (Rugg et al. 2019). Thus, the estimated maximum annual number of adult wild fish that encountered Intake prior to or during project construction (N = 19), including the subset that were adversely affected by the closure of the NSC (N = 8; 41% of 19), were below the estimated number of adult pallid sturgeon that would be affected annually (Service 2016).

Consistent with the 2016 Biological Opinion and ITS, we conclude that the pallid sturgeon that will be adversely affected by the closure of the NSC during project construction are the same fish that will be affected by placement of rock on the existing weir. In section 5.2.1.1 (page 38), we estimated that up to 162 pallid sturgeon from 600 – 800 mm FL and 141 pallid sturgeon > 800 mm FL will be blocked annually from migrating upstream of Intake by the existing weir, with rocking; the affected fish are represented by 5 and 20 telemetered pallid sturgeon 600 – 800 mm and >800 mm FL, respectively. We estimate that the same number of fish in each length group may be blocked from passing upstream of Intake annually by the closure of the NSC for up to a five year period (through 2023) during project construction and until the bypass channel is connected to the Yellowstone River.

5.2.3 Operation and maintenance of the Lower Yellowstone Project after Intake Project construction

5.2.3.1 Irrigation diversions and operation and maintenance of the fish screens

In section 5.2.1.3, we discussed the potential effects to pallid sturgeon, primarily free embryos, resulting from irrigation diversions into the Main Canal and O&M of the fish screens during project construction. The same effects are likely at Intake after construction is completed. We discuss quantifying the effects of irrigation diversions into the Main Canal and operation of the fish screens on drifting free embryos further in section 5.2.5.

5.2.4 Monitoring and adaptive management

Several uncertainties exist regarding the design and performance of recent management actions at Intake, as well as pallid sturgeon and other native fish species' biological response to those management actions. To reduce these uncertainties, Reclamation, in cooperation with the Corps, developed a MAMP to ensure the effectiveness of the headworks structure and fish screens, replacement weir, and bypass channel (Reclamation and Corps 2020 *in review*). The scope of the MAMP will include fish passage and entrainment dynamics in an area that includes one mile upstream and downstream of the bypass channel (Reclamation and Corps 2020 *in review*). Consistent with the *Adaptive Management, The U.S. Department of the Interior's Technical Guide*, the MAMP provides a structured decision-making framework using an iterative process to (1) formulate a plan or design, (2) implement a management action(s), (3) monitor resource response, (4) assess monitoring data, and (5) make a decision (Reclamation and Corps 2020 *in review*).

The primary goal for the Intake Project is to improve passage for pallid sturgeon, with a secondary goal to improve fish passage for other native species (Reclamation and Corps 2020 *in review*). While the Service supports the secondary goal, passage by other native species is beyond the scope of this consultation and will not be discussed further. Specific objectives toward meeting the primary goal were derived from BRT recommendations related to physical and biological criteria. Objective 1 is to construct and maintain the bypass channel to appropriate physical criteria parameters that allow improved pallid sturgeon passage at Intake. Appropriate physical criteria are those recommended by the BRT (Table 6). Objective 2 is to provide upstream and downstream passage for pallid sturgeon at Intake. Sub-objectives were derived from the passage criteria recommended by the BRT, which are specific to pallid sturgeon life stage and passage direction (Table 8). Through the MAMP, Reclamation and the Corps will implement adaptive management measures if these objectives and sub-objectives are not met (Reclamation and the Corps 2020 *in review*).

Table 8. Summary of Biological Review Team biological success criteria recommendations for passage through the bypass channel (Reclamation and Corps 2016a).

Passage direction pallid sturgeon life stage		Passage criteria
Upstream		
Adult	-	≥85% of motivated individuals[1] pass upstream of the weir annually during the spawning period (April 1 – June 15) without substantial delay (≥0.19 miles/hour)
Juvenile	-	No criteria[2]
Downstream		
Adult	-	<1% annual mortality for 10 years after construction.
	-	Document injury or evidence of adverse stress related to downstream passage.
Juvenile	-	No criteria
≤ age-1	-	Assess impingement and entrainment of free embryos, larvae, and young-of-the-year sturgeon species[3] at headworks screen, irrigation canal, and downstream of the replacement weir

[1] Adult pallid sturgeon that move up to the weir.
[2] MAMP notes the need to develop criteria to trigger adaptive management options to improve upstream passage for juveniles if the lack of juvenile passage is demonstrated to result in negative population level effects.
[3] Pallid and shovelnose sturgeon--see section 5.2.5.

Monitoring is a critical component of the adaptive management process because it documents progress toward achieving MAMP goals and objectives, resource response to specific management actions, and increases understanding of resource dynamics (Reclamation and Corps 2020 *in review*). Physical and biological aspects of the Intake Project will be monitored for at least an 8-year period following project construction—Reclamation and the Corps' respective roles and responsibilities in implementing the MAMP, including monitoring commitments, were formalized in a Memorandum of Agreement between Reclamation and the Corps dated April 7, 2015, and are detailed in the *Draft* MAMP (Dated February 2020; Reclamation and Corps 2020 *in review*, pages 10 – 12). After the initial 8-year monitoring period, Reclamation will convene with the Service to determine the long-term need and scope for monitoring at Intake (Reclamation and Corps 2020 *in review*).

Physical criteria (water depth and velocity, percent of total discharge into the bypass channel) will be monitored using an Acoustic Doppler Current Profiler deployed by boat or line at various locations across the bypass channel and nearby Yellowstone River (Reclamation and Corps 2020 *in review*). Such activities are not expected to adversely affect pallid sturgeon. In contrast, biological monitoring will require capturing, handling, collecting, and/or tagging pallid sturgeon at all life stages. Such activities may adversely affect some individuals by inducing injury or potentially death. Although short-term injury is inherent to tagging pallid sturgeon, injury in the context of evaluating potential effects to pallid sturgeon resulting from monitoring activities refers to chronic injury that may ultimately result in death. Adult and juvenile pallid sturgeon passage at Intake will be monitored by both manual tracking via boat and six ground-based telemetry stations located one-mile upstream and downstream of the bypass channel, within the bypass channel (N = 3), and near the replacement weir (Reclamation and Corps 2020 *in review*). This telemetry infrastructure will monitor movements by individuals that were or will be tagged for other monitoring or research purposes. However, Reclamation will also capture, radio-tag, and release juvenile and adult pallid sturgeon during project construction (up to four years or through 2023) and over the 8-year period after construction, as part of the MAMP. The capture, handling, and tagging of pallid sturgeon will comply with protocols set forth by the Pallid Sturgeon Recovery Team (Service 2012), which have resulted in no known mortalities to date. However, because the potential for injury or death exists and consistent with the 2016 Biological Opinion, the Service estimates that up to two and five pallid sturgeon 600 – 800 mm and >800 mm FL, respectively, will be injured or killed during the initial 8-year monitoring period as a result of being captured and tagged (Reclamation and Corps 2020 *in review*). Because the number of wild pallid sturgeon remaining in RPMA 2 is low (N= 125 in 2008; Jaeger et al. 2009) and also consistent with the 2016 Biological Opinion, we expect that no more than two of the estimated five pallid sturgeon >800 mm FL that may be injured or killed resultant from monitoring activities will be wild individuals. This estimate also includes pallid sturgeon that will be captured, handled, and transported for translocation upstream of Intake (see reasonable and prudent measure #2 in the ITS below). While this is likely an overestimate based on previous monitoring efforts, it establishes a threshold for reassessment should the numbers be exceeded. Adverse effects to pallid sturgeon resultant from MAMP monitoring are in addition to those already accounted for through the existing 10(a)(1)(A) permits or the Section 6 agreement with the State of Montana.

