Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana

Record of Decision

Prepared by Joint Lead Agencies:

December 2016

U.S. Department of the Interior
Bureau of Reclamation
Billings, Montana

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

Mission Statements

Department of the Interior and Bureau of Reclamation

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

U.S. Army Corps of Engineers

The mission of the U.S. Army Corps of Engineers is to serve the Armed Forces and the Nation by providing quality, responsive engineering services including: planning, designing, building and operating water resources and other civil works projects; designing and managing the construction of military facilities for the Army and Air Force; and providing design and construction management support for other Defense and federal agencies, to meet national security, emergency and other national requirements.

Record of Decision

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This Record of Decision completes the procedural requirements of the National Environmental Policy Act for the Current Immediate Need Action.

Approved:

MICHAEL J. RYAN
Regional Director
U.S. Bureau of Reclamation

JOHN W. HENDERSON, P.E.
Colonel, Corps of Engineers
District Commander

Date 02 DEC 2016

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ATTACHMENTS

List of Acronyms

AMP	Adaptive Management Plan
BRT	Biological Review Team
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FWCA	Fish and Wildlife Coordination Act of 1958
GPMU	Great Plains Management Unit
IEPR	Independent External Peer Review
LYIP	Lower Yellowstone Irrigation Project Board of Control
LYP	Lower Yellowstone Project
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
O&M	Operation and maintenance
OM&R	Operation, maintenance and replacement
PSCAP	Pallid Sturgeon Conservation Augmentation Program
Reclamation	Bureau of Reclamation
ROD	Record of Decision
SHPO	State Historic Preservation Officer
The Corps	U.S. Army Corps of Engineers
The Service	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act

1 Introduction

This document is the joint Record of Decision (ROD) of the United States Department of the Interior, Bureau of Reclamation (Reclamation), Great Plains Region, and the U.S. Army Corps of Engineers (Corps), Omaha District, (jointly referred to as the Agencies) for the Lower Yellowstone Intake Diversion Dam Fish Passage Project. The Agencies prepared the Lower Yellowstone Intake Diversion Dam Fish Passage Project Final Environmental Impact Statement (FEIS) dated October 2016. The FEIS was developed in compliance with the National Environmental Policy Act (NEPA) to analyze the direct, indirect, and cumulative effects associated with actions to improve fish passage at the Lower Yellowstone Intake Diversion Dam in Dawson County, Montana. Cooperating agencies include Montana Fish Wildlife and Parks, Montana Department of Natural Resources and Conservation, the U.S. Fish and Wildlife Service (Service), the Lower Yellowstone Irrigation Project Board of Control, and the Western Area Power Administration.

The pallid sturgeon (*Scaphirhynchus albus*) was listed by the Service on September 6, 1990 as endangered throughout its range under the Endangered Species Act (ESA) (Service 1990). Pallid sturgeon occur in the Mississippi and Missouri river drainages. Of importance to this study is the population designated as the Great Plains Management Unit (GPMU) that occupies the upper Missouri and lower Yellowstone Rivers in Montana and North Dakota, upstream of Garrison Dam. Adult and juvenile pallid sturgeon are found in the Missouri River year-round. Adult pallid sturgeon are present seasonally in the Yellowstone River, with approximately 60 to 90% moving upstream from the Missouri River as temperatures and river flows increase in spring (Bramblett 1996; Fuller and Braaten 2012), for spawning.

The Lower Yellowstone Intake Diversion Dam, located on the lower Yellowstone River at River Mile 70, has impeded upstream migration of pallid sturgeon and other native fish for more than 100 years. The best available science suggests that the weir is essentially a total barrier to pallid sturgeon, due to increased turbulence and high velocities associated with the rocks at the weir and immediately downstream of the weir (Jaeger et al. 2005; Fuller et al. 2008; Helfrich et al. 1999; White & Mefford 2002; Bramblett & White 2001; Service 2000, 2003, 2007).

Pallid sturgeon spawning has been documented in the lower Yellowstone River near River Mile 10 (Allen et al. 2016; Elliot et al. 2015). If spawning occurs downstream of Intake Diversion Dam, newly-hatched pallid sturgeon (free embryos and larvae) likely drift into Lake Sakakawea before they are able to settle into suitable riverine habitats for rearing (Braaten et al. 2008; 2010). Recent research indicates oxygen levels in the headwaters of reservoirs such as Fort Peck and Lake Sakakawea are too low for free embryos or larval pallid sturgeon to survive due to the deposition of fine sediments and the decomposition of organic material which depletes oxygen in the lake's headwaters (Guy et al. 2015; Bramblett & Scholl 2016).

Improving fish passage at Intake Diversion Dam appears to be one of the most promising actions that could contribute to recovery of pallid sturgeon by providing access to as much as 165 additional miles of the Yellowstone River for migration, spawning, and development of larvae (Service 2014; Jacobson et al. 2016). Newly hatched pallid sturgeon drift for long distances before settling into suitable riverine rearing habitats – anywhere from 80 to over 300 miles depending on water temperature and water velocity (Kynard et al. 2007; Braaten et al. 2008). The distance between the next upstream barrier on the Yellowstone River, Cartersville Diversion Dam, and Lake Sakakawea is about 250 miles. In contrast, the distance between Fort Peck Dam on the Missouri River and Lake Sakakawea is approximately 200 miles.

2 The NEPA Process

The basic purpose of the NEPA process is to ensure that all branches of the federal government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. The results of a NEPA analysis are used to inform decision makers and the public of proposed actions and reasonable alternatives considered, to disclose potential environmental impacts, and consider public comments before final decisions are made.

The Corps and Reclamation issued a Final Environmental Assessment (EA) for the Intake Diversion Dam Modification Project in April 2010. In the EA, a new screened headworks (subsequently constructed and put into operation in 2012) and rock ramp were selected for implementation.

A Supplemental EA issued in April 2015 addressed changes in the project. It presented new information related to improving fish passage at Intake Diversion Dam regarding the cost and effectiveness of the rock ramp and pallid sturgeon use of side channels. The Supplemental EA identified a bypass channel as the preferred alternative.

In February 2015, Defenders of Wildlife and Natural Resources Defense Council filed a lawsuit alleging ESA violations, which was later amended to include a challenge of the adequacy of the Agencies' NEPA process. The Corps awarded a contract for the construction of the bypass channel and replacement weir on August 31, 2015. On September 4, 2015, the United States District Court for the District of Montana, Great Falls Division, granted plaintiffs' motion for a preliminary injunction, halting construction of the project. On January 5, 2016 the Agencies and the plaintiffs entered into a stipulated stay agreement in which the Federal Agencies committed to completing an Environmental Impact Statement (EIS) on the proposed fish passage project.

The EIS process began with formal scoping, including a public meeting held in Glendive, Montana in January 2016. A total of 89 individuals, 14 agencies/organizations and 6 elected officials submitted scoping comments. Comments were generally classified into 22 topic areas, primarily addressing alternatives, threatened and endangered species, economics, project process, costs, water rights and mitigation.

In furtherance of the government to government relationship between federal agencies and Native American tribes, the Corps and Reclamation reached out to each tribe along the Lower Yellowstone and Missouri Rivers, seeking their input on concerns “that uniquely or significantly affect your Tribe, related to the project.” Specifically, information on Indian Trust Assets, Traditional Cultural Properties, and other resources of tribal concern was requested.

A Draft Environmental Impact Statement (DEIS) was released for public review with a Notice of Availability (NOA) published in the *Federal Register* on June 3, 2016. The public review period ended July 28, 2016. The Bypass Channel Alternative was identified as the preferred alternative in the DEIS. Public meetings were held in Sidney, Glendive and Billings, MT, at which time verbal and written comments were accepted. A total of 13,258 individuals, organization representatives, agency staff, business representatives and elected officials provided comments on the DEIS. Comments addressed a wide variety of topics. Most comments did not ask specific questions but rather stated a preference for one alternative or another. In addition, the majority of comments addressed pallid sturgeon and other listed species, costs and funding, questions on the project description, and the overall environmental and permitting process.

Additional information was incorporated into several sections of the Final Environmental Impact Statement (FEIS) in response to comments made on the DEIS to provide additional information on pallid sturgeon use of natural and man-made side channels, the uncertainty associated with recruitment of pallid sturgeon no matter which alternative is selected, and data indicating that only limited impacts are likely to downstream-migrating pallid sturgeon larvae passing the headworks and over the new weir.

A FEIS was released for state and agency and public review with a NOA published in the *Federal Register* on October 21, 2016.

2.1 Substantive Comments Received on the FEIS

As of November 21, 2016, a total of 11 comment letters from individuals, agencies, organizations were received. Many of the comments were previously addressed in the FEIS, therefore, no additional response is provided to these comments. Comments raising issues not previously addressed or needing further clarification are found below.

WWC Engineering submitted comments on behalf of the Lower Yellowstone Irrigation Project. These comments included the “Yellowstone River Pump Station Study” (Performance Engineering and Consulting 2016), which is a consolidation of information on the performance and reliability of Yellowstone River pump stations. The study highlights concerns regarding the dependability of pump stations on the Yellowstone River.

Comments were made regarding who will be responsible for the funding of long term operation, maintenance and replacement (OM&R) and adaptive management measures. The FEIS and response to previous comments reflects that the Lower Yellowstone Irrigation Project Board of Control (LYIP) will be responsible for the OM&R and aspects of the Adaptive Management Plan (AMP). The LYIP provided comments on the DEIS and FEIS providing their support for implementation of the Bypass Channel Alternative citing that the alternative does provide for the continued viable and effective operation of the LYP and the AMP provides a level of surety that the Bypass Channel will be functional for pallid sturgeon. Additionally, Reclamation memorandum dated September 9, 2016, to the U.S. Fish and Wildlife Service amending the Biological Assessment provided language to clarify funding and project support. Reclamation plan to provide additional funding, through transfers or other means within existing authorities, to implement adaptive management measures or additional monitoring the AMP Technical and Executive teams believe beneficial.

On November 16, the Corps and Reclamation received two petitions dated July 8, 2016 and November 2, 2016 from the Defenders of Wildlife. The petitions are included in this document, but signatures are not. The full petition and the entire list of signatures can be found on Reclamation's Lower Yellowstone Project Website:
http://www.usbr.gov/gp/mtao/loweryellowstone/

Copies of the all the comment letters received on the FEIS are attached in Attachment A.

3 Purpose and Need for the Action

3.1 Purpose

The purposes of the proposed action are to improve pallid sturgeon fish passage and ecosystem restoration while continuing viable and effective operations of the Lower Yellowstone Project (LYP).

3.2 Need – Continue Viable and Effective Operation of the Lower Yellowstone Project

The proposed action needs to allow for continued viable and effective operation of the LYP, which is a congressionally authorized project. Aspects most likely to influence viable and effective operations are increases in agricultural production costs and decreases in crop production due to insufficient or unreliable water deliveries. Project operation, maintenance and replacement (OM&R) responsibilities are carried out by the Lower Yellowstone Irrigation Project Board of Control through funds generated by assessments on farms within the LYP. The ability of farms to pay assessments is dependent on income from crop production, which is a function of reliable and sufficient water deliveries to meet crop requirements.

3.3 Need – Improve Fish Passage

Since Intake Diversion Dam impedes upstream movement of pallid sturgeon in the main channel of the Yellowstone River, the proposed project is needed to improve fish passage at this structure. Pallid sturgeon recovery is a fundamental purpose of a multitude of discrete and programmatic actions in the Missouri River Basin, carried out by the Agencies and others. Improving passage for pallid sturgeon at the Intake Diversion Dam supports recovery objectives by providing access to a large area of the sturgeon's historical range that has been mostly inaccessible since the LYP was built in 1909.

Upstream habitats, such as bluff pools, appear to be suitable for spawning and rearing of juveniles (Bramblett and White 2001; Jaeger et al. 2005, 2006) and a small number of adult pallid sturgeon were tracked passing upstream of the weir via an existing side channel in 2014 and 2015 (Rugg 2014, 2015). The fragmentation of the Yellowstone River by the Intake Diversion Dam and other diversions has been hypothesized as a factor in the lack of recruitment of pallid sturgeon and has contributed to their decline; anoxic conditions at the headwaters of Lake Sakakawea has also been identified as a factor contributing to this impact (Bramblett and Scholl 2016). While pallid sturgeon recovery is not the specific scope for this project, improving passage for pallid sturgeon at the Intake Diversion Dam would provide access to a large area of the sturgeon's historic range that has been mostly inaccessible since 1909. This reach of the Yellowstone River provides a relatively natural flow regime, water temperatures, and habitat conditions.

3.4 Need – Contribute to Ecosystem Restoration

The 2007 Water Resources Development Act (Pub. L. 110–114; 121 Stat. 1041) (Section 3109) authorizes the Corps to assist Reclamation in the design and construction of the Lower Yellowstone Project at Intake, Montana for the purpose of ecosystem restoration.

Improvements to fish passage at the Intake Diversion Dam will support migration for numerous fish species and contribute to the sustainability of fish populations in the Yellowstone River. This project will support ecosystem functions by restoring access to a large area of suitable fish habitat throughout the lower Yellowstone River ecosystem consistent with the Corps authority provided in WRDA of 2007.

4 Alternatives Considered in Detail in the FEIS

Reclamation has been addressing endangered species issues associated with operation and maintenance of its Lower Yellowstone Project since the 1990's. Concurrently the Corps has been working to restore habitat and assist with recovery of endangered pallid sturgeon in the Missouri River Basin. In 2005, Reclamation and the Corps, along with the Service, the state of Montana, and The Nature Conservancy, signed a Memorandum of Understanding (MOU) to collaboratively address LYP pallid sturgeon issues. Since 2005, Reclamation and the Corps, in consultation with the Service, have been partners in developing and analyzing pallid sturgeon passage alternatives for the Intake Diversion Dam.

A wide range of alternatives has been considered and analyzed since 2005, either in planning studies or in formal environmental review. Beginning with 110 ideas that came out of an initial value engineering and value planning effort, several alternatives have been developed. Two previous environmental review processes, the 2010 Environmental Assessment (EA) and the 2015 Supplemental EA considered the environmental effects of several alternatives. Six alternatives were evaluated in detail in this FEIS; No Action, Rock Ramp, Bypass Channel, Modified Side Channel, Multiple Pump Stations, and Multiple Pumps with Conservation Measures. These alternatives included new alternatives and refinements of alternatives considered in previous NEPA documentation.

Eight alternatives proposed during scoping were also considered, but eliminated from detailed analysis in the FEIS; Weir Removal with Pumping and Hydropower, Steep Bypass Channel, Sturgeon Relocation and Study, Relocate Diversion Upstream, Short Weir, Retractable or Inflatable Gates, Supplement Natural Flows, and Hydraulic Ram Pumps. These alternatives were each considered (see Section 2.3.1 of the FEIS), but were determined to not meet the purpose and need or to have substantial feasibility concerns and were thus eliminated from detailed analysis.

4.1 No Action

The No Action Alternative is defined as the continued operation, maintenance, and rehabilitation of the LYP as authorized. This approach is consistent with Council on Environmental Quality (CEQ) policy, which states that no action could involve ongoing programs initiated under existing legislation and regulations that will continue, even as new plans are developed. A No Action Alternative must be included in an EIS (40 CFR 1502.14 (d)) and provides a baseline from which to measure benefits and impacts of implementing fish passage improvement alternatives considered in this document.

The Lower Yellowstone Irrigation Project Board of Control would continue to operate, maintain and repair the existing weir and the new headworks. Operational activities would include lowering fish screens into place for the irrigation season, daily and seasonal adjustments to the headworks gates in response to river flow conditions and crop requirements, and ensuring conveyance of diverted water through LYP canals. Diversions—up to 1,374 cfs—generally occur from mid-April to mid-October. Operational and maintenance activities would also include continued operation of supplemental pumps, maintenance and inspection of the LYP conveyance system (canals, laterals, drains, etc.), and maintenance of associated access roads.

To maintain required water surface elevations, Intake Diversion Dam maintenance would include annual placement of rock on the crest of the weir to replace rock moved by ice and high flows. Rock replacement typically occurs in late July or early August, when river flows are low. The rock is stockpiled with a loader, dumped into a skid, and then hauled by an existing overhead trolley cableway over the river to be dumped. The trolley system is old and there is continual risk of failure, which would require repair or replacement in order to continue the placement of rock.

The estimated annual operation and maintenance cost of No Action over a 50-year period is $2,643,000. The trolley is assumed to need rehabilitation within the first 10 years. Power costs assumed amounts and rates consistent with existing project power use contracts with the four irrigation districts. Monitoring costs are assumed to be incurred for the first 8 years.

4.2 Rock Ramp

The Rock Ramp Alternative would replace the existing rock-and-timber weir structure with a concrete weir and a shallow-sloped, un-grouted boulder and cobble rock ramp extending downstream well beyond the existing boulder field. The replacement weir would be located approximately 40 feet upstream of the existing Intake Diversion Dam at the same average elevation as the top of the rock placed on the existing weir to divert the LYP's full water right of 1,374 cfs into the Main Canal.

The rock ramp would be designed to mimic natural river function and would have reduced water velocities and turbulence so that migrating fish could pass over the weir, thereby improving fish passage and contributing to ecosystem restoration. Because pallid sturgeon are sensitive to flow velocities and turbulence, the rock ramp would be constructed to be relatively flat over much of its width to keep flow velocities as low as possible. The final configuration would be optimized as much as feasible for pallid sturgeon passage. Passage might be problematic due to the amount of time a fish must sustain a burst swimming speed as it passes across the entire rock ramp. Nonetheless, the Rock Ramp Alternative would improve passage for fish by reducing velocities and increasing the range of flows and seasonal timeframes when fish can pass.

Like the no action alternative, operational activities would include operation and maintenance of the screened headworks, supplemental pumps, conveyance system and access roads. Temporary access would need to be built for major operation and maintenance on the replacement weir and the rock ramp. If vehicular access across the weir structure cannot be safely achieved, then the existing trolley system might be repaired, a new trolley system constructed, or access provided by a barge. The estimated annual operation and maintenance cost of the Rock Ramp Alternative over a 50-year period is $2,840,000. Monitoring costs are assumed to be incurred for the first 8 years.

4.3 Bypass Channel

The Bypass Channel Alternative proposes to improve passage for pallid sturgeon around the Intake Diversion Dam by constructing a bypass channel on Joe's Island on the south side of the Yellowstone River. The bypass channel would be approximately 11,150 ft in length and extend from the upper end of the existing side channel to just downstream of the existing Intake Diversion Dam and boulder field. With the fish entrance to the bypass channel near to the downstream end of the weir, fish that are stopped by the presence of the weir are more likely to find the bypass channel and use it to continue their movement upstream.

A replacement concrete weir would be built to an elevation of 1991 feet (the same as the average elevation of the existing weir with rock placed on its crest) just upstream from the existing

Intake Diversion Dam in order to provide sufficient water surface elevation to maintain irrigation diversions through the new headworks and screens.

Operation and maintenance activities for the bypass channel would include periodic inspection and possible replacement of riprap and removal of sediment or debris at the bypass channel's upstream and downstream confluence areas with the Yellowstone River. Operational activities would include operation of the headworks, supplemental pumps, and LYP conveyance system. Maintenance activities would include maintenance of the headworks screens and gates, maintenance and inspection of the LYP conveyance system, and maintenance of access roads. The estimated annual operation and maintenance cost of the Bypass Channel Alternative over a 50-year period is $2,799,000. Monitoring costs are assumed to be incurred for the first 8 years.

4.4 Modified Side Channel

The Modified Side Channel Alternative would improve passage for pallid sturgeon around the Intake Diversion Dam by creating an improved fish bypass using the existing side channel located on the south side of the Yellowstone River. Pallid sturgeon were documented passing upstream of the Intake Diversion Dam through the existing side channel during the 2014 and 2015 spring runoff seasons. The intent of this alternative is to increase flow in the existing side channel to attract migrating fish and to be passable during most years.

The major features of the Modified Side Channel Alternative are excavation of 6,000 feet of new channel at three bend cutoffs, 14,600 feet of channel modification to lower the bed of the existing side channel, three backwater areas, 4,500 feet of bank protection, five grade control structures, one 150-foot single-span bridge, and placement of 50,000 cubic yards of channel cobble substrate to simulate a natural channel bed and bed/bank edges.

Under this alternative the existing Intake Diversion Dam would remain in place. This would require the continued placement of rock on the crest of the weir to replace rock moved by ice and high flows. Operation and maintenance activities for the modified channel would include periodic inspection and possible replacement of riprap and removal of sediment or debris from the existing side channel's upstream and downstream confluence areas with the Yellowstone River. Periodic inspections would be performed on the vehicular road and bridge. Operation and maintenance at the Intake Diversion Dam and headworks would be similar to the No Action Alternative, including maintenance of the headworks screens and gates, maintenance and inspection of the LYP conveyance system, and maintenance of associated access roads. The estimated annual operation and maintenance cost of the Modified Side Channel Alternative over a 50-year period is $2,907,000. Monitoring costs are assumed to be incurred for the first 8 years.

4.5 Multiple Pumps Alternative

This alternative would remove the Intake Diversion Dam down to the riverbed and construct five pumping stations on the Yellowstone River to deliver water to the Lower Yellowstone Project. The pumping stations would be designed for a total diversion capacity of 1,374 cfs. They would be constructed at locations along the Lower Yellowstone Project between the headworks and the community of Savage. When conditions allow during the irrigation season gravity diversion would continue to occur through the existing headworks. The pumps would be used the rest of the season.

Each pumping station would be designed for a capacity of 275 cfs. Water would be drawn from the river through a feeder canal to a fish screen structure. Fish would be screened out and returned to the river through a fish return pipe. Irrigation water would pass through the fish screen and flow into the pumping station. Discharge pipes would convey the irrigation water to the Main Canal.

The power demand for the pumps would exceed the capacity of the existing power system in this area, requiring uprating and extension of existing powerlines. Existing sub-stations would also be uprated to meet the power demand.

The removal of the existing Intake Diversion Dam down to the river bed would improve fish passage for the pallid sturgeon and other native fishes by providing a continuous river geometry. It is assumed that only the portion of the weir that is above the adjacent ground elevation would be demolished and removed; the foundation with timber piles and downstream apron would remain in place.

Operation and maintenance activities would include pump repair/maintenance, screen removal and replacement, sediment removal at the pump feeder canals, repair of bank protection at the pump sites, and similar actions at the headworks and Main Canal as the No Action Alternative, including maintenance of the headworks screens and gates, maintenance and inspection of the LYP conveyance system, and maintenance of associated access roads. The estimated annual operation and maintenance cost of the Multiple Pumps Alternative over a 50-year period is $4,950,000.

4.6 Multiple Pumps with Conservation Measures Alternative

This alternative includes water conservation measures, pumping, gravity diversions through the existing headworks, and the use of wind energy to offset pumping costs. The existing weir would be removed to allow fish passage on the Yellowstone River, with new components providing the water source to the LYP.

Conservation measures include check structures, flow measuring devices, laterals to pipe, sprinklers, lining the Main Canal and laterals, control over checking, and groundwater pumping. With these measures, diversion requirements would be reduced by 766 cfs so that required water delivery to the project would be only 608 cfs. Seven installations of six Ranney wells each would be constructed to deliver the required 608 cfs. The Main Canal and conveyance system would likely have to be reconfigured to allow the gravity delivery of water to the laterals with a flow of only 608 cfs.

Removal of the existing Intake Diversion Dam down to the river bed would improve fish passage for the pallid sturgeon and other native fishes by providing continuous river geometry through the current weir location.

A wind turbine would be used to supply enough energy on average to meet the pumping loads of this alternative. This would require either partnering with a planned wind farm or construction of wind turbines as part of the project. Typically a wind farm requires several years of study for siting and permitting. That analysis has not been completed for this EIS and would be carried out separately and require additional NEPA analysis. Because wind generation would occur over all 12 months of the year while irrigation pump loads would be limited to May through September, arrangements would be made to deliver unneeded wind-generated power to a utility in exchange for receiving power back from that utility when pump loads exceed the wind generation.

Operation and maintenance activities would include Ranney well inspections, repairs/maintenance/replacement, groundwater monitoring, removal of sediment in the canals, canal monitoring and inspections, repair of pipelines and canal linings, and similar maintenance at the headworks as the No Action Alternative. The estimated annual operation and maintenance cost of the Multiple Pumps with Conservation Measures Alternative over a 50-year period is $4,567,000.

5 Environmental Consequences of the Alternatives

Impacts of each of the alternatives were evaluated in the FEIS for each of the following environmental resources:

- Air Quality
- Surface Water Hydrology and Hydraulics
- Groundwater Hydrology
- Geomorphology
- Water Quality
- Aquatic Communities
- Wildlife
- Federally Listed Species and State Species of Concern
- Lands and Vegetation
- Recreation
- Visual Resources
- Transportation
- Noise
- Social and Economic Conditions
- Environmental Justice
- Historic Properties
- Indian Trust Assets

Impacts to resources were also analyzed in the context of climate change. Potential impacts were both adverse and beneficial, depending upon the alternative. The No Action Alternative would not achieve the project purpose and need and would continue to be an impediment to fish passage and provides a limited opportunity for spawning or recruitment. All of the action alternatives would improve fish passage conditions compared to the No Action Alternative, with weir removal alternatives providing the most improvement in fish passage. However, each of the action alternatives also have changes to or adverse effects on surface water hydrology and hydraulics, aquatic communities, federally listed species (primarily pallid sturgeon), lands and vegetation, recreation, social and economic conditions, and historic properties.

The primary impacts commented upon during the public review of the DEIS and further addressed in the FEIS were related to the likelihood of success in passing pallid sturgeon, particularly for the bypass channel, and the social and economic effects of the weir removal alternatives that have substantially higher construction and operation costs than other alternatives.

The Rock Ramp Alternative would have beneficial effects by reduced velocities and turbulence that may improve fish passage; however, the velocities and depths would not always meet the criteria developed by the Service's Biological Review Team (BRT) and may be less successful in passing fish than other alternatives. Approximately 34 acres of the river would change in characteristics by the placement of riprap over this area and aquatic communities, federally listed species and state species of concern, and water quality would be frequently disturbed or degraded associated with frequent and difficult maintenance of the ramp that would require more extensive rock placement than the No Action Alternative. The Fishing Access Site would be relocated and paddlefish aggregations would be reduced. Historic properties would be removed or modified (Intake Diversion Dam and trolley).

The Bypass Channel Alternative would have beneficial effects by providing suitable flows, velocities and depths similar to natural side channels for fish passage at a location in proximity to where pallid sturgeon are known to be present below the weir. The new concrete weir would have reduced velocities and increased depths across a wide range of flows that may facilitate passage over the weir by some native fish species that currently pass Intake Diversion Dam and would improve downstream passage conditions and reduce the need for placement of rock in the river. The existing side channel would be partially filled and converted from a seasonal flow-through channel to a backwater channel. Vegetation and wetlands on Joe's Island and shoreline would be removed or filled, and measures to revegetate the site would be undertaken. Paddlefish aggregations would be reduced and historic properties would be removed or modified (Intake Diversion Dam and trolley).

The Modified Side Channel Alternative would have beneficial effects by providing suitable flows, velocities and depths year-round similar to natural side channels for fish passage, although with a downstream entrance nearly two miles below the weir. Vegetation and wetlands on Joe's Island and shoreline would be removed or filled, and measures to revegetate the site would be undertaken. Paddlefish aggregations may be reduced. Operation and maintenance of the existing weir would continue.

The Multiple Pumps and Multiple Pumps with Conservation Measures alternatives would have beneficial effects by removing the Intake Diversion Dam and returning the river to a natural channel slope with more natural water depths and velocities. Removal of the weir would lower the water surface elevation of the river upstream for a distance of approximately 7 miles, thus reducing connectivity and flows with two side channels and reducing depths for several surface water pumps. The proposed pump stations would require substantial energy inputs (electrical power) and generate noise from operation and maintenance activities that would disturb wildlife and federally listed species and state species of concern. The irrigation districts would have substantially higher costs and operational requirements. Paddlefish aggregations would be reduced. Historic properties would be removed or modified (Intake Diversion Dam and trolley).

No impacts to Indian Trust Assets were identified for any of the alternatives.

6 Environmentally Preferable Alternative

The Council on Environmental Quality's (CEQ) NEPA regulations require federal agencies to identify the alternative or alternatives they consider to be environmentally preferable in the ROD. The Department of the Interior's NEPA regulations clarify that it is not necessary that the environmentally preferable alternative or alternatives be selected for implementation in the ROD. The environmentally preferable alternative is considered the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. This generally includes the consideration of the alternative that can achieve the least damage to the biological and physical environment, and protects, preserves, and enhances historic, cultural, and natural resources (42 USC § 4331).

The Agencies considered both construction and long-term operation and maintenance impacts disclosed in the FEIS of each of the alternatives in determining the environmentally preferable alternative. When impacts to all historic, cultural, and natural resources are balanced against each other as defined by Congress, the NEPA regulations, and the CEQ's Forty Most Asked Questions Concerning NEPA Regulations, the No Action Alternative is environmentally preferable, however this alternative does not meet the purpose and need of the project and is therefore not the preferred alternative.

7 Decision

The Corps and Reclamation have selected the Bypass Channel Alternative and associated Monitoring and Adaptive Management Plan (see FEIS, Appendix E) for implementation. The Corps and Reclamation have considered the purpose and need of the proposed action and have analyzed a reasonable range of alternatives that adequately address the objectives of the proposed action. The Corps and Reclamation have engaged in informed decision-making and have considered public and agency comments received during the EIS review periods. In balancing the projected effects of the various alternatives presented in the EIS and the public interest, the Bypass Channel Alternative is the selected plan. The Bypass Channel alternative reflects implementation of all reasonable, practicable means to avoid, minimize or compensate for environmental harm from the action. All applicable laws, regulations, and local government plans were considered in evaluation of these alternatives. The Corps finds the selected plan represents the course of action, which on the balance, best serves the public interest.

This alternative includes the construction and operation of a bypass channel to provide fish passage around Intake Diversion Dam and a new weir to provide the primary source of continued diversions of water into the Lower Yellowstone Project (LYP) for irrigation purposes.

Primary project features include:

- Excavation of a bypass channel extending for 11,150 feet from the entrance to near the existing side channel upstream end down to just below the existing weir/boulder field.
- Construction of a replacement concrete weir to an elevation of 1,991 feet (the same as the average elevation of the existing weir with rock placed on its crest) just upstream from the existing Intake Diversion Dam, with a low-flow notch at elevation 1,989 feet.
- Placement of rock and cobble upstream and downstream of the new weir to provide a smooth transition for flows and to incorporate and bury the existing weir into the overall structure.
- Placement of the material excavated during construction of the bypass channel as a channel plug into the existing side channel to prevent flows from entering the existing side channel below river flows of approximately 97,000 cubic feet per second (cfs).

Long-term maintenance will include periodic inspections, and possible replacement of riprap, removal of sediment or debris in the bypass channel, maintenance of the headworks screens and gates, maintenance and inspection of the weir and boulder field, maintenance and inspection of the canal system, and maintenance of access roads. Long-term operational activities will include operation of the headworks, supplemental pumps, and conveyance system.

The Corps will design and construct the Bypass Channel Alternative. Reclamation will modify the existing operation, maintenance and replacement (OM&R) agreements with the Lower Yellowstone Irrigation Project Board of Control to include, among other items, operation and maintenance of the fish passage facilities. Should the Corps experience unforeseen changes in funding or other circumstances that prevent design or construction of the Bypass Channel Alternative, Reclamation will consider the changed circumstances and determine the need to consider other alternatives and subsequent environmental compliance.

In addition, Reclamation and the Corps will implement a Monitoring and Adaptive Management Plan (AMP) (included as Appendix E of the FEIS) to provide a structured framework for adjusting Bypass Channel Alternative features and operations if monitoring results indicate the project is not meeting performance objectives as contemplated in the FEIS. The AMP defines the project goals and objectives, adaptive management process, agency roles and responsibilities, funding, and decision making process. The AMP also describes uncertainties in the science, proposed monitoring activities, and potential adaptive management measures that could be carried out, if necessary.

Key monitoring activities will include 1) monitoring the physical parameters of the bypass channel to ensure they remain within the Service's BRT criteria (depth, velocity, flows); 2) monitoring upstream and downstream passage of pallid sturgeon; 3) monitoring upstream and downstream passage of other native species; and 4) monitoring reliability of water delivery for irrigation purposes.

The FEIS provides the necessary NEPA documentation to undertake this federal action. Technical and economic criteria used in the formulation and evaluation of alternative plans were those specified in the Water Resources Council's Principles and Guidelines, dated March 10, 1983 and the Department of the Interior's 2015 Agency Specific Procedures for implementation of the 2014 Principles, Requirements and Guidelines. All applicable laws, regulations, Executive Orders, guidelines, and local governmental plans were considered in evaluating the alternatives. Based on these evaluations, we find that the overall benefits gained by construction of the authorized project outweigh adverse effects.

8 Basis of Decision and Issues Evaluated

Reclamation and the Corps selected the Bypass Channel Alternative because it best meets the purpose and need of improving pallid sturgeon fish passage and ecosystem restoration while continuing viable and effective operations of the Lower Yellowstone Project. The Bypass Channel Alternative is expected to improve pallid sturgeon passage at Intake Diversion Dam. At the same time, while an increase in operations and maintenance costs is expected, it is not anticipated to irreparably disrupt operation of the Lower Yellowstone Project.

Comments on whether or not the Bypass Channel will work have been noted through both the public review process (FEIS, Appendix F) and the Independent External Peer Review (IEPR) process (FEIS, Appendix I). The current design of the bypass channel includes a review of information on the swimming ability of pallid sturgeon, performance of other fish bypass channels, potential causes for bypass channel failures, and use of side channels for upstream movement. The current design also follows recommendations made from the Service's Biological Review Team which includes fisheries biologists from the Corps, Reclamation, U.S. Geological Survey (USGS), Montana Fish, Wildlife and Parks and the Service.

To address uncertainty associated with the Bypass Channel Alternative, Reclamation and the Corps will implement a Monitoring and Adaptive Management Plan (FEIS, Appendix E), that will evaluate project goals and objectives for at least eight years. This plan includes a list of potential adaptive management measures that could be implemented to correct deficiencies that are discovered.

Although the Modified Side Channel is of similar concept to the Bypass Channel Alternative, the Agencies did not choose this alternative due to the location of the channel entrance and the length of the channel. The entrance would be approximately two miles downstream of the current weir location, which could be detrimental to fish trying to locate that passageway near the barrier (Intake Diversion Dam). The modified side channel is also two miles longer than the bypass channel increasing uncertainties with passage success.