Reclamation will also monitor the effects to drifting free embryos resultant from downstream passage at Intake and entrainment into the Main Canal during project construction (up to four years or through 2023) and over the 8-year period after project construction, as part of the MAMP (Reclamation and Corps 2020 *in review*). Sampling will occur in the Yellowstone River, both upstream of the headworks and downstream of the boulder field, to evaluate the effects of downstream passage over the replacement weir, existing weir, and boulder field and in the Main Canal to evaluate entrainment dynamics (Reclamation and Corps 2020 *in review*). Sampled free embryos or larvae may be injured or killed during their capture, and sampled individuals are often collected and preserved for genetic identification (D. Trimpe, Reclamation, unpublished data). This monitoring will be conducted in cooperation with the Service, USGS, and Montana Fish, Wildlife and Parks (MFWP), and the related effects are accounted for under an existing Section 10(a)(1)(A) permit and Section 6 agreement with the State of Montana. We discuss quantifying the effects of sampling free embryos as a component of the MAMP in section 5.2.5.

5.2.5 Estimating the number of pallid sturgeon free embryos to be adversely affected by irrigation diversions, fish screens, downstream passage at Intake, and monitoring

If adult pallid sturgeon successfully spawn upstream of Intake and the fertilized eggs survive to hatch, some portion of drifting free embryos are likely to be injured or killed at Intake. Potential causes of injury or death include entrainment into the Main Canal, impingement on the fish screens, passage over the replacement weir, existing weir, and boulder field, or sampling at Intake.

Information that supports estimating the number of drifting free embryos that will be adversely affected at Intake is sparse. Since 2012, Reclamation has monitored pallid sturgeon entrainment into the Main Canal and drift dynamics in the Yellowstone River both upstream of the headworks and downstream of the existing weir and boulder field. From 2012 – 2018, 10 Acipenseriforme larvae were sampled in the Main Canal, of which genetic analysis indicated that four were paddlefish, one was a shovelnose sturgeon, four were sturgeon that couldn't be identified to species (i.e., either pallid or shovelnose sturgeon), and one was unidentifiable (D. Trimpe, Reclamation, unpublished data). In 2019, an additional six (five eggs and one larvae) and five (four eggs and one larve) Acipenseriformes were collected in the Main Canal and Yellowstone River upstream of the headworks structure, respectively, but genetic identification of these samples is pending (D. Trimpe, Reclamation, unpublished data). Although pallid sturgeon free embryos have not been conclusively detected at Intake since monitoring began in 2012, the Intake Project is intended to improve passage at Intake to facilitate pallid sturgeon spawning in upstream reaches. Successful spawning upstream of Intake has the potential to substantially alter the number of drifting pallid sturgeon free embryos that are adversely affected at Intake.

5.2.5.1 Surrogacy

The potential for some drifting free embryos or larvae to experience adverse effects at Intake after the Intake Project is completed is high. Intake Project goals include passing ≥85% of motivated adult pallid sturgeon upstream of Intake. Resultant increases in successful spawning upstream of Intake may substantially increase the number of drifting free embryos that encounter Intake relative to existing conditions. The Service has very little information to support estimating the number of free embryos or larvae that will encounter Intake after project completion.

Consistent with the 2016 Biological Opinion and ITS, the Service believes that best approach for assessing the effects of Intake on drifting free embryos during and after project construction is to use a surrogate species. The Service's policy for using surrogates to describe effects and incidental take is as follows (Service 1998):

> *In some situations, the species itself or the effect on the species may be difficult to detect. However, some detectable measure of effect should be provided. For instance, the relative occurrence of the species in the local community may be sufficiently predictable that impacts on the community (usually a surrogate species in the community) serve as a measure of take… if a sufficient causal link is demonstrated, then this can establish a measure for the impact on the species or its habitat and provide a yardstick for reintiation.*

The Service also affirmed the use surrogate species in recently promulgated regulations (50 CFR 402.14 (*i*)(1)(i):

> *A surrogate (e.g., similarly affected species or habitat or ecological condition) may be used to express the amount or extent of anticipated take provided that the biological opinion or incidental take statement: Describes the causal link between*

> *the surrogate and take of the listed species, explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and sets a clear standard for determining when the level of anticipated take has been exceeded.*

Consistent with the 2016 Biological Opinion and ITS, we use shovelnose sturgeon as a surrogate species for describing and measuring the scale of adverse effects to drifting pallid sturgeon free embryos at Intake. The rationale and underlying assumptions for using shovelnose sturgeon as a surrogate species are described in the 2016 Biological Opinion and incorporated by reference (Service 2016, pages 51 – 52).

Shovelnose sturgeon are abundant in the Yellowstone River and are presumed to be a reliable indicator of the effects of Intake to pallid sturgeon free embryos in the future (Service 2016). Based on the underlying assumptions described in the 2016 Biological Opinion, proportionally similar effects (i.e., the proportion of free embryos that experience adverse effects at Intake relative to the number of individuals present in the Yellowstone River at Intake) between the two sturgeon species at Intake will not result in population level negative effects to pallid sturgeon. A scientific panel convened by Reclamation supported that some adverse effects to drifting pallid sturgeon free embryos at Intake would be acceptable if successful spawning upstream of Intake were to increase in response to the Intake Project (Service 2016, page 50):

> *"The net benefit of passage and spawning upstream from Intake Dam is likely to be significant even if a portion of the reproduction is subject to entrainment losses as long as associated diversion fractions are not excessive."*

Because shovelnose sturgeon in the Yellowstone River are considered abundant and the population viable (Rugg 2017), the Service concludes that the pallid sturgeon population in RPMA 2 can withstand injury or mortality to free embryos at Intake, so long as the proportion of drifting free embryos that experience adverse effects resultant from entrainment into the Main Canal, impingement on the fish screens, downstream passage over the replacement weir, existing weir, and boulder field, or monitoring relative to the number of drifting pallid sturgeon in the Yellowstone River does not exceed the proportion of drifting shovelnose sturgeon that experience the same effects.

Monitoring will be a critical component of this biological opinion toward understanding the validity of the underlying assumptions that support using shovelnose sturgeon as a surrogate species. As described above, Reclamation will monitor drifting pallid and shovelnose sturgeon free embryos in the Main Canal, at the fish screens, and in the Yellowstone River, both upstream of the headworks structure and downstream of the boulder field (Reclamation and Corps 2020 *in review*). The Service also supports the study proposed in the MAMP that proposes to release pallid sturgeon free embryos immediately upstream of Intake to evaluate impingement and entrainment rates at the headworks structure and injury or mortality rates over the replacement weir, existing weir, and boulder field, or resulting from sampling (Reclamation and Corps 2020 *in review*). Including shovelnose sturgeon free embryos in the study to compare drift dynamics between the two sturgeon species would also inform whether using shovelnose sturgeon as surrogate species is appropriate.

5.3 Summary of effects of the action

As described above, elements of the proposed action that were determined to have insignificant or discountable effects to various pallid sturgeon life stages in Reclamation and the Corps' effects analysis are incorporated by reference (Reclamation and Corps 2016a, Table 11, pages 90 – 94). Those effects were related to noise, turbidity, disturbance, pumps, and temporary increases in water velocity due to coffer dams (Reclamation and Corps 2016a).

Intake Project elements that were likely to adversely affect pallid sturgeon included (1) the O&M of the LYP during Intake Project construction, including the annual placement of rock on the existing weir, irrigation diversions, and fish screen operation; (2) construction of the bypass channel and replacement weir, including the physical presence of the weir and closure of the NSC; (3) future O&M of the LYP, including irrigation diversions and fish screen operation; and (4) monitoring and adaptive management—see Table 9 in section 2.0 of the ITS below for a summary of the effects and anticipated take of pallid sturgeon for each component of the proposed action.

During the project construction period (up to four years or through 2023), adverse effects to pallid sturgeon are expected to occur due to the annual placement of rock on the existing weir (sections 5.2.1.1 and 5.2.1.2), irrigation diversions and O&M of the fish screens (section 5.2.1.3), and closure of the NSC (section 5.2.2.3). We estimated that the annual placement of rock on the existing weir would annually block upstream migrations for 162 and 141 pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, and that the estimated number of individuals from each length group that will be blocked from migrating upstream past Intake would be represented by 5 (600 – 800 mm FL) and 20 (>800 mm FL) telemetered pallid sturgeon. A subset of those same individuals, represented by the same number of telemetered individuals for each length group, will not be able to circumvent Intake through the NSC due to its closure in 2019. Further, we estimated that annual mortality or injury to adult and juvenile pallid sturgeon resulting from downstream passage over the existing weir, with rocking, would not exceed 1% of individuals that pass over the weir; these effects will be quantified using telemetered pallid sturgeon where injury or mortality to telemetered individuals during downstream passage is not expected to exceed 1% of telemetered individuals or one individual, whichever number is greater for a given year. Additionally, drifting pallid sturgeon free embryos may be injured or killed during downstream passage over the existing weir and adjacent boulder field or resulting from irrigation diversions into the Main Canal and O&M of the fish screens; the proportion of free embryo pallid sturgeon that are injured or killed resultant from these Intake Project elements relative to the number of free embryos drifting in the Yellowstone River is not expected to exceed that of shovelnose sturgeon free embryos or larvae (section 5.2.5).

The ongoing physical presence of the replacement weir for the life of this project is expected to adversely affect multiple pallid sturgeon life stages. As described above, we estimate that annually up to 162 and 141 pallid sturgeon from 600 – 800 mm and > 800 mm FL, respectively, will encounter the replacement weir during upstream migrations (section 5.2.2.1). Reclamation and the Corps adopted the BRT recommended criteria for successful adult passage (85%) and will implement adaptive management measures if less than 85% of adult pallid sturgeon pass upstream of Intake (section 5.2.4), though upstream passage criteria have not been established for juveniles. For estimating the number of pallid sturgeon that may be blocked from passing upstream of Intake by the replacement weir and not utilizing the new bypass channel, we evaluated historical passage rates through the NSC under optimal conditions (elevated Yellowstone River discharge; section 5.2.2.2); we estimated that annually a minimum of 33% (N = 53) and 36% (N = 51) of pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, that encounter Intake would pass upstream through the bypass channel (section 5.2.2.2). Further, we estimate that the annual mortality or injury of adult and juvenile pallid sturgeon during downstream passage over the replacement weir, existing weir, and boulder field will not exceed 1% of individuals that pass over the weir; such effects will be quantified using telemetered pallid sturgeon where injury or mortality to telemetered individuals during downstream passage is not expected to exceed 1% of telemetered individuals or one individual, whichever number is greater for a given year. Lastly, drifting pallid sturgeon free embryos may be injured or killed during downstream passage at Intake. We estimated that the proportion of pallid sturgeon free embryos that are killed or injured during downstream passage over the replacement weir, existing weir, and boulder field, through the bypass channel (sections 5.2.2.1, 5.2.2.2, and 5.2.5), or resulting from irrigation diversions and O&M of the fish screens (5.2.3.1) relative to the number of free embryos drifting in the Yellowstone River are not expected to exceed that of shovelnose sturgeon (section 5.2.5).