The Agencies believe the pumping alternatives considered in detail in the FEIS would provide fish passage benefits, but could result in potential for increases in operation and maintenance costs and resulting assessments that would severely impact many farms and jeopardize continued operation of the Lower Yellowstone Project. This would not meet the purpose and need for the project.

The Agencies looked hard at options to reduce costs of the pumping alternatives in response to public comments. The Agencies investigated establishing a trust fund to address operation and maintenance costs, alternative energy sources, and evaluated options to reduce construction and operation and maintenance costs of the pumping alternatives. After considering this information, the Agencies were concerned about the uncertainty and length of time needed to establish a trust fund or alternative energy sources, and review of the preliminary designs did not indicate a significant reduction in construction or operation and maintenance costs could be achieved without impacting water delivery reliability.

The Agencies also heard comments concerned with the complexity and reliability of a combined gravity and pump-fed system. Reclamation shares this concern with shifting from a gravity-fed irrigation system to a combined gravity and pump-fed system. Reclamation believes the complexity of such a system is likely to expose the Lower Yellowstone Project to more vulnerabilities in water delivery, increasing risks to farm operations, and potentially the viability of the Lower Yellowstone Project. This concern was also relayed in the Lower Yellowstone Irrigation Project's comment letter dated November 16, 2017 where they provided a detailed study on pumping stations located on the Yellowstone River (Performance Engineering and Consulting 2016).

Providing fish passage at Intake Diversion Dam may increase the chances of natural recruitment and contribute to meeting recovery goals as defined in the revised Pallid Sturgeon Recovery Plan (Service 2014). Even though passage will increase the potential for recruitment and thus recovery, there is insufficient data to meaningfully analyze and differentiate among the alternatives within the context of recovery because recruitment remains uncertain regardless of the chosen alternative.

The Agencies did not select the environmentally preferable alternative, the No Action Alternative, for implementation because it does not meet the project purpose and need. Furthermore, the Agencies believe that providing pallid sturgeon passage by means of the Bypass Channel Alternative will provide important ecosystem restoration benefits to Yellowstone River aquatic environments that would not be achieved under no action. It is understood that the Bypass Channel Alternative will result in adverse construction impacts on resources, such as historic properties, noise, and air quality that are greater than those anticipated under the No Action Alternative. This would be the case for any of the action alternatives considered in the FEIS. However, the impacts of the Bypass Channel Alternative would not result in the level of long-term adverse impacts on historic properties, noise, and air quality or any added entrainment impacts that would occur under the pumping alternatives.

In summary, based on the rationale provided above and the evaluation of potential impacts contained in the FEIS:

- The Agencies believe the Bypass Channel Alternative is practicable and could be constructed, operated, and maintained to meet the physical and biological criteria identified by the Service's BRT, and therefore will provide passage for pallid sturgeon and other native fish.
- The Bypass Channel Alternative is a cost effective means of providing fish passage (see Section 2.4.4 in the FEIS).
- Of the action alternatives, the Bypass Channel has one of the lowest overall costs and is expected have the lowest annual O&M costs (See Table 2-34 in the FEIS).
- On balance, the Bypass Channel Alternative is likely to provide a significant improvement in fish passage while avoiding the considerably higher economic and social costs and risks that could adversely affect the viability and effective operation of the LYP.
- There is equal uncertainty about recruitment and recovery of pallid sturgeon under all alternatives, but providing a bypass channel for fish passage will benefit and not harm pallid sturgeon.
- The agencies believe, based on the analysis in this FEIS, implementation of the Bypass Channel Alternative and the associated actions to minimize impacts will not result in significant long-term adverse environmental impacts.

9 Compliance with Federal Regulations

The Corps and Reclamation will follow all required federal, state and local permits and approvals in implementing the Bypass Channel Alternative, including but not limited to the following:

Endangered Species Act - Reclamation and the Corps requested formal consultation under Section 7 of the ESA with the Service on August 29, 2016. The Biological Opinion (BO) for this project was received from the Service on November 18, 2016. In compliance with the Incidental Take Statement, the non-discretionary mitigation measures listed in the BO will be implemented by Reclamation and the Corps.

Fish and Wildlife Coordination Act (FWCA) - The Corps and Reclamation received notification from the Service that the FWCA compliance had been completed for the Lower Yellowstone Intake Diversion Dam Fish Passage Project on November 18, 2016.

Clean Air Act - Reclamation completed a de minimis emissions conformity evaluation of the project, demonstrating that the project can conform to the Clean Air Act.

Clean Water Act - The Corps has completed its Section 404(b)(1) analysis for project construction and Reclamation will obtain any necessary discharge permits for operation and maintenance activities. Both the Corps and Reclamation will ensure compliance with permit requirements, and require their respective construction contractors to develop and adhere to respective Storm Water Pollution Prevention Plans.

National Historic Preservation Action, Section 106 - Reclamation and the Corps have completed consultation with the State Historic Preservation Officer (SHPO) and signed a Memorandum of Agreement (MOA) dated September 2016.

10 Environmental Commitments and Monitoring

Project planning, as described in the FEIS, integrated all practicable means of avoiding adverse environmental impacts into the design of the alternative. Where avoidance is not possible, Reclamation and the Corps have committed to implement actions, where appropriate and necessary, to minimize effects of the alternative on environmental resources. All applicable actions to minimize effects pertaining to construction of the bypass channel in the FEIS are adopted in this ROD as environmental commitments. Attachment B provides the environmental commitments.

To ensure that project activities and environmental commitments are completed, Reclamation and the Corps will establish an Environmental Review Team (ERT). The ERT will be comprised of federal, state, and local entities, which will develop the specific actions and monitoring programs and provide input to Reclamation and the Corps. This team could include technical representatives from the following agencies:

- Bureau of Reclamation
- U.S. Army Corps of Engineers
- Lower Yellowstone Irrigation Project Board of Control
- Montana Department of Natural Resources and Conservation
- Montana Fish, Wildlife & Parks
- U.S. Fish and Wildlife Service
- Montana State Historic Preservation Officer
- Other technical entities as deemed important to the process

When construction affects private lands or lands administered by agencies other than those listed above, landowners or specialists representing other agencies will be invited to participate on the team for the components that potentially affect their lands.

10.1 Monitoring and Adaptive Management

In addition to the environmental commitments, Reclamation and the Corps will implement a Monitoring and Adaptive Management Plan (AMP) (included as Appendix E of the FEIS) to provide a structured framework for adjusting Bypass Channel Alternative features and operations if monitoring results indicate the project is not meeting performance objectives as contemplated in the FEIS. The AMP defines the project goals and objectives, adaptive management process, agency roles and responsibilities, funding, and decision making process. The AMP also describes uncertainties in the science, proposed monitoring activities, and potential adaptive management measures that could be carried out, if necessary.

Key monitoring activities will include 1) monitoring the physical parameters of the bypass channel to ensure they remain within the Service's BRT criteria (depth, velocity, flows); 2) monitoring upstream and downstream passage of pallid sturgeon; 3) monitoring upstream and downstream passage of other native species; and 4) monitoring reliability of water delivery for irrigation purposes.

Potential adaptive management measures could include modifications to the bypass channel widths or depths, modifications to vertical grade control features, modifications to channel upstream or downstream entrances, installation of a guidance structure such as a jetty, modifications to the replacement weir, and/or removal of portions of the rock rubble field. Additional environmental compliance will be completed on measures proposed for implementation as an outcome of the AMP process, as appropriate.

11 Implementation

Following approval of this Record of Decision, the Corps will issue a Notice to Proceed for the construction of the Bypass Channel Alternative in early 2017. Construction will begin in spring of 2017 with anticipated completion by September 2019.

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ATTACHMENT A

COMMENTS RECEIVED ON THE FEIS

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Subject:

-----Original Message-----
From: Colton Black [mailto:cgussblack@gmail.com]
Sent: Tuesday, October 18, 2016 8:34 PM
To: CENWO-Planning <CENWO-Planning@usace.army.mil>
Subject: [EXTERNAL] Yellowstone Fish Bypass Channel

Hello, my name is Guss, and I am a concerned citizen of North Eastern Montana. I am writing you in regards of the controversy of the Intake Dam, just North of Glendive, Montana. I would hope that my voice is heard and my email is not skimmed over and cast aside like so many other times I have implored a government agency.

I will just get straight to the point and say that I strongly oppose removing the Intake Dam. Let me explain why I and so many others are opposed.

Let me say first off, that removing the dam is going to hurt many, many people. This area is first and foremost a farming community. Farms play a big role in the economy here. Everyone relies on them. Everyone from oil field companies down to small family owned business and retailers. If the dam is removed, it would limit how farmers can irrigate crops. Yes, there are alternatives to irrigation canals, but they are costly and would soon drive hundreds of farms out of business. That would affect farmers firstly then to shortly follow would be local businesses. These businesses would not be able to sell anything because of the lack of demand for their product.

Farm equipment being one example. Many dealerships would see a huge drop in sales revenue and many dealerships that sell equipment and implements would go out of business. Think of the job loss. It affects more than just farms. That is only one example. There are more. Hardware stores, clothing retailers, restaurants, just to name a few others. These businesses would lay off or let go of employees or go out of business altogether. This directly affects my job. I haul freight for a trucking company and if businesses are not ordering more stock for customers because there isn't demand for it, I am out of a job. Tearing out the dam doesn't just put the sugar factory out of business. This affects every single person in the community!

The lasting effects from this would also hurt families that are already struggling to provide for themselves due to a bearish oilfield economy.

Now that you understand how this issue can hurt so many families and individuals, let me tell you why I know the Bypass Channel would work.

I am an avid outdoorsman. Let's just say I've probably caught more fish than I have hair on my head. I love to stream fish. Observing how fish behave and adapt to their environment has taught me a lot. When I go into the mountains in the springtime to fish the streams flowing down the canyons I have run into the challenge of locating fish to catch. This is because when the snow melts in the springtime it will often dam a portion of the stream somewhere at a higher elevation, leaving more shallow, fast flowing currents below the snow damming the stream. I always wondered why I could not find any fish in the lower parts of the canyons at that time of year. At age 14, while walking next to a mountain stream I made an incredible discovery.

Most fish are not comfortable in or are unable to survive fast flowing water for an extended period of time. One day I came across a pile of snow damming a mountain stream. I looked past it, hopeful to find pools of water just beyond it. At the base of the snow dam was a larger pool of water. The pool had small fast flowing inlets coming around the sides of the snow bank and shortly dumping into the pool just below. In that pool I caught a glimpse of a few fish struggling in the lower pool. I wasn't quite sure of how many fish were in the pool, if any at all, so I crouched close to the pool to get a better look. Unexpectedly, a fish streaked across the surface of the pool and jumped up one of the tiny inlets and escaped from me above the snowbank. The little inlets to the pool seemed too small and swift moving for fish to navigate to the upper portions of the stream. To make a long story short, I walked above the snow bank dam to find that the stream was slower flowing and more habitable for fish and found success in my adventure

The point is, if these sturgeon want to survive, they will find their way through the bypass channel. Granted, sturgeon are not anything like cutthroat trout, but life always finds a way. We can see from my example that a bypass channel would work. The only other options we have are leave the dam, or tear it out. I care about the wildlife, but people are more important than fish. Please, do not tear out the existing dam. So many people are going to be hurt by doing so. I am writing this, because I love and care about the people in this area and I do not want to see them hurt and see everything they have worked for go to waste. Please, don't remove the existing dam!

Sincerely concerned,

Guss Black

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Subject:

-----Original Message-----
From: cohouch [mailto:cohouch@yahoo.com]
Sent: Friday, October 21, 2016 2:19 PM
To: CENWO-Planning <CENWO-Planning@usace.army.mil>
Subject: [EXTERNAL] Yellowstone by pass channel

I support the by pass! Please build and save our area!

Sent from my Verizon, Samsung Galaxy smartphone

THE IZAAK WALTON LEAGUE OF AMERICA

U.S. Army Corps of Engineers - Omaha District
Attention: CENWO-PM-AA
Tiffany Vanosdall
1616 Capitol Avenue
Omaha, NE 68102

Dear Ms. Vanosdall,

The Izaak Walton League of America (IWLA) thanks the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (BOR) for the opportunity to provide comments on the final Environmental Impact Statement (EIS) for the proposed changes at the Intake Diversion Dam (Intake) on the Yellowstone River in northeastern Montana.

The League, one of the nation's longest established conservation organizations, has over 43,000 members - many of whom live in the Missouri River Basin. Our members deeply care about the health of our nation's rivers.

The purpose of this project is to improve passage for the endangered pallid sturgeon and other native fish in the lower Yellowstone River by creating a fish bypass channel around Intake. Science shows that very few wild pallids are known to still exist in the upper Missouri River basin. That's why we believe success of this proposed project is so critical.

The IWLA considers the preservation and genetic diversity of the upper basin pallid as well as the other native fish that reside in the Yellowstone and Missouri rivers as something that must be successfully done.

The IWLA continues to have serious concerns about this proposed project. For more than a century Intake has impeded migration of pallid sturgeon and other native fish on the Yellowstone River. Intake is an obstacle to fish passage with greater turbulence and increased water velocities caused by the large rocks that have been placed in the Yellowstone.

As stated in the EIS there is still be a very high level of uncertainty whether the pallid sturgeon will even utilize the upstream habitat beyond Intake. There is also great uncertainty whether this proposed project will result in successful recruitment of pallid sturgeon.

The IWLA is also concerned about the proposed plan to create a rock-lined bypass channel. We ask if a more naturalized bypass channel that closely mimics the natural substrate of the Yellowstone could have a higher probability of success while greatly lessening the overall cost of the proposed project.

The League is also very concerned the proposed new concrete weir will actually create an additional threat to the existence of pallid sturgeon and other native fish. The weir will become a dam on what previously was the longest undammed river in America. Drift distance is crucial to pallid reproduction. We fear larval pallids hatched above Intake will not survive the turbulence or even be able to successfully pass the obstacle created by the constructed weir.

The IWLA wonders, is this an irrigation project that will be constructed utilizing a tremendous amount of the future Missouri River Recovery Management Program (MRRMP) funds or will this modification actually benefit the pallid sturgeon and other native fish?

This project is estimated to take at least three years to construct. It will consume at least $60 million dollars of future MRRMP budgets, at a time when recovery program funds are in very short supply. The IWLA believes that enormous amount of money from future MRRMP budgets, with no guarantee of successful fish passage or pallid reproduction and recruitment is a major gamble on the future existence the endangered pallid sturgeon in the upper Missouri River.

We also have great concern the new weir and associated bypass channel and other structures will not be able to withstand the massive ice flows that come down the Yellowstone River nearly every spring.

As a science based organization the IWLA strongly believes comprehensive long-term monitoring must be implemented, in consultation with the U.S. Fish and Wildlife Service, if the concrete weir and bypass channel are constructed. The established monitoring program needs to thoroughly evaluate the project's success. If that ongoing monitoring shows no positive response from native fish species, especially the pallid, an adaptive management plan must be in place. That plan must have changes that can quickly be implemented to make this project successful. The huge amount of recovery program funds that would be spent on this project demands it achieves its goal.

Finally, it's the League's understanding all maintenance of the completed project will be the sole responsibility of the Lower Yellowstone Irrigation District. We wonder how a very limited number of irrigators that benefit from Intake will be able to pay for that needed maintenance. Ongoing maintenance of the project is a major component that must be addressed. The public needs to be able to review all of the maintenance agreements if any federal funds are required.

The IWLA again thanks you for the opportunity to provide comments on the proposed Intake project and respectfully requests to be added to the list for all future information regarding the Intake Diversion Dam project.

Thank you for your time and consideration.

Sincerely,

Paul Lepisto

Paul Lepisto
Regional Conservation Coordinator
Izaak Walton League of America
1115 South Cleveland Avenue
Pierre, SD 57501-4456
605-224-1770
plepisto@iwla.org

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Cc:
Subject:

Attachments:

David,

Attached are our comments on behalf of the LYIP on the Lower Yellowstone Intake Diversion Dam Fish Passage Project Final Environmental Impact Statement. Please note that we provided references to source documents used in our comments as found in the EIS. However, I could not find a reference to the PEC September 2016 Yellowstone River Pump Station Study so I have attached that document for your reference. It was my understanding the document was included in the EIS, but I could not find a reference. Thanks for allowing the LYIP to comment,

Shawn

Shawn Higley, P.E. | Branch Manager

1275 Maple Street, Suite F | Helena, MT 59601

Tel 406-443-3962 | Cell 406-459-3379

WWCengineering.com <Blockedhttp://www.wwcengineering.com/>

WWC ENGINEERING

1275 Maple Street, Suite F - Helena, MT 59601 - (406) 443-3962
Fax (406) 449-0056 - Email: infohln@wwcengineering.com

November 16, 2016

U.S. Army Corps of Engineers
Omaha District
ATTN: CENWO-PM-AA
1616 Capitol Avenue
Omaha, NE 68102

RE: Comments Regarding the Lower Yellowstone Intake Diversion Dam Fish Passage Project Final Environmental Impact Statement

To Whom This May Concern:

On behalf of the Lower Yellowstone Irrigation Project LYIP), WWC Engineering (WWC) is providing comments on the final Lower Yellowstone Intake Diversion Dam Fish Passage Project Environmental Impact Statement. The LYIP remains committed to working with the federal agencies to improve fish passage at Intake while maintaining a viable and effective irrigation system. During our more than one hundred years of operation, area residents – indeed, entire communities - wildlife, waterfowl, migratory birds, aquatic species, and others have come to rely upon water provided by the LYIP. We look forward to working with you to continue serving the lower Yellowstone valley with vitally needed water while improving the area's ecosystem and fish passage.

We note that the LYIP, and any project undertaken at the LYIP, cannot, and should not, be held responsible for the full recovery of the pallid sturgeon. The pallid sturgeon's native habitat extended over nearly the entire Missouri and Mississippi river basins – of which, the lower Yellowstone valley is just small part. While we are committed to improving fish passage where possible, the responsibility for full pallid sturgeon recovery is more appropriately born by all users and residents of the Missouri and Mississippi river basins, not just the farmers and communities who depend upon the LYIP water.

We offer the following comments to the final EIS, noting no necessary revisions and emphasizing the importance of moving forward with the Bypass Channel alternative:

- The Bypass Channel is the only alternative as presented in the EIS that successfully meets the project purpose and need, which is to improve fish passage, contribute to ecosystem restoration, **AND** provide for the continued viable and effective operation of the LYIP, which supplies dependable and affordable irrigation water to nearly 58,000 acres of productive cropland.
  - The Bypass Channel design is consistent with the best available science and in accord with BRT criteria, which was established by the foremost experts in Pallid Sturgeon migration based on their observations of conditions Pallid Sturgeons used while migrating.
  - The Bypass Channel Alternative, preserves the continued operation of the LYIP, which was **authorized by the U.S. Congress in 1905,** by maintaining the gravity diversion.
  - Maintaining the gravity diversion of the LYIP results in the least operation and maintenance costs and impacts to the LYIP.

  - The proposed Adaptive Management Plan found in Appendix E of the final EIS will provide a level of surety that the Bypass Channel will be functional as a bypass for Pallid Sturgeon.

- Rock Ramp Alternative
  - This alternative does not meet the BRT velocity and depth criteria in all river conditions.
  - Increased rock placement will be significantly difficult, time consuming, and expensive.
  - Impacts due to ice scour and large floating debris will require annual repairs to the rock ramp and riverbed.

- Modified Side Channel Alternative
  - This alternative may cause migration of the Yellowstone River away from the existing diversion, which would result in the need for additional annual rocking or other work to ensure the LYIP's ability to divert its full water right.
  - The side channel would require maintenance and sediment removal over its entire length. Because the channel is significantly longer, this represents a significant increase in the O&M costs for the LYIP.

- Multiple Pump Stations Alternative
  - Because the pump sites would be subject to Yellowstone River migration, it would require significant bank stabilization and potentially riverbed alteration along a significant portion of the Yellowstone River that would have detrimental effects on river geomorphology.
  - Construction of each pump station, discharge lines, electrical lines, substations, and roads represents multiple new disturbances which will impact wildlife and habitat. Additional negative impacts will be wide-spread during required maintenance, operation, and inspections as documented in the WWC Biological Report dated July 2016 that was attached to WWC's July 29, 2016 letter to the USACE commenting on the Draft EIS, labeled BP-246.
  - The annual maintenance costs of this alternative far exceed the financial capability of the LYIP farmers to pay as documented in WWC's July 29, 2016 letter to the USACE commenting on the Draft EIS, labeled BP-246.
  - The functionality of this system would be substantially different than the current system, requiring a high level of operational scrutiny to be able to provide adequate irrigation water to the LYIP farmers.
  - The LYIP has significant operational concerns with the new pump stations in low flow river conditions, based on historical data from neighboring pump stations as documented in the September 2016 Yellowstone River Pump Station Study prepared by Performance Engineering & Consulting.
  - Pump stations on the lower end of the Yellowstone River are not reliable due to sediment loading, river migration and other concerns, as documented in the September 2016 Yellowstone River Pump Station Study prepared by Performance Engineering & Consulting.
  - This alternative would require changes to the LYIP and BOR water rights, which may subject them to objections and administrative proceedings.

    - The proposed pump station would be subject to extreme damage from ice jam events, as documented in the September 2016 Yellowstone River Pump Station Study prepared by Performance Engineering & Consulting.
- Multiple Pump Stations with Conservation Measures Alternative
    - Water conservation on a mass scale within the LYIP system will change the hydrologic system that was put in place more than one hundred years ago when the congressionally authorized LYIP was constructed. Providing significantly less water to the system will eliminate recharge to the underlying groundwater aquifer, leaving wells, wetlands, surface waters and other water features dry. This, in turn, will devastate habitat and the current ecosystem that has come to rely on the water provided by the LYIP.
    - This alternative is based on overstated losses and therefore, estimated water conservation will not be realized.
    - The LYIP has a legal right to divert 1,374 cfs from the Yellowstone River. Changes that require the use of groundwater or different diversion locations would likely require a new or revised water right, which could be subject to senior water rights, objections, and administrative proceedings.
    - Water rationing occurs nearly every year, even though the main canal is up to 90% efficient during periods of peak demand, therefore, there is likely not as much water available for the conservation measures.
    - The amount of water required to satisfy the peak crop water requirement within the LYIP is very close to the legal rate of diversion of 1,374 cfs, and significant reductions in the rate of diversion would have devastating impacts to the LYIP farmers as documented in WWC's letter dated March 7, 2016 to Tetra Tech as found in Attachment 3 of Appendix A3 of the Final EIS.
- Any additional time delays will significantly impact the ability of the aging native Pallid Sturgeon to perpetuate, as they are near the end of their biological ability to reproduce.

After review of the final EIS for the Lower Yellowstone Intake Diversion Dam Fish Passage Project, we believe the agencies have thoroughly studied the alternatives. We urge you to issue a Record of Decision that chooses the Bypass Channel for implementation. Additionally, we appreciate your expeditious efforts and urge you to continue moving this process forward as quickly as possible, in light of the precarious position of the aging pallid sturgeon. To that end, if you require assistance or information from the LYIP, please contact us.

Sincerely,

Shawn Higley, P.E., P.H.
Helena Branch Manager

SH/mh

cc: Victoria Marquis, Crowley Fleck
Mark Stermitz, Crowley Fleck
James Brower, LYIP

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Yellowstone River
Pump Station Study

Prepared For
Montana Water Resources Assoc.
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and

Lower Yellowstone Irrigation Project
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September 2016

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1.0 STUDY PURPOSE

1.1 Study Purpose

The Yellowstone River Pump Station Study is a collaborative project commissioned by the Montana Water Resource Association (MWRA) and the Lower Yellowstone Irrigation Project (LYIP). The purpose of the study was to identify large pump station facilities along the Yellowstone River and the operational concerns that have arisen in recent years with the vast fluctuations in river conditions. Having experienced significant high-flow and low-flow events within the last 10 years this study aims to identify and document impacts to pump station operations due to these events. This is not an all-inclusive document and is intended to collect data from operators on recent events within the last ten years. The window from 2006 to 2016 was selected because it captures both high-flow and low-flow extremes in the Yellowstone River. Additionally, pump stations along the river have implemented numerous capital improvements projects aimed to improve pump station efficiencies and operational ranges to better accommodate high and low-flow conditions.

The Yellowstone River is unlike most large river basins in Montana experiencing large fluctuations in river conditions based on its varied watershed conditions and tributaries. Furthermore the river is uncontrolled allowing for natural flooding conditions as well as low flow conditions in drought years. The fluctuation in river conditions has been an issue of concern for pump station operators as it relates to pumping capacity and efficiency under both circumstances. Large fluctuations in some cases have permanently changed pump station operational conditions. For the purposes of this study flow conditions within the river references have been taken from the U.S. Geological Survey (USGS) records at Station 06214500 located at Billings, Montana and Station 06329500, located outside near Sidney, Montana. These two stations were selected to bracket in the vast majority of large pumping facilities located along the Yellowstone River. Additionally, these stations will illustrate the inflow impacts on the Lower Yellowstone from its various tributaries.

1.2 Yellowstone River Flow Conditions 2006-2016

This study focuses primarily on flow conditions within the years of 2006 through 2016. This period was selected to capture both significant low-flow events as well as high-flow and flooding events. This period is also significant for large pump facilities along the Yellowstone River as a number of facilities have made significant capital investments in their facilities. In large part these investments were made to improve pumping operational ranges based on river levels, protect or stabilize infrastructure, or add fish barriers or screening equipment. These improvements coincide with significant recent events within the Yellowstone River which have impacted the facilities and their investments.

Tables 1 and 2 show monthly peak and low flows as well as average flows for the study period at the Billings and Sidney USGS gauging stations. These flows were based on mean daily discharges at each associated station. Flow rates from the two stations are presented graphically in Appendix A.

Table 3 shows the monthly mean suspended sediment concentrations in the Yellowstone River near Sidney, MT (USGS 06329500). The data sets for the suspended sediment concentrations were taken between the periods of 2006 through 2012.

Table 1. Mean Daily Discharge at Yellowstone River at Billings, MT (USGS 06214500)

	January			February			March			April			May			June		
	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)
2006	2,460	3,200	2,778	2,000	3,230	2,445	2,190	3,700	2,488	2,450	6,610	4,275	7,210	31,200	16,504	10,800	31,900	18,930
2007	1,600	2,920	2,251	1,760	2,840	2,404	2,200	3,830	2,859	3,100	9,770	4,292	9,510	22,100	15,191	7,910	26,000	14,909
2008	1,800	2,770	2,136	2,130	2,470	2,290	2,090	2,430	2,191	2,170	2,830	2,397	2,760	32,400	12,916	17,400	45,700	30,707
2009	1,530	3,160	2,552	2,210	2,920	2,626	1,830	3,270	2,727	2,910	10,100	5,413	6,350	36,900	18,016	21,500	40,300	29,723
2010	1,500	2,750	2,324	2,020	2,490	2,298	2,330	3,030	2,553	2,310	7,580	3,588	3,440	20,100	7,246	14,100	45,700	27,927
2011	1,500	3,720	2,626	1,600	3,440	2,349	2,420	4,130	3,033	3,100	4,500	3,877	3,750	60,700	19,541	24,900	59,400	40,193
2012	1,190	3,600	2,904	2,560	3,200	2,854	2,670	3,610	3,008	3,240	16,000	5,942	6,290	23,300	12,878	12,900	42,100	22,967
2013	1,700	2,670	2,323	2,140	2,570	2,438	2,230	2,590	2,406	2,220	3,140	2,596	2,610	23,200	13,271	12,300	31,800	18,893
2014	2,010	3,260	2,885	1,700	3,740	2,616	1,980	11,800	5,384	4,870	11,800	7,228	8,300	56,800	24,599	21,500	49,800	32,480
2015	1,780	4,460	3,503	2,910	3,820	3,498	2,990	4,430	3,534	3,950	7,950	5,369	8,700	24,800	14,871	9,720	36,900	22,347
2016	2,410	3,140	2,832	2,440	3,070	2,774	2,450	2,840	2,651	2,750	9,690	5,140	5,660	20,500	13,026	7,310	27,400	16,705

	July			August			September			October			November			December		
	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)
2006	3,140	10,800	6,896	2,030	3,010	2,386	1,870	3,050	2,356	2,530	5,080	3,921	2,400	5,340	3,539	2,060	3,210	2,723
2007	2,570	7,520	4,098	1,870	2,630	2,150	1,830	2,380	2,132	2,280	4,210	3,275	2,440	3,650	3,031	1,870	3,650	2,425
2008	9,890	40,500	22,287	3,460	9,480	5,649	3,600	5,650	4,388	3,420	4,940	4,131	3,230	4,020	3,687	800	3,340	2,497
2009	8,970	26,500	15,402	3,900	8,830	5,964	2,870	4,010	3,208	3,330	4,730	4,219	3,300	4,130	3,707	1,200	3,280	2,285
2010	6,730	29,800	13,746	3,130	6,800	4,920	3,550	5,120	4,563	3,380	4,190	3,743	1,600	4,330	3,412	1,890	4,010	3,145
2011	15,800	67,400	38,152	6,520	15,500	9,894	3,850	6,510	4,962	3,820	5,030	4,484	3,700	4,480	4,116	2,380	3,760	3,099
2012	5,280	15,900	9,076	2,240	4,830	3,171	2,160	2,390	2,258	2,230	3,130	2,820	2,780	3,270	3,028	1,700	3,070	2,548
2013	3,030	15,900	7,480	1,710	3,260	2,254	1,790	5,170	3,220	3,990	6,210	4,843	3,000	4,380	3,823	1,670	3,740	2,943
2014	7,900	28,800	18,075	5,180	8,370	6,582	5,250	8,500	6,107	4,740	6,530	5,282	2,860	4,880	4,320	1,920	5,000	3,783
2015	3,670	9,380	5,754	2,560	4,560	3,295	2,260	3,090	2,562	2,570	4,090	3,510	2,270	4,410	3,576	2,170	3,640	2,958
2016	2,810	7,440	4,895	1,690	2,700	2,206	1,610	1,960	1,789	---	---	---	---	---	---	---	---	---

Table 2. Mean Daily Discharge at Yellowstone River near Sidney, MT (USGS 06329500)

	January			February			March			April			May			June		
	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)
2006	6,100	7,500	6,748	1,800	6,300	5,029	5,700	8,600	6,388	6,370	15,200	9,579	8,660	32,900	16,842	11,400	31,600	20,233
2007	2,600	6,300	4,955	4,200	5,900	5,232	5,300	8,700	6,730	7,050	10,200	8,210	9,210	25,900	19,682	11,800	40,100	22,940
2008	2,900	6,000	4,994	4,900	5,300	5,145	5,000	6,000	5,358	4,260	5,800	5,095	4,580	38,100	15,391	30,500	56,500	42,060
2009	4,400	6,500	5,719	4,600	5,900	5,561	5,200	8,100	6,744	7,120	15,300	10,375	12,400	38,800	20,384	31,800	51,200	40,730
2010	4,900	5,700	5,300	5,000	5,400	5,275	5,300	9,000	6,706	5,460	10,500	6,635	8,480	33,200	14,953	28,400	55,100	42,773
2011	4,420	6,910	5,849	4,680	8,140	6,369	4,990	31,600	13,280	9,350	20,300	12,033	12,400	121,000	48,397	53,800	83,500	69,490
2012	941	8,670	6,590	6,770	9,510	7,974	7,540	10,700	9,005	7,250	19,600	9,563	8,760	24,500	15,643	16,800	39,600	23,957
2013	2,040	5,020	4,319	4,660	5,320	5,007	4,890	6,300	5,648	4,900	6,390	5,872	4,250	40,000	15,113	15,400	52,000	27,363
2014	4,740	8,290	7,176	3,320	11,100	6,947	3,850	35,800	16,001	14,900	22,300	17,197	18,900	58,900	31,071	29,200	67,900	45,000
2015	3,600	10,400	7,313	7,600	9,200	8,157	6,700	9,220	8,405	7,390	11,200	8,669	9,170	33,100	16,532	21,900	55,800	41,343
2016	ICE	ICE	ICE	ICE	ICE	ICE	5,320	6,400	5,806	5,410	14,200	7,978	9,220	26,100	17,343	8,710	32,300	21,087

	July			August			September			October			November			December		
	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)	Low (cfs)	High (cfs)	Ave. (cfs)
2006	3,280	11,100	7,215	1,800	3,110	2,412	1,920	6,140	3,499	5,260	7,250	6,135	2,000	7,230	5,687	900	7,600	5,061
2007	2,050	10,800	4,937	2,180	4,020	2,756	2,800	4,900	3,778	4,730	6,510	5,650	2,800	6,250	5,643	3,300	6,100	5,197
2008	14,700	53,300	31,100	4,930	14,000	8,102	5,220	9,280	7,540	7,260	9,890	8,395	7,200	8,260	7,751	2,700	7,380	5,842
2009	11,700	42,400	25,661	6,330	14,500	9,836	5,810	6,440	6,090	6,390	9,480	8,319	7,150	8,450	7,632	1,100	7,130	4,597
2010	10,500	42,800	23,381	5,420	10,100	7,493	5,950	9,940	8,656	6,950	7,760	7,217	3,320	7,450	6,635	4,910	7,300	6,290
2011	32,400	84,000	58,539	11,200	30,500	19,532	8,940	11,400	9,974	8,730	11,500	10,229	6,400	10,500	9,345	5,510	9,190	7,834
2012	5,780	20,100	10,761	1,810	5,910	3,479	1,790	3,500	2,689	4,040	5,840	5,207	5,200	6,140	5,711	658	5,950	3,954
2013	3,440	18,300	9,757	2,160	7,460	3,699	2,380	8,100	5,023	6,930	10,300	8,816	3,760	7,900	6,780	857	8,990	5,560
2014	11,400	40,600	25,710	7,970	18,000	10,229	10,200	12,500	11,070	9,170	13,100	11,027	2,600	10,500	8,126	5,200	11,000	8,074
2015	5,920	20,100	10,736	3,950	5,540	4,595	3,900	5,930	4,847	5,660	7,690	6,938	7,030	7,670	7,356	ICE	ICE	ICE
2016	3,450	8,140	5,799	2,280	4,390	3,050	2,720	4,060	3,385	---	---	---	---	---	---	---	---	---

Table 3. Monthly Mean Suspended Sediment Concentration (mg/l) at Yellowstone River near Sidney, MT (USGS 06329500)

Year	January	February	March	April	May	June	July	August	September	October	November	December
2006	---	---	---	56,710	50,450	39,720	1,590	316	4,890	3,544	750	---
2007	---	---	---	15,120	88,290	87,140	5,683	1,574	660	2,071	966	---
2008	---	---	---	1,640	83,550	112,900	50,810	3,741	2,104	7,036	1,371	---
2009	---	---	---	46,460	58,940	93,200	33,820	15,670	2,411	6,676	1,204	---
2010	---	---	---	3,682	106,400	148,900	55,910	1,520	9,863	1,129	1,222	---
2011	---	---	35,050	34,060	357,900	180,000	100,200	13,430	1,380	1,677	2,766	---
2012	---	---	---	6,100	24,680	50,880	6,178	620	229	---	---	---
Mean	---	---	35,050	23,396	110,030	101,820	36,313	5,267	3,077	3,689	1,380	---

1.3 Ice Flow Conditions

The Yellowstone River typically sees large ice flow events in the spring. These events generally happen in the Lower Yellowstone reach between Miles City and the confluence with the Missouri River. Ice flow events are triggered by rapid early runoff events in the Upper Yellowstone watershed while the Lower Yellowstone reach is still covered with sheet ice. Early runoff events are a result of unseasonably early rainfall events or periods of warm weather in the upper watershed. A number of reaches within the Lower Yellowstone jam with ice at necked down areas of the river. Reaches around Glendive and Sidney, Montana are primarily the areas in which these events occur. Little ice flow data is available and varies drastically depending on location making it difficult to specifically document. River stage data is available but difficult to project out to each large pumping facility due to the nature of the ice flow conditions. The study documents impacts of these events but does not specifically identify exact river conditions during them.

Since the late 1800s over 100 ice jams have occurred on the Yellowstone River. These ice jams have caused infrastructure damage, flooding, and loss of life and property. On the Yellowstone River, only three reaches have more than five reported ice jams. These reaches include the areas of the cities of Miles City, Glendive, and Sidney, Montana. The majority of ice jams at Miles City occurred in March. Ice jams develop near Glendive during the months of December, January, February, March, and April. Historically, ice jams occur near Sidney during the months of January through April. Appendix B contains a tabulated summary of ice jam events that are recorded in the USACOE Ice Jam Information Clearinghouse for the Yellowstone River and its major tributaries.[1]

Ice flow events have created a number of operational concerns for large pump facility operators. Because these events rapidly raise river levels as they build and then rapidly lower, river levels as the ice breaks free it is difficult to plan for or design around. Rapid

[1] Thatcher, Tony, and Karin Boyd. *Yellowstone River Historic Events Timeline: Flooding, Ice Jams, Bridges, and Irrigation Infrastructure*, 2008.

river rises allow for large sheet ice to flow perpendicular to the facilities and create flooding conditions in many instances pushing the river out of its banks. Rapid river level drawdowns create dewatering effect on river banks causing severe river bank sloughing and instability where steep slopes are present. Ice flow conditions are unpredictable and rarely similar from year to year making it difficult to plan for or design around. Recent ice flows have caused millions of dollars of damage to new and renovated pumping facilities in the Lower Yellowstone reach during the study period. Damages and operational concerns will be documented in further detail in Section 2.0.

2.0 PUMPING FACILITIES

2.1 Facility Identification

Research for the study identified sixteen large pumping facilities along the Yellowstone River. There are a number of private pump station facilities located along the Yellowstone River used to facilitate irrigation along the river. Private facilities are removable and pulled from the river following completion of the irrigation season. Private facilities are serving fewer than five users. These facilities are significantly different from large pump station facilities and do not directly relate to the operation and maintenance concerns facing large facilities. Therefore private pump stations were not included in this study. It should be noted that these facilities are not resistant to the conditions identified and they have been impacted by the flow conditions documented in this study.

Large facilities, in the context of this report, are identified as permanent facilities or facilities that operate year-round. These facilities range from 2 to 400 cfs in discharge capacity. Large facilities service either large industrial users, municipalities, or irrigation districts with multiple users. Industrial and municipal facilities operate year-round while irrigation pumping facilities are only operated between April and October. These facilities vary from permanent concrete pump stations to infiltration galleries. Facilities locations along the river vary depending on pump station style and river conditions in the area. Some facilities are located directly adjacent to the river on the river banks and some have constructed intake channels allowing for facilities to be located further from the river.

2.2 Pump Facility Descriptions

In the following subsections identify operation and maintenance concerns for individual pump facilities as well as damage cause by extreme river flow conditions. This section is not meant to be all-inclusive but to identify and document significant occurrences and conditions for each facility within the study period. Information was collected from local facility operators and/or engineering professionals with working knowledge of the facilities.

2.2.1 City of Laurel Municipal Intake

City of Laurel operates a municipal water intake system located along the north bank of the Yellowstone River south of Laurel. The City has drawn water from the river in various forms since 1908. The current raw water intake was constructed in 2003, replacing a concrete intake constructed in the 1950s which was left dry by river migration from the floods of 1996-1997. The new intake was constructed as a horizontal flooded suction intake in the middle of the main channel when constructed in 2003. During the 2011 floods the intake was compromised by severe scour and river migration. It is estimated that up to 4.5-feet of bedrock scoured adjacent to the intake and upwards of 14-feet under the adjacent bridge. Additionally, the river migrated south away for the intake with the intake now located along the northern edge of the main channel. This has limited the ability of the City to draw water on a consistent, year-round basis. During the winter of 2012 ice accumulation over the intake cause a temporary shutdown of the raw water line. Low-flow conditions in the Yellowstone in August and September of 2012 prompted emergency construction of a temporary rock weir in the river across a portion of the main channel to redirect flows to the intake. The rock weir is still in place but is only a temporary solution and violates U.S. Corps of Engineers regulations. The City is currently experiencing low water conditions in 2016 which has required constant work within the river bed to ensure flows are directed to the facility. The City of Laurel is currently working with the State of Montana and FEMA to construct another new intake facility which will require relocation of the intake upstream to be positioned within the main channel of the Yellowstone again. Below is a summary of both low-flow and high-flow operational issues.

High-Flow Condition Operational Issues

- River migration away from the intake; and
- Sediment and gravel deposition over and around the intake.

Low-Flow Condition Operational Issues

- Inconsistent water supply;
- Freezing/blockage of intake structure;
- Sedimentation and sediment intake into the system; and
- Pump wear due to excessive sediment and cavitation.

2.2.2 Lockwood Water & Sewer District Intake

The current Lockwood Water District (District) intake consists of three wells drilled diagonally from the southern river bank out under the main channel. The wells act as an infiltration gallery to allow for pulling through the shallow gravel layer into the wells and up to the treatment plant. During the floods of 2011 a large gravel bar was deposited over the infiltration gallery while the river migrated away from the pump site to the northern side of the river. The gravel deposits over the intake have made it difficult to draw consistent water from the Yellowstone. Additionally, the infiltration gallery now draws substantial sediment during operation requiring the facility to purge or backflow the pumps to clear the intake. This purging of the system wears the pumps and temporarily creates a high concentration of turbidity in the river in a small area around the intake. As a response to these issues the District has installed a secondary raw water pump in the Lockwood Irrigation District's Intake Canal to draw from the Intake Canal during high-flow months to address turbidity issues. The existing wells have worn due to their diagonal placement and the District is currently reviewing options for replacement or relocation of the infiltration gallery as it exists currently to gain better access to the main channel.

High-Flow Condition Operational Issues

- Debris build-up around intake;
- Heavy sediment loading;
- River migration away from intake; and
- Gravel deposition over intake area.

Low-Flow Condition Operational Issues

- Sufficient water elevation over pumps;
- Constant back-flushing or purging of intake wells; and
- Pump wear due to low head and high sediment.

2.2.3 Lockwood Irrigation District Pump Station

The Lockwood Water District (LID) Pump Station consists of three centrifugal pumps with a capacity of approximately 44 cfs, housed in a pump facility along the southern bank of the Yellowstone River. The Pump Station has a large wet well fed by an intake canal diverting water to the facility from the Yellowstone River. The facility was constructed in the 1930s and rehabilitated in the mid-1980s with pump and electrical upgrades to better match water demands at the time. The facility operates seasonally and usually shuts down due to low flows in the Yellowstone River. During the floods of 2011 over 50% of the LID intake canal was washed away leaving the district users without water at the end of the season. The District spent over $250,000 to rebuild the intake canal to feed the pump station following flooding damage. The floods also flooded the pump station building and deposited large volumes of sediment and debris around the facility. Trash racks on the intake canal and pump station wet well were not able to keep the debris from entering the facility. Upwards of 65% of the wet well capacity was filled with sediment deposition which had to be removed through vacuum truck and hauled off site for disposal. LID has struggled to maintain the primary pumps within the facility. Pumps have experienced substantial wear due to heavy sediment loads pumped through the facility and periodic cavitation due to low river levels. The pumps are dismantled annually now and inspected, repaired, repacked, and reinstalled to maintain reliable operation. According to LID pump impellors are scheduled for repair every 3 to 5 years due to operational wear from sediment laden water. In 2012 LID was forced to end its irrigation season nearly 30 days early due to low-flow conditions in the Yellowstone and the inability to provide sufficient suction head for the pumps. This left irrigated row crops dry during pivotal yield forming weeks at the end of the growing period. The LID is facing a similar issue with facility inefficiency due to low-flow conditions in 2016. On average LID is forced to shut down the pump station for 7-10 days each year due to the conditions listed above.

High-Flow Condition Operational Issues

- Debris build-up around trash racks;
- Heavy sediment loading and deposition in wet well;
- Intake canal erosion and damage;
- River migration away from intake; and
- Gravel deposition at head of intake canal.

Low-Flow Condition Operational Issues

- Lack of sufficient suction head for pumps;
- Low pumping efficiency;
- Inability to meet irrigation demands;
- Excessive energy consumption; and
- Pump wear due to low head leading to cavitation.

2.2.4 Buffalo Rapids Irrigation District 1 – Glendive Pump Station

The Buffalo Rapids Irrigation District 1 (BRID1) Glendive Pump Station consists of three centrifugal pumps housed in a concrete pump facility along the northern bank of the Yellowstone River downstream of Fallon, Montana. The facility is three stories with the centrifugal pumps located in the lower level allowing for flooded suction. The facility was constructed on the northern edge of the floodplain with a large intake canal cut perpendicular to the Yellowstone River to feed water into the facility. The facility was constructed in the 1930s, with a capacity of approximately 300 cfs, by the USBR and

rehabilitated periodically in the last 30 years with electrical upgrades and discharge line improvements to replace worn portion of the facility. The system operates seasonally starting in early May and usually shuts down in late September each year.
This facility is located in an ice flow area and was constructed with engineered large vertical wing walls to prevent erosion and flooding of the facility during ice flow and high-water period. During the spring runoff ahead of the floods of 2011 a large ice flow event tore both wingwalls off the facility and caused severe erosion and bank sloughing within the intake canal. The wingwall collapse deposited debris and large portions of the embankment into the facility intake, which plugged the facility and caused a late system start up. Wingwalls were replaced on the facility in 2012 at a cost of over $500,000. Additional work was required to repair the intake canal and remove a sand bar deposited at the entrance limiting water intake. This facility has struggled with low-flow conditions in the Yellowstone as well watching pumping efficiency reduce as intake water levels fall leading to increased energy consumption.

Pumps for the facility where all removed and rehabilitated in 2012. Wear of the pumps, shafts, motors, etc. drove the rehabilitation cost to over $1,000,000 to allow for operation in 2013. BRID1 has modified operation and maintenance of the pumps with monthly inspections during operation by pump experts. Since rehabilitation of the pumps the BRID1 has spent upwards of $300,000 additionally on further repairs to greasing mechanism, seals, bearings, and shafts. The pumps are scheduled to be removed and shipped for maintenance and repairs every 5 years with an estimated cost of $250,000 per pump per cycle. The pump experts who rehabilitated the pumps recommended placing the pumps on a 5-year rotation for full removal and rehabilitation to maintain reliable operation of the equipment.

In 2015 major repair work was completed on the pump discharge lines for the Glendive Pump Station. The three steel discharge lines were replaced with HDPE lines to prevent future deterioration of the infrastructure due to corrosion. Within one month of operation in 2016 the discharge lines failed at the couplers connecting the HDPE pipelines to the steel manifold. Failure occurred due to material defects in the HDPE pipeline which allowed the pipelines to contract beyond the manufacturer's specifications. This failure resulted in a four-week system shutdown of the entire system to allow for full repair. The shutdown created unnecessary stress on young row crops planted in the District and caused permanent yield damage to crops. Local growers estimate yield reductions of at least 20% due to the four-week system shutdown.

Operational costs of the aging facility have exponentially increased in the last ten years to maintain the pumps. Additionally, significant dredging and excavation is required annually to maintain flows into the intake canal and facility as the river migrates away from the facility.

High-Flow Condition Operational Issues

- Heavy sediment loading and deposition in intake canal;
- Intake canal erosion and damage;
- River migration away from the intake; and
- Sand deposition at head of intake canal.

Low-Flow Condition Operational Issues

- Low pumping efficiency;
- Inability to meet irrigation demands;
- Excessive energy consumption; and
- Pump wear due to low head.

2.2.5 Buffalo Rapids Irrigation District 2 – Terry Pump Station

The Buffalo Rapids Irrigation District 2 (BRID2) Terry Pump Station consists of three centrifugal pumps with a capacity of approximately 300 cfs, housed in a concrete pump facility along the southern bank of the Yellowstone River upstream of Terry, Montana. The facility is three stories with the centrifugal pumps located in the lower level allowing for flooded suction. The facility was constructed on the southern bank directly adjacent to the Yellowstone River. The facility was constructed in the 1930s by the USBR and rehabilitated periodically in the last 30 years with electrical upgrades and discharge line improvements to replace worn portion of the facility. The system operates seasonally starting in early May and usually shuts down in late September each year. This facility is located in an ice flow area and was constructed with vertical wing walls to prevent erosion and flooding of the facility during ice flow and high-water period. BRID2, in conjunction with the USBR and Montana Fish, Wildlife, and Parks to install a large fish screen on the intake of the facility. Engineered concrete wingwalls and supports for the screens were installed along with required electrical and mechanical components. During an ice flow event in 2011 the new concrete work was damaged and collapsed requiring BRID2 to demolish the damaged screen supports and replace them with new concrete supports. The fish screens have been installed and operated for two seasons. Due to ice flows in the area the screens themselves are required to be installed in the spring and removed in the fall to prevent damage from ice in the river. This requires the BRID2 to contract a crane service to install and remove the screens each year as a cost of over $20,000 annually. The increased operational cost, reliability issues, and difficult maintenance of the screen has led the BRID2 to remove the Screen completely, having not been installed in recent years.

BRID2 faces similar pump maintenance and repairs for their large centrifugal pumps. This facility has struggled with low-flow conditions and main channel migration in the Yellowstone as well watching pumping efficiency reduce as water levels fall leading to increased energy consumption. Pumps for the facility have been periodically removed and repaired. Wear of the pumps, shafts, motors, etc. drive the rehabilitation cost of the pumps. BRID2 has spent upwards of $200,000 on repairs to greasing mechanism, seals, bearings, shafts impellors, and motors. Operational costs of the aging facility have increased in the last ten years to maintain the pumps. Additionally, dredging and excavation is required annually to maintain flows into the facility as the river migrates north away from the intake.

High-Flow Condition Operational Issues

- Heavy sediment loading and deposition at facility;
- River migration away from the facility; and

- Gravel deposition at facility intake.

Low-Flow Condition Operational Issues

- Low pumping efficiency;
- Inability to meet irrigation demands;
- Excessive energy consumption; and
- Pump wear due to low head.

2.2.6 Sidney Water Users Irrigation District – Pump Stations

The Sidney Water Users Irrigation District (SWUID) manages three separate pump station facilities along the southern bank of the Yellowstone River. All three pump station, with capacities of approximately 45 cfs each, are located directly adjacent to the river using screened inlets and a wet well to feed vertical turbine pumps. Wet wells vary in depth from 20 to 30 feet allowing for sufficient suction head to prevent cavitation. The inlet consists of a gated concrete structure with a large trash rack mounted to the structure preventing debris and rock from entering the wet well. Slopes around all three structures is armored with large riprap to prevent erosion and provide bank stability.

In recent years SWUID has consistently fought bank stabilization to protect their structures. The riprap installed to stabilize the banks is constantly moved or dislodged during ice flow periods in the river stacking rock over the inlet screens and blocking flows into the facilities. Ice has dislodged and damaged the trash racks as recent as 2016. SWUID annually repairs and restacks large riprap to protect the structures and open the intakes. Additionally, debris accumulation during high-flow periods in the river deposits large debris along the banks and inlets requiring constant monitoring of the facilities to maintain wet well water levels. During the 2011 floods sandbars were deposited in front of the pumping facilities as the river migrated away from the intakes. These newly developed sandbars further reduce flows into the wet wells, causing problems specifically during low-flow years. During the 2012 irrigation season, while the Yellowstone experienced unseasonable low flows, SWUID was force to reduce its pumping capacity by 75% to continue operation due to low levels in the wet wells. This forced water rationing and a reduced irrigation season for high-value row crops grown in the District. Local growers noted that rationing led to yield reductions of up to 30-40% in some cases due to the inability to provide consistent water during critical yield forming months. Similarly, in 2016 the SWUID is facing reduced pump capacity due to unseasonable low flows in the river. This has caused water rationing and severely reduced pump station efficiency. During low flow periods the SWUID's pump efficiency drops by up to 40% and causes substantial wear on the pumps and equipment due to cavitation and heavy sediment/sand loads. SWUID has experienced periodic pump station shutdowns through the study period which have lasted from 7-14 days depending on water levels in the Yellowstone River.

Pump maintenance and repair currently accounts for over 35% of the overall SWUID annual budget. SWUID annually spends on average $50,000 rotating pumps out for repairs and replacement of parts. SWUID has placed its pumps on a four-year rotation to be removed and shipped for rehabilitation to address wear from the sediment loaded water pumped through the facilities. Without completing the pump removal and rehabilitation rotation SWUID's pumps have documented permanent failures and system shutdowns. The cost associated with just repairs and maintenance of the pumping facilities has prevented the SWUID from implementing water conservation projects within the systems infrastructure.

High-Flow Condition Operational Issues

- Heavy sediment loading and sandbar deposits at intakes;
- Slope stability and erosion protection for facilities;
- Rock accumulation over intake;
- River migration away from the intake areas; and
- Sand deposition at the intakes.

Low-Flow Condition Operational Issues

- Low pumping efficiency;
- Inability to meet irrigation demands and water rationing;

- Excessive energy consumption; and
- Pump wear and damage due to low levels in wet wells.

3.0 SUMMARY

3.1 River Flow Conditions

Through the investigation of pump stations all noted concerns and operational issues experienced during both low- and high-flow periods of the Yellowstone River. In general, flood conditions or high-flow periods in the river have created sand or gravel deposits at intakes and pushed the river to migrate away from the pumping facilities. Heavy debris carried down the river during high flow periods in most cases has caused damage to intake structures. By far the most impact during high-flow periods is the impact on the river as high water recedes exposing channel migration. Permanent pump stations struggle to develop effective and non-intrusive ways to mitigate and account for channel migration. It was common that at the time of construction of every pump station it was built to be either located in the center of the main channel or on the outer edge of a river bend to effectively collect water into the facility. In every case noted the permanent pump stations have experienced channel migration which has either reduced inflows to the facilities or deposited sand or gravel bars in front of the intakes. This, in most cases, requires channel excavation or work within the river banks to direct water to the facilities to continue to provide un-interrupted service and access to their water right.

Similarly low flows caused water availability and access issues for most pump facilities discussed. Low flows impact pump efficiency by reducing the net suction head for facilities and in some cases causing periodic cavitation in the pumps. Damage to pumping equipment generally occurs during low-flow periods according to the operators contacted during the study. Rarely can permanent facilities operate all pumps within the station at once during low flow periods without causing extensive damage to the pumps. This leads to water rationing and shortening of irrigation seasons. The negative economic impact of water rationing and reduced irrigation seasons was not in the scope of this study but is worth noting. As with high-flow river conditions, permanent pumping facilities are not equipped to move or mitigate low-flow conditions without significant costs and substantial environmental impacts to the river through dredging and channel modifications.

Ice flows in the Lower Yellowstone River create extensive damage to permanent facilities as found in the study. In each case noted permanent facilities experienced hundreds of thousands of dollars of damage in ice flow events in the last ten years. In the case of the BRID2 Terry Pump Station new construction was designed to account for all forces in the Yellowstone River before it was constructed, went through numerous state and federal reviews, and still was severely damaged by ice flows. Ice flows are difficult to predict and nearly impossible to design for in every case. Ice flows are however a significant threat each year to stability and operation of the pump facilities in the Lower Yellowstone.

3.2 Pump Facility Configurations

The study revealed that regardless of the permanent pump station configuration each facility struggled with consistent and steady operation during low- and high-flow periods in the Yellowstone River. Submerged intakes and infiltration galleries were used on substantially smaller permanent facilities where the draw was between 4 and 20 cfs. These types of facilities are not viable for large draw systems in most cases. Even so, submerged inlets and galleries struggled with low-flow periods in the river and were subject to channel migration vulnerability. Providing steady and consistent water flows from these inlets was possible during high-flow periods but not low-flows.

Permanent facilities using intake canals allowing the stations to be set off the main river channel were found to operate better in high-flow periods however struggled significantly during low-flow periods. Intake canal facilities where susceptible to gravel and sand bar deposits at their entrance and sediment deposition in the intake canal itself restricting flows to the facilities. Additionally, in the Lower Yellowstone reach being set off the river did not assure that the facility was protected against ice flows. In the case of BRID1 severe damage occurred during the 2011 ice flows causing over $500,000 in damage to the facility.

Facilities located directly adjacent to the river on the river bank were found to be susceptible to bank stabilization and erosion during high-flow periods. Intakes on these facilities consistently struggled to manage debris buildup and riprap or gravel deposits over the intake structure. Ice flows create significant issues with these facilities. Low-flow periods can be catastrophic it found in conjunction with channel migration for facilities directly adjacent to the river.

All pump stations struggled with maintenance and repairs of pumps and equipment. Yellowstone River water is typically high in suspended solids and sand which wears on pump impellors and casings. Abrasion resistant coatings are available and typically applied but only last 3-5 years at best in Yellowstone River conditions. Typical maintenance schedules included full pump removal every five years to be re-worked and implement preventative maintenance. For large pump systems like BRID1 and BRID2 (300-400 cfs) that can cost up to $200,000-$250,000 every five years. For smaller pump stations such as SWUID (40 cfs) the cost is typically $50,000 or more per rotation. Maintenance costs cannot be overstated and shouldn't be underestimated. In the case of SWUID it consumes over 35% of their overall budget annually.

3.3 Findings

The following items came from the interviews and reviews of pump stations along the Yellowstone River.

- Pump maintenance and repair costs should generally be estimated at 25-35% of the annual budget. This cost should cover annual maintenance and repairs as well as budgeting for reserve accounts to cover 5-year major pump overhauls.
- Ice flows in the Lower Yellowstone should be considered a significant design factor for new facilities or facility rehabilitation efforts. Normal and/or high-flow river conditions considered during design are not sufficient to protect facilities during ice flow events. As exhibited by the BRID2 Terry Fish Screen Project, even USCOE standards were not sufficient to account for ice forces in the Lower Yellowstone.
- Fish screens on permanent pumping facilities cannot be designed or constructed

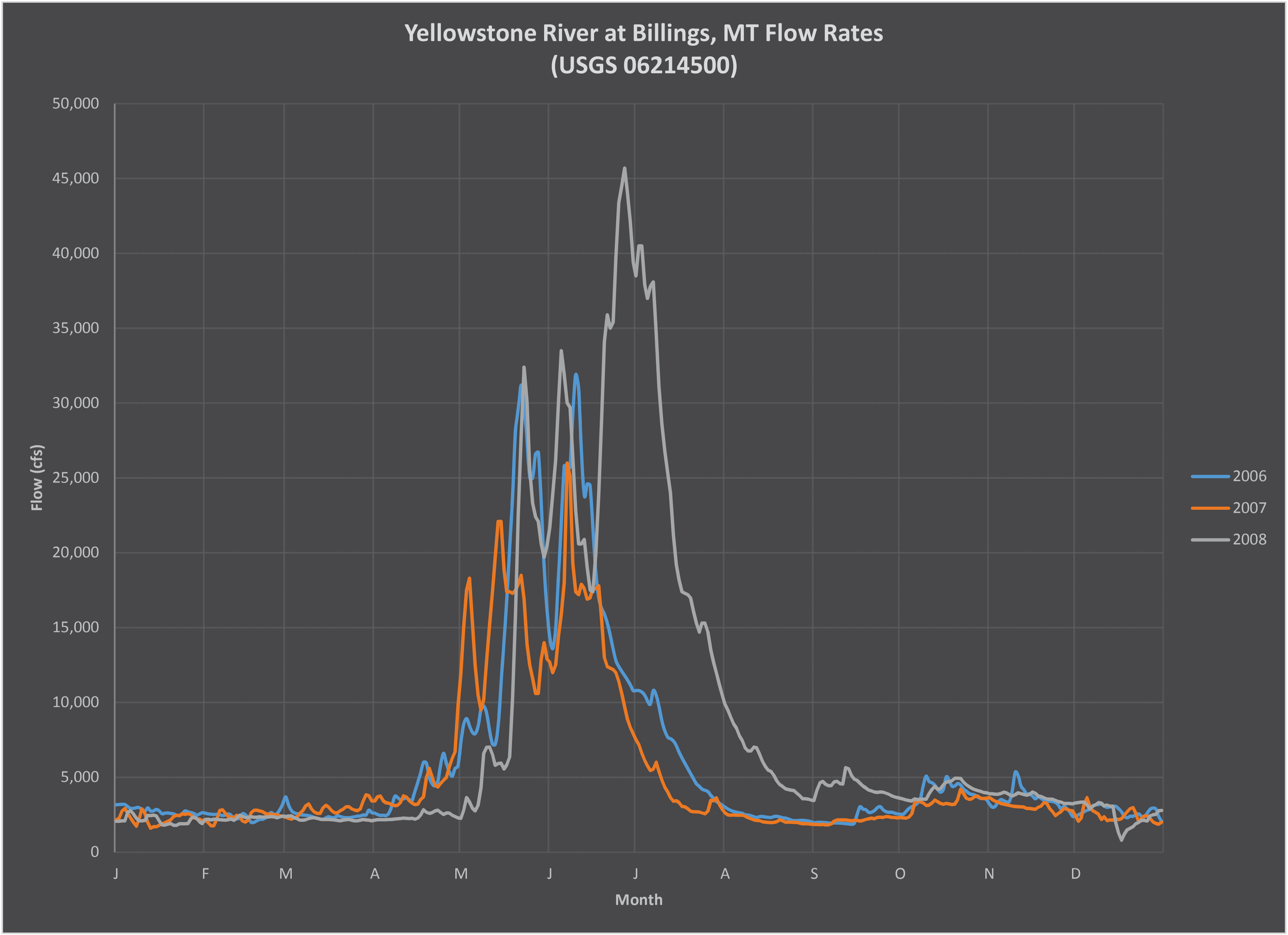
to withstand ice flow issues at this point. Any fish screen project incorporated in pump station design or rehabilitation should account for annual installation and removal of the screen and equipment. If possible the facility should be set with hydraulic cranes capable of pulling equipment without requiring outside contracting. Districts and municipalities need to ensure that annual installation and removal/storage costs are included in their operation budgets.

- Pump station configuration does not appear to reduce the impact pump operations during low- or high-flow periods. Style of intake rarely properly accounts for the vast range of operational conditions from high to low flows in the river to significantly improve the operation of the facility. In no instance was a permanent pump station found to be more reliable in providing steady water flows than gravity diversion systems.
- Each permanent pumping facility mentioned in the study has experienced temporary or early seasonal shutdowns during their respective operational seasons within the study period. Reliability of water supply at each permanent facility has been brought into question during low-flow periods in the Yellowstone River.
- Unreliable water supply from permanent irrigation pumping facilities has led to reduced crop yields and crop losses periodically through the study period. Operators and local producers have documented up to 40% crop yield losses due to unreliable water supply caused by changing river conditions impacting pump station operations.
- River migration is the leading cause of pump station flow problems. River migration during high-flow or flooding periods leaves permanent pumping facilities susceptible to drying up with channel access. Main channel migration should be expected and planned for in new facility construction as should the cost of temporary or emergency work to restore water to facilities during low-flow periods.
- The environmental impacts of continual river channel work and bank stabilization are rarely accounted for and planned for in permanent pump station construction and operation but can be significant.

This list is not intended to be all inclusive but only to highlight the significant issues facing permanent pump facility operation and maintenance concerns. As more information becomes available this document can be updated.