Reclamation will monitor pallid sturgeon at Intake during project construction (up to four years or through 2023) and for at least an 8-year period after Intake Project completion, in association with the MAMP; following the initial 8-year monitoring period, Reclamation will meet with the Service to evaluate the need for continued, modified, or reduced monitoring of pallid sturgeon at Intake. Whereas some aspects of the MAMP are not expected to adversely affect pallid sturgeon, monitoring adult and juvenile pallid sturgeon movements at Intake will require capturing, handling, and tagging individuals (section 5.2.4), which may cause chronic injury or death. Such effects are not expected because these activities will occur in compliance with protocols set forth by the Pallid Sturgeon Recovery Team (Service 2012); however, the Service estimates that up to two and five (no more than two wild individuals) pallid sturgeon from 600 – 800 mm and > 800 mm FL, respectively, may be chronically injured or killed resulting from monitoring activities, as a threshold for reassessment should those numbers be exceeded (section 5.2.4). The effects to drifting free embryos resultant from entrainment into the Main Canal, impingement on the fish screens, or downstream passage over the replacement weir, existing weir, and boulder field will also be assessed during and after project construction. Sampled free embryos may be injured or killed during their capture, and sampled individuals are often collected for genetic identification. We estimate that the proportion of pallid sturgeon free embryos that will be injured or killed during related monitoring efforts relative to the number of free embryos drifting in the Yellowstone River will not exceed that of shovelnose sturgeon (section 5.2.5).

Lastly, the Service notes that the design and construction of the bypass channel at Intake is a novel approach for providing passage around a known impediment to pallid sturgeon migrations. The bypass channel was designed to meet BRT recommendations regarding hydraulic and physical criteria that were thought to increase the probability of successful passage, based on the best available information on pallid sturgeon swimming capabilities and substrate preference (Reclamation and Corps 2016a). However, several uncertainties remain with respect to the hydraulic and physical conditions that will be suitable for pallid sturgeon passage through the bypass channel. As such, the opportunity to learn about pallid sturgeon preferences related to these criteria exists, which may be used to inform suitable conditions for pallid sturgeon passage at Intake or other engineered bypass channels in the future. With that in mind, the Service supports prioritizing the BRT recommended biological success criteria over the hydraulic and physical criteria for implementing actions described in the MAMP. Development of passage criteria for juveniles and drifting free embryos in the MAMP is also a critical consideration toward understanding whether physical and hydraulic conditions outside of the BRT recommended criteria are acceptable.

5.4 Cumulative effects

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions in the action area are not considered in this section because they require separate consultation pursuant to section 7 of the Act. We are unaware of future non-Federal actions that are reasonably certain to occur in the action area. Thus, cumulative effects are not expected.

6.0 Jeopardy Discussion and Conclusion

6.1 Jeopardy discussion

The proposed action is expected to both adversely affect and benefit pallid sturgeon. A summary and synthesis of those adverse and beneficial effects is described below.

6.1.1 Adverse effects

Intake Project components and elements that are likely to adversely affect pallid sturgeon are analyzed in section 5.0 and summarized in section 5.3. In summary, an estimated 162 and 141 pallid sturgeon from 600 – 800 mm FL and >800 mm FL, respectively, will encounter Intake annually during upstream migrations. During the project construction period (up to four years or through 2023), these fish will likely be blocked from migrating upstream of Intake due to the annual placement of rock on the existing weir and closure of the NSC. Thereafter, we estimated that annually a minimum of 33% and 36% of pallid sturgeon 600 – 800 mm and >800 mm FL, respectively, will be able to pass upstream of Intake through the new bypass channel for the life of the project. Both during (up to four years or through 2023) and after project construction (for the life of the project), we expect that adverse effects to juvenile and adult pallid sturgeon during downstream passage at Intake will be minimal and estimated that related injury or mortality will not exceed 1% of individuals that pass over the weir.

Monitoring by Reclamation may chronically injure or kill adult and juvenile pallid sturgeon, both during (up to four years or through 2023) and after project construction (for an 8-year period after project construction), due to the capture, handling and tagging of individuals. We also expected such effects to be minimal and estimated that no more than two and five (no more than two wild individuals) pallid sturgeon from 600 – 800 mm FL and >800 mm FL, respectively, will be injured or killed during related activities. Adverse effects to adult and juvenile pallid sturgeon in excess of the estimated amounts will be cause for reassessment of the effects of related monitoring activities to pallid sturgeon.

Pallid sturgeon free embryos may be adversely affected during downstream passage at Intake or during monitoring of related effects. During (up to four years or through 2023) and after project construction (for the life of the project), drifting free embryos may be injured or killed by being entrained into the Main Canal, impinged on the fish screens, or while passing over the replacement weir (after project construction), existing weir, and boulder field. The extent of such effects will be monitored during project construction (up to four years or through 2023) and for at least an 8-year period after project construction (Reclamation and Corps 2020 *in review*), which may result in injury or mortality to free embryos, and sampled individuals may be collected and preserved for genetic identification. We estimated that the proportion of pallid sturgeon free embryos that are injured or killed due to entrainment into the Main Canal, impingement on the fish screens, passage over the weirs and boulder field, or during sampling relative to the number of free embryos drifting in the Yellowstone River will not exceed the proportion of shovelnose sturgeon that are subject to those same effects.

6.1.2 Beneficial effects

Providing pallid sturgeon passage at Intake is considered a high priority among the suite of management actions that may contribute to pallid sturgeon recovery in the GPMU (Service 2014). In RPMA 2, the presence of dams, including Intake, has limited pallid sturgeon upstream access to suitable breeding, feeding, and sheltering habitats. The Intake Project was designed to improve upstream and downstream fish passage at Intake.

The existing weir at Intake has presumably contributed to the apparent pallid sturgeon recruitment failure in RPMA 2 since the 1950s (Braaten et al. 2015). Among the Intake Project goals is to pass ≥85% of adult pallid sturgeon that encounter Intake during upstream migrations (Reclamation and Corps 2016a), and the MAMP identifies adaptive management measures toward meeting that goal. For this biological opinion, we estimated that, based on optimal passage conditions through the NSC (section 5.2.2.2), the minimum annual upstream passage rates through the bypass channel will be 33% and 36% of pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively. Both Reclamation and the Corps' goal for adult upstream passage (≥85%) and our estimates for minimum passage rates represent an improvement on existing conditions. Successful spawning in upstream habitats by reproductive adults will increase free embryo drift distances above Lake Sakakawea relative to existing conditions, thereby increasing the likelihood for restoring natural recruitment in RPMA 2. In addition to the remaining adult wild population (N = 125 in 2008; Jaeger et al. 2009), several HOPS are now reaching sexual maturity and may potentially spawn upstream of Intake; in 2016, an estimated 238 HOPS from 15 – 20 years of age were alive in RPMA 2 (Rotella 2017).