Appendix A

Yellowstone River Flow Rates



Yellowstone River at Billings, MT Flow Rates
(USGS 06214500)
Flow (cfs)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
J
F
M
A
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J
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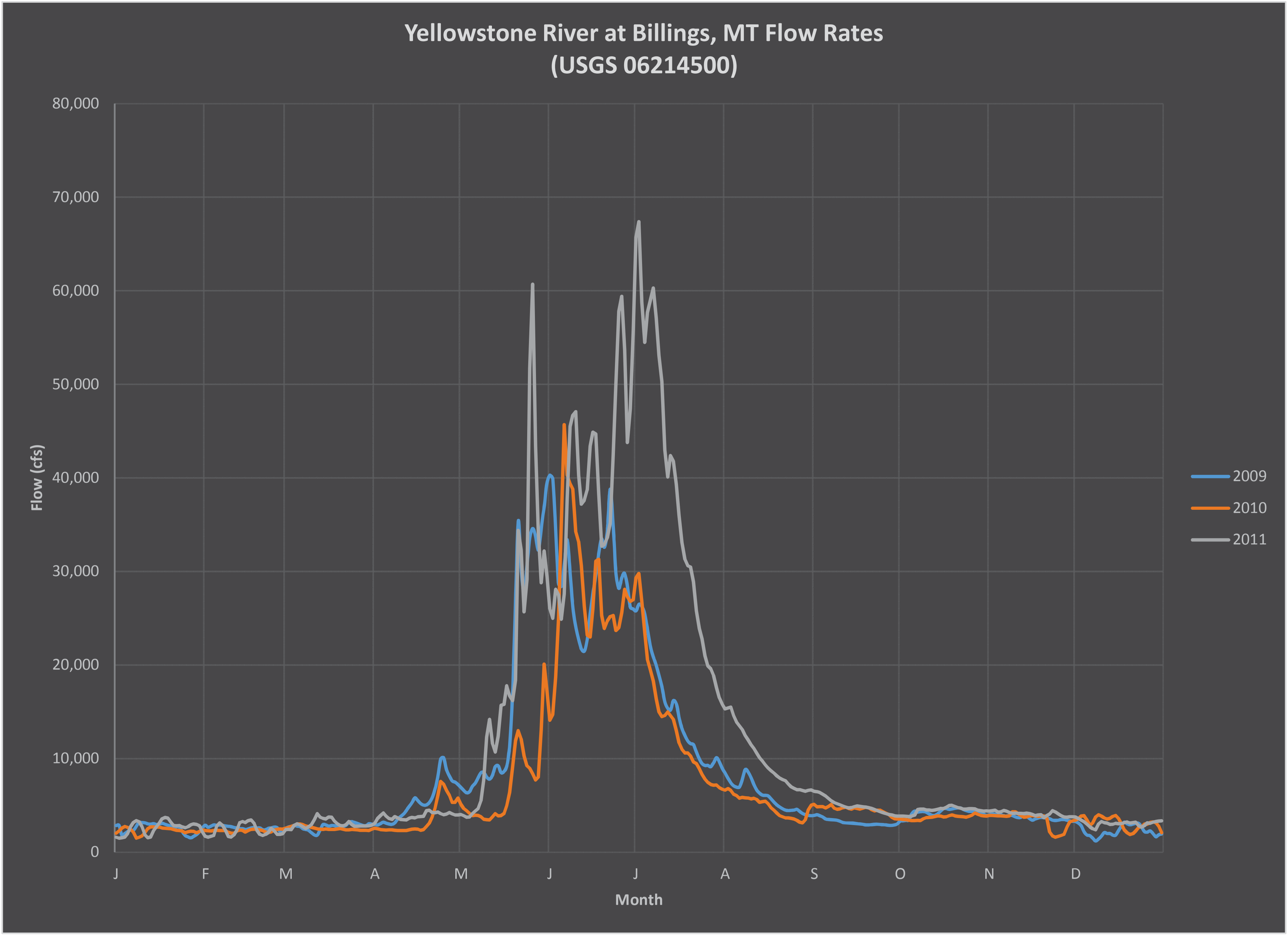
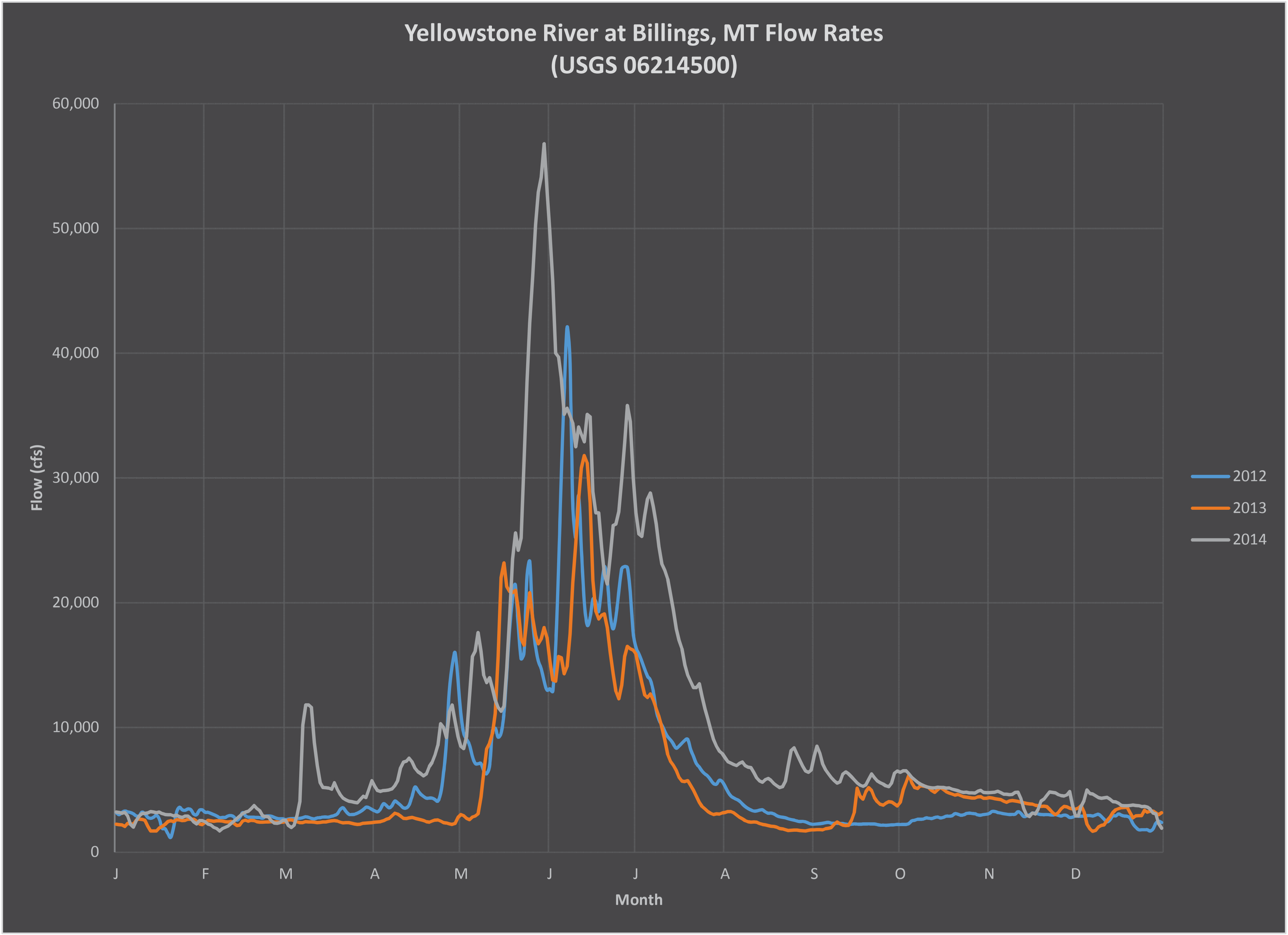
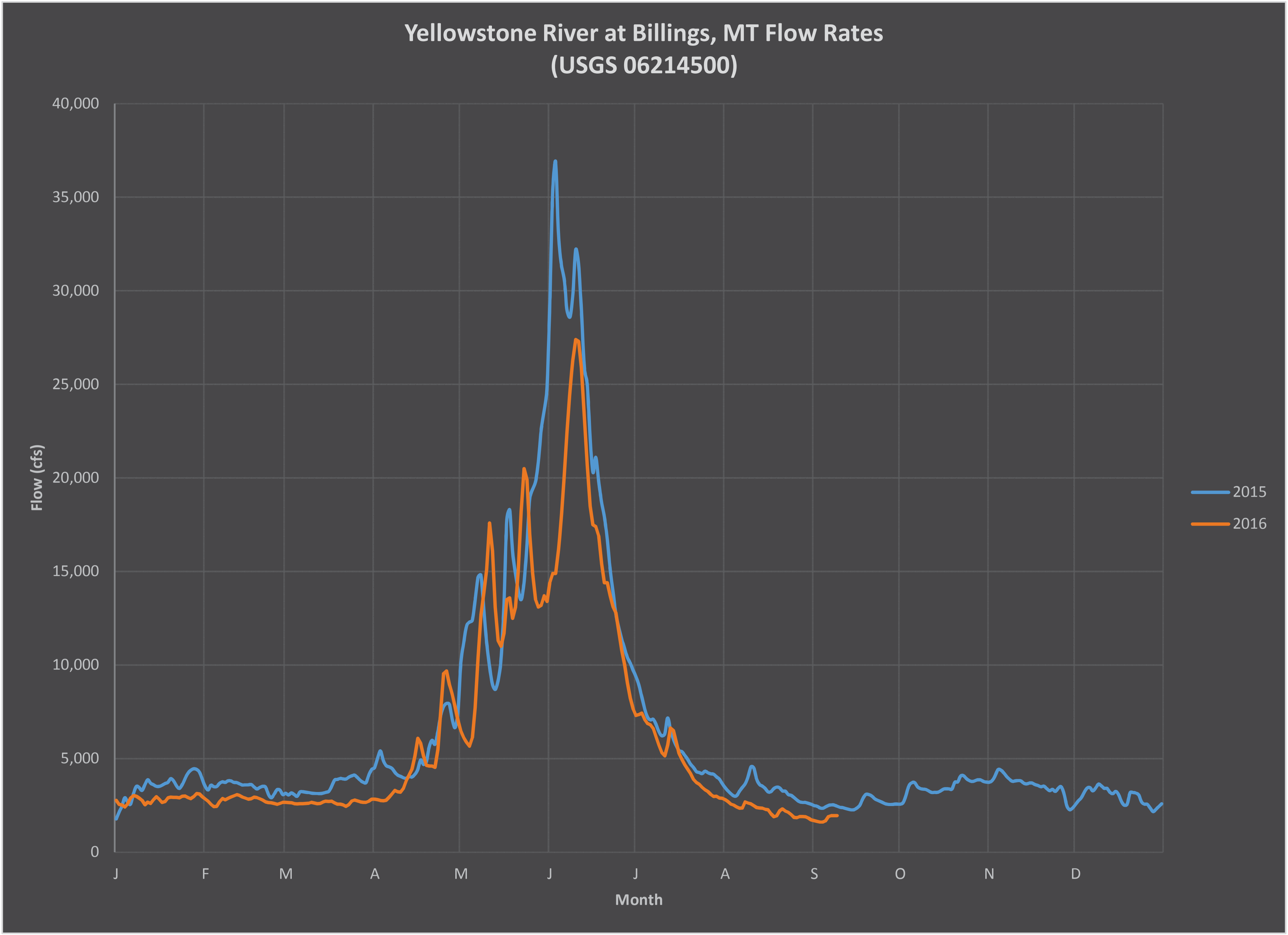
S
O
N
D
Month
2006
2007
2008



Yellowstone River at Billings, MT Flow Rates
(USGS 06214500)
Flow (cfs)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
2009
2010
2011



Yellowstone River at Billings, MT Flow Rates
(USGS 06214500)
Flow (cfs)
60,000
50,000
40,000
30,000
20,000
10,000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
2012
2013
2014


Yellowstone River at Billings, MT Flow Rates
(USGS 06214500)
Flow (cfs)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
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J
F
M
A
M
J
J
A
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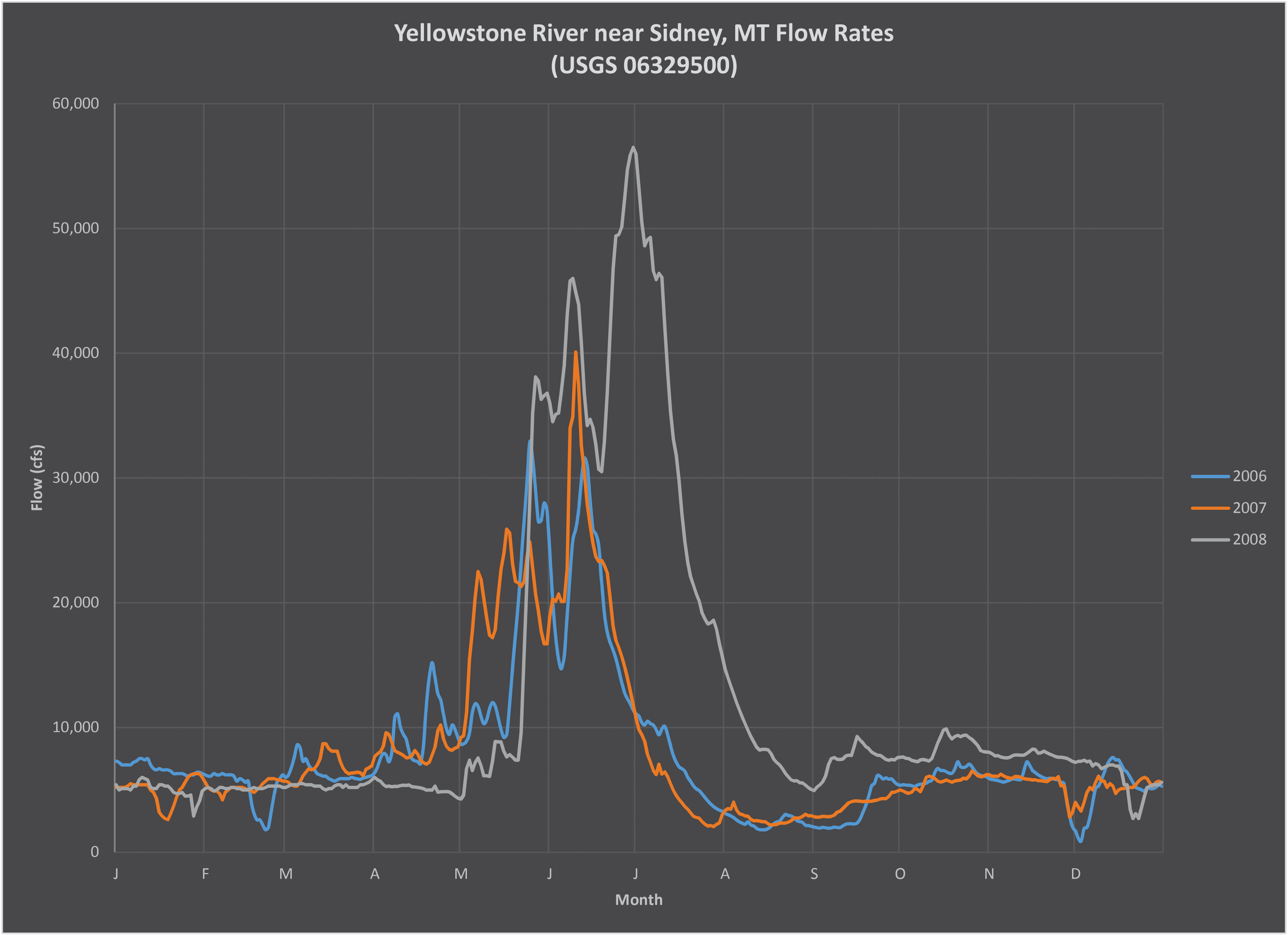
O
N
D
Month
2015
2016


Yellowstone River near Sidney, MT Flow Rates
(USGS 06329500)
60,000
50,000
40,000
30,000
20,000
10,000
0
Flow (cfs)
J
F
M
A
M
J
J
A
S
O
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D
Month
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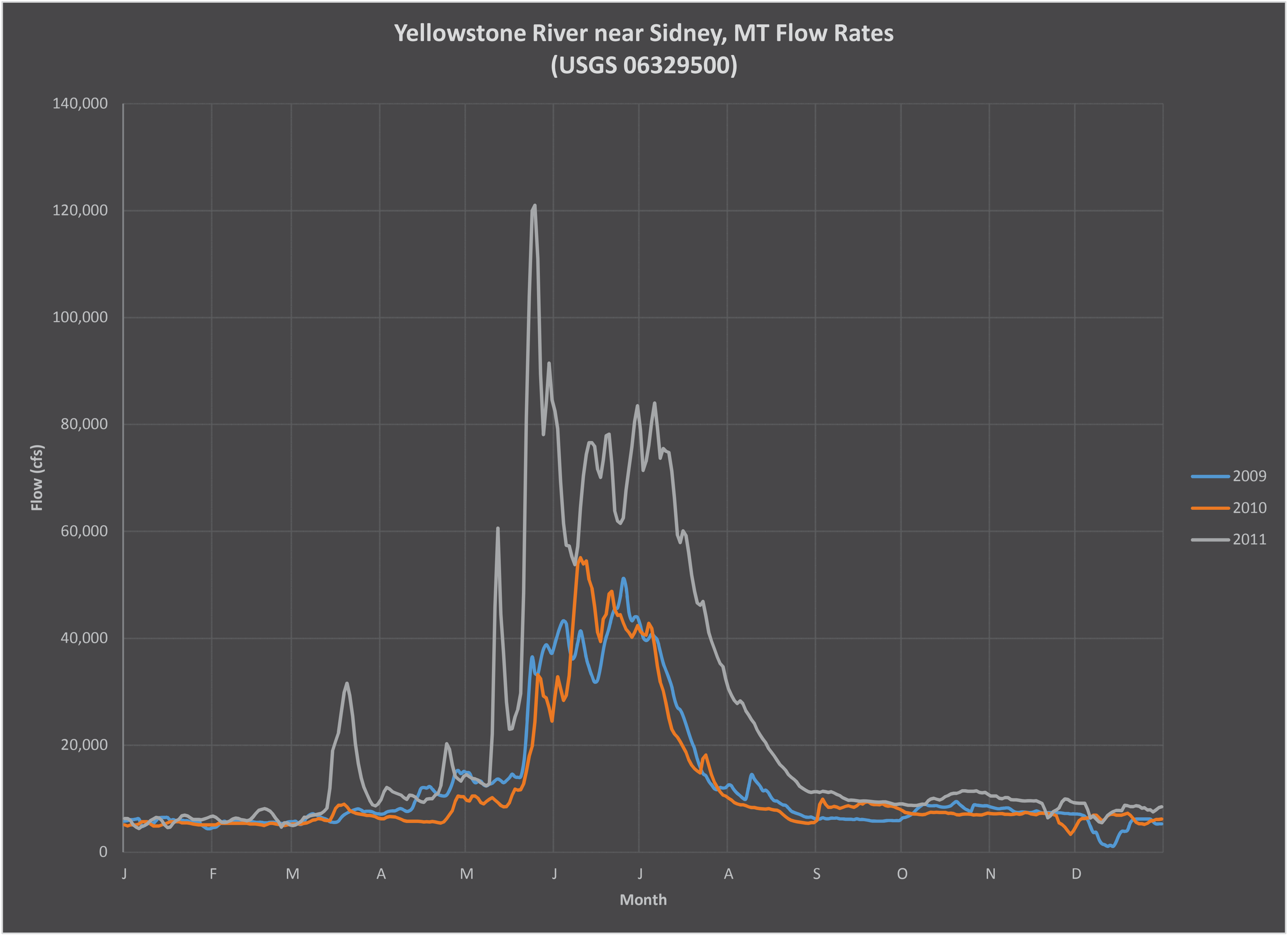
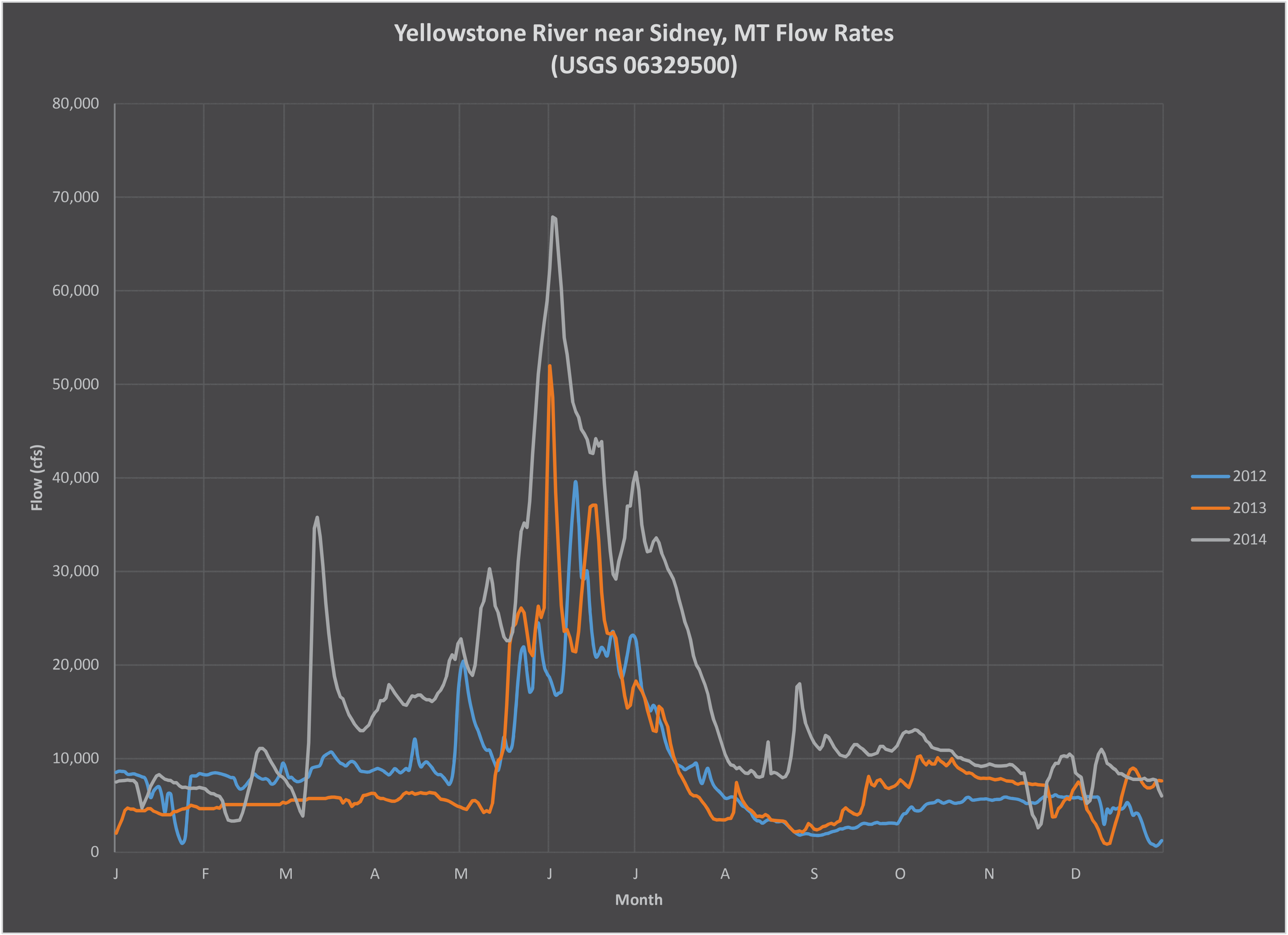
2007
2008


Yellowstone River near Sidney, MT Flow Rates
(USGS 06329500)
Flow (cfs)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
2009
2010
2011



Yellowstone River near Sidney, MT Flow Rates
(USGS 06329500)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
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Flow (cfs)
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F
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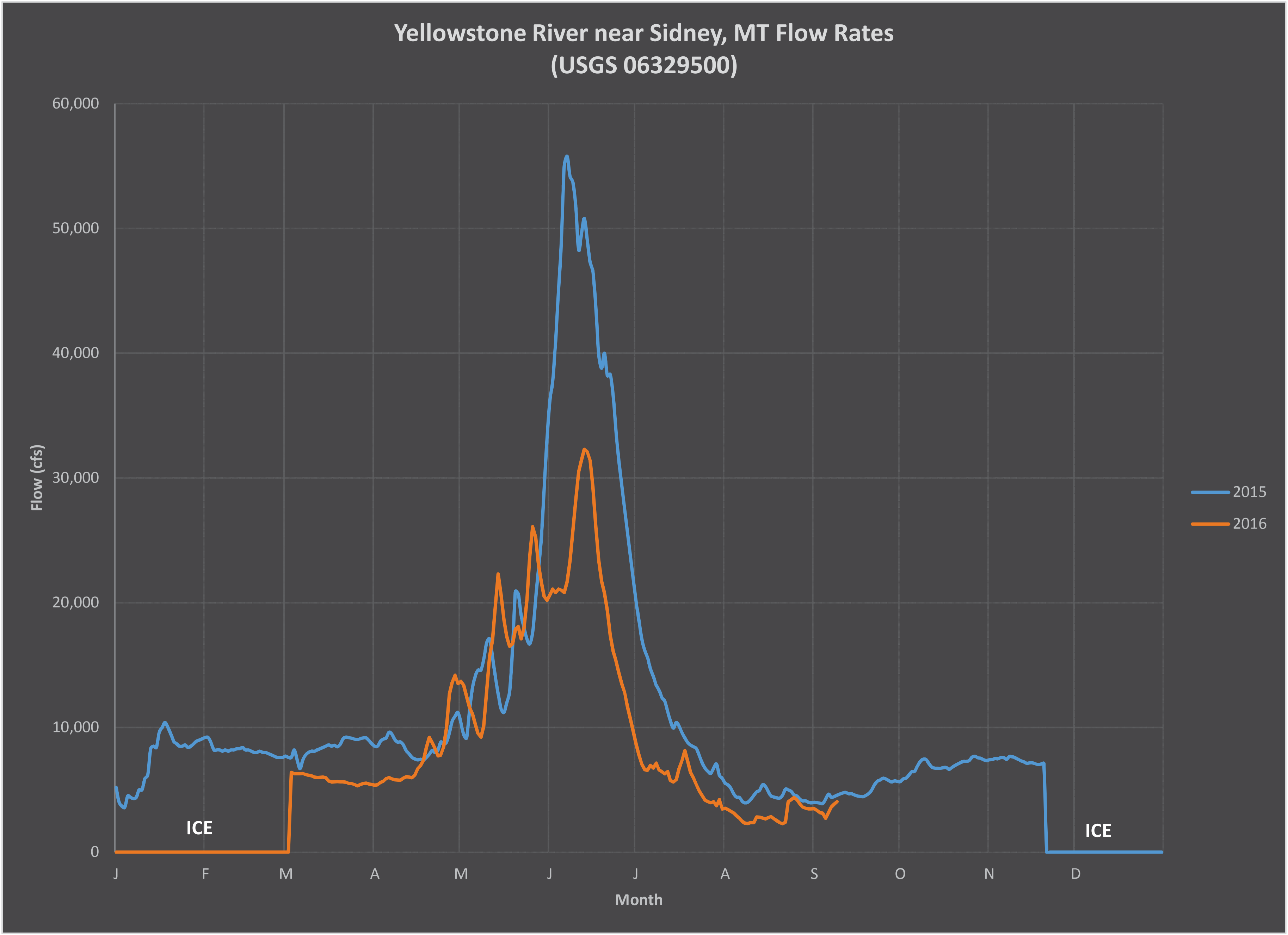
J
A
S
O
N
D
Month
2012
2013
2014


Yellowstone River near Sidney, MT Flow Rates
(USGS 06329500)
Flow (cfs)
60,000
50,000
40,000
30,000
20,000
10,000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
ICE
ICE
2015
2016

Appendix B

Yellowstone River Ice Jam Events

Appendix B. Ice Jam Occurrences

B.1. Mainstem Yellowstone

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
Yellowstone	Livingston	PC13	1/17/2007	Released	At 955 AM MST Wednesday 17 January 2007, the National Weather Service of Billings MT, issued a Flood Warning for Central Park County in South Central Montana. The Department of Emergency Services in Park County reported flooding along the Yellowstone River, 13 miles south of Livingston, caused by water backup due to a freeze-up ice jam. Water had inundated one house in the area. People residing in the area along the Yellowstone River, from 4 miles south of Livingston to Pine Creek, were urged to be alert to the possibility of flooding through Thursday morning. In an Area Forecast Discussion issued by NWS in Billings at 853 AM MST Fri 19 January, the flood warning was canceled. River gages indicated that the jam had released and water was flowing freely again. -- Keywords: Yellowstone River at Livingston, MT on Jan 17, 2007 [20070117130138]	1 house flooded
Yellowstone	Livingston	PC15	2/8/1996		Ice jams clog rivers and create floods. Livingston is among the "hardest hit" [Billings Gazette, Feb, 8, 1996]. The counties of Carbon, Custer, Lewis and Clark, Lincoln, Park Sanders, Stillwater and Teton also reported flooding from ice jams. -- Keywords: Yellowstone River at Livingston, MT on Feb 08, 1996 [20010717135823]	?
Yellowstone	Columbus	A13	2/6/1996	Break-up	As reported in the Billings Gazette on February 6, 1996, "Gary Witt;s bowling night was cut short Thursday, when he had to rescue 22 head of his father's from the flooding Yellowstone River across the street from Air Bowl Lanes in Columbus. 'When I went bowling at about 7 p.m. (Thursday) everything was fine,' he said. 'About an hour later the whole field was flooded.' Witt and about five other volunteers from Columbus spent the next hour and a half in waist-deep water getting Witt's father's cows out of the pasture-turned-lake. Fourteen cows, six yearlings and two baby calves were taken from the field and moved out to Witt's brother's property outside of town. Just one stubborn cow remains roaming around on the high ground in the field. Witt said an ice jam on the Yellowstone sent water into his father's pasture on the southern edge of Columbus. The ice jam broke and the water has receded, but the one cow in the field remains uncooperative." -- Keywords: Yellowstone River at Columbus, MT on Feb 06, 1996 [1757]	Flooding

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Laurel	A17	2/6/1996		An ice jam on the Little Bighorn River near Crow Agency, MT completely flooded four homes and threatened 50-60 others. The jam was located south of Crow Agency near the I-90 interchange with Route 212. I-90 was being flooded though it remained open to traffic. The jam was estimated as 3 football fields long. Other jams were reported along the Yellowstone south of Billings where Jellison and River Roads were being flooded. Another jam near Huntley was causing some flooding along the Yellowstone. Dynamite was used in Laurel to blast other jams on the Yellowstone. In Miles City, a five-mile-long jam blocked the mouth of the Tongue River where it empties into the Yellowstone. Twenty-nine of Montana's 56 counties reported flooding on this day. Hysham had reportedly been flooded with 5 feet of Yellowstone water on a nearby highway on Feb 8. The total damages for February's ice jams in Montana include...$1.8 million in publically owned fascilities, two homes completely destroyed, 197 homes damaged 46 of which had to be evacuated, three deaths and two train derailments. -- Keywords: Yellowstone River at Laurel, MT on Feb 06, 1996 [1767]	Flooding
Yellowstone	Laurel	A17	2/21/1997	Freeze-up	An ice jam was reported on Feb 21, 1997 as moving toward Miles City at 1.5 feet above flood stage. The jam was located near the 7th Street Bridge. Water was seen flowing over the ice. More ice is moving towards the jam and building up towards Miles City. In Laurel, a jam is causing lowland flooding around the 56th Street Bridge area. Another jam has been spotted in Hathaway as well. Flooding was also occuring in Kinsey. The Miles City jam was reported to extend several miles. -- Keywords: Yellowstone River at Laurel, MT on Feb 21, 1997 [1768]	?
Yellowstone	Billings	B2	12/31/1968	Freeze-up	The 1969 USGS Water Resources Data for Montana reported a minimum discharge on the Yellowstone River at Billings, MT, of 1,090 cfs on 31 December 1968 as a result of a freeze-up ice event. Gage height was 1.44 ft. No other information was available. -- Keywords: Yellowstone River at Billings, MT on Dec 31, 1968 [20060717192230]	?
Yellowstone	Billings	B2	2/6/1996		An ice jam on the Little Bighorn River near Crow Agency, MT completely flooded four homes and threatened 50-60 others. The jam was located south of Crow Agency near the I-90 interchange with Route 212. I-90 was being flooded though it remained open to traffic. The jam was estimated as 3 football fields long. Other jams were reported along the Yellowstone south of Billings where Jellison and River Roads were being flooded. Another jam near Huntley was causing some flooding along the Yellowstone. Dynamite was used in Laurel to blast other jams on the Yellowstone. In Miles City, a five-mile-long jam blocked the mouth of the Tongue River where it empties into the Yellowstone. Twenty-nine of Montana's 56 counties reported flooding on this day. Hysham had reportedly been flooded with 5 feet of Yellowstone water on a nearby highway on Feb 8. The total damages for February's ice jams in Montana include...$1.8 million in publically owned fascilities, two homes completely destroyed, 197 homes damaged 46 of which had to be evacuated, three deaths and two train derailments. -- Keywords: Yellowstone River at Billings, MT on Feb 06, 1996 [1754]	Flooded roadways

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Billings	B2	1/3/1997		Ice floes, several miles long, was jamming the Yellowstone River causing evacuations from homes and ranches. Over a foot of water covered Riverfront Park where the Yellowstone's waters surpassed bankful. Ice jams were also reported along the Musselshell River between Lavina and Ryegate (causing minor flooding of U.S. Highway 12) and the Bighorn River which reached its flood stage of 9.0 feet. Ice jams continued to cause flooding on Jan 4 with waters covering and forcing the closure of North 14th Road in Billings. Some of the chunks of ice left behind in yards were 1.5 feet thick. This flooding was estimated to cause $40,000-50,000 in damages to Yellowstone County. Six homes and a trailer park (Blain's Mobile Home Court) were affected. Outside of Yellowstone County, the river never reached its flood stage. An ice jam was also forming aroung West 57th Street west of Billings by Jan 12. Another ice jam was located near the Duck Creek Bridge, extending at least a half a mile west of the bridge. By Feb 22, 1997 the ice jam north of Miles City broke up, but smaller ice jams still persisted near Rosebud, Hathaway, Huntley (Road 14), Pompeys, and Laurel though they have all broken up into smaller packs of ice less than a quarter mile long. -- Keywords: Yellowstone River at Billings, MT on Jan 03, 1997 [1755]	Flooding, evacuations
Yellowstone	Billings	B2	1/10/1997		An ice jam was forming and water was ponding in low-lying areas as a result just West of Billings. This ice jam is located at the 56th Street Bridge area and is backed up toward Laurel. An ice jam was also located near the Clarks Fork confluence near Laurel. Minor low-land flooding was reported. In February, the ice jam is still located near the Duck Creek Bridge and was backed up toward Laurel. Another ice jam was located at the confluence of the Yellowstone and Tongue Rivers adding to the low-land flooding with water backing up behind the jam. -- Keywords: Yellowstone River at Billings, MT on Jan 10, 1997 [1756]	?
Yellowstone	Worden	B6	1/3/1997	Freeze-up	Severe flooding along the Yellowstone River, east of Worden, forced a few families to evacuate due to high waters and ice jams. The "ice dam" was located between North 7th and 8th Roads. -- Keywords: Yellowstone River at Worden, MT on Jan 03, 1997 [1777]	Severe flooding, evacuations
Yellowstone	Glendive	C4	1/1/1962	Break-up	As reported by McClure and Herman, "A fairly new bridge built in the latter 1950's on the State Primary System at Glendive, Montana ended up with a badly cracked pier after the spring ice run [on the Yellowstone River] of 1962." -- Keywords: Yellowstone River at Glendive, MT on ? ?, 1962 [20000224082744]	pier cracked
Yellowstone	Glendive	C4	3/15/1972		According to Anderson (1972), several ice jams along the Yellowstone River affected towns from Glendive through the confluence of the Yellowstone and Missouri Rivers. The river waters raged through for four days before subsiding. Many people were evacuated as several feet of water raged through their homes and the hardest hit area was Cheney point as well as the lowlands near Savage and Crane. This flood has been dubbed the worst flood since 1928. Ice jams were reported along the Lone Tree Creek, Fox Creek, and Yellowstone Rivers due to warm temperatures and high waters. Roberts (1972) reported that the Highway 16 Bridge in Sidney was weakening with only 2 of the 3 piers were standing. Also, Highway 16 to Glendive was closed. Also, due to the Fox Creek waters in the Newlon area, the East Redwater Bridge was	Severe flooding

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
					washed out (between Richey and Highway 201) and the Kenneth Voss Bridge was washed out. There were no reported injuries or deaths. In some areas, the Yellowstone River waters extended over four miles wide. -- Keywords: Yellowstone River at Glendive, MT on Mar 15, 1972 [9128]	
Yellowstone	Hysham	C5	2/8/1996	Freeze-up	Ice jams clog rivers causing them to overflow. "State officials received a report of 5 feet of Yellowstone River water over a highway near Hysham" [Billings Gazette, Feb. 8, 1996]. The counties of Carbon, Custer, Lewis and Clark, Lincoln, Park Sanders, Stillwater and Teton also reported flooding from ice jams. -- Keywords: Yellowstone River at Hysham, MT on Feb 08, 1996 [20010717141128]	?
Yellowstone	Hysham	C5	1/2/1997		An ice jam just East of Hysham in Treasure County has caused the Yellowstone River to flood a fish and game preserve North of town. Many low-land areas have been flooded as well as some roadways near streams and rivers. -- Keywords: Yellowstone River at Hysham, MT on Jan 02, 1997 [1765]	?
Yellowstone	Hysham	C5	3/15/2003	Break-up	The NWS reports on 16 March 2003 that the Flash flood warning due to ice jam has been canceled at Hysham. However, the ice jam that broke up Saturday night on the Yellowstone River near Hysham has moved downstream and set up near Hathaway. No other information available. -- Keywords: Yellowstone River at Hysham, MT on Mar 15, 2003 [20030317103005]	?
Yellowstone	Forsyth	C10	2/7/1996	Break-up	A 2/7/96 NWS Flood Advisory stated that an ice jam had formed on the Yellowstone River in Forsyth, MT. -- Keywords: Yellowstone River at Forsyth, MT on Feb 07, 1996 [1762]	?
Yellowstone	Hathaway	C14	2/7/1996	Break-up	A NWS Flood Advisory on 2/7/96 reported that the Yellowstone River had an ice jam in Hathaway, MT and was causing flooding. -- Keywords: Yellowstone River at Hathaway, MT on Feb 07, 1996 [1763]	Flooding
Yellowstone	Hathaway	C14	2/20/1997	Freeze-up	An ice jam was reported on Feb 21, 1997 as moving toward Miles City at 1.5 feet above flood stage. The jam was located near the 7th Street Bridge. Water was seen flowing over the ice. More ice is moving towards the jam and building up towards Miles City. In Laurel, a jam is causing lowland flooding around the 56th Street Bridge area. Another jam has been spotted in Hathaway as well. Flooding was also occuring in Kinsey. The Miles City jam was reported to extend several miles. An ice jam has been reported near Hathaway in Custer County along the Yellowstone, 16 miles Southwest of Miles City and East of Rosebud. Low-land flooding had occurred. Much of the jamming was closer to Rosebud than Miles City concerning Hathaway. Hathaway was being flooded as a result of those jams near Rosebud. -- Keywords: Yellowstone River at Hathaway, MT on Feb 20, 1997 [1764]	Lowland flooding
Yellowstone	Hathaway	C14	2/3/1998	Break-up	On Tuesday, February 3, 1998 at 5:37 pm the NWS reported that ice jams had developed along the Yellowstone River near the town of Hathaway in Rosebud County. Water was flowing into low lying areas and most back channels were reported full. Livestock had been moved from the ice jam area. On Thursday, February 5, 1998 at 3:49 pm the NWS reported that minor ice jamming near Hathaway dissipated. Minor flooding was no longer being reported. -- Keywords: Yellowstone River at	Lowland flooding