If successful spawning occurs upstream of Intake and the fertilized eggs survive to hatch, the Intake Project was designed to facilitate downstream passage at Intake for drifting free embryo pallid sturgeon. The replacement weir will improve water depths and velocities over the weir relative to existing conditions and include a low flow notch that aligns with the river thalweg, where the majority of drifting free embryos will be concentrated, to further improve free embryo downstream passage (section 5.2.2.1). Though adverse effects are possible during downstream passage at Intake and these effects are expected to be minimal, such effects may result from entrainment into the Main Canal, impingement on the fish screens, or downstream passage over the replacement weir, existing weir, and boulder field. The extent of these effects to drifting free embryos will continue to be evaluated through the MAMP (section 5.2.4).

6.1.3 Synthesis of effects

Intake Project construction will likely continue through 2022, but may extend through 2023 (Reclamation and Corps letter to the Service dated April 17, 2020). During this construction period, pallid sturgeon upstream passage at Intake will be limited. We estimated that annually up to 162 and 141 pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, would be blocked from accessing upstream habitats related to breeding, feeding, or sheltering during the construction period. While additional wild pallid sturgeon may die before realizing the potential benefits of the Intake Project due to the extended construction period, stocked HOPS were derived from wild pallid sturgeon and are strategically propagated and stocked to perpetuate wild population genetics (Service 2019). Thus, short-term impacts during project construction are not expected to reduce appreciably the likelihood of survival or recovery of the pallid sturgeon, particularly in consideration of the thousands of HOPS that exist in the area, many of which are just now reaching sexual maturity (section 3.3.4).

Upon completion, the Intake Project is expected to pass pallid sturgeon upstream of Intake annually and under a broader range of Yellowstone River discharges than the NSC (section 5.2.2.2). In comparison, the NSC only passed pallid sturgeon intermittently among years with moderate to high discharge levels in the Yellowstone River (section 4.2.3.2). Annual passage at Intake will allow pallid sturgeon access to breeding, feeding, and sheltering habitats that was previously limited. Specifically, improved access to upstream spawning habitats will increase the total distance between spawning locations and Lake Sakakawea relative to existing conditions such that retention times will increase for free embryo development into non-drifting larvae. Further, the replacement weir was designed to facilitate downstream passage at Intake for drifting free embryos. Collectively, the Intake Project may facilitate pallid sturgeon natural recruitment in RPMA 2, which has not been detected for decades. Although some components of the Intake Project may continue to adversely affect pallid sturgeon for the life of the project (entrainment into the Main Canal, impingement on the fish screens, injury or death resultant from monitoring activities), the Intake Project, taken as a whole, has the potential to significantly contribute to the recovery of pallid sturgeon.

6.2 Jeopardy conclusion

Blockage of the NSC and annual rocking of the existing weir currently maintains a barrier to upstream migration of pallid sturgeon and will continue to do so until construction of the bypass channel is complete, which may take up to four years or through 2023. This barrier prevents access to upstream habitats, which provide for breeding, feeding, and sheltering and may allow adequate drift distance for pallid sturgeon free embryos to recruit to the population. Following construction, we expect that the new bypass channel will improve upstream passage over preproject conditions, making upstream habitats available under most conditions and potentially allowing for natural recruitment of pallid sturgeon into the population. Construction of the bypass channel is therefore a high priority recovery action for pallid sturgeon. Pallid sturgeon of any life stage may be injured or killed when moving downstream over the new and existing weirs and boulder field; we expect such adverse effects to occur rarely because they have never been observed in ongoing monitoring. Ongoing O&M of the LYP may result in impingement or entrainment of free embryos into the irrigation system, but we expect this adverse effect to be of a low magnitude because the irrigation intake is physically separated from the channel's thalweg (where most free embryos are expected to drift through the project area). Ongoing monitoring of the project will involve capture, handling, and tagging of adult and juvenile pallid sturgeon, which could result in chronic injury or death; however, we expect these adverse effects to occur rarely or never, because such monitoring is ongoing and chronic injury or death has never been observed. Ongoing monitoring may also result in capture and death of pallid sturgeon free embryos, but we expect a small proportion of any individuals present to be captured and killed. Although the project is expected to have adverse effects during and after construction, we have explained why those effects are expected to be of low magnitude, and that project beneficial effects of increasing pallid sturgeon access to breeding, feeding, and sheltering habitat upstream of Intake Dam are important for survival and recovery. In summary, we find that, overall, the proposed action will not be likely to reduce the reproduction, numbers or distribution of the pallid sturgeon; in fact, it is likely to increase the distribution of the sturgeon, substantially increase the potential for reproduction, and, thus, increase the numbers of pallid sturgeon. For those reasons, the project is not likely reduce appreciably the likelihood of survival and recovery of the pallid sturgeon.

After reviewing the current status of pallid sturgeon, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is the Service's biological opinion that the Lower Yellowstone Project: Intake Diversion Dam Fish Passage, as proposed, is not likely to jeopardize the continued existence of the pallid sturgeon.

INCIDENTAL TAKE STATEMENT

1.0 Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service 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 (50 CFR 17.3). Harass is defined by the Service 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 behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3). Incidental take is defined as taking that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by Reclamation and the Corps so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation and the Corps have a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation and the Corps (1) fail to assume and implement the terms and conditions or (2) fail to require grant or permit applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation and the Corps must report the progress of the action and its impact on pallid sturgeon to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

2.0 Amount or Extent of Take Anticipated

During Intake Project construction (up to four years or through 2023), the Service estimates that annually up to 11.2% of pallid sturgeon (≥600 mm FL) in RPMA 2 will encounter Intake during an upstream migration, but will be blocked from migrating upstream of Intake due to the annual placement of rock on the existing weir (biological opinion, section 5.2.1.1) and closure of the natural side channel (biological opinion, section 5.2.2.3). Individuals that are blocked from passing upstream of Intake are subject to harm resulting from habitat modifications that significantly impair behavioral patterns related to feeding and sheltering (600 – 800 mm FL) or breeding, feeding, and sheltering (>800 mm FL; biological opinion, section 5.2.1.1). Based on recent preliminary pallid sturgeon abundance estimates (M. Colvin, Pallid Sturgeon Technical Team, unpublished data), we estimated that annually up to 162 and 141 pallid sturgeon from 600

– 800 mm and >800 mm FL, respectively, which would be represented[6] by 5 (600 – 800 mm FL) and 20 (>800 mm FL) telemetered pallid sturgeon (amended biological opinion, section 5.2.1.1), would be blocked from passing upstream of Intake. Incidental take would be exceeded if more than 5 or 20 telemetered pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, are blocked from migrating upstream of Intake annually during construction.

During project construction (up to four years or through 2023), adult and juvenile pallid sturgeon may also be injured or killed during downstream passage over the existing weir, with rocking (biological opinion, section 5.2.1.2). We estimated that annual mortality or injury to adult and juvenile pallid sturgeon will not exceed 1% of individuals that pass downstream over the existing weir, with rocking. Incidental take during project construction would be exceeded if annually more than 1% of telemetered individuals or more than one individual, whichever number is greater for a given year, are injured or killed during downstream passage at Intake.

After Intake Project construction is completed and for the life of the project, pallid sturgeon may be blocked from passing upstream of Intake by the replacement weir. Those individuals that encounter Intake, but are unable to pass upstream through the bypass channel, will be subject to harm resulting from habitat modifications that significantly impair behavioral patterns related to feeding and sheltering (600 – 800 mm FL) or breeding, feeding, and sheltering (>800 mm FL; biological opinion, section 5.2.2.2). Although Reclamation and the Corps anticipate ≥85% passage success for adult pallid sturgeon and will implement adaptive management measures if that passage rate is not realized (biological opinion, section 5.2.4), we used historical data to estimate that annual passage rates through the bypass channel would meet or exceed observed passage rates through the natural side channel under optimal conditions (elevated Yellowstone River discharges; biological opinion, section 5.2.2.2) such that a minimum of 33% and 36% of pallid sturgeon from 600 – 800 mm FL and >800 mm FL, respectively, that encounter Intake will pass upstream through the bypass channel. Conversely, we estimate that after the Intake Project construction is complete, at worst, 67% and 64% of pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, would be blocked annually from accessing habitats upstream of Intake. The percentage of pallid sturgeon that encounter Intake during upstream migration and pass through the bypass channel will be represented by telemetered pallid sturgeon for each length group. Incidental take after project construction and for the life of the project would be exceeded if annually more than 67% and 64% of telemetered pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, that encounter Intake are blocked from passing upstream through the bypass channel.

Adult and juvenile pallid sturgeon may be injured or killed during downstream passage at Intake after project construction is completed and for the life of the project. Similar to what was described above for downstream passage during project construction, annual mortality or injury to adult and juvenile pallid sturgeon is not expected to exceed 1% of individuals that pass downstream over the replacement weir, existing weir, and boulder field. Incidental take after

[6] We assume that telemetered individuals migrate upstream in the same proportion as non-telemetered individuals, such that their movements represent those of the entire population; see biological opinion section 5.2.1.1, last paragraph, for further discussion. We have no evidence that movements of telemetered individuals differ from those of non-telemetered and it is not practical to monitor non-telemetered individuals; therefore, using the number of telemetered individuals affected to extrapolate the total individuals affected is the best available approach.

project construction would be exceeded if annually more than 1% of telemetered individuals or more than one individual, whichever number is greater for a given year, are injured or killed during downstream passage at Intake.

During (up to four years or through 2023) and after (at least an 8-year period) project construction, Reclamation and will monitor adult and juvenile pallid sturgeon movements at Intake using telemetry equipment (biological opinion, section 5.2.4). Such monitoring activities will require capturing, handling, and tagging individuals, which may result in chronic injury or mortality. We estimated that up to two and five (no more than two wild individuals) pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, may be chronically injured or killed as a result of monitoring activities (biological opinion, section 5.2.4). Incidental take would be exceeded if more than two or five pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively, are chronically injured or killed as a result of monitoring activities during the period between the issuance of this biological opinion and ITS and the 8-year monitoring period after Intake Project construction.

During and after Intake Project construction, free embryo and larval pallid sturgeon may be injured or killed over the life of the project during downstream passage at Intake or during monitoring activities. Injury or death during downstream passage at Intake may result from entrainment into the Main Canal, impingement on the fish screens, or downstream passage over the existing weir and boulder field during construction or over the replacement weir, existing weir, and boulder field after construction. Sampling activities during and after project construction may injure or kill drifting free embryos or larvae, and sampled individuals are often collected for genetic identification. In section 5.2.5 of the biological opinion, we describe our rationale and assumptions for using shovelnose sturgeon as a surrogate species to quantify such adverse effects to pallid sturgeon free embryos or larvae. Therein, we estimate that the proportion of pallid sturgeon that are injured or killed resultant from entrainment into the Main Canal, impingement on the fish screens, downstream passage at Intake, or monitoring activities relative to the number observed drifting in the Yellowstone River will not exceed the proportion of shovelnose sturgeon that experience those same effects. Incidental take would be exceeded if, based on a three-year running average, the proportion of free embryo or larval pallid sturgeon that are injured or killed as a result of entrainment in to the Main Canal, impingement on the fish screens, downstream passage at Intake, or monitoring activities associated with the MAMP (8-year period following Intake Project construction) is significantly greater (e.g., using a t-test or other appropriate statistical analysis) than the proportion of shovelnose sturgeon that experience those same effects during project construction (up to four years or through 2023) or after project construction (for the life of the project). We chose to use a three-year running average for analyzing the relationship between the proportions of sturgeon species that are injured or killed by the project elements listed above to account for potentially low numbers of sturgeon free embryos that may be sampled at Intake, as has been previously observed (see biological opinion, sections 5.2.1.2 and 5.2.1.3), and annual variability in environmental conditions that influence the reproductive success of sturgeon species and sampling capture efficiency; a three-year running average will increase the sample size, and thus, our confidence that the observed relationships between the proportions of sturgeon species, based on standardized sampling and statistical analysis, are representative of the same relationships at the level of the populations. Additionally, analysis of the relationships between the proportions of sturgeon species will use a significance level of $\alpha = 0.05$ because it is common among fisheries analyses and reduces the potential for incorrectly concluding that a significantly higher proportion of pallid sturgeon free embryos are impacted than that of shovelnose sturgeon relative to higher significance levels (e.g., $\alpha = 0.10$; Brown and Guy 2007).

A summary of the amount or extent of take anticipated for each Intake Project component, as described above, is summarized in Table 9.

Table 9. Summary of the amount or extent of anticipated take for pallid sturgeon length groups or life stages for each Intake Project component.