River	City	Reach	Date	Jam Type	Description	Damages
					Hathaway, MT on Feb 03, 1998 [2035]	
Yellowstone	Hathaway	C14	3/15/2003	Break-up	The NWS report for March 15: at 930 PM MST an ice jam on the Yellowstone River just west of Hathaway broke and caused a surge of water to flow rapidly downstream. This surge of water resulted in flooding along the Yellowtone River in Hathaway. As this water surge moves downstream flooding will be possible up to 10 to 15 miles downstream of Hathaway. Flash flood warnings in effect. The NWS report for March 16: Rosebud County Emergency Manager reports that the Yellowstone River in Hathaway continues to remain frozen this morning. This is allowing the water levels to continue to rise in Hathaway. At 432 PM EST it was reported that the ice jam in Hathaway broke free. This has allowed the water in the Yellowstone River in the vicinity of Hathaway to flow freely. The flood warning has been canceled. -- Keywords: Yellowstone at Hathaway, MT on Mar 15, 2003 [20030317105016]	?
Yellowstone	Miles City	C16	3/10/1934		maximum annual gage height of 11.02 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 10, 1934. -- Keywords: Yellowstone River at Miles City, MT on Mar 10, 1934 [11436]	?
Yellowstone	Miles City	C16	3/22/1939		maximum annual gage height of 11.37 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 22, 1939. -- Keywords: Yellowstone River at Miles City, MT on Mar 22, 1939 [11437]	?
Yellowstone	Miles City	C16	3/23/1941		maximum annual gage height of 7.82 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 23, 1941. -- Keywords: Yellowstone River at Miles City, MT on Mar 23, 1941 [11438]	?
Yellowstone	Miles City	C16	3/26/1943		maximum annual gage height of 14.0 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 26, 1943. Maximum high water stage for the period 1923, 1929-1963: 14.05 feet (82,800 cfs) on June 30, 1944, followed by 13.05 feet (70,500 cfs) on June 8, 1948. -- Keywords: Yellowstone River at Miles City, MT on Mar 26, 1943 [11439]	?
Yellowstone	Miles City	C16	3/20/1944		maximum annual gage height of 12.9 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 20, 1944. Note says "Backwater from ice; gage height, 21.7 feet, present site and datum, from flood mark." As reported in the Miles City Star on Tuesday, June 17, 1997, "Severe ice jams in 1944 pushed the Yellowstone past 19 feet before the river crested. Hundreds of residences had to be evacuated before planes were called in to bomb the ice jams and even the flow. ... After the dike was built, [the Miles City Dike, built in 1936] it suffered its first extensive damage during the March 1944 flood in Miles city. The cause of the flood was by ice jams at the mouth of the Tongue River during the spring runoff and ice breakup, which caused the water to back up and rise, according to Corps history. Due to runoff and ice-breakup period in March the flow in the Yellowstone River subjected the levee to erosion and undercutting. Local interests are reported to have fixed the damage and restore the levee to its original cross-section, orientation and profile. Four locations were listed by the Corps for areas of damage during the 1944 flood. The first place was upstream from Main Street bridge during	Flooding and evacuations

River	City	Reach	Date	Jam Type	Description	Damages
					that era. The second place was downstream from the Chicago, Milwaukee. St. Paul and Pacidic Railroad area. At this site, the Tongue River overflowed the levee, washing out the dike for about 60 feet. The third place was at the intersection of the levee and Vinton Street, where the Yellowstone River undercut the levee through erosion of the river bank and the levee slope-foundation for approximately 125 feet. The final location of damage was between Lewis Street and Tatro Street, where the levee was breached for about 220 feet, according to the Corps report, which added that repairs were completed that same year by local interests as a cost unknown." -- Keywords: Yellowstone River at Miles City, MT on Mar 20, 1944 [11440]	
Yellowstone	Miles City	C16	3/2/1946	Break-up	Weather Bureau reports ice broke up in the Yellowstone River March 2, 1946. Stage at gage at Miles City was 5.0 feet on March 1, 8.3 feet on March 2, and 5.0 feet on March 3. Gage datum 2337.88 feet MSL, flood stage 13 feet. -- Keywords: Yellowstone River at Miles City, MT on Mar 02, 1946 [11441]	?
Yellowstone	Miles City	C16	3/20/1947	Break-up	Weather bureau reports ice jam downstream from gage Yellowstone River at Miles City on March 20, 1947. Peak stage 12.6 ft. Gage datum 2337.88 ft MSL, flood stage 13 ft. -- Keywords: Yellowstone River at Miles City, MT on Mar 20, 1947 [11442]	?
Yellowstone	Miles City	C16	3/26/1949		maximum annual gage height of 10.3 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 26, 1949. -- Keywords: Yellowstone River at Miles City, MT on Mar 26, 1949 [11443]	?
Yellowstone	Miles City	C16	4/6/1950		maximum annual gage height of 13.8 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on April 6, 1950. -- Keywords: Yellowstone River at Miles City, MT on Apr 06, 1950 [11444]	?
Yellowstone	Miles City	C16	3/26/1951		maximum annual gage height of 12.8 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 26, 1951. -- Keywords: Yellowstone River at Miles City, MT on Mar 26, 1951 [11445]	?
Yellowstone	Miles City	C16	3/26/1956		maximum annual gage height of 12.42 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 26, 1956. -- Keywords: Yellowstone River at Miles City, MT on Mar 26, 1956 [11446]	?
Yellowstone	Miles City	C16	2/21/1958		maximum annual gage height of 10.83 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on February 21, 1958. -- Keywords: Yellowstone River at Miles City, MT on Feb 21, 1958 [11447]	?
Yellowstone	Miles City	C16	3/13/1959		maximum annual gage height of 12.9 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on March 13, 1959. -- Keywords: Yellowstone River at Miles City, MT on Mar 13, 1959 [11448]	?
Yellowstone	Miles City	C16	3/19/1960		maximum annual gage height of 15.5 feet, affected by ice, reported at USGS gage Yellowstone River at Miles City on March 19, 1960. This is the maximum stage for the period 1923, 1929-1963 (see note on 3/20/44); maximum open water stages: 14.05 feet (82,800 cfs) on June 30, 1944 and 13.05 feet (70,500 cfs) on June 8, 1948. -- Keywords: Yellowstone River at Miles City, MT on Mar 19, 1960 [11449]	?

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Miles City	C16	2/17/1962		maximum annual gage height of 14.84 feet, affected by backwater from ice, reported at USGS gage Yellowstone River at Miles City on February 17, 1962. Maximum open water stages for the period 1923, 1929-1963: 14.05 feet (82,800 cfs) on June 30, 1944 and 13.05 feet (70,500 cfs) on June 8, 1948. -- Keywords: Yellowstone River at Miles City, MT on Feb 17, 1962 [11450]	?
Yellowstone	Miles City	C16	3/17/1966		On 17 March 1966 at the USGS Yellowstone River station, at Miles City, Montana, an annual maximum gage height of 11.10 feet was recorded, caused by an ice jam. Discharge 14,000 cfs. -- Keywords: Yellowstone River at Miles City, MT on Mar 17, 1966 [20020722151152]	?
Yellowstone	Miles City	C16	3/1/1968		On 1 March 1968 at the USGS Yellowstone River station, at Miles City, Montana, an annual maximum gage height of 16.43 feet was recorded, caused by an ice jam. Discharge 13,000 cfs. -- Keywords: Yellowstone River at Miles City, MT on Mar 01, 1968 [20020722150724]	?
Yellowstone	Miles City	C16	3/19/1969		As a result of backwater from ice, an annual maximum gage height of 16.11 feet was recorded at the USGS Yellowstone River station at Miles City Montana on 19 Mar 1969. Associated discharge 22,000 cfs. -- Keywords: Yellowstone River at Miles City, MT on Mar 19, 1969 [20020722145750]	?
Yellowstone	Miles City	C16	2/1/1971	Break-up	As reported in the Miles City Star on June17, 1997, "The next serious flood in Miles City was recorded in February of 1971. Again, ice jams along the Yellowstone River during the February-March runoff and ice-breakup period caused the water to back up and rise on both the Tongue and Yellowstone Rivers. Corps history states that the levee was severely threatened by erosion in the reach immediately upstream from the Burlington Northern Railroad crossing of the Tongue River, where the top of the levee was eroded to about two feet wide from its 9- to 36-feet-wide variance. Again repairs were completed that same year by local interests at a cost unknown, the report states." -- Keywords: Yellowstone River at Miles City, MT on Feb ?, 1971 [11451]	Levee threatened by erosion
Yellowstone	Miles City	C16	3/1/1972	Break-up	As reported in the Miles City Star on June 17, 1997, "The following year [1972], the dike received more damage from ice jams in March. The repair location was recorded at the old Tongue River channel where erosion and undercutting were repaired to the kie's orifinal cross-section, orientation and profile. Repairs also were completed within the year at a cost unknown by local interests." -- Keywords: Yellowstone River at Miles City, MT on Mar ?, 1972 [11452]	Dike damage
Yellowstone	Miles City	C16	3/8/1994		Ice jams on the Yellowstone River near Miles City caused high rising waters to damage a 150-200 foot long section of the city dike. No emergency repairs were needed. -- Keywords: Yellowstone River at Miles City, MT on Mar 08, 1994 [11453]	Miles City dike damaged
Yellowstone	Miles City	C16	2/8/1996	Break-up	According to a NWS River Statement, an ice jam was reported on the Yellowstone River in Miles City, MT on 2/8/96. The jam broke loose on 2/12/96. The jam damaged the gage at Miles City. -- Keywords: Yellowstone River at Miles City, MT on Feb 08, 1996 [11454]	Damaged water gauges

River	***City***	***Reach***	***Date***	***Jam Type***	***Description***	***Damages***
Yellowstone	Miles City	C16	2/18/1997		An ice jam has formed about 2.5 miles Northeast of Miles City near Buffalo Rapids. This jam later backed up below Miles City. Some portions of the Dike were damaged or broken. Some homes have been flooded. The first ice movement was for the 7th Street jam in Miles City. An ice jam was reported on Feb 21, 1997 as moving toward Miles City at 1.5 feet above flood stage. The jam was located near the 7th Street Bridge. Water was seen flowing over the ice. More ice is moving towards the jam and building up towards Miles City. In Laurel, a jam is causing lowland flooding around the 56th Street Bridge area. Another jam has been spotted in Hathaway as well. Flooding was also occuring in Kinsey. The Miles City jam was reported to extend four miles. -- Keywords: Yellowstone River at Miles City, MT on Feb 18, 1997 [11455]	Flooding in low-lands, dike damaged
Yellowstone	Miles City	C17	3/20/1944		On 20 March 1944 the maximum gage height of 21.7 feet was recorded at the USGS station at Yellowstone River, Miles City, Montana due to an ice jam. Period of record 1923, 1928-1970. -- Keywords: Yellowstone River at Miles City, MT on Mar 20, 1944 [20020703093751]	?
Yellowstone	Miles City	C17	1/7/1970	Freeze-up	A minimum annual discharge of 2,290 cfs was recorded at USGS station at Yellowstone River, Miles City, Montana on 7 January 1970, due to freezeup. Gage height 1.31 feet. -- Keywords: Yellowstone River at Miles City, MT on Jan 07, 1970 [20020703093316]	?
Yellowstone	Miles City	C17	2/14/1971		The USGS reported a maximum gage height of 20.59 ft on 14 February 1971, on the Yellowstone River at Miles City, Montana due to an ice jam. Discharge was 45,000 cfs. -- Keywords: Yellowstone River at Miles City, MT on Feb 14, 1971 [20021216125603]	?
Yellowstone	Kinsey	C19	3/5/1994		An ice jam was reported to break on March 5, 1994 near Kinsey (a few miles northeast of Miles City) causing flooding of lowlands in the area along the Yellowstone River. -- Keywords: Yellowstone River at Kinsey, MT on Mar 05, 1994 [1766]	?
Yellowstone	Terry	D1	3/26/1993	Break-up	An ice jam broke 20 miles west of Terry along the Yellowstone River on Mar 26 , 1993. There was also a jam reported where the Powder River flows into the Yellowstone on this date. -- Keywords: Yellowstone River at Terry, MT on Mar 26, 1993 [1773]	?
Yellowstone	Terry	D1	2/9/1996	Break-up	According to NWS Flood Statements an ice jam broke loose in Terry, MT on 2/9/96 and another jam was reported downstream of Terry on the Yellowstone River on 2/10/96. A three-mile ice jam was located between Terry and Fallon and was causing high water. -- Keywords: Yellowstone River at Terry, MT on Feb 09, 1996 [1774]	?

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
Yellowstone	Fallon	D2	4/1/1943	Break-up	As reported in the Sidney Herald on Thursday, April 1, 1943, "With the break up of the Yellowstone and ice jams going out at Fallon and this side of Glendive, a 13 foot rise in the river at Intake was reported Sunday with the swift current carrying the pack ice down to the junction with the Missouri where it gorged from Buford to Trenton and backed up the water over the lowlands to a depth of from three to five feet. Livestock in the area were moved to higher ground but many of the farmers remained in their homes, taking refuge in the attics and second floors of their homes, and some in the haylofts of their barns. All had been warned before the water reached their farms, but a number remained at their homes regardless. A dozen or more row boats and several motor boats were brought into play evacuating other families from Sunday through Tuesday when the flood reaches its peak to drop three feet that night. While the women and cildren were taken out, the men stayed at the farms to take care of their livestock which were hearded to ground above the flood level. One farmer, Bill Severance built a platform to put his sheep on and saved them without any loss. Glen Cray, Hohnny Beaver and Hank Falkenhagen moved their cattle and other livestock to a sand knoll where they kept them throught the worst of the hish water, standing in several inches of water for three days without food, according to one report. Other farmers with livestock , in the flood area, resorted to like practices to save their stock and while it is conceded that some livestock losses, in both sheep and cattle were sustained, they were not as serious as expected under the circumstances. Roy Milligan of Miles City spent two days in the area with his plane flying over the flood area to keep contact with the stranded farmers and counted fifty farm homes partly, and in several cases almost entirely submerged. ... It is the worst flood condition that has occurred in the lower valley in history, so far as is known. The ice gorge from Buford to Trenton blocked the escape of the water, but the flood level did drop three feet Wednesday and farmers are getting some of their stock back to their feed yards." -- Keywords: Yellowstone River at Fallon, MT on Apr 01, 1943 [1760]	Severe flooding affecting farmers
Yellowstone	Fallon	D2	2/1/1996	Break-up	A NWS Flood Statement on 2/14/96 stated that ice jams downstream of Fallon were causing lowland flooding. The jam on the Yellowstone River is located between Fallon and Marsh. -- Keywords: Yellowstone River at Fallon, MT on Feb ?, 1996 [1761]	Lowland flooding
Yellowstone	Marsh	D4	3/4/1994	Break-up	Four ice jams between Marsh and Intake carried ice onto roads near Marsh and called for evacuations in Intake. -- Keywords: Yellowstone River at Marsh, MT on Mar 04, 1994 [1769]	Evacuations
Yellowstone	Glendive	D6	3/23/1932		maximum annual gage height of 14.60 feet affected by backwater from ice, reported at USGS gage Yellowstone River at Glendive, on March 23, 1932. This is maximum ice affected gage height of the period 1903-1910, 1932-1934. The maximum open-water event for the same period was 12.7 feet at 118,000 cfs on June 8, 1909. -- Keywords: Yellowstone River at Glendive, MT on Mar 23, 1932 [9123]	?
Yellowstone	Glendive	D6	1/7/1934		maximum annual gage height of 6.83 feet affected by backwater from ice, reported at USGS gage Yellowstone River at Glendive, on January 7, 1934. -- Keywords: Yellowstone River at Glendive, MT on Jan 07, 1934 [9124]	?

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Glendive	D6	1/1/1936		An ice jam was reported on the Yellowstone near Glendive in 1936 flooding the rooftops of buildings in the West Glendive lowlands. Floodstage is 53.65 feet. -- Keywords: Yellowstone River at Glendive, MT on ? ?, 1936 [9125]	?
Yellowstone	Glendive	D6	4/1/1943	Break-up	As reported in the Sidney Herald on Thursday, April 1, 1943, "With the break up of the Yellowstone and ice jams going out at Fallon and this side of Glendive, a 13 foot rise in the river at Intake was reported Sunday with the swift current carrying the pack ice down to the junction with the Missouri where it gorged from Buford to Trenton and backed up the water over the lowlands to a depth of from three to five feet. Livestock in the area were moved to higher ground but many of the farmers remained in their homes, taking refuge in the attics and second floors of their homes, and some in the haylofts of their barns. All had been warned before the water reached their farms, but a number remained at their homes regardless. A dozen or more row boats and several motor boats were brought into play evacuating other families from Sunday through Tuesday when the flood reaches its peak to drop three feet that night. While the women and cildren were taken out, the men stayed at the farms to take care of their livestock which were hearded to ground above the flood level. One farmer, Bill Severance built a platform to put his sheep on and saved them without any loss. Glen Cray, Hohnny Beaver and Hank Falkenhagen moved their cattle and other livestock to a sand knoll where they kept them throught the worst of the hish water, standing in several inches of water for three days without food, according to one report. Other farmers with livestock , in the flood area, resorted to like practices to save their stock and while it is conceded that some livestock losses, in both sheep and cattle were sustained, they were not as serious as expected under the circumstances. Roy Milligan of Miles City spent two days in the area with his plane flying over the flood area to keep contact with the stranded farmers and counted fifty farm homes partly, and in several cases almost entirely submerged. ... It is the worst flood condition that has occurred in the lower valley in history, so far as is known. The ice gorge from Buford to Trenton blocked the escape of the water, but the flood level did drop three feet Wednesday and farmers are getting some of their stock back to their feed yards." -- Keywords: Yellowstone River at Glendive, MT on Apr 01, 1943 [9126]	Severe flooding affecting farmers
Yellowstone	West Glendive	D6	3/19/1959	Break-up	warm air temperatures caused ice breakup."Flooding started at West Glendive at 2:15 a.m. on 19 [March] when a large ice jam 6 miles above the town broke up and moved downstream to join another jam 1.5 miles below Glendive. At about 2:50 p.m. [NB may be a.m.] the lower jam broke up and by 6 a.m. 19 March the flood waters had generally receded. Peak stage 60.5 feet at USGS gaging station at Glendive (flood stage 54.3 feet). 20 homes and businesses flooded, 28 families evacuated, 40 farmsteads inundated. -- Keywords: Yellowstone River at West Glendive, MT on Mar 19, 1959 [1775]	25K USD

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Glendive	D6	1/1/1969		As reported in Andy Tuthill's Trip Report, 2 Oct, 1997, "In 1969 a major ice jam flood overtopped the Cottonwood Dike (then at 2071 ft MSL) by 6 inches, inundating agricultural land and a few homes. No ice got past the dike in 1969. Sections of Highway 335 both on both approaches to the Cottonwood Grove area were also flooded, including the bildings of Western Oil Well Supply, located to the north of Cottonwood Grove. Downstream, the ice jam was level with the tops of the piers on the Interstate 94 Bridge and a sewage pump station in Glendive was flooded. Art [Art Gehnert, a long time resident of Glendive] remembers finding 12-ft-thick "neatly stacked" ice in his fields and observing shear walls 30-ft-high along the channel edges after the ice jam had released. That year the Cottonwood Dike was raised 4 ft to its present elevation of 2075 ft MSL. This improvement prevented flooding during an ice jam that occurred the following year (1970) and all subsequent floods to date. The 7000-ft-long West Glendive Dike was constructed in 1957. Art Gehnert said that, according to Don Peckman, an engineer involved with the original design of the dike, its top elevation was set at 2072 ft, two ft higher than the record high stage of the 1936 ice jam flood. During the 1969 event, and a more recent ice jam flood in 1994, the peak water elevation came to within ,5 ft of the crest of the dike, Gehnert estimated a rate of stage irse of 1 ft e ery 10 minutes during the 1994 event." -- Keywords: Yellowstone River at Glendive, MT on ? ?, 1969 [9127]	Highway, sewage pump sta., oil well supply flooded
Yellowstone	Glendive	D6	2/21/1982		An ice jam was reported on the Yellowstone near Glendive with a river gage of 60.02 feet on March 21, 1959. Flood stage is 53.65 feet. -- Keywords: Yellowstone River at Glendive, MT on Feb 21, 1982 [9129]	?
Yellowstone	West Glendive	D6	12/29/1992		An ice jam reported on the Yellowstone River near West Glendive is threatening the Bell Street Bridge, the only evacuation route for West Glendive residents. -- Keywords: Yellowstone River at West Glendive, MT on Dec 29, 1992 [1776]	?
Yellowstone	Glendive	D6	3/5/1994		An ice jam was reported on the Yellowstone near Glendive with a river gage of 64.0 feet on March 3, 1994. Flood stage is 53.65 feet. According to the Missouri River Division Datacol, an ice jam caused water and ice to nearly overtop the dike at Glendive on March 4, 1994. An ice jam was reported to break on March 5, 1994 near a ranch 14 miles southwest of Glendive along the Yellowstone River. There were several evacuations due to flooding. The river rose to within 18 inches of the dike. Near River Butte, west of Glendive, the water dropped to 59 feet (6 feet above flood stage). In Hathaway, one rancher lost 60 cattle in the floods. -- Keywords: Yellowstone River at Glendive, MT on Mar 05, 1994 [9130]	Dike nearly overtopped, 60 cattle died,

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
Yellowstone	Glendive	D6	2/11/1996	Break-up	The MRD Datacol 2/11/96 indicated that ice was piling up along the Bell Street Bridge in Glendive, MT on the Yellowstone River. The jam extended 10 miles upstream with a 4 mile stretch of open water followed by another 6 mile jam. On 2/13/96 a NWS Flood Statement reported that some of the ice was breaking up but the river was still jammed between the Town Street Bridge and the interstate bridge. Flooded fields were also reported. On 2/16/96 the jam was between the Black bridge and the interstate bridge. The jam was still in existence on 2/20/96. The MRD Datacol 3/13/96 stated that there were several ice jams in Glendive, MT on the Yellowstone River. Newspapers reported that an ice jam at the Glendive bridge was causing flooding along the Yellowstone River on Feb 12, 1996. Another report states that two jams are located near Glendive. One was reportedly 10 miles long while the other was 6 miles long each seperated by 4 miles of open water. Hysham had reportedly been flooded with 5 feet of Yellowstone water on a nearby highway on Feb 8. The total damages for February's ice jams in Montana include...$1.8 million in publically owned fascilities, two homes completely destroyed, 197 homes damaged 46 of which had to be evacuated, three deaths and two train derailments. -- Keywords: Yellowstone River at Glendive, MT on Feb 11, 1996 [9131]	Flooding
Yellowstone	Glendive	D6	2/18/1997		An ice jam was reported near the fairgrounds in Glendive. An ice jam near Engle's Island South of Glendive was backing up water in low-lying areas upstream of Ingle's Island. There was a third jam under the Interstate 94 Bridge. Many people South of Glendive were evacuated. An ice jam was reported on the Yellowstone River near Glendive with a river gage of 51.65 feet on March 20, 1997. Notes mention the I-94 bridge. By Mar 24, an ice jam located near the Dawson/Richland County line was reported to be about 6 miles long causing extensive flooding of low-lying areas. -- Keywords: Yellowstone River at Glendive, MT on Feb 18, 1997 [9132]	?
Yellowstone	Glendive	D6	3/9/1998	Break-up	On Monday March 9, 1998 at 750 PM the NWS reported ice jams along the Yellowstone River near Glendive, "Ice jamming has been occurring along the Yellowstone River in the Glendive area creating rapid river rises. Water flowing into some low lying areas has been noticed. This has created an inconvenience for cattle ranchers along the river with no damage to property or structures. Ice jams will likely continue to affect the area through midweek. Forecast high temperatures through the period will moderate some...with teens expected by Wednesday...forcast lows to be in the single digits below zero." On Tuesday, March 10, 1998 at 9:40 PM the NWS reported, "Ice freeze up has been occurring along the Yellowstone River in the Glendive area creating some rapid river rises. Wate flowing into some low lying areas was noticed before the river began freezing again during the last few days." As reported by the NWS on Thursday, March 12, 1998 at 2:49 PM, "River levels along the Yellowstone River near Glendive have fallen over the past few days. Colder weather has resulted in less flow of water along the river in the area. As a result...this has not allowed any immediate concerns of ice jam flooding along the Yellowstone River in the Glendive area." -- Keywords: Yellowstone River at Glendive, MT on Mar 09, 1998 [9133]	Lowland flooding

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
Yellowstone	Glendive	D6	3/16/2003	Break-up	The NWS reports on March 16: Minor breakup ice jam flooding is occurring on the Yellowstone River at Glendive. Stage is 55.8 feet measured at 7 PM Sunday. The stage exceeded the flood stage of 53.5 feet at 08 AM Sunday. The river is expected to remain above flood stage overnight. -- Keywords: Yellowstone at Glendive, MT on Mar 16, 2003 [20030317110342]	?
Yellowstone	Glendive	D6		Break-up	Yellowstone River at Glendive--1899 Often a search of local historical records reveals ice jam information that is not contained elsewhere. One such example is the Yellowstone River flood at Glendive in April 1899, of which no mention was made in the usual sources. Discussions with local residents led to a search of old newspaper records which indicated that, in fact, twelve people lost their lives, numerous livestock drowned, many homes were washed away, and several spans of the Yellowstone River Bridge were destroyed during this event. These types of historical records can be quite dramatic: according to the newspaper records, when the ice broke and began running on Friday evening, April 7, 1899, nearly the entire population of Glendive gathered to view the huge (nearly one hundred square foot) cakes of ice crush against the ice breaks (rock-filled timber crib structures) built in front of each pier on the Yellowstone River Bridge. Moments before the ice began to move, the water gage on the ice break registered 19 feet, but after the ice began moving the gage rapidly rose to 30 feet. After the ice run, three of the bridge spans had been washed downstream. Witnesses said that had the bridge been five feet higher, and had all of the ice breaks been built as large and as strong as ice break No. 2, the bridge would still be standing. At the time, the Yellowstone River Bridge was the largest wagon bridge in the entire northwest. It was 1750 feet long and included a draw span that was 326 feet long. The bridge, including approaches and ice breaks, cost Dawson County 50,000 dollars to construct, and was estimated to cost at least 20,000 dollars to rebuild (1899 dollars). According to the newspaper account, when the waters started to inundate the land surrounding the Snyder Ranch, Mrs. R.W. Snyder, Miss Nellie Regan, Miss Rose Wybrecht, Mr. Eugene O'Conner, and Mr. Joseph Myers had to decide whether to move to higher ground (the railroad embankment) or to stay at the ranch. When they finally did make their decision to move to higher ground, which was approximately one block from the ranch, it was too late. The icy water was up to their waists before they made it halfway to the railroad embankment. Mr. O'Conner and Mr. Myers tried to assist the women into a tree, but the water and ice made it impossible, so they decided to tie Miss Regan and Miss Wybrecht to the tree with their suspenders so that the women wouldn't be washed downstream. Mr. Myers was able to climb the tree, but Mr. O'Conner and Mrs. Snyder were unable to climb to safety and were washed downstream, never to be found. Miss Regan and Miss Wybrecht were later found dead, still tied to the tree by the suspenders. Mr. Myers, the only ranch survivor, spent seven hours in the tree before he was rescued. The Snyder Ranch lost all of its livestock except two horses, one cow, two chickens, and two dogs. The bodies of the James Sullivan family were found on Sunday, April 9, 1899. All were found in bed except the eldest daughter and one of the younger children, who were found on the	Three bridges destroyed, 12 deaths

River	City	Reach	Date	Jam Type	Description	Damages
					floor. The eldest daughter's skull was crushed. It was presumed that she received the wound from a piece of ice while trying to battle the angry waters. (The above information was edited from the Glendive Independence. The dateline for Saturday, April 8, 1899, appeared on the paper, although it was actually printed on Sunday, April 9, 1899, because of the ice jam.) -- Keywords: Yellowstone River at Glendive, MT on Apr 07, 1899 [20000216100330]	
Yellowstone	Glendive	D6			As reported in Andy Tuthill's Trip Report, 2 Oct, 1997, "The Glendive area has a long history of ice jam flooding and two of these events resulted in loss of life. ... In 1894 three men died while trying to escape floodwaters on the east side of the river, near the present location of the Black Bridge." -- Keywords: Yellowstone River at Glendive, MT on ? ?, 1894 [9121]	Death of 3 men
Yellowstone	Glendive	D6	4/1/1904		maximum annual gage height of 11.9 feet affected by backwater from ice, reported at USGS gage Yellowstone River at Glendive, on April 1, 1904. -- Keywords: Yellowstone River at Glendive, MT on Apr 01, 1904 [9122]	?
Yellowstone	Savage	D11	3/10/1943	Break-up	An ice jam was spotted at the junction of the Missouri and Yellowstone Rivers. The jam extends 15 miles from east of Fairview to the junction of the two rivers. By April 1, the same jam was reported to break up at Fallon along the Yellowstone River. A 13 foot rise in river waters were reported at Intake. -- Keywords: Yellowstone River at Savage, MT on Mar 10, 1943 [1770]	Severe flooding
Yellowstone	Savage	D11	3/4/1994	Break-up	As a result of the ice jam, in "Richland Co. the river looks like big lake east of Savage" (Datacol) *See also Glendive and Marsh same date -- Keywords: Yellowstone River at Savage, MT on Mar 04, 1994 [1771]	?
Yellowstone	Savage	D11	2/13/1996	Break-up	On 2/13/96 a NWS Flood Statement reported that an ice jam on the Yellowstone River had caused flooding near Savage, MT. The jam is located upstream of Savage. The Savage jam went out at about 1330 on the 17th with no problems. -- Keywords: Yellowstone River at Savage, MT on Feb 13, 1996 [1772]	Flooding
Yellowstone	Elk Island	D11	2/16/1996	Break-up	A large ice jam was reported, via NWS on 2/16/96, on the Yellowstone River at Elk Island, MT. -- Keywords: Yellowstone River at Elk Island, MT on Feb 16, 1996 [1758]	Flooding
Yellowstone	Savage	D11	3/18/2003	Break-up	The NWS reports on March 18: Ice jams reported just downstream from Savage. Some county roads have been inundated and barricaded as water flows around the ice jams. Ice jams reported midway between Sidney and Savage have resulted in flooding from around the town of Crane to just downstream of Savage. -- Keywords: Yellowstone at Savage, MT on Mar 18, 2003 [20030319090337]	?
Yellowstone	Sidney	D13	4/3/1917		maximum annual gage height of 11.6 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on April 3, 1917. -- Keywords: Yellowstone River at Sidney, MT on Apr 03, 1917 [9141]	?
Yellowstone	Sidney	D13	3/31/1923		maximum annual gage height of 11.0 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 31, 1923. -- Keywords: Yellowstone River at Sidney, MT on Mar 31, 1923 [9142]	?

River	City	Reach	Date	Jam Type	Description	Damages
Yellowstone	Sidney	D13	1/1/1927		A printout obtained by Andy Tuthill from Richland County, Montana reported a 1927 flood caused by ice jams caused an estimated $21,400 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on ? ?, 1927 [9143]	21,400 USD estimated rural damages
Yellowstone	Sidney	D13	3/2/1938		maximum annual gage height of 16.66 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 2, 1938. -- Keywords: Yellowstone River at Sidney, MT on Mar 02, 1938 [9144]	?
Yellowstone	Sidney	D13	3/22/1939		maximum annual gage height of 13.20 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 22, 1939. -- Keywords: Yellowstone River at Sidney, MT on Mar 22, 1939 [9145]	?
Yellowstone	Sidney	D13	3/25/1943		maximum annual gage height of 18.00 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 25, 1943. March 29, 1943, C.F.S= 132,000. A printout obtained by Andy Tuthill from Richland county Montana reported a 1943 flood caused by ice jams and snowmelt caused an estimated $484,800 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on Mar 25, 1943 [9146]	484,800 USD estimated rural damages
Yellowstone	Sidney	D13	1/1/1944		A printout obtained by Andy Tuthill from Richland County, Montana reported two floods during 1944 caused by ice jams, heavy rains, and snowmelt caused an estimated $86,600 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on ? ?, 1944 [9147]	86,600 USD estimated rural damages
Yellowstone	Sidney	D13	1/1/1946		A printout obtained by Andy Tuthill from Richland County, Montana reported two floods during 1946 caused by ice jams and snowmelt caused an estimated $50,400 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on ? ?, 1946 [9148]	50,400 USD estimated rural damages
Yellowstone	Sidney	D13	3/22/1947		The maximum gage height of 21.85 feet was recorded on 22 March 1947 at the USGS Yellowstone River station, near Sidney, Montana, caused by backwater from ice. Period of record 1910-1969, except for water year 1932. -- Keywords: Yellowstone River at Sidney, MT on Mar 22, 1947 [20020718141237]	?
Yellowstone	Sidney	D13	1/1/1948		A printout obtained by Andy Tuthill from Richland County, Montana reported that two floods in 1948 caused by ice jams and snowmelt caused an estimated $11,300 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on ? ?, 1948 [9150]	11,300 USD estimated rural damages
Yellowstone	Sidney	D13	3/8/1949		maximum annual gage height of 18.16 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 8, 1949. A printout obtained by Andy Tuthill from Richland county, Montana reported a 1949 flood caused by ice jams caused an estimated $50,500 in rural damages. As reported in the Sidney Herald on March 10, 1948, "A week of flood scare in this valley is receiving relief from reports of the last few hours that a breakup of the ice jam at the junction of the Missouri and Yellowstone is near. The frozen Missouri below that is heaving and cracking and will have to give way to the water pressure soon. This will simultaneously cause a general eruption of the ice jam at the junction which will release the dammed up waters now flooding a large area of the lower valley within the triangle the convergence of the two rivers creates. The ice jam on the Yellowstone as The Herald goes to press Thursday afternoon extends 15 miles from east of Fairview	50,500 USD estimated rural damages

River	City	Reach	Date	Jam Type	Description	Damages
					to the junction." -- Keywords: Yellowstone River at Sidney, MT on Mar 08, 1949 [9151]	
Yellowstone	Sidney	D13	4/4/1950		maximum annual gage height of 12.51 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney on April 4, 1950. -- Keywords: Yellowstone River at Sidney, MT on Apr 04, 1950 [9152]	?
Yellowstone	Sidney	D13	3/27/1951		maximum annual gage height of 11.07 feet affected by backwater from ice, reported at USGS Yellowstone River near Sidney, on March 27, 1951. An ice jam near Sidney on the Yellowstone River forced several families to evacuate, loss of livestock, and an estimated hundreds of thousands of dollars in damages on Mar 29, 1951. The middle span of the Bridge on Highway 14 on the south edge of Sidney gave out. A printout obtained by Andy Tuthill from Richland county, Montana reported a 1951 flood caused by ice jams caused an estimated $54,100 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on Mar 27, 1951 [9153]	Severe flooding, evacuations, 100,000s USD in damages
Yellowstone	Sidney	D13	4/1/1952	Freeze-up	Two people of Richland County lost a law suit to the county on charges that their neglegance was the cause of the flood. Supposedly, the dam they were attending to (Upper Anderson Dam) was neglected and as it gave out it let out tons of chunks of ice and debris which jammed and caused the massive flooding. The county was awarded $27,473.33 in damages. The flooding occured on the north side of the river east of Buford and south of Trenton. In a later lawsuit the Andersons won the case. By May 1, the state of Montana was awaiting a $25 million appropriation for flood relief. maximum annual gage height of 19.7 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 30, 1952. March 31, 1952 C.F.S= 138,000 A printout obtained by Andy Tuthill from Richland county, Montana reported a 1952 flood caused by ice jams caused an estimated $44,900 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on Apr 01, 1952 [9154]	44,900 USD estimated rural damages,severe flooding
Yellowstone	Sidney	D13	4/3/1955		maximum annual gage height of 12.33 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on April 3, 1955. A printout obtained by Andy Tuthill from Richland county, Montana reported a 1955 flood caused by ice jams caused an estimated $1,800 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on Apr 03, 1955 [9155]	1,800 USD estimated rural damages
Yellowstone	Sidney	D13	3/26/1956		maximum annual gage height of 15.84 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 26, 1956. -- Keywords: Yellowstone River at Sidney, MT on Mar 26, 1956 [9156]	?
Yellowstone	Sidney	D13	3/21/1959		Ice was observed and reported jamming on the Yellowstone in the Sidney area between March 18 and March 22, 1959. An ice jam was reported on the Yellowstone near Sidney with a river gage of 19.14 feet on March 21, 1959. Flood stage is 19.0 feet. Bankful is 18.5 feet. A printout obtained by Andy Tuthill from Richland county, Montana reported two floods during 1959 caused by ice jams and snowmelt caused an estimated $30,000 in rural damages. maximum annual gage height of 19.14 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 21, 1959. Ice was observed and reported jamming on the	30K USD estimated rural damages

River	City	Reach	Date	Jam Type	Description	Damages
					Yellowstone in the Sidney area between March 18 and March 22, 1959. -- Keywords: Yellowstone River at Sidney, MT on Mar 21, 1959 [9157]	
Yellowstone	Sidney	D13	3/21/1960		maximum annual gage height of 15.1 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 21, 1960. A printout obtained by Andy Tuthill from Richland county, Montana reported a 1960 flood caused by ice jams caused an estimated $69,000 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on Mar 21, 1960 [9158]	69K USD estimated rural damages
Yellowstone	Sidney	D13	3/17/1961		maximum annual gage height of 12.60 feet affected by backwater from ice, reported at USGS gage Yellowstone River near Sidney, on March 17. 1961. -- Keywords: Yellowstone River at Sidney, MT on Mar 17, 1961 [9159]	?
Yellowstone	Sidney	D13	4/7/1965		Photographs were taken of an ice jam upstream of Sidney along the Yellowstone on April 7, 1965. -- Keywords: Yellowstone River at Sidney, MT on Apr 07, 1965 [9160]	?
Yellowstone	Sidney	D13	4/7/1965		Photographs were taken of an ice jam upstream of Sidney along the Yellowstone on April 7, 1965. -- Keywords: Yellowstone RIver at Sidney, MT on Apr 07, 1965 [9139]	?
Yellowstone	Sidney	D13	3/17/1966		On 17 March 1966 at the USGS Yellowstone River station, near Sidney, Montana, an annual maximum gage height of 13.34 feet was recorded, caused by backwater from ice. Discharge 15,000 cfs. -- Keywords: Yellowstone River at Sidney, MT on Mar 17, 1966 [20020718142105]	?
Yellowstone	Sidney	D13	3/26/1969	Break-up	An ice jam east of Sidney flooded 14,000 acres of property causing an estimated $230,000 in damages. The water level rose to 20.27 feet, the second highest in record as of this date. The highest was in 1965 with a height of 21.30 feet. There were no human casualties, but one-third of the deer on the islands of the river were killed. The ice was observed as being up to 4 feet thick. -- Keywords: Yellowstone River at Sidney, MT on Mar 26, 1969 [9161]	230K USD and 14,000 acres flooded
Yellowstone	Sidney	D13	2/17/1971		The USGS reported a maximum gage height of 21.67 ft on 17 February 1971, on the Yellowstone River near Sidney, Montana due to backwater from ice. Discharge was 50,000 cfs. -- Keywords: Yellowstone River at Sidney, MT on Feb 17, 1971 [20021216130609]	?
Yellowstone	Sidney	D13	3/19/1979		An ice jam was reported on the Yellowstone near Sidney with a river gage of 19.57 feet on March 19, 1979. Flood stage is 19.0 feet. Bankful is 18.5 feet. -- Keywords: Yellowstone River at Sidney, MT on Mar 19, 1979 [9163]	?
Yellowstone	Sidney	D13	2/27/1986		An ice jam was reported on the Yellowstone near Sidney with a river gage of 19.60 feet on February 27, 1986. Flood stage is 19.0 feet. Bankful is 18.5 feet. Photographs were taken of an ice jam upstream of Sidney along the Yellowstone on February 27, 1986. -- Keywords: Yellowstone River at Sidney, MT on Feb 27, 1986 [9164]	?
Yellowstone	Sidney	D13	3/6/1994		An ice jam was reported on March 6, 1994 on the Yellowstone near Sidney with a max gage height of 24.03 ft. One was also recorded at this location on Mar 22, 1947 with a max gage height of 21.85 ft. This jam was at the bridge. Photographs were taken of an ice jam upstream of Sidney along the Yellowstone on March 5, 1994. -- Keywords: Yellowstone River at Sidney, MT on Mar 06, 1994 [9165]	?

River	*City*	*Reach*	*Date*	*Jam Type*	*Description*	*Damages*
Yellowstone	Sidney	D13	2/13/1996	Break-up	A 2/13/96 NWS Flood Statement and MRD Datacol both reported an ice jam north of the highway 23 bridge near Sidney on the Yellowstone River. The exact formation date is unknown. This jam caused very high water. The jam moved out on 2/13/96. A NWS Flood Statement reported other ice jams occuring upstream and east of Sidney on 2/14/96. -- Keywords: Yellowstone River at Sidney, MT on Feb 13, 1996 [9166]	High water
Yellowstone	Sidney	D13	2/14/1997		An ice jam was reported as part of a USGS memo on the Yellowstone River near Sidney. Gage station no. 06329500. Feb 24 "Clear at Cableway-Ice jam below." Feb 25 "Ice jam below & above gage." Feb 25 "Floating ice chunks. Ice jam just above cableway." Mar 6 "Some floating & shore ice. Ice jam @ bridge on left bank." Mar 20 "Looks like a possible ice jam." Numerous ice jams were reported along the Yellowstone River from Miles City to Sydney. The ice jams continued through March with the largest jam being located at the Montana-North Dakota state line. -- Keywords: Yellowstone River at Sidney, MT on Feb 14, 1997 [9167]	?
Yellowstone	Sidney	D13			A printout obtained by Andy Tuthill from Richland county, Montana reported an 1899 flood caused by a series of ice jams that causes an estimated $35,200 in rural damages. -- Keywords: Yellowstone River at Sidney, MT on ? ?, 1899 [9140]	35K USD estimated rural damages
Yellowstone	Fairview	D15	2/12/1996	Break-up	On 2/12/96 a NWS Flood Statement reported that an ice jam had formed on the Yellowstone River near Fairview, MT. The MRD Datacol 2/12/96 reported that an ice jam was at the Hwy 10 bridge U/S of the confluence on the Missouri River. Ice jams were also reported near Fairview (reported Fairfax, ND) on the Yellowstone River. Stages were above flood stage at Williston, ND due to the ice. -- Keywords: Yellowstone River at Fairview, MT on Feb 12, 1996 [1759]	?

B.2. Tributaries

River	*City*	*Date*	*Jam Type*	*Description*	*Damages*
Big Horn River	Treasure County	1/3/1997		Ice floes, several miles long, was jamming the Yellowstone River causing evacuations from homes and ranches. Over a foot of water covered Riverfront Park where the Yellowstone's waters surpassed bankful. Ice jams were also reported along the Musselshell River between Lavina and Ryegate (causing minor flooding of U.S. Highway 12) and the Bighorn River which reached its flood stage of 9.0 feet. -- Keywords: Big Horn River at Treasure County, MT on Jan 03, 1997 [79]	?
Big Horn River	Bighorn	1/3/1997		Ice floes, several miles long, was jamming the Yellowstone River causing evacuations from homes and ranches. Over a foot of water covered Riverfront Park where the Yellowstone's waters surpassed bankful. Ice jams were also reported along the Musselshell River between Lavina and Ryegate (causing minor flooding of U.S. Highway 12) and the Bighorn River which reached its flood stage of 9.0 feet. -- Keywords: Big Horn River at Bighorn, MT on Jan 03, 1997 [78]	?

AMERICAN FISHERIES SOCIETY
MONTANA CHAPTER
FOUNDED IN 1967

18 November 2016

Mike Ryan, Regional Director
U.S. Bureau of Reclamation
Montana Area Office,
ATTN: Intake Diversion Dam EA
PO Box 30137
Billings, MT 59107

Tiffany Vanosdall
U.S. Army Corps of Engineers,
1616 Capitol Ave.
Omaha, NE 68102

tiffany.k.vanosdall@ usace.army.mil

Dear Mr. Ryan and Ms. Vanosdall,

The Montana Chapter of the American Fisheries Society (MTAFS) would like to comment on the Final Environmental Impact Statement (FEIS) on the Lower Yellowstone Intake Diversion Dam (Intake) with respect to the preferred alternative's potential effects on endangered pallid sturgeon and dozens of other native fish species. The American Fisheries Society (AFS), the oldest professional society in North America dealing with natural resources, was organized in 1870. The Montana Chapter of AFS was chartered in 1967. Among its objectives are conservation, development and wise utilization of the fisheries, promotion of the educational, scientific and technological development and advancement of all branches of fisheries science and practice, and exchange and dissemination of knowledge about fish, fisheries and related subject.

The MTAFS Resource Management Concerns Committee is on record as commenting on the draft supplemental Environmental Assessment, the Draft EIS, and the planning and peer review process. We have been participating and contributing to the environmental review process of this project for quite some time. As an organization of fisheries professionals, our primary concerns relate to whether the best available science is being used to develop actions necessary to achieve meaningful recovery of Pallid Sturgeon throughout their range in Montana and beyond. For this letter, our comments focus on the FEIS preferred alternative for Intake, but as biologists, we also question the overall direction of the recovery program throughout the Missouri Basin within Montana.

The FEIS states that under the preferred alternative (Bypass Channel Alternative), the agencies would:

- abandon the existing weir in place;
- construct a new concrete weir;
- construct, operate, and maintain a two-mile long bypass channel for fish passage around the weir;
- place fill in the upstream portion of existing side channel for stabilization;
- divert up to 1,374 cfs through the screened headworks; and

- continue operation and maintenance of the irrigation distribution facilities and supplemental pumps.

MTAFS is of the opinion that the Bypass Channel Alternative would:

- Create additional obstacles to Pallid Sturgeon passage by homogenizing and raising the surface of the weir across the main channel of the Yellowstone;
- Obligate the use of an artificial channel that may or may not support passage by Pallid Sturgeon or other native, migratory fishes in the Yellowstone;
- Allow operation of the project without adequate biological criteria or specific, actionable management plans for adult, juvenile, and larval passage to assess or address potential shortcomings of the efficacy of the Bypass Channel; and
- Disregard the professional opinion of the Biological Review Team that opening the main channel of the Yellowstone River would be the most effective way to restore Pallid Sturgeon migration beyond the Intake Dam Diversion project.

MTAFS maintains several of our original concerns related to the long-term impacts of the proposed Bypass Channel Alternative, including:

The Selected Alternative should Retain and Strengthen Stakeholder Accountability:

- The Adaptive Management Plan (AMP) should include specific actions that will happen if the 8-year targets are not met.
- The AMP should identify which agencies involved in the planning, engineering, and operation of Intake would take responsibility if pallid sturgeon success criteria are not met
- The US Army Corps of Engineers' responsibility should extend beyond the construction of the physical structure, and associated hydrologic parameters, and should focus on the original intent of the design to support successful fish passage.

The revised 2013 Recovery Plan found that in order for pallid sturgeon to be recovered, the populations must have, "successful natural spawning and recruitment" (Jordan, 2013). Current propagation programs have shown success in postponing extinction, but to restore wild, self- sustaining populations, these stocked fish and the remaining wild fish need access to spawning areas and need to be able to migrate above the Intake structure on the Yellowstone (Recovery Task 1.1.2). **Therefore, MTAFS is of the opinion that the most scientifically defensible alternative that would support Pallid Sturgeon recovery would include removal of the existing weir and opening the main channel of the Yellowstone River.**

In summary, the focus of the project at Intake should be whether the selected alternative functionally improves fish passage. If the agencies move forward with their selected alternative, once the bypass is completed, the structure must be evaluated in the context of the fish's ability to successfully navigate the bypass channel. Finally, responsibility for fish passage success must be explicitly assigned and carried through so shortfalls are addressed directly and effectively. We appreciate your attention to our concerns.

Sincerely,

Leslie Nyce
President
Montana Chapter of the American Fisheries Society

CC:
Noreen Walsh, USFWS
Jodi Bush, USFWS
Jeff Hagener, Montana Department of Fish, Wildlife and Parks
Governor Steve Bullock
John Tubbs, Department of Natural Resources and Conservation
Brent Esplin, Bureau of Reclamation
Pam Spoonholtz, President, Western Division of the American Fisheries Society

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Jordan, G. (2013). *US Fish and Wildlife Service Draft Revised Recovery Plan for the Pallid Sturgeon (Scaphirhynchus albus).* Denver: US Fish and Wildllife Service, Mountain Prairie Region.

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Subject:

-----Original Message-----
From: Butch Renders [mailto:butchr13@gmail.com]
Sent: Monday, October 17, 2016 11:16 PM
To: CENWO-Planning <CENWO-Planning@usace.army.mil>
Subject: [EXTERNAL] Intake Diversion bypass

I am writing this in support of the Lower Yellowstone Intake Diversion Dam Fish Passage Project
As a life long (69 years) resident of Richland County and fisherman of the Missouri & Yellowstone rivers, I urge you to PLEASE go ahead with the fish passage project and leave the weir in place for the use of the area farmers and the continued infusion of our ground water supply.

I would like to support the intake bypass channel and save the fish, save the dam, save the farmers, save the whole Lower Yellowstone River Valley.
Sidney and all its neighboring communities face near extinction if the Defenders of Wildlife get their way and eliminate economically sustainable irrigated farming in this valley. Our entire existence depends on that water. The pallid sturgeon has survived in the river for the more than 100 years that the irrigation system has been in place. Hundreds of Lower Yellowstone River Valley farmers, as well as the communities of Terry, Glendive, Savage, Sidney, Fairview, Buford and Williston are dependent on the delivery of water from the Yellowstone River for their livelihood. The elimination of the irrigation system would result in the bankruptcy of approximately 300 family farms and the closure of countless businesses dependent on agriculture, as well as the loss of hundreds of other jobs related to the agriculture sector. The Sidney Sugars sugar beet factory, which provides approximately 150 full-time jobs and another 150 part-time jobs, would close forever.

The major point being, the pallid sturgeon has survived in the river for the more than 100 years that the irrigation system has been in place.
AND the no matter what you promise or think the irrigation project and it's people will be around for how ever long it takes to care of the pallid sturgeon and the diversion project. Something none of the others involved in this can guarantee.

William C Renders
1311 S Central Ave
Sidney, Mt. 59270

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Subject:

-----Original Message-----
From: Ross Rosaaen [mailto:niehenkewelding@gmail.com]
Sent: Monday, October 17, 2016 5:46 PM
To: CENWO-Planning <CENWO-Planning@usace.army.mil>
Subject: [EXTERNAL] Fish Bypass on the yellowstone

To whom it may concern I am the owner of Niehenke Welding in Sidney MT this business has been around since 1921 and we have made a living on the agriculture. If this Bypass does not get built it will destroy my business and countless others in the valley these defenders of wildlife don't care about the people that this will destroy the city of Sidney will be destroyed and Fairview, Savage, Glendive. So I support the fish Bypass and just another note anyone that destroys my lively hood and my families will have a fight and that is a promise get the damn thing built these people fighting don't even live here this doesn't even affect there lives get it built

Ross Rosaaen

Vanosdall, Tiffany K CIV USARMY CENWO (US)

Sent:
To:
Subject:

-----Original Message-----
From: Stan Rosaaen [mailto:ssrosaaen@gmail.com]
Sent: Wednesday, October 19, 2016 8:51 PM
To: CENWO-Planning <CENWO-Planning@usace.army.mil>
Subject: [EXTERNAL] Intake, Fish Bypass.

I support the fish bypass. The irrigation system has supported many family's and business's in the area. I owned a business that relied on area farmers business.Now my son owns the business,that still depends on the local farmers.It's all do too the irrigation system.One business just feeds another and so on.The livelihood of the people are more important,than a fish,that is still surviving,they will adapt, to a bypass.

Thank You
Stan Rosaaen.

P.O. Box 7186   Missoula, MT 59807 (406) 543-0054

21 November, 2016

Tiffany Vanosdall
U.S Army Corps of Engineers
Omaha District
Attn: CENWO-PM-AA
1616 Capitol Avenue
Omaha, NE 68102

Mike Ryan, Regional Director
U.S. Bureau of Reclamation

Dear Ms. Vanosdall and Mr. Ryan:

Thank you for the opportunity to comment on the Corps' and U.S. Bureau of Reclamation's (BoR) Final Environmental Impact Statement (FEIS) for the Lower Yellowstone Intake Diversion Dam Fish Passage Project. Montana Trout Unlimited represents 4,200 conservation-minded anglers, most are native or long-time Montanans who have an abiding interest in the free-flowing character and aquatic community of the Yellowstone River.

We commented on the draft version of this EIS and, herein, will reiterate some of our previous comments, which we believe are still valid and have not been sufficiently addressed, as well as present new observations based on changes in the FEIS. In short, we continue to strongly urge the Corps and BoR to refine the technical, biological and economic effects analysis for the "Multiple Pump Alternative," and to adopt this option as the best solution for accommodating fish passage, recovery of pallid sturgeon and the interests of water users in the Lower Yellowstone Irrigation Project ("the project").

Here is an abbreviated version of our comments on the DEIS that we believe still apply to the FEIS. For further explanation, please refer to our written comments submitted for the DEIS on July 28, 2016:

- The BoR, Corps and U.S. Fish and Wildlife Service continue to admit that the best possible chance for passage of pallid sturgeon is an open river.

- Requirements under NEPA, ESA, and language in WRDA 2007 (funding source for this project) explicitly call for ecosystem restoration. The preferred alternative in the FEIS – a new weir that blocks all upstream movement of fish, a 2-mile engineered channel, and filling in of portions of a natural side channel that has on occasion passed pallid sturgeon, does not qualify as ecosystem restoration. In fact, these actions constitute degradation of the ecosystem and could be a misappropriation of Congressionally authorized funding.

- The FEIS, like the DEIS, continues to favor some fish passage and/or not jeopardizing pallid sturgeon, rather than pallid sturgeon recovery as *the primary goal* of this project. Because the Corps is investing in a BoR project with the expectation the U.S Fish and Wildlife Service will then relieve it of its recovery obligations in the upper Missouri River Basin, the agency must see this investment as a "recovery" action.

- The USFWS amplifies the importance of recovery when it states in the DEIS that *"the value of restoring the Yellowstone River as a natural migratory route for sturgeon and making the middle Yellowstone function as the spawning and nursery grounds for pallids cannot be overstated (pg xxvii)."* This continues to be the case in the FEIS and should be the primary goal of this project.

- The FEIS is heavily biased in favor of the preferred alternative. Descriptions of the Dam/Bypass Channel option are subjectively positive and/or assume that alternative will be selected. Descriptions of the other alternatives, especially the open river alternatives, are presented as subjectively negative.

- Post-project monitoring and assessment is inadequate. The 8-year monitoring and adaptive management time period is too short to determine successful spawning and recruitment. The FEIS (like the DEIS) admits that the preferred alternative might fail to pass pallid sturgeon. Although the FEIS added details about adaptive management strategies and responsibilities, it still does not specify what would happen after eight years if the bypass and new weir fail to meet passage and recovery goals. It should be explicit what will happen and who will be financially and legally responsible if the preferred alternative fails after eight years of monitoring and adapting. Complete removal of the new weir, bypass canal, and restoration of the natural side channel would be the likely and exorbitantly expensive solution.

- O&M costs for the preferred alternative in the FEIS continue to be underestimated. In particular, there is not sufficient analysis of costs associated with flooding Joe's Island or the predictable yearly damage to the upstream entrance of the bypass. Battelle's Independent External Peer Review of this project provides a thorough critique of this possibility and the underestimated costs associated with the bypass maintenance in this regard. We strongly support the IEPR critique on this point.

- Similarly, Montana TU agrees with analysis in the IEPR that points to cost overestimations of the open river solutions. In particular, we do not believe that the agencies have given a hard enough look at the engineering and cost savings associated with breaching the existing dam and allowing the river to remove the rest of it under the open river alternatives. This option deserves closer, fairer review than it has received by the agencies.

- The FEIS, like the DEIS, fails to include project design costs associated with the preferred alternative. Even though project design has already been conducted and paid for the bypass alternative does not mean those costs should not be included in the balance sheet for that option. All other alternatives are charged with design costs. This is another example of cost bias favoring the preferred alternative.

- In the FEIS, the agencies do not provide analysis of a myriad of factors that influence fish movement and that should be considered when evaluating the bypass channel alternative. These include overhead cover, turbidity, temperature, chemistry, time of day, channel geometry, substrate (especially for benthic species), presence of predators, human disturbance, discharge volume, ability to locate entrances (and be comfortable with them), and other values. None of these have been properly evaluated in determining the probability of whether spawning pallid sturgeon in sufficient numbers will successfully navigate the bypass channel.

- Given the admitted high degree of uncertainty for upstream movement of pallids under the Dam/Bypass Channel Option, this alternative should only be implemented if it doesn't include the new, concrete-capped diversion dam. The new dam is not necessary for successful upstream movement of sturgeon and other species in the bypass channel. It is simply not needed for ecosystem restoration, which the agencies say is the objective of the project. If the bypass is constructed and didn't work, as seems highly likely, the funding currently proposed for building the concrete capped dam could then be directed to an alternative that has a higher degree of potential success, such as an open-river option.

- The Dam/Bypass Channel alternative includes filling in portions of the natural side channel on Joe's Island with fill from excavating the bypass. There are significant biological implications to degrading natural stream habitat in this way. The bypass alternative should, if it is selected, require that the natural side channel remain unaffected.

- The FEIS, like the DEIS, includes limited consideration of how the project affects recruitment of pallid sturgeon and other species. Simply providing for passage is only part of the puzzle. Without reliable information on survival of larvae, it will be difficult to determine recruitment. Without recruitment, there is no recovery. Therefore, the project must not lead to additional harm to free-drifting eggs and larvae. No empirical evidence is provided demonstrating that larvae will drift downstream past the LYIP canal headgate and over the new weir without harm, entrainment, or other injury. It is a guess. Eggs and larvae could get stuck behind the dam, or damaged in the hydraulics on the downstream side. The FEIS states that approximately 99.9 percent of all sturgeon larvae currently perish, and so a few percent more of the remaining won't be harmful. This is counter-intuitive when mortality is already significant. Because of high natural mortality, sturgeon larvae can not afford any additional pressures or detrimental impacts due to this project. The agency proposal to allegedly improve larval survival by notching the new concrete-capped dam is simply not backed up by available science.

- The Corps' Fish Passage Connectivity Index has not been subjected to scientific peer review. The fact that the FEIS provides more detail than the DEIS about how each number in the FPCI was selected, does nothing to change the fact that nowhere in the scientific literature has the Corps' internal method of calculating probability of fish passage been assessed. Furthermore, having the agency's own Corps Ecosystem Restoration Center of Expertise review the FPCI for this project, which is supposedly being done currently, does not constitute independent scientific review. We still believe that many of the values used in the FPCI are arbitrary. Similarly, the agencies' response in the FEIS to our previous comments on Habitat Units is still insufficient. We continue to recognize that Habitat Units for the bypass alternative rely on a FPCI for multiple species rather than the lower number for only pallids, which are the species of concern for this project. To reiterate, if the number of Habitat Units provided by the bypass channel is recalculated using only the FPCI for pallid sturgeon (.50 instead of .67), the cost of each Habitat Unit for that alternative becomes greater than the Habitat Unit cost of an open river Multiple Pumps alternative, which guarantees 100% fish passage.

In addition to reiterating the comments above, which we offered in greater detail during the DEIS comment period, MTU has concern with additional items in the FEIS. One of its greatest shortcomings is that, like the DEIS, it contains very little, new, real-world evidence to substantiate the claims that pallid sturgeon will use an engineered bypass channel. The FEIS even states that: "Because, to date, no upstream fish passage facility of any type has been built specifically for shovelnose or pallid sturgeon, the best available science that is available is on behavior and swimming ability of these species during migration in rivers or from observations during fish passage and swimming studies mostly done on juveniles in a fishway environment, and observation of pallid sturgeon use of natural and constructed side channels in the Missouri River basin (FEIS, liii)." In general, we think that risking jeopardy to the ESA-listed pallid sturgeon on an untested alternative is unwise and potentially a waste of taxpayer dollars. Specifically, we would encourage the agencies to take the following concerns into consideration:

- The agencies offer as new evidence that a bypass will work for pallid sturgeon such things as B. Kynard's design of two bypasses that were never built but "would likely have successfully passed shortnose sturgeon" and lake sturgeon in places like Cape Fear River, NC, and Savannah Bluff Lock and Dam in SC. Those are completely different ecosystems with sturgeon species that are evolutionarily very different than pallids. Plus, it is complete guesswork as to whether bypasses would have worked. This cannot be considered evidence supporting the preferred alternative at Intake. In fact, using it as such in the FEIS points out the very *lack* of empirical evidence for pallid sturgeon using artificial channels (FEIS, lvi).

- The other major evidentiary claim the FEIS relies on to show that pallid sturgeon will use an engineered side channel is the DeLornay (2014) survey, which was a 2011 telemetry study of tagged fish in the lower Yellowstone. In 2011 the Yellowstone experienced, "unprecedented" runoff due to a large snowpack and heavy spring rain, according to the study, which estimated it to be a 200-500 year flood event (pg. 2-10). It was the sixth highest flood on the Yellowstone in recorded history. Accordingly, "The rarity of the 2011 high-flow event diminishes its value to serve as an analog for possible management action (pg. 10). Regarding pallids at Intake the annual report states: "With regard to the proposed bypass channel, little information is available on use of side channels by migrating adult pallid sturgeon in the Yellowstone River and there is uncertainty regarding side channel size (or discharge conveyed relative to the main stem) as an attractant for increasing the likelihood of use and passage around Intake Diversion Dam (pg. 62)." Also, extreme flood conditions during the spring spawning time period meant that no telemetry tagged pallids were recorded by boats, rather they were picked up using logging stations. The discharge at the time of this tracking effort for this stretch of river ranged from roughly 53,000 to 78,000 cfs. Migrations of the small number of fish recorded with tags in the Yellowstone were highly variable. Some fish moved long distances in short time periods, other hardly moved. Only 7-8 pallids were recorded by the Intake station. In other words, this survey presents highly anomalous conditions from which to draw conclusions about what pallid sturgeon will do during their usual spawning migrations. Furthermore, all fish observed using a side channel did so on an inside bend, whereas the downstream entrance to the bypass will be on the outside bend (pg. 69). This study acknowledges that a bypass on the southside, outside bend could necessitate creating attraction characteristics because it does not mimic observed use of side channels (pg. 73).

- Adaptive management costs were estimated at 1% of construction costs. This is erroneous. Adaptive management of the more expensive open river options could, and would likely, be lower than for adaptive management necessary at the closed river alternatives. For example, the bypass could necessitate removing the new dam, altering it, rerouting the bypass, etc.

- We believe that monitoring and adaptive management needs to be much more thorough for the bypass alternative. In the FEIS, the Corps is only responsible for the first year of monitoring physical characteristics of the bypass, then it is turned over to the LYIP. By what criteria have the agencies assessed the ability of the LYIP to conduct monitoring and adaptive management? By years 4-6, monitoring will be, according to the FEIS, pre- and post-spawning, not during spawning. Monitoring should be conducted from pre- through post-spawning. Finally, by year seven, monitoring is reduced to only during or after "severe or unique events (FEIS, Appendix E, pg. 27)." Thorough monitoring needs to continue throughout the eight-year period. All of these necessary changes would, of course, increase costs associated with the bypass alternative and change its incremental cost analysis.

- Similar to the shortcomings of the monitoring, adaptive management of the bypass appears nominal in the FEIS. Adaptive management in case of no use or limited us by pallid sturgeon entails modifying flow levels, speeds, and bypass channel structures such as rocks, sand, gravel, and eddies. But, for the first three years after limited or lack of passage is observed, the agencies only proposed more study. Efforts to correct physical criteria to improve passage need to be more responsive (FEIS, Appendix E, pg. 32-33). And to reiterate our earlier comment about long-term success, the FEIS is silent on what ultimately happens if the bypass fails to pass sturgeon after eight years. The agencies need to present an explicit contingency plan with associated cost estimates.

- The Corps' commitment to post-construction monitoring and adaptive management, as well as implementing a long-term fix if the preferred alternative fails after eight years remains too vague. We insist that the Corps commit to financial liability for the success of any alternative throughout the entire monitoring and adaptive management period and to being part of a solution if the chosen alternative is deemed a failure or insufficient for recovering pallid sturgeon at Intake.

- The FEIS acknowledges that a federally-funded trust fund could be established to cover O&M costs above the no action alternative, especially in regard to open river and pump alternatives. This possibility should be explored in detail and made clear to LYIP users.

- Finally, MTU believes that Montana Fish, Wildlife and Parks (FWP), along with the state's Department of Natural Resources and Conservation (DNRC) offered numerous sound critiques of the bypass alternative and the DEIS that have not been adequately addressed in the FEIS. Specifically, FWP and DNRC reiterated our concern for the "ecosystem impairment caused by the existing dam and the effect of adding a concrete weir," plugging the natural side channel under the bypass alternative, insufficiency of the monitoring and adaptive management, the lack of evidence to show that pallid sturgeon will use an engineered bypass, and arbitrary nature of the FPCI and ICA used to compare alternatives (FEIS, Appendix F, pg. 1205, 1208, 1212-1220 (viewer)). Generally, the FEIS response to criticism offered by the state agencies is dismissive. For example, FWP and DNRC offer that there would be significant positive recreational benefits associated with an open river. The FEIS dismissed those benefits by stating that an open river solution would also have negative recreational benefits by temporarily closing the Intake FAS during construction. Construction closure of an FAS is, clearly, a short-term negative impact that does not come close to negating the positive, long-term benefits, such as an improved FAS and unimpeded boat travel through Intake, associated with an open river (FEIS, Appendix F, pg. 1219 (viewer)).

Thank you for the opportunity to comment.

Sincerely,

Bruce Farling
Executive Director

Yellowstone River

YELLOWSTONE RIVER
CONSERVATION DISTRICT COUNCIL
1371 Rimtop Drive
Billings, MT 59105
Phone: 406-247-4412
♦
Dan Rostad
Coordinator
Dan@
YellowstoneRiverCouncil.org
♦
CONSERVATION DISTRICT
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♦
Don Youngbauer, Chairman
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Rick Herman
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RICHLAND COUNTY
Shawn Conradson
♦
STILLWATER COUNTY
Steve Story
♦
SWEET GRASS COUNTY
Paul Gilbert
♦
TREASURE COUNTY
Phil Fox
♦
MCKENZIE COUNTY, ND
Orvin Finsaas
♦
YRCDC RESOURCE ADVISORY
COMMITTEE, Chair
John Moorhouse
♦
yellowstonerivercouncil.org
♦
"Working relationships yield a shared vision..."

November 10, 2016

Colonel John Henderson, Commander
Omaha District, - USACE
1616 Capitol Ave., Ste. 9000
Omaha, NE 68102

Regarding: Yellowstone River Diversion Dam Modification Project at Intake, Montana

Dear Colonel Henderson,

I am writing to you today to include our concerns about the Yellowstone River Intake project during the public comment process.

As you know, the Yellowstone River Conservation Districts Council has partnered with your agency to complete the Yellowstone River Cumulative Effects Assessment scientific study. During this process, the Council developed a position statement regarding the Intake dam project undertaken by both your agency and the Bureau of Reclamation.

The position statement of the Council developed and approved by the Council in December 2007, outlines the needs for and goals of the dam modification project. The Council supported those goals and lent their voice during the project development, working with your agencies and other stakeholders.

Since that time, the project design and concept changed radically and has become a much more cumbersome and controversial project.

While the Council still supports the two resource issue goals of water distribution and species protection, several of us have concerns about how these goals can be insured for future generations.

Providing assurances to irrigators and landowners that future maintenance of this new dam modification proposal will be met by your agency and/or the Bureau of Reclamation is paramount to guaranteeing a successful project long into the future. Many in our group have voiced their concerns about who would be responsible for repairs in the event of a major structural failure.

The Council continues to support all efforts made as long as they are based on the latest scientific findings and can insure protection of the pallid sturgeon, while also protecting the historic river geomorphology.

We remain steadfast in support of our position which seeks to eliminate conflict between economic and conservation interests, while maintaining overall river health.

As you may remember our friend Gerard Baker spoke with us at the Council's Yellowstone River Symposium last March in Billings, about his vision for the continued preservation of the river. Sharing the experiences of his native ancestors, he reminded us that we need to "listen to the river". Knowing that man's interference with the river is often times detrimental, I remember his challenge and take it to heart every day.

I hope that during this project process, all of the stakeholders involved consider carefully how best to protect our river resources and be ever diligent to make sure we are using the best methods and practices to do so.

Thank you for your time and consideration of my concerns.