Project component Project element	*Cause of take* Form of take	*Duration* Frequency	Pallid sturgeon size group or life stage	*Estimated amount/extent of take* Measurable estimated amount/extent of take	Biological opinion Effects Section
O&M of the LYP during project construction					
Annual placement of rock on the existing weir	*Blocked upstream passage*	*4 years or through 2023*			
	Harm: injury (impaired access to feeding or sheltering habitats)	Annually	600 – 800 mm FL	*≤162 individuals* ≤5 telemetered individuals	Section 5.2.1.1 (page 33)
	Harm: injury (impaired access to breeding, feeding, or sheltering habitats)	Annually	>800 mm FL	*≤141 individuals* ≤20 telemetered individuals	Section 5.2.1.1 (page 33)
	Downstream passage				
	Harm: physical injury or mortality	Annually	Adult and juvenile	*≤1% of individuals that pass over the weir* ≤1% of telemetered individuals or one individual, whichever number is greater for the year, that pass over the weir	Section 5.2.1.2 (page 38)
	Harm: physical injury or mortality	Annually, based on a three-year running average	Free embryos or larvae	*≤ proportion of shovelnose sturgeon subject to same effects* ≤ proportion of shovelnose sturgeon subject to same effects quantified via monitoring	Sections 5.2.1.2 and 5.2.5 (pages 38 and 53)

Table 9. Continued.

Project component Project element	*Cause of take* Form of take	*Duration* Frequency	Pallid sturgeon size group or life stage	*Estimated amount/extent of take* Measurable estimated amount/extent of take	Biological opinion Effects Section
O&M of the LYP during project construction					
Irrigation diversions and fish screen operation	*Entrainment into Main Canal or impingement on fish screens*	*4 years or through 2023*			
	Harm: physical injury or mortality	Annually, based on a three-year running average	Free embryos or larvae	*≤ proportion of shovelnose sturgeon subject to same effects* ≤ proportion of shovelnose sturgeon subject to same effects quantified via monitoring	Sections 5.2.1.3 and 5.2.5 (pages 40 and 53)
Construction of replacement weir and bypass channel					
Presence of replacement weir and bypass channel	*Blocked upstream passage*	*Life of the project after construction*			
	Harm: injury (impaired access to feeding or sheltering habitats)	Annually	600 – 800 mm FL	*≤67% of individuals that encounter Intake* ≤67% of telemetered individuals that encounter Intake	Sections 5.2.2.1 and 5.2.2.2 (pages 41 and 46)
	Harm: injury (impaired access to breeding, feeding, or sheltering habitats)	Annually	>800 mm FL	*≤64% of individuals that encounter Intake* ≤64% of telemetered individuals that encounter Intake	Sections 5.2.2.1 and 5.2.2.2 (pages 41 and 46)

Table 9. Continued.

Project component Project element	*Cause of take* Form of take	*Duration* Frequency	Pallid sturgeon size group or life stage	*Estimated amount/extent of take* Measurable estimated amount/extent of take	Biological opinion Effects Section
Construction of replacement weir and bypass channel					
Presence of replacement weir and bypass channel	*Downstream passage*	*Life of the project after construction*			
	Harm: physical injury or mortality	Annually	Adult and juvenile	*≤1% of individuals that pass over the weir* ≤1% of telemetered individuals or one individual, whichever number is greater for the year, that pass over the weir	Section 5.2.2.1 (page 41)
	Harm: physical injury or mortality	Annually, based on a three-year running average	Free embryos or larvae	*≤ proportion of shovelnose sturgeon subject to same effects* ≤ proportion of shovelnose sturgeon subject to same effects quantified via monitoring	Sections 5.2.2.1 and 5.2.5 (pages 41 and 53)
Closure of NSC	*Blocked upstream passage*	*4 years or through 2023*			
	Harm: injury (impaired access to feeding or sheltering habitats)	Annually	600 – 800 mm FL	*≤162 individuals*[1] ≤5 telemetered individuals[1]	Section 5.2.2.3 (page 49)
	Harm: injury (impaired access to breeding, feeding, or sheltering habitats)	Annually	>800 mm FL	*≤141 individuals*[1] ≤20 telemetered individuals[1]	Section 5.2.2.3 (page 49)

[1]A subset of the same individuals, including telemetered individuals, blocked from passing upstream of Intake by the existing weir, with rocking, will be blocked from passing upstream by the closure of the NSC.

Table 9. Continued.

Project component Project element	*Cause of take* Form of take	*Duration* Frequency	Pallid sturgeon size group or life stage	*Estimated amount/extent of take* Measurable estimated amount/extent of take	Biological opinion Effects Section
O&M of the LYP after project construction					
Irrigation diversions and fish screen operation	*Entrainment into Main Canal or impingement on fish screen*	*Life of the project after construction*			
	Harm: physical injury or mortality	Annually, based on a three-year running average	Free embryos or larvae	≤ *proportion of shovelnose sturgeon subject to same effects* ≤ proportion of shovelnose sturgeon subject to same effects quantified via monitoring	Sections 5.2.3.1 and 5.2.5 (pages 51 and 53)
Monitoring and adaptive management					
Monitoring activities	*Capture, handling, collecting, and/or tagging of individuals*	*From the issuance of this document to 8 years after construction*[2]			
	Harm: chronic physical injury or mortality	For the duration of this project component	600 – 800 mm FL	≤2 individuals	Section 5.2.4 (page 51)
	Harm: chronic physical injury or mortality	For the duration of this project component	>800 mm FL	≤5 individuals (≤2 wild individuals)	Section 5.2.4 (page 51)
	Harm: physical injury or mortality	Annually, based on a three-year running average	Free embryos or larvae	≤ *proportion of shovelnose sturgeon subject to same effects* ≤ proportion of shovelnose sturgeon subject to same effects quantified via monitoring	Sections 5.2.4 and 5.2.5 (pages 51 and 53)

[2] Reclamation will meet with the Service after the initial 8-year period after Intake Project construction to evaluate the need for continued, modified, or reduced monitoring of pallid sturgeon at Intake.

3.0 Effect of the Take

The Service determined that the effects to pallid sturgeon described in section 5.0 of the biological opinion and the resulting amount or extent of incidental take described above (section 2.0 of this incidental take statement) are not likely to jeopardize the continued existence of pallid sturgeon in the Great Plains Management Unit and the species as a whole. Our rationale for this conclusion can be found in section 6.0 of the biological opinion.

4.0 Reasonable and Prudent Measures

Incidental take statements provide reasonable and prudent measures that are expected to minimize the impact of the amount of incidental take. Reasonable and prudent measures are those measures necessary or appropriate to minimize incidental take resulting from proposed actions. Reasonable and prudent measures are nondiscretionary and must be implemented by the agency in order for the exemption in section 7(o)(2) to apply.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of pallid sturgeon:

1. In cooperation with the Service and other parties, as appropriate, identify and implement a monitoring strategy to determine if the amount or extent of take is exceeded for periods during and after Intake Project construction.