Please feel free to call me if you have any questions or comments.

Very sincerely,

Don Youngbauer, Chairman

Don Youngbauer, Chairman

-Enclosure: 2007 Position Statement

Version: December 14, 2007

Intake Diversion Fish Passage Position Statement

<u>Position Statement:</u> The Yellowstone River Conservation District Council (YRCDC) supports and encourages the efforts of the Lower Yellowstone Irrigation Districts, the Bureau of Reclamation, the Corps of Engineers, Montana Fish Wildlife and Parks, and other partners to modify Intake Diversion to allow fish passage and protect fish from entrainment while continuing to provide irrigation water for the Lower Yellowstone Irrigation Districts.

Introduction

Fisheries and agricultural irrigation are two resource issues intertwined along the Yellowstone River. Free flowing river water is needed for either or both to occur and prosper. Where irrigation water is derived by diversion structures which block the entire river channel it can affect the viability of some fish species. Data has established that the distributions and movements of many species of Yellowstone River fishes, one of which is the federally endangered pallid sturgeon, are affected by Intake Diversion Dam,. In addition, for some unscreened diversions, significant numbers of fish can become entrained. Studies at Intake indicate that nearly half a million fish of 34 species can be entrained in Intake ditch annually.

Pallid sturgeon has been listed as endangered in the Missouri/Mississippi River systems under the Endangered Species Act. In the Yellowstone River, pallid sturgeon are presently limited to a 70 mile reach of the river below Intake Diversion structure, although they have been documented to have been present at least as far upstream as Miles City and the mouth of the Tongue River. Fish passage at Intake diversion would allow pallid sturgeon and other important warm water fish species restored access to about 235 miles of the Yellowstone River mainstem plus tributaries including the Tongue and Powder Rivers.

Background

<u>Endangered Species Act and Fish and Wildlife Service:</u> The pallid sturgeon was listed as endangered in 1990. It has been a long struggle to find a way to increase and stabilize habitat for these very large (adults can reach 70 pounds) sturgeon that utilize high flows in the main channel of the Missouri and Yellowstone for spawning. The population at issue here exists between Fort Peck Dam and Garrison (Sakakawea) Reservoir on the Missouri River and in the Yellowstone River from its confluence with the Missouri upstream to Intake Diversion. Finding a solution to fish passage at Intake is a critical step in making it possible for this population to naturally reproduce. At present there is no evidence that reproduction is occurring. The 150 or so adult fish left in the system are reaching senescence.

Fish and Wildlife Service has two areas of responsibility with regard to Intake and the fish passage efforts. First, they are the agency with the formal responsibility under the Endangered Species Act to establish the US Government position through their Biological Opinion on whether or not the project is an acceptable way of addressing pallid sturgeon habitat and survival problems. Second, in other branches of their agency they have fisheries biologists who have participated in designing the proposed modifications at Intake Diversion.

Bureau of Reclamation: The Bureau of Reclamation or "Reclamation" constructed the Intake Diversion dam and the water distribution system that comprise the Lower Yellowstone Irrigation Project as part of the nation-wide effort to establish and sustain economies in the West. The LYIP is a highly successful project providing a valuable public resource. The dam was constructed in 1905-1909.

Under the provisions of the Endangered Species Act, Reclamation is required to consult with the U.S. Fish and Wildlife Service to assure that project operations do not jeopardize the existence of pallid sturgeon. That process has resulted in the development of fish passage and protection measures. In the 17 years since the ESA listing of the pallid sturgeon, knowledge of pallid sturgeon behavior, and the options for passing fish by a structure such as Intake have both increased.

Reclamation included the U. S. Fish and Wildlife Service, Montana Fish Wildlife and Parks, Corps of Engineers, Lower Yellowstone Irrigation Districts, and the Nature Conservancy in a series of meetings and work efforts to find the most feasible solution that would accomplish three objectives: (1) attract and pass sufficient numbers of pallid sturgeon by Intake diversion that would allow spawning upstream along the Yellowstone River and its tributaries; (2) protect fish from being entrained in the canal system through the irrigation headworks at Intake diversion; and (3) provide an economically viable method of solving the passage and entrainment issues that would ensure continued irrigation through the Intake diversion.

After consideration of over 100 alternatives, Reclamation and the Corps of Engineers, with input from the other entities involved have identified that constructing a rock ramp which would span the width of the river to pass fish by Intake is likely the best option to achieve their three objectives. This structure would serve three purposes: (1) provide a sufficient quantity of water at main channel velocities to attract the fish to the passage; (2) eliminate/reduce the present turbulence to a more laminar flow so that pallid sturgeon (and other warm water fish) can navigate the rise needed for irrigation head; and (3) replace the present rock and crib diversion dam with a hardened sill at the same height to divert water into the irrigation system. In addition a screening device would be constructed adjacent to the headworks to prevent fish from entering the canal system.

Lower Yellowstone Irrigation Districts:

The districts, LYID #1 in Montana and LYID #2 in North Dakota, were established to accept the operation and maintenance and replacement duties on the original physical features of the Bureau of Reclamation's Lower Yellowstone Irrigation Project (LYIP). The districts are non-profit public corporations. It is their duty to divert water from the Yellowstone River and distribute it through a network of canals and laterals to the valley's farm units. There are about 400 miles of public waterways involved in delivering water to 56,000 irrigable acres. The districts' constituents pay annual assessments that cover all O&M&R costs. The districts are concerned about the future O, M & R of the proposed fish protection devices and will assist in selecting devices that are manageable.

The districts maintain the Project's Intake Diversion Dam. The dam is wood crib and rock feature that spans the entire Yellowstone River except for a small side channel (natural) that flows only during the spring runoff. It creates a head of 5 feet during low flow. The districts add additional rock to the downstream side of the wooden dam each year after all snowmelt has passed. The purpose of this procedure is to maintain the water level to about 1' above the crest of the dam and to protect the dam during incidents of high flow and ice movement. The rock creates rapids and a barrier that pallid sturgeon and other native fish species cannot navigate. The districts seek a fish passage option that preserves an economically viable diversion of water for agriculture.

Corps of Engineers (COE): COE has a large scale species recovery program which was initiated because the series of federal dams and reservoirs along the Missouri River, along with river modifications to make the river navigable for barge traffic, has caused the decline of several species now listed under the Endangered Species Act including pallid sturgeon/ Because the COE has received authorization to work with Reclamation on the Yellowstone River through the passage of the Water Resources Development Act, the COE will add the expertise and resources associated with its Recovery Program and apply those resources with Reclamation on Intake and the Yellowstone River.

Montana Fish Wildlife and Parks (MFWP)
Montana Fish, Wildlife and Parks is the agency responsible for management of fish and wildlife resources within the state. MFWP has been instrumental in assessing the effects of Intake Dam on warm water fishes, including pallid sturgeon, over the past 30 years, and will be the lead agency conducting the evaluation of the fish passage structure's ability to pass pallid sturgeon and other key species within the Yellowstone River native fish assemblage once it is completed.

State of Montana, nonprofit organizations and other conservation interests: Because the Yellowstone River remains free-flowing and offers the potential of long reaches of spawning and rearing habitat, Montana and nonprofit groups such as the Nature Conservancy with an interest in pallid sturgeon survival have made the fish passage project at Intake a high priority. Other warm water fish species will also benefit from this fish passage project.

Role of the YRCDC: The governor, state government agencies, and regional citizens are looking to the YRCDC for leadership in managing the Yellowstone River. YRCDC, made up of a coalition of conservation districts, has both resource management and producers' well-being as goals. The position taken by the YRCDC is based on recent science findings from the rivers where pallid sturgeon live, and on science experiments done in a laboratory setting on warm water fish swimming abilities. This position seeks to eliminate conflict between economic and conservation interests and supports the Council's role as a grass roots supporter of wise use of resources.

National Headquarters
1130 17th Street, N.W. | Washington, D.C. 20036-4604 | tel 202.682.9400 | fax 202.682.1331
www.defenders.org

November 16, 2016

To: Tiffany Vanosdall, PMP
Senior Plan Formulate/Project Manager
U.S. Army Corps of Engineers

Re: Save the Endangered Pallid Sturgeon

Dear U.S. Army Corps of Engineers and Bureau of Reclamation,

On July 8, 2016, Defenders of Wildlife asked our online community to write in support of protecting the endangered pallid sturgeon by removing Intake Dam from the Yellowstone River. Since then, we have collected 28,540 signatures. Enclosed is a CD containing the names of all the signers. The petition reads as follows:

> Thank you for the opportunity to comment on the Lower Yellowstone Fish Passage Project in Montana. I support an open river alternative for the Lower Yellowstone Fish Passage Project. Your own analysis shows that the best outcome for the endangered pallid sturgeon from this project is to remove the outdated Intake Dam, open the river and allow full river passage. I do not support building a new dam and artificial bypass, as the likelihood that endangered pallid sturgeon will use it is slim. The pallid sturgeon needs all the help it can get. Please adopt an alternative that removes the dam, provides pumps or other means to get irrigators water and gives the pallid sturgeon a fighting chance. Spending taxpayer dollars on an alternative that won't work will cost more money in the future - pay to do this right the first time.
>
> Thank you for your consideration.

Sincerely,
Defenders of Wildlife

National Headquarters
1130 17th Street, N.W. | Washington, D.C. 20036-4604 | tel 202.682.9400 | fax 202.682.1331
www.defenders.org

November 16, 2016

To: Tiffany Vanosdall, PMP
Senior Plan Formulate/Project Manager
U.S. Army Corps of Engineers

Re: No New Dams - Protect the Pallid Sturgeon!

Dear U.S. Army Corps of Engineers and Bureau of Reclamation,

On November 2, 2016, Defenders of Wildlife asked our online community to write in support of protecting the endangered pallid sturgeon by removing Intake Dam from the Yellowstone River. Since then, we have collected 23,230 signatures. Enclosed is a CD containing the names of all the signers. The petition reads as follows:

As a Defender of Wildlife, I strongly oppose the action proposed in the Final Environmental Impact Statement (EIS) for the Lower Yellowstone Intake Diversion Dam Fish Passage Project. Approximately 125 wild pallid sturgeon remain in the upper Missouri and Yellowstone rivers, and sadly none of these critically endangered fish have successfully reproduced in the Yellowstone River in decades because Intake Dam is preventing them from reaching spawning areas with expanses of free-flowing river necessary for young sturgeon to survive. These wild fish will go extinct in the next few years unless the dam is removed altogether.

Multiple scientific reviews have cast doubt on whether the fish bypass proposed in the EIS will work at all, and the U.S. Army Corps of Engineers and the Bureau of Reclamation have produced no analysis that suggests that the endangered pallid sturgeon will use this structure in numbers that will result in improvements to sturgeon breeding. In fact, analysis from both the Corps and the Bureau show that the best action for the endangered pallid sturgeon would be to remove the outdated Intake Dam, open the river and allow full river passage.

The pallid sturgeon needs all the help it can get. Please reject your proposed action and instead adopt an alternative that removes the dam, provides pumps or other means to get irrigators water and gives the pallid sturgeon a fighting chance. Spending taxpayer dollars on an alternative that won't work will cost more money in the future - do this right the first time.

Thank you for your consideration.

Sincerely,
Defenders of Wildlife

ATTACHMENT B

ENVIRONMENTAL COMMITMENTS

Reclamation and the Corps commit to implementing a Monitoring and Adaptive Management Plan (AMP) and measures to minimize adverse environmental effects of constructing the Bypass Channel Alternative. The AMP provides a structured framework for decision making for adjusting Project features and operations if monitoring results indicate the Project is not meeting performance objectives as contemplated in the FEIS. The Corps and Reclamation will follow all required federal, state and local permits and approvals in implementing the Bypass Channel Alternative. Additionally, the actions to minimize adverse effects that will be implemented are provided in the following.

Actions to Minimize Effects

Air Quality

- Minimize clearing vegetation within the construction work areas, access areas, and project facilities.
- Conduct construction activities to minimize the creation of dust. This may include measures such as limitations on equipment type, speed, and/or travel routes. Water, dust palliative, gravel, combinations of these, or similar control measures may be used.
- Implement measures to minimize the transfer of mud onto public roads.
- Maintain construction equipment in good working order. Equipment and vehicles with excessive emissions due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- In active construction areas, including access roads, limit speeds of non-earth-moving equipment to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph.
- Limit idling of heavy equipment to less than 5 minutes unless needed for the safe operation of the equipment; verify through unscheduled inspections. Turn off idling equipment when not in use.
- Implement a fugitive particulate emission control plan that specifies steps to minimize fugitive dust generation.
- Stabilize spoil piles and sources of fugitive dust by implementing control measures, such as covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions.
- Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- Prevent spillage when hauling spoil material.
- Plan construction scheduling to minimize vehicle trips.
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels. Prevent tampering of source engines (i.e., knowingly disabling an emission control system component or element of design of a certified engine so that it no longer meets the manufacturer's specifications). Conduct unscheduled inspections to ensure these measures are followed.

Surface Water Hydrology and Hydraulics

- Ensure compliance with the provisions of Section 404 of the Clean Water Act for temporary or permanent discharges of dredge or fill material into waters of the U.S., including minimizing quantities of dredge or fill.

- Design coffer dams to obstruct the least amount of the channel or floodway to minimize the potential for affecting flood flows or ice jams.

Groundwater

Minimize the Potential for Release or Mismanagement of Hazardous Materials

- Contamination of water at construction site from spills of fuel, lubricants, and chemicals will be minimized by following safe storage and handling procedures in accordance with state laws and regulations.
- Personnel training on health, safety, and environmental matters will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- Any herbicides used during construction will be applied according to label instructions and any federal, state, and local regulations.
- Emergency and spill response equipment will be kept on hand during construction.
- Refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals will be restricted within 100 feet of wetlands, surface water bodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- Sanitary toilets convenient to construction will be provided. These will be located more than 100 feet from any stream, tributary or wetland. They will be regularly serviced and maintained. Waste disposal will be properly manifested. Employees will be notified of sanitation regulations and will be required to use sanitary facilities.

Minimize Changes to Stormwater Runoff and Infiltration Rates

- Measures will be employed to reduce wind and water erosion. Erosion and sediment controls will be monitored daily during construction for effectiveness, particularly after storm events. The most effective techniques will be identified and employed.
- Contractor will be required to have an approved construction stormwater management plan to control runoff.
- All areas along the bank disturbed by construction will be seeded with native vegetation to minimize erosion.
- Silt barriers, fabric mats, or other effective means will be placed on slopes or other eroding areas where necessary to reduce sediment runoff into stream channels and wetlands until vegetation is re-established. This will be accomplished before or as soon as practical after disturbance activities.
- Clearing of vegetation within construction areas will be minimized.
- Vehicular travel will be restricted to construction areas and other established areas within the construction, access, or maintenance easements.
- Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding.
- Avoid or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terrace. If these features or improvements are inadvertently damaged, they will be repaired or replaced.
- Minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).

- Minimize the amount of time that any excavations remain open.

Minimize Changes to Existing Groundwater Availability

- Access roads will be constructed to minimize disruption of natural drainage patterns, including perennial, intermittent, and ephemeral streams.
- Groundwater wells and springs within 150 feet of construction areas will be identified and protected.
- Water will be procured from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners.

Geomorphology

- Ensure compliance with the provisions of Section 404 of the Clean Water Act for temporary or permanent discharges of dredge or fill material into waters of the U.S., include minimizing quantities of dredge or fill.
- Design coffer dams to obstruct the least amount of the channel or floodway to minimize the potential for affecting flood flows or ice jams and causing undesirable scour.
- Minimize duration of in-water work.
- Minimize the placement of rock and remove rock where feasible.

Water Quality

- Conduct water quality program to ensure that required water quality standards are achieved during construction activities or that any exceedances are detected and rectified quickly.
- Equipment for handling and conveying materials during construction will be operated to prevent dumping or spilling the materials into wetlands and waterways.
- Discharges of dredge or fill material into waters of the U.S. will be carried out in compliance with provisions of Section 404 of the Clean Water Act.
- Ensure compliance with the provisions of the Montana State Water Quality Certification for compliance with state water quality standards.
- Ensure compliance with the provisions of Section 402 of the Clean Water Act and obtain a construction stormwater National Pollution Discharge Elimination System (NPDES) permit.
- Erosion control measures will be employed where necessary to reduce wind and water erosion. Erosion and sediment controls will be monitored daily during construction for effectiveness, particularly after storm events, and the most effective techniques will be used.
- Silt barriers, fabric mats, or other effective means will be placed on slopes or other eroding areas where necessary to reduce sediment runoff into stream channels and wetlands until vegetation is re-established. This will be accomplished either before or as soon as practical after disturbance activities.
- Contamination of water at construction sites from spills of fuel, lubricants, and chemicals will be prevented by following safe storage and handling procedures in accordance with state laws and regulations.

- Hazardous materials will be handled and disposed of in accordance with a hazardous waste plan.
- In-water work, such as installation and removal of cofferdams, will be done during low flows, when practicable, to reduce disturbance of sediment into the water column.
- The Contractor will be required to have an approved construction storm water management plan to control runoff.

Aquatic Communities

General Aquatic Communities

- All work in the river will be performed in a manner to minimize increased suspended solids and turbidity.
- All areas along the bank disturbed by construction will be seeded as soon as practical after disturbance with native vegetation to minimize erosion.
- All contractors will be required to inspect, clean and dry all machinery, equipment, materials and supplies to prevent spread of Aquatic Nuisance Species.

Fish

- Cofferdam construction and in-stream heavy equipment activity will be conducted outside of the pallid sturgeon migration season and minimized as feasible to avoid and or minimize potential impacts.
- All pumps will have intakes screened with no greater than ¼-inch mesh when dewatering cofferdam areas in the river channel. Pumping will continue until water levels within the contained areas are suitable for salvage of juvenile or adult fish occupying these areas. Fish will be removed by methods approved by the Service and MFWP prior to final dewatering.

Wildlife

A Migratory Bird Management Plan (Plan) will be developed and implemented to prevent “take” under the MBTA. The Plan will provide guidelines to modify avian habitat only outside of the breeding season to discourage nesting activity while minimizing the potential for harassing or harming birds. Other protocols will include adjusting timing of construction, avoiding certain habitats at certain times of year, and/or performing pre-construction breeding avian surveys to identify if any protections are necessary for nesting birds.

Other commitments to minimize effects on wildlife are as follows:

- Conduct pre-construction survey of the construction areas to document sensitive wildlife resources and establish construction buffers or timing restrictions, such as adjacent to an active bird nest or turtle nesting site. Monitoring of the sensitive resources will occur periodically to ensure they are not disturbed or harmed by construction activities, and to document if and when they move away from the area.
- A wildlife biologist will provide awareness trainings to the construction crew to educate them on sensitive wildlife resources they may encounter during construction, and provide a procedure to follow when an encounter occurs.
- Active work zones will be fenced to prevent wildlife access.

- To protect wildlife and their habitats, project-related travel will be restricted to existing roads or designated new access roads. Drivers should be cognizant of safely avoiding vehicle strikes. Species at particular risk to vehicle strikes include ungulates during twilight hours, various bird species, snakes, and small and mid-sized mammals.
- Removal and/or degradation of specific habitat features identified as important to wildlife will minimized to the extent possible. Examples include mature trees, large snags, and native grassland and shrubland habitat.
- Reestablish native vegetation to areas disturbed by construction as quickly as practical after disturbance. This will include minimizing the establishment of invasive plant species.

Federally Listed Species and State Species of Concern

- Conduct pre-construction surveys within the construction footprint for listed and sensitive wildlife and plant species and establish buffers or timing restrictions to avoid and minimize effects.
- All pumps used in the river during construction will use intakes screened with no greater than ¼” mesh when dewatering cofferdam areas in the river channel. Pumping will continue until water levels within the contained areas are suitable for salvage of any juvenile or adult fish occupying these areas. All fish will be removed by methods approved by the Service and MFWP prior to final dewatering.
- Care will be taken to prevent any petroleum products, chemicals, or other harmful materials from entering the water.
- All work in the waterway will be performed in such a manner to minimize increases in suspended solids and turbidity.
- All areas disturbed by construction activity will be seeded with vegetation native to the area for protection against subsequent erosion and the establishment of noxious weeds.
- Clearing vegetation will be limited to that which is absolutely necessary for construction of the project.
- Coffer dam sheet piles will be installed outside of the pallid sturgeon adult migratory season using vibratory equipment to the extent practicable to minimize noise levels and potential disturbance to fish.
- At the start of pile driving each day, conduct a low-energy ramp up with reduced noise levels to allow fish the opportunity to move from the area within close proximity of the dam.

Whooping Crane

- Reclamation will monitor the Service’s whooping crane sighting reports to ensure that whooping cranes are not in the Intake Project area during construction. If any are sighted during construction, the project managers will consult with the Service regarding appropriate actions.

Interior Least Tern

- Visual surveys will be conducted weekly from May 15 to August 15 at all potential least tern nesting areas (sparsely vegetated sandbars) within line of site of the construction area.

- All surface-disturbing and construction activities will be prohibited from occurring within 0.25 mile of any existing and active least tern nest within the dates of May 15 to August 15.

Piping Plover

- Visual surveys will be conducted weekly from May 15 to August 15 at all potential piping plover nesting areas (sparsely vegetated sandbars) within line of site of the construction area.
- All surface-disturbing and construction activities will be prohibited from occurring within 0.25 mile of any existing and active piping plover nest within the dates of May 15 to August 15.

Pallid Sturgeon

- The construction activities will be monitored to minimize direct disturbance to pallid sturgeon and other sensitive fish by coordination with MFWP and USGS regarding observation of movements and locations of radio-tagged pallid sturgeon and other monitored native fish during the construction season.
- Any in-stream construction activity will be conducted during periods most likely to minimize the potential impact to the pallid sturgeon. In-water work will not occur during the adult pallid sturgeon migration season (April 15 – July 1).
- A catch and haul program will be implemented during construction to offset effects from blocking the existing side channel.

Lands and Vegetation

- Disturbance of vegetation will be minimized through construction site management (e.g., using previously disturbed areas and existing access routes for access and staging areas).
- Specific vegetation such as mature trees and snags will be fenced or flagged for protection from disturbance.
- All areas temporarily impacted during construction will be replanted with native vegetation immediately after construction.
- Erosion control measures will be employed where necessary to reduce wind and water erosion. Erosion and sediment controls will be monitored frequently during construction for effectiveness and only effective techniques will be used.
- No permanent or temporary structures will be located in any floodplain, riparian area, wetland or stream that will interfere with floodwater movement, except for those described in the EIS.
- Discharges of fill material into wetlands or other waterbodies will be carried out in compliance with Section 404 of the Clean Water Act. No wastes or debris will be placed in wetlands or waterbodies.
- Low pressure equipment or pressure-spreading mats will be used as feasible to minimize compaction of wetland soils during construction.
- Rock quarry materials will come from approved upland sites.
- Grasslands temporarily affected during construction will be restored with similar native species immediately following construction.
- Topsoil will be removed and conserved from the bypass channel construction site. Topsoil not returned to the bypass channel banks will be used to cover fill sites and then seeded.

- Seeding should take place as soon as practical following topsoil placement. Seeding between October 15 and April 15 is the most effective throughout Montana because late winter/early spring is the most reliable period for moist soil conditions. In general, fall seeding (between October 15 and when the frost line is deeper than four to six inches) in eastern Montana has been more successful than spring seeding.
- Vegetation and soil removal will be accomplished in a manner that will prevent erosion and sedimentation.
- Noxious weeds will be controlled, as specified under state law, within the construction footprint during and following construction. Herbicides will be applied in accordance with labeled instructions and state, federal, and local regulations.
- All construction equipment will be cleaned and inspected prior to mobilizing to the project site to prevent transport of noxious weed seeds and fragments.
- Grass seeding will be monitored for at least three years. Where grasses do not become adequately established, areas will be reseeded with appropriate species.
- The disposal of waste material, topsoil, debris, excavated material or other construction related materials within riparian areas will be minimized to the extent possible.
- Woodland and riparian areas impacted by the Project will be restored with native species.
- Native trees and shrubs will be replaced with similar native species.
- Wood rows will be established, as feasible, along any areas disturbed along the river or new channels/canals to provide wildlife habitat and channel stability.
- All equipment tracks and tires working on Joe's Island or other noxious weed infested areas will be cleaned daily to reduce potential transportation to an uninfested site.
- The contractor will be required to prepare an integrated weed management plan to be approved by the Corps. It will identify best management practices to control the spread or introduction of any noxious weeds or plants.
- Seed shall be certified as cheat grass and weed free and "blue tag."
- Temporary wildlife-proof fencing will be installed, if it is determined that wildlife species and/or livestock are impeding successful vegetation establishment. Fencing will be maintained until vegetation is established per consultation with the ERT.

Recreation

- Contractor will be required to maintain dirt or gravel roads within or leading to the construction zone in a drivable condition for typical passenger vehicles throughout construction and to return all existing roads to a similar or better condition prior to demobilizing from the site.
- Contractor will be required to prepare a public safety and detour plan to manage public traffic on existing roads when equipment or large volumes of trucks will be transiting the areas, such as the entrance road to the campground and picnic/day use area.
- The MFWP will be consulted to evaluate and coordinate closures of the fishing access and Joe's Island and to designate access corridors around or through the construction area when construction activities will obstruct existing access to recreation sites or the river.
- Construction activities at the weir or near the fishing access site will be minimized during the paddle fishing season.
- Contractor will be required to implement dust abatement activities on all dirt or gravel roads within or leading to the construction zone, including activity on Joe's Island.

- A communication plan will be developed in coordination with MFWP to alert visitors of current access restrictions, closures, and ongoing construction activities. Signs will be posted including warnings limiting or prohibiting certain recreational uses within the construction zone, such as swimming, fishing, boating, hiking, camping, etc. Signs will be posted upstream and downstream of the Intake Diversion Dam to warn boaters of construction activity and to provide a portage or hand-carry route past construction areas.

Visual Resources

- Minimize access road use and maintain in non-rutted condition.
- Manage construction schedule to minimize duration of truck, equipment, and personnel presence.
- Minimize footprint of clearing and grubbing to protect as much existing vegetation as possible.
- Minimize stream crossings and restore shoreline or instream habitat that are damaged.
- Mulch and reseed areas that are cleared after construction is complete to facilitate return to vegetated conditions.
- During revegetation, create irregular margins around treatment areas to better maintain existing scenic character of the landscape;

Transportation

- Delivery and removal of material and equipment from the construction area will be scheduled to avoid peak traffic times along Highway 16 and other local roadways.
- Contractor will be required to designate construction routes and access points and utilize only these routes.
- Parking areas for construction workers will be designated to avoid parking impacts at Intake FAS or to other landowners.
- Contractor will be required to post informational signage at key intersections to advise the public about active construction areas and traffic issues.
- Contractor will be required to maintain Road 551, Road 303, and other roads along construction haul routes throughout construction, and perform post-construction rehabilitation, such that the roads are serviceable for public traffic to Intake FAS and to residents along Road 303 during construction and are left in equal or improved condition after construction.

Noise

- Equipment and trucks used for project construction will utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds) wherever feasible.
- Stationary noise sources such as pumps or generators will be located as far from adjacent receptors as possible and will be muffled and enclosed within temporary sheds, incorporate insulation barriers or other measures to the extent feasible.

- Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for project construction will be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically-powered tools. However, where use of pneumatically powered tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves will be used where feasible. This could achieve a reduction of 5 dBA. Quieter procedures will be used such as drilling rather than impact equipment whenever feasible.
- Sheet piling and heavy construction equipment operations will be limited to allowable daytime working periods only.
- Sheet piling operations will incorporate a three sided sound barrier wall to enclose the sheet piling when residences are within 1 mile of the sheet piling. The sound barrier wall will have an overall minimum height 15 feet.

Social and Economic Conditions

- Construction activities at the weir or adjacent to the Intake FAS will be minimized during the paddle fishing season.
- A communication plan will be developed to alert visitors of current access restrictions, closures, and ongoing construction activities. The construction contractor will clearly post and sign any areas within any designated construction zones. Signs will include warnings limiting or prohibiting certain recreational uses within the zone, such as swimming, fishing, boating, hiking, camping, etc.

Historic Properties

- Engineering drawings and photographs of affected structures, if available, will be filed with the State Historic Preservation Office (SHPO) and the National Archives.
- If engineering drawings and photographs are not available, the structures will be recorded in accordance with the Historic American Buildings Survey and the Historic American Engineering Record, as appropriate.
- If practicable, historic structures that must be moved for construction will be returned to their original locations after construction of the Project is completed. If that is not feasible, Reclamation will seek a party that will be willing and able to adopt the historic structure or building with appropriate preservation covenants.
- Reclamation will develop and implement a data recovery plan in consultation with the Montana SHPO, Advisory Council on Historic Preservation, and other interested parties, as appropriate, for mitigation of the Headworks Camp (24DW447).
- One or more signs will be installed at or near the Intake FAS to summarize the history of the Lower Yellowstone Irrigation Project.
- A fence will be installed around the Old Cameron and Brailey Sub-Camp (24DW298) to protect it from disturbance by unloading and storage of rock or other construction activities.
- Impacts on Intake Diversion Dam (24DW0443) will be mitigated through detailed recording of the structure.

- Potential impacts on unidentified cultural resources in unsurveyed portions of the APE may be reduced to no effect through avoidance of unsurveyed areas. If avoidance is infeasible, impacts may be mitigated to minor or moderate by surveying such areas within the APE. Additional mitigation measures may be necessary to avoid impacts on newly identified resources/potential historic properties as a result of the survey.
- Impacts on the south rock tower and boiler building, part of 24DW0443, as a result of necessary relocation will be mitigated to no effect if the buildings can be returned to their original locations after construction. If return of the buildings is infeasible, impacts may be mitigated to moderate by identifying a party that will be willing and able to adopt the historic buildings with appropriate preservation covenants.
- Impacts on 24DW0296 may be mitigated to no effect through avoidance (i.e. not widening the access road through the site). If avoidance is infeasible, impacts may be mitigated to minor or moderate through monitoring of the archaeological site under an approved monitoring plan.
- Impacts on 24DW0430 and 24DW0442 may be mitigated to no effect through avoidance (i.e. not stockpiling materials on top of or driving through the sites). If avoidance is infeasible, impacts may be mitigated to moderate through consultation to resolve the NRHP-eligibility of 24DW0442 and conducting data recovery at 24DW0430 (and 24DW0442 if determined NRHP-eligible) under an approved research design.
- Potential impacts on unidentified subsurface archaeological resources may be mitigated to minor or moderate by surveying deep excavation areas using subsurface probes combined with a geo-archaeological study under an approved study plan. Additional mitigation measures may be necessary to avoid impacts on newly identified resources/potential historic properties as a result of the survey.

Actions to Minimize Effects during Operation

Surface Water Hydrology

- Surface water hydrology shall be monitored as described in the Monitoring and Adaptive Management Plan.

Geomorphology

- River morphology will be monitored via aerial photography on a two-year basis to assess changes to the river resulting from construction of the bypass channel alternative. The ERT will be consulted regarding specific adaptive management measures if substantive changes are determined to have been caused by the Intake Project.

Lands and Vegetation

- Plantings will be monitored on an annual basis for five years following construction to ensure compliance with federal and state permits. Reporting will be completed as required. The long-term success of plantings will be reviewed and approved by the ERT.

Wildlife

- Intake Project-related operation and maintenance travel will be restricted to existing roads and Intake Project easements. No off-road travel will be allowed, except when approved through the ERT.

Federally Listed Species and State Species of Concern

- Federally listed species and state species of concern shall be monitored as described in the Monitoring and Adaptive Management Plan.

Historic Properties

- Reclamation will continue consultation with the Montana State Historic Preservation Office during implementation of the formal memorandum of agreement stipulating the mitigation and treatment plan.

ATTACHMENT C

LOWER YELLOWSTONE INTAKE DIVERSION DAM FISH PASSAGE PROJECT ESA CONSULTATION DOCUMENTS

United States Department of the Interior
BUREAU OF RECLAMATION
Great Plains Region
Montana Area Office
P.O. Box 30137
Billings, Montana 59107-0137

IN REPLY REFER TO:

GP-4200
ENV-7.00

AUG 29 2016

MEMORANDUM

To: Assistant Regional Director, Ecological Services,
U.S. Fish and Wildlife Service, Lakewood, Colorado
Attn: Michael Thabault

From: Steve Davies [signature]
Montana Area Office, Area Manager

Subject: Biological Assessment for the Intake Diversion Dam Fish Passage Project, Lower Yellowstone, Montana

The Bureau of Reclamation, Montana Area Office (Reclamation), and the U.S. Army Corps of Engineers, Omaha District (Corps), are hereby requesting initiation of formal consultation on the proposed federal action, described herein, and is providing two copies of the subject biological assessment (BA) for your review. The proposed federal action includes: (1) Interim operation and maintenance of the Lower Yellowstone Project, (2) Construction of a bypass channel and replacement weir to improve upstream passage of the endangered pallid sturgeon, (3) Long-term operation and maintenance of the Lower Yellowstone Project, and (4) Implementation of an adaptive management and monitoring plan.

Reclamation and the Corps have prepared the subject BA in compliance with Section 7 of the Endangered Species Act of 1973, as amended, and the regulations on Interagency Cooperation (50 CFR 402). The BA evaluates the effects of the proposed action on federally-listed species, proposed species, and candidate species residing in or migrating through the action area in eastern Montana and western North Dakota.

Based on our analysis in the BA, Reclamation and the Corps have determined that interim and future operation and maintenance of the Lower Yellowstone Irrigation Project, construction of the fish passage facilities, and implementation of an adaptive management and monitoring plan is:

(1) Likely to adversely affect the Pallid Sturgeon,
(2) May affect, but is not likely to adversely affect, the Interior Least Tern
(3) Will have no effect on the Whooping Crane
(4) May affect, but is not likely to adversely affect, the Piping Plover
(5) Will have no effect on the Red Knot
(6) Will have no effect on the Black-Footed Ferret
(7) Will have no effect on the Gray Wolf
(8) May affect, but not likely to adversely affect, the Northern Long-Eared Bat
(9) Will have no effect on the Dakota Skipper

Reclamation and the Corps are requesting Ecological Services prepare a biological opinion on the potential effects the proposed action may have on Pallid Sturgeon. We also request written concurrence with our determination that the proposed action may affect, but is not likely to adversely affect, the Interior Least Tern, the Piping Plover, and the Northern Long-Eared Bat.

This letter is being submitted on behalf of the U.S. Army Corps of Engineers. If you have any questions or require additional information, please contact David Trimpe at 406 247-7717 or Tiffany Vanosdall at 402 995-2695.