2. In cooperation with the Service and other parties, as appropriate, identify and implement a plan to relocate motivated adult and juvenile pallid sturgeon upstream of Intake until the bypass channel is connected to the Yellowstone River and available for pallid sturgeon passage.

3. Implement reporting requirements as outlined in the terms and conditions below.

4.1 Terms and conditions

In order to be exempt from the prohibitions of section 9 of the Act, Reclamation and the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

To fulfill reasonable and prudent measure #1, the following terms and conditions shall be implemented:

1. Monitor the amount or extent of incidental take of pallid sturgeon during project construction (up to four years or through 2023). Such monitoring will quantify the number of telemetered pallid sturgeon from 600 – 800 mm and > 800 mm FL that encounter Intake during upstream migrations but are blocked from passing upstream, the percent or number of telemetered pallid sturgeon that are injured or killed during downstream passage at Intake, and the proportion of pallid and shovelnose sturgeon that

are injured or killed due to entrainment into the Main Canal, impingement on the fish screens, passage at Intake, or monitoring activities relative to the number of drifting free embryos sampled in the Yellowstone River immediately upstream of Intake.

2. As described in the MAMP, monitor (as described in the preceding term and condition) the amount or extent of incidental take of pallid sturgeon for at least an 8-year period after project construction (Reclamation and Corps 2020 *in review*). Such monitoring activities will quantify the percent of telemetered pallid sturgeon from 600 – 800 mm and >800 mm FL that encounter Intake during upstream migrations but do not pass through the bypass channel, the number and percent of telemetered pallid sturgeon that are injured or killed during downstream passage at Intake, and the proportion of pallid and shovelnose sturgeon that are injured or killed due to entrainment into the Main Canal, impingement on the fish screens, passage at Intake, or monitoring activities relative to the number of drifting free embryos that are sampled in the Yellowstone River immediately upstream of Intake.

3. During and after project construction, monitor the number of pallid sturgeon from 600 – 800 mm and >800 mm FL that are chronically injured or killed resulting from telemetry monitoring activities.

4. Reclamation will convene with the Service and other parties, as appropriate, following the 8-year monitoring period (as described in the MAMP) after project construction to evaluate the need for continued, modified, or reduced monitoring of the amount or extent of incidental take of pallid sturgeon at Intake.

5. In the event that pallid sturgeon are injured or killed during implementation of the proposed action, contact the Service regarding appropriate actions for care of injured individuals or disposal of killed individuals.

To fulfill reasonable and prudent measure #2, the following terms and conditions shall be implemented:

1. Reclamation will continue to cooperate with the Service and other parties, as appropriate, to establish and implement protocols for the safe capture, handling, transport, and release of translocated pallid sturgeon. Such cooperation will occur annually and prior to each translocation season until the bypass channel is connected to the Yellowstone River and available for pallid sturgeon passage. The Service notes that there are inherent risks to pallid sturgeon associated with translocation activities. Specifically, translocated pallid sturgeon may be injured or killed during the translocation process. While adverse effects to translocated pallid sturgeon are possible, such activities from 2017 – 2020 resulted in no known injuries or mortalities of translocated individuals (N = 34; see table 3 in the biological opinion). Therefore, the Service believes that the benefits of translocating motivated pallid sturgeon upstream of Intake (biological opinion, section 4.2.3.1) outweigh the potential risks. Incidental take of pallid sturgeon resulting from translocation activities would be included in reporting of the amount or extent of incidental take exempted for monitoring activities through the MAMP (up to two and five

[no more than two wild individuals]) pallid sturgeon from 600 – 800 mm and >800 mm FL, respectively; incidental take statement, section 2.0).

2. Reclamation will meet annually with the Service and other agencies, as appropriate, during Intake Project construction and until the bypass channel is connected to the Yellowstone River and available for pallid sturgeon passage to ensure that the movement and reproductive behavior of translocated pallid sturgeon upstream of Intake are monitored to the extent possible.

To fulfill reasonable and prudent measure #3, the following terms and conditions shall be implemented:

1. Report the amount or extent of incidental take of pallid sturgeon resulting from the Intake Project as quantified by monitoring described in reasonable and prudent measure #1, term and condition #1 or #2, to the Service annually and no later than March 1 of the following year (beginning in 2021).

2. During project construction, report the results of monitoring associated with reasonable and prudent measure #2 to the Service annually and not later than March 1 of the following year (beginning in 2021).

3. Meet annually with the Service and other parties, as appropriate, after the reports described in reasonable and prudent measure #3, term and condition #1 and #2, are submitted to the Service, and no later the April 30 (beginning in 2021), to discuss potential alternatives to further minimize or avoid adverse effects, including incidental take, to pallid sturgeon resulting from the Intake Project.

The Service believes that no more than the number or extent of pallid sturgeon described in section 2.0 will be incidentally taken as a result of the proposed action (Table 9). The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

5.0 Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The Service recommends implementing the study proposed in the MAMP that would release pallid sturgeon free embryos or larvae upstream of Intake to assess entrainment into the Main Canal, impingement on the fish screens, or injury resulting from downstream passage at Intake (Reclamation and Corps 2020 *in* review). Including shovelnose sturgeon free embryos or larvae in such a study would also inform the validity of using shovelnose sturgeon as a surrogate species to quantify the amount or extent of incidental take of pallid sturgeon.

2. The Service recommends evaluating passage at Intake and the related effects for pallid sturgeon <600 mm FL.

3. The Service recommends that Reclamation continue to work with the Service and other parties, as appropriate, to define successful upstream and downstream passage criteria for juvenile pallid sturgeon and downstream passage criteria for free embryo or larval pallid sturgeon in the Monitoring and Adaptive Management Plan.

4. The Service recommends that Reclamation and the Corps continue to work with other agencies involved in pallid sturgeon recovery and monitoring in RPMA 2 to improve sampling efficiency of drifting free embryos or larvae in the Yellowstone River.

5. The Service recommends that Corps continues to evaluate the benefits of drawdown at Lake Sakakawea for larval pallid sturgeon retention in RPMA 2.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

6.0 Reinitiation Notice

This concludes the formal consultation on the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project that was requested by Reclamation and the Corps in a letter dated April 17, 2020. As provided in 50 CFR 402.16,
(a) Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:
(1) If the amount or extent of taking specified in the incidental take statement is exceeded;
(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or
(4) If a new species is listed or critical habitat designated that may be affected by the identified action.

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APPENDICES

Appendix A.

Lower Yellowstone Project: Intake Diversion Dam

Fish Passage Project Biological Assessment

August 2016

Appendix B.

Biological Opinion on Effects to the Pallid Sturgeon from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project November 2016