Attachments - 2

cc: U. S. Fish and Wildlife Service
Montana Ecological Services Field Office
Attn: Jodie Bush and Brent Esmoil
585 Shepard Way, Suite 1
Helena, MT 59601

U.S. Fish and Wildlife Service
Attn: Doug Laye
134 Union Boulevard, Suite 650
Lakewood, CO 80228

U.S. Army Corps of Engineers
Omaha District Headquarters
Attn: Tiffany Vanosdall
1616 Capitol Avenue, Suite 9000
Omaha, NE 68102

bc: GP-4200 (DEpperly, DTrimpe)
MT-100 (SDavies), MT-200 (JBaumberger)

WBR:DTrimpe:JGeorge:08/22/2016:406-247-7717
V:\Shared\Correspondence\2016\100\BA Transmittal Letter Corps and Reclamation 08.16.2016

LOWER YELLOWSTONE PROJECT: INTAKE DIVERSION DAM FISH PASSAGE PROJECT

BIOLOGICAL ASSESSMENT

August 2016

Prepared by Joint Lead Agencies:

U.S. Department of the Interior
Bureau of Reclamation
Billings, Montana

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

Acronyms and Terms

AM	Adaptive Management
BA	Biological Assessment
BiOp	Biological Opinion
BO	Biological Opinion
BRT	Biological Review Team
cfs	Cubic Feet Per Second
CFR	Code of Federal Regulations
CLMU	Central Lowlands Management Unit
Corps	U.S. Army Corps of Engineers
CPMU	Coastal Plain Management Unit
EA	Environmental Assessment
ESA	Endangered Species Act
EIS	Environmental Impact Statement
FPCI	Fish Passage Connectivity Index
GIS	Geographic Information System
GPMU	Great Plains Management Unit
GPS	Global Positioning System
IHMU	Interior Highlands Management Unit
IPMP	Integrated Pest Management Plan
LYIP	Lower Yellowstone Irrigation Project Board of Control
LYP	Lower Yellowstone Project
AMP	Monitoring and Adaptive Management Plan
MFWP	Montana Fish, Wildlife & Parks
MNHP	Montana Natural Heritage Program
NDNHP	North Dakota Natural Heritage Program
NMFS	National Marine Fisheries Service
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OHWM	Ordinary High Water Mark
PSCAP	Pallid Sturgeon Conservation Augmentation Program
Reclamation	U.S. Bureau of Reclamation
RPA	Reasonable and prudent alternative
Service	U.S. Fish and Wildlife Service
TL	Total Length
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

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INTRODUCTION

The U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (Reclamation) have prepared this Biological Assessment (BA) for the Lower Yellowstone Intake Diversion Dam Fish Passage Project (Project), which includes interim operation and maintenance (O&M) of the Lower Yellowstone Project (LYP), construction of a bypass channel and replacement weir, future O&M of the LYP with fish passage, and implementation of an adaptive management and monitoring plan (AMP). This BA is being submitted for consultation in accordance with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended, by both agencies.

The proposed Project involves improving fish passage at Intake Diversion Dam, located at approximately river mile (RM) 74 on the Yellowstone River (Figure 1) in eastern Montana. Intake Diversion Dam is the only diversion weir associated with the Lower Yellowstone Project and is the downstream-most of the six primary diversion structures on the Yellowstone River. The Yellowstone River is the largest tributary to the Missouri River.

This BA evaluates the proposed project to determine whether there may be effects to species listed or proposed to be listed under the ESA or their designated critical habitat. Species lists were requested from the U.S. Fish and Wildlife Service (Service) in December 2015 to encompass a potential action area from Cartersville Dam at RM 237 on the Yellowstone River down to the headwaters of Lake Sakakawea on the Missouri River. Species lists were received on January 19, 2016 for both Montana and North Dakota (see Appendix B). Subsequent to receipt of the species lists in January 2016, the Sprague's pipit was removed as a candidate species for listing on April 5, 2016 (Service 2016a) and is thus, not discussed in this BA. This BA addresses the potential effects to the species listed in Table 1 that may occur in the action area.

Table 1: Listed and Candidate Species that May Occur in the Action Area.

Common Name	Scientific Name	MT[b]	ND[b]	ESA Status	Presence in Study Area
Fish					
Pallid sturgeon	*Scaphirhynchus albus*	X	X	Endangered	Present
Birds					
Least tern	*Sternula antillarum*	X	X	Endangered	Likely to be present
Whooping crane	*Grus americana*	X	X	Endangered	Likely to be present
Piping plover	*Charadrius melodus*	X	X	Threatened	Likely to be present
Red knot	*Calidris canutus rufa*	X	X	Threatened	Not present
Mammals					
Black-footed ferret	*Mustela nigripes*	X	X	Endangered	Not present
Gray wolf[a]	*Canis lupus*		X	Endangered	Not likely to be present
Northern long-eared bat	*Myotis septentrionalis*	X	X	Threatened	Not likely to be present
Insects					
Dakota skipper	*Hesperia dacotae*		X	Threatened	Not present

a. Gray wolf has been delisted in Montana and is considered in recovery; it remains endangered in North Dakota.
b. Checked boxes indicate the species is federally listed for protection within that state.

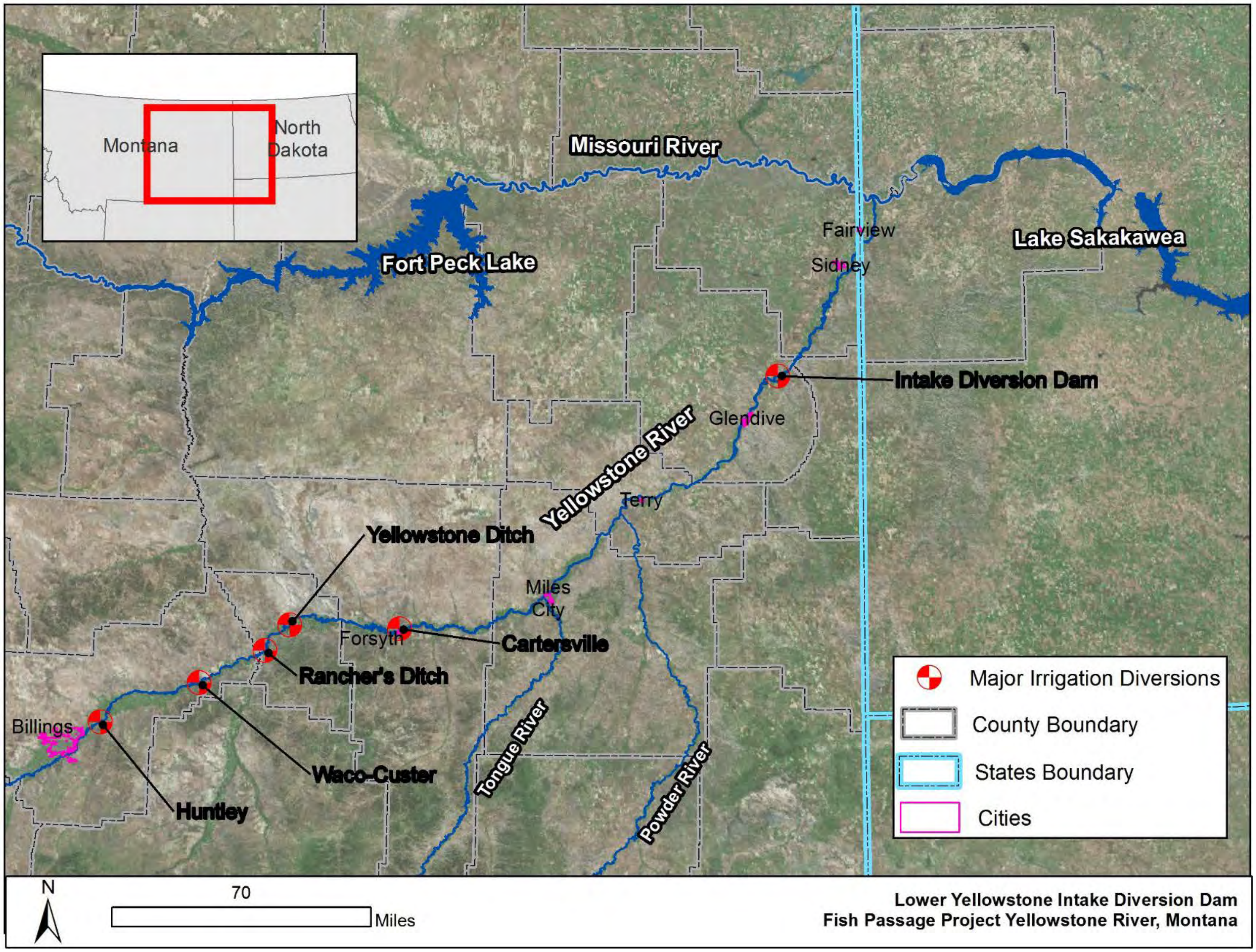

Figure 1: Lower Yellowstone River and Intake Diversion Dam Vicinity Map

ACTION AREA

The action area is defined (50 CFR 402.20) as all areas that may be affected directly or indirectly by the proposed Federal action and is not merely the immediate area involved in the action. The action area encompasses the geographic extent of environmental changes (including the physical, chemical, and biological effects) that would result directly or indirectly from the action. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. The action area also includes the potential area of effect for any interrelated or interdependent actions.

Based on the area where modifications to the land, water, or air may occur or be perceived (either directly or indirectly), the action area for this consultation is defined as follows and shown in Figures 2 and 3.

The lower Yellowstone River (river miles 0 to 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 that would be subject to future operation and maintenance activities and Joe's Island. Three miles upstream of Intake Diversion Dam is the furthest distance upstream that any potential changes to the river or its floodplain might occur based on construction or maintenance actions taken at the weir or Joe's Island and any resultant adjustments in river morphology, sediment transport, or surface water elevations. Upstream of this point, it is highly unlikely that any modifications to the land, water or air would occur as a result of the proposed action. Cartersville Diversion Dam at RM 237 presents another fish passage barrier but would not be affected by any actions included in this consultation (see Figure 1 for locations of other diversion dams).

The Missouri River downstream of Fort Peck to the Yellowstone River confluence is not considered within the Action Area of this consultation. Currently, the Corps has reinitiated consultation with the Service on the Missouri River and are in the process of developing an Adaptive Management Plan that will look at a suite of options on the Missouri River Main Stem. Fish passage at Intake is a site-specific project that will fit within a larger programmatic effort to recovery pallid sturgeon as described in the Recovery Plan, the Corp's Biological Opinion, and the programmatic adaptive management plan the Corps is developing for recovery on the Missouri and Yellowstone rivers.

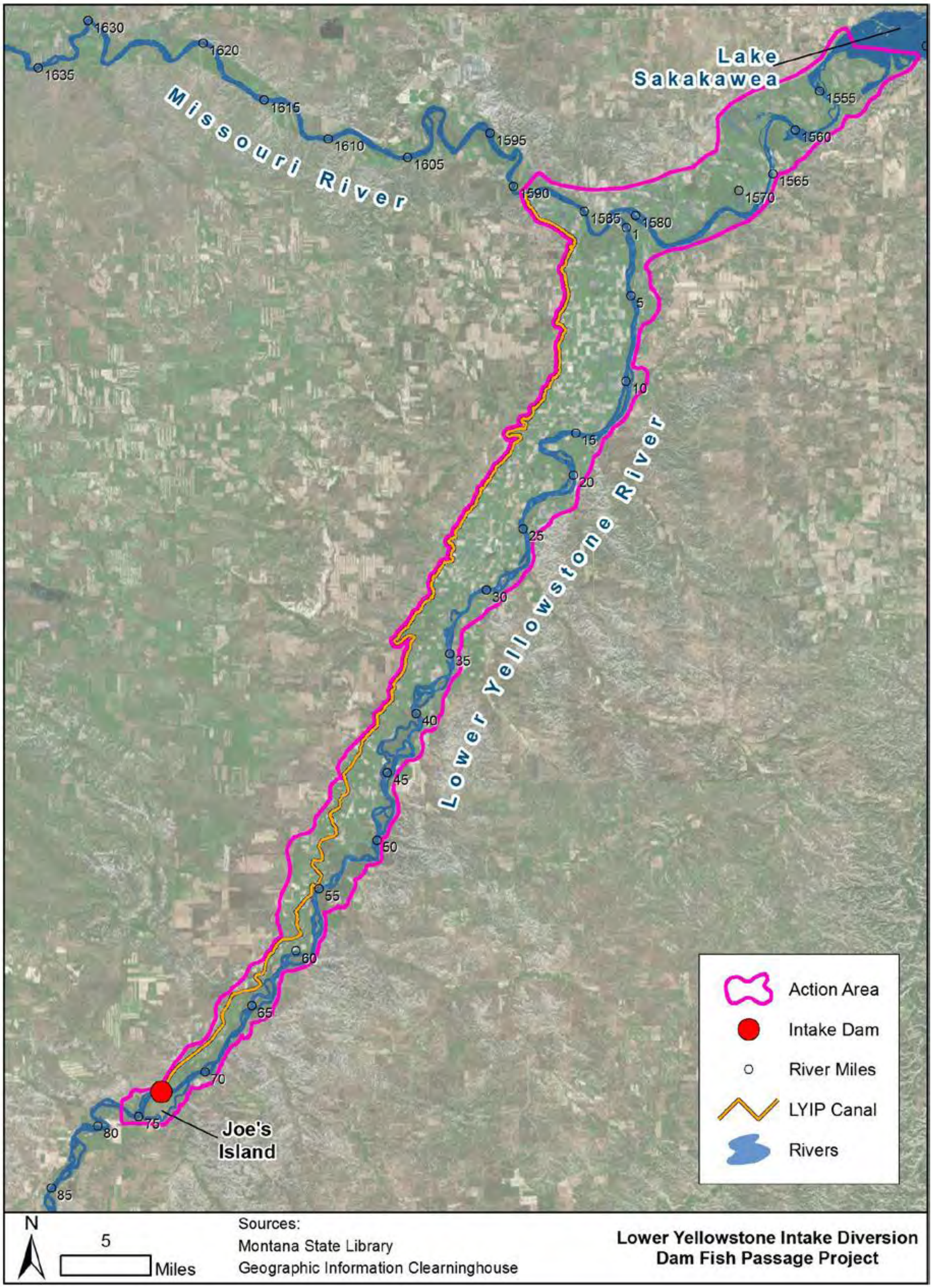

Figure 2: Map of Action Area.

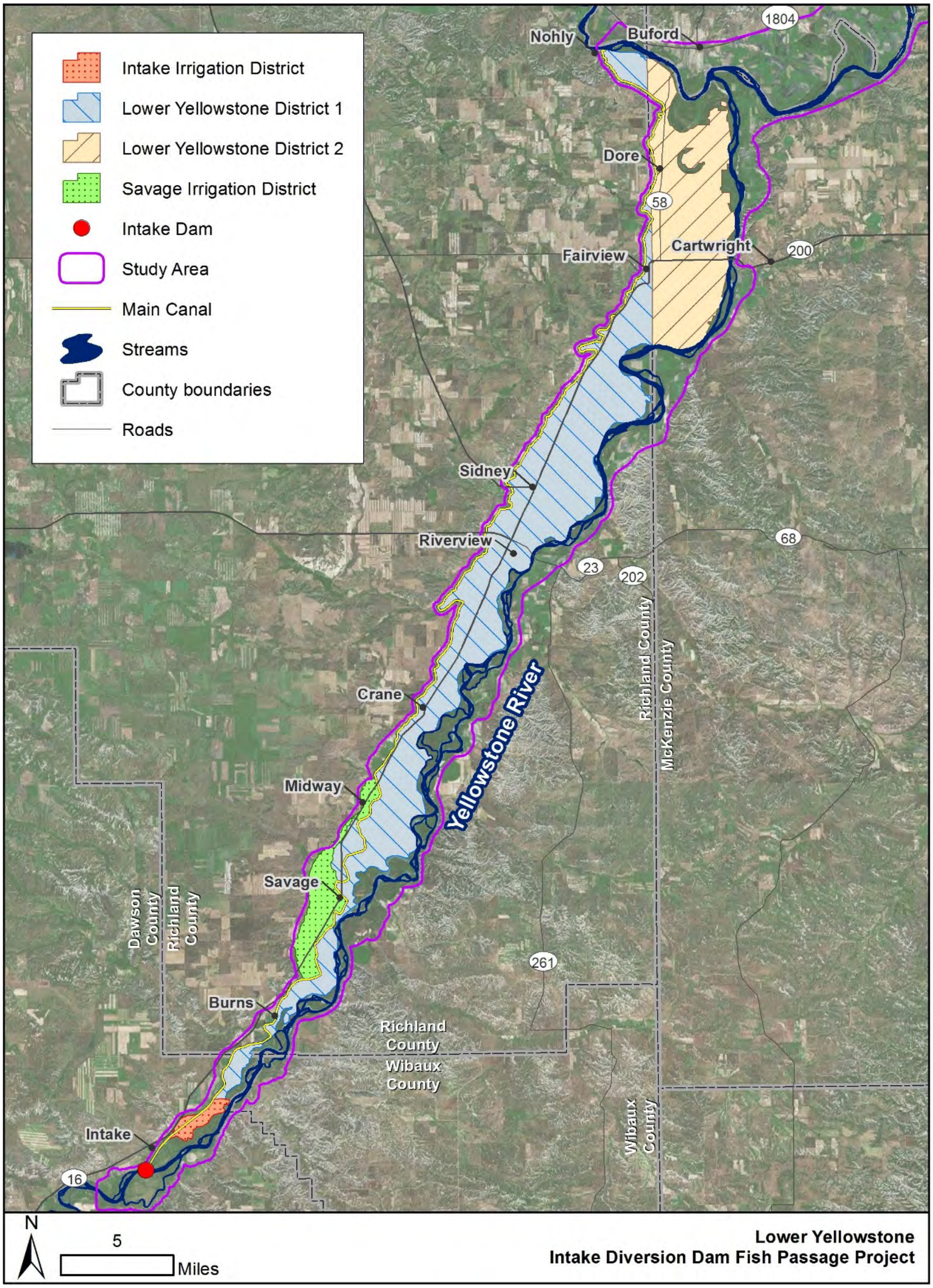

Figure 3: Action Area Showing Lower Yellowstone Project and Irrigation Districts.

PROJECT PURPOSE AND NEED

The purpose of the proposed action is to improve fish passage for pallid sturgeon and other native fish at the Intake Diversion Dam, continue the viable and effective operation of the Lower Yellowstone Project, and contribute to ecosystem restoration.

Improve Fish Passage

Pallid sturgeon occupy the Missouri and Yellowstone Rivers in Montana and North Dakota. The Service listed the pallid sturgeon as endangered under the Federal Endangered Species Act (ESA) in 1990. Adult pallid sturgeon move upstream from the Missouri River into the lower Yellowstone River for spawning in spring as temperatures and river flows increase. While it remains important to support the irrigation served by the LYP, the requirements of the ESA and benefits to pallid sturgeon and other native species must be supported as well.

Habitats upstream of the Intake Diversion Dam appear to be suitable for spawning and rearing of pallid sturgeon juveniles, but few pallid sturgeon have been observed upstream of the weir. A small number of adult pallid sturgeon were tracked in 2014 and 2015 passing upstream of the Intake Diversion Dam by way of the existing side channel around Joe's Island.

All available data indicates that Intake Diversion Dam is a barrier to upstream passage that prevents most pallid sturgeon from accessing upstream reaches. Therefore, the proposed project is needed to allow fish passage at this structure. Improving passage for pallid sturgeon at the Intake Diversion Dam would provide access to a large area of the sturgeon's historical range that has been mostly inaccessible since construction of the LYP, starting in 1905.

Continue Viable and Effective Operation of the Lower Yellowstone Project

The proposed Project allows for continued viable and effective operation of the LYP. Project operation, maintenance and rehabilitation is carried out by the Lower Yellowstone Irrigation Project Board of Control (LYIP) through funds generated by assessments on farms within the LYP. The ability of farms to pay assessments is dependent on income from crop production, which is a function of reliable and sufficient water deliveries to meet crop requirements.

The LYP encompasses approximately 58,000 acres on over 400 farms along the Main Canal. Agriculture is an important sector of economic activity in the region, with 2010 agricultural income for the region around the project totaling about $26.5 million. The LYP provides water to four irrigation districts. Reclamation and the following four districts hold unadjudicated water rights in the state of Montana totaling 1,374 cubic feet per second (cfs):

- Lower Yellowstone Irrigation District #1
- Lower Yellowstone Irrigation District #2
- Intake Irrigation District
- Savage Irrigation District

The Lower Yellowstone #1, Intake and Savage Irrigation Districts make up about two-thirds of the district lands and are located in Montana. The Lower Yellowstone Irrigation District #2, is in North Dakota and represents the remaining one-third of the irrigated lands. Each of the four districts has water service and repayment contracts with Reclamation. All have met their full financial obligation for repayment of the diversion structure and supply works for the project.

Contribute to Ecosystem Restoration

The 2007 Water Resources Development Act (Pub. L. 110–114; 121 Stat. 1041) (Section 3109) authorizes the Corps to use funding from the Missouri River Recovery and Mitigation Program to assist Reclamation in the design and construction of the Lower Yellowstone Project at Intake, Montana for the purpose of ecosystem restoration.

Improvements to fish passage at the Intake Diversion Dam would support migration for numerous fish species and contribute to the sustainability of fish populations in the lower Yellowstone River. The Project would support ecosystem functions by restoring access to a large area of suitable fish habitat throughout the lower Yellowstone River ecosystem.

BACKGROUND ON LOWER YELLOWSTONE PROJECT

Reclamation constructed the LYP under the authority of the Reclamation Act/Newlands Act of 1902 (Public Law 161; Act). The Act authorized development of irrigation projects to establish farms in the western United States. As is the case for most authorized Reclamation projects, the long-term O&M of project facilities is the responsibility of the water users. Reclamation retains ownership of the LYP facilities, and O&M is carried out by the LYIP under contract with Reclamation.

Under the authority of Section 5 of the Reclamation Extension Act of August 13, 1914 and subsection nine (9) of the December 5, 1924 Fact Finders' Act, O&M of the diversion and supply works were transferred to the two Lower Yellowstone districts in 1926, to Intake Irrigation District in 1945, and to Savage Irrigation District in 1951. The LYIP is required to maintain the transferred works in full compliance with Reclamation law, other federal and state laws, and the regulations of the Secretary of the Interior. By policy, Reclamation is required to inspect the facilities every six years. Should the Districts fail to maintain the facilities, Reclamation could resume O&M and charge the LYIP for the cost of O&M.

The LYP was developed to provide a dependable supply of irrigation water for approximately 58,000 acres of land along the west bank of the lower Yellowstone River. Approximately two-thirds of the irrigated lands are in Montana with the remaining lands located in western North Dakota.

The LYP diverts water from the Yellowstone River into the Main Canal at the headworks located just upstream of Intake Diversion Dam near Intake, Montana; fifteen miles northeast of Glendive. Water flows by gravity through 71 miles of the Main Canal, 225 miles of laterals, and 118 miles of drains that return flows back to the Yellowstone River.

BACKGROUND ON PALLID STURGEON

The pallid sturgeon (*Scaphirhynchus albus*) was listed by the Service on September 6, 1990 as endangered throughout its range under the ESA (Service 1990). The population that occurs in the action area is within the Great Plains Management Unit, extending from Great Falls, Montana to Fort Randall Dam, South Dakota and including the Yellowstone, Marias, and Milk rivers. An estimated 158 wild pallid sturgeon adults remained in 2004 (Klungle & Baxter 2005; 95% confidence interval [CI] equals 129 to 193), in the segment of this population that occurs in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea and includes the Yellowstone River (Service 2014a). Now that it is 12 years later, the wild adult population may be reduced to as few as 90 (based on an estimated mortality rate of 5%; Braaten, et al. 2009).

The Pallid Sturgeon Conservation Augmentation Program (PSCAP) has been supplementing the wild population with hatchery juveniles since 1998 to help prevent extirpation. To date, the majority of these fish are not mature and are not known to be reproducing in the wild. Two hatchery females have been identified by Montana Fish, Wildlife & Parks (MFWP) staff to have reached maturity in the population that occurs in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea and includes the Yellowstone River (G. Williams, Corps, pers. comm. 2016). It is anticipated that many of these fish will reach maturity over the next few years and will become reproductively active.

Adult pallid sturgeon are present seasonally in the Yellowstone River, moving upstream from the Missouri River as temperatures and river flows increase in spring (Bramblett 1996; Fuller and Braaten 2012), for spawning. Very few have been observed above Intake Diversion Dam, although upstream habitats appear to be available for spawning and rearing of juveniles (Bramblett and White 2001; Jaeger et al. 2005). Recently, a small number of adult pallid sturgeon were tracked passing upstream of the weir via an existing side channel in 2014 and 2015 during high river flows (40,000-65,000 cfs) and at least one female appeared to have spawned in the Powder River (Rugg 2014, 2015). The lack of passage at Intake Diversion Dam limits spawning access and subsequently, drift distance for free embryos and larvae which has been hypothesized as a key factor in the lack of recruitment of pallid sturgeon and has contributed to their decline. Improving passage for pallid sturgeon at Intake Diversion Dam would provide access to a 165 miles of the sturgeon's historic range that has been inaccessible since approximately 1905. In addition, the Yellowstone River provides a relatively natural flow regime, water temperatures, and habitat conditions.

PROPOSED ACTION

The proposed action includes four components:

- 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 (Section 10) by the Corps (Corps action);
- Construction of a bypass channel and replacement weir to improve upstream and downstream fish passage at the Intake Diversion Dam (Corps action);
- Operation and maintenance of the LYP after implementation of the fish passage project (Reclamation action); and
- Implementation of an adaptive management and monitoring plan (Corps and Reclamation action).

These four components of the action are described in more detail in each subsection below. If the agencies modify the proposed action significantly as a result of its parallel NEPA process, Reclamation and the Corps will submit either an addendum to this biological assessment or a new biological assessment to FWS in accordance with the ESA and implementing regulations.

Operation and Maintenance Prior to and during Construction of the Proposed Fish Passage Improvements

O&M of the LYP for up to 3 years before the fish passage improvements are complete (2017-2019) would include the following specific elements:

- The track-mounted fish screens would be lowered into place over the gates prior to the initiation of the irrigation season. The range of dates may vary due to ice-off variability, weather, and crop requirements, but the screens would always be lowered before the gates are opened to divert water, except as noted below for the initial sediment clean-out.
- Daily and seasonal adjustments to headwork gates in response to flow conditions and crop requirements. Diversions generally occur from April 15 to October 15. Weather and/or flow conditions could extend the irrigation season up to two weeks earlier or later. Gate position is fully automated and can be accessed from the bridge deck on the headworks.
- Diversions up to 1,374 cubic feet per second (cfs) from the Yellowstone River through the headworks into the Main Canal during the irrigation season.
- Minor screen cleaning/maintenance on the headworks structure. During maintenance, the gate associated with that screen would be closed and a back-up screen and gate operated to divert a similar volume of water.
- In the event two or more screens need to be raised simultaneously, unscreened water would enter the canal. Screens may need to be raised in the event of inadequate water delivery such as during extreme drought or screen blockage. Drought conditions would typically only occur during late August and September. A screen blockage is not generally anticipated (i.e. a cottonwood pinned on a screen). All repairs, replacement,

and/or maintenance would be made as expeditiously as possible to minimize unscreened water diversion. Screens are accessed from the bridge deck.

- Diverting unscreened water into the Main Canal at the beginning of the irrigation season (approximately one day) to sluice sediment and debris that accumulates in front of the headworks. If larger quantities of sediment are present, dredging may be necessary.
- Occasional gate maintenance or repair may be required, although this is generally not anticipated. If gate maintenance was necessary the individual gate would be isolated from the river by use of a small coffer dam or coffer box to allow work to be conducted in the dry.
- Raising screens when water is not being diverted to avoid potential damage from ice and debris (outside of irrigation season).
- Routine inspection of the headworks structure and gates. Inspections would occur annually after spring runoff and following ice events to ensure the integrity of the structure.
- Monitoring and recording screen operations to identify effectiveness of screening protocol.
- Placement of rock on the existing diversion structure, up to elevation 1991.0 feet, to provide sufficient head to allow diversion of the full water right of 1,374 cfs into the Main Canal until construction of the new diversion weir is complete. Rock would be placed on top of the existing weir with the existing trolley system. This action would require a Section 10 permit from the Corps for placement of fill in a navigable waterway.
- Conveyance of diverted water through LYP canals, laterals, and drains.
- Operation of the five small supplemental surface water pumps (four on the Yellowstone and one on the Missouri) to supplement Main Canal diversions.
- O&M activities within the irrigation system such as canal maintenance, inspections, upgrades, canal access road maintenance, and weed control.

Existing Headworks

A headworks with state-of-the-art integrated rotating drum fish screens was constructed in 2011 in accordance with the Service’s (2010) written concurrence that construction of the headworks and fish screens was not likely to adversely affect listed species. The first year of water delivery using the new headworks was the 2012 irrigation season. The headworks structure controls the diversion of water into the Main Canal and includes twelve removable rotating drum screens to minimize fish entrainment (Figure 4).

Figure 4: New Headworks with Fish Screen at Intake (screens submerged)

The top of the headworks is approximately five feet above the 100-year ice-affected water surface elevation. Eleven of the gates and screens are used to divert the full 1,374 cfs water right, when necessary, with one additional back-up gate and screen that can be used if any of the screens require repair, replacement, or maintenance. Because screen design criteria specific to pallid sturgeon do not exist, the screens were designed to meet juvenile salmonid criteria established by the Service and the National Marine Fisheries Service (NMFS 2011).

Each drum screen is 6.5 feet in diameter and 25 feet in length. The headworks structure supporting the screens is 310 feet long. The screens have a maximum mesh size of 1.75 millimeters (mm) with a profile bar of 2.38 mm woven wire. Maximum approach velocity in front of the screen is designed at 0.4 feet per second providing even velocity distribution across the rotating screens. The cylindrical screens were constructed to be approximately one meter above the river bed to minimize entrainment of drifting free embryos and larval pallid sturgeon. Water flows by gravity through the screens and slide gates where it then enters the Main Canal.

Removable rotating drums allow each screen to be adjusted on a track and be raised above the river when not in use (Figure 5). This feature minimizes damage from ice during winter and from other debris. Fixed brushes mounted on the inside and outside of the screens clean the screens when in use and remove aquatic organisms potentially impinged on the screens (Figure 6).

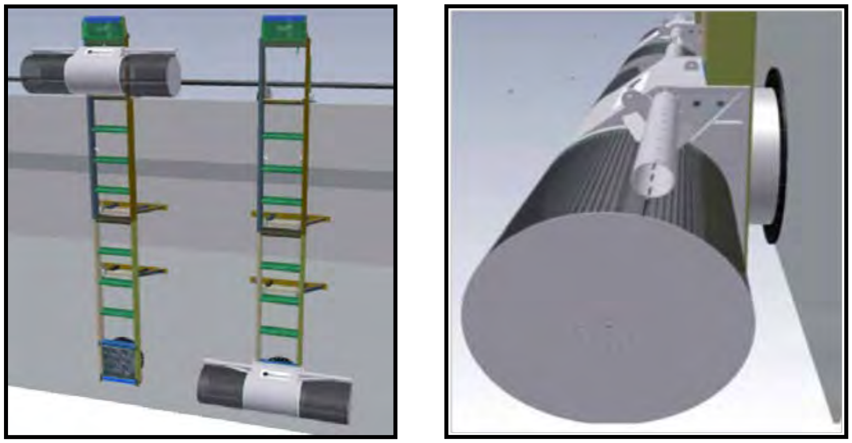

Figure 5: Removable Drum Screens on Adjustment Track

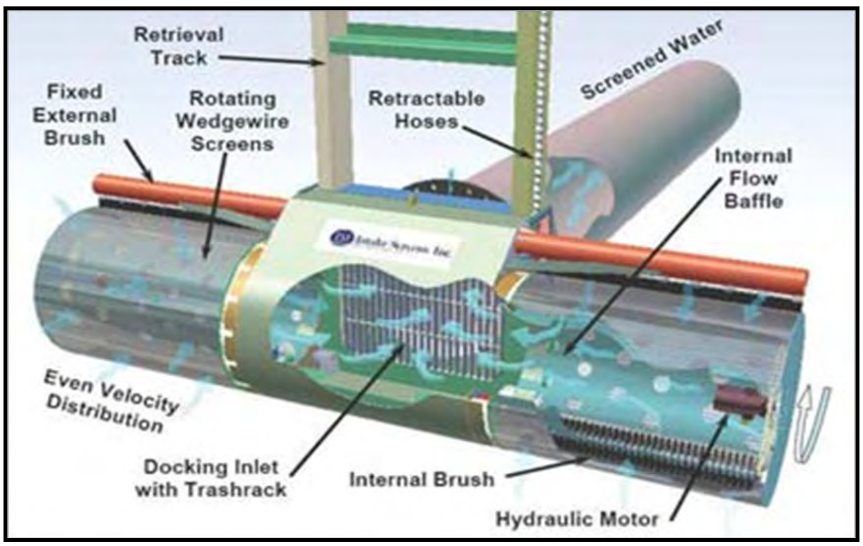

Figure 6: Schematic of Removable Drum Screen

Existing Diversion Weir

The existing Intake Diversion Dam is a timber crib structure filled with rock and some segments of steel sheet piling that have been added during various repairs over the years. The crest of the timber crib structure has an average elevation of 1989.0 feet. Because this elevation is not adequate to divert the full water right, the LYIP places rock on top of the timber crib structure to bring the average elevation up to 1991.0 feet. This additional rock accounts for the head-loss through the screens and raises the water surface elevation sufficiently to deliver the full 1,374 cfs water right during summer low flows, which also corresponds to the peak demand times. This rock placement occurs almost annually because ice and/or high flows frequently move the rock off of the timber crib structure from the year before. The placement of rock fill within the river that is a navigable waterway requires a Corps Section 10 permit.

Even if further maintenance of the Intake Diversion Dam were to stop, the timber crib structure would likely remain in place for decades, although diversions into the Main Canal would be reduced because water surface elevation needed to maintain the full diversion would not be met.

Construction of Replacement Weir and a Bypass Channel for Fish Passage

Construction of the replacement weir and bypass channel includes:

- Constructing a replacement concrete diversion weir at elevation 1991.0 feet with a low flow notch at elevation 1989.0 feet that is located approximately 40 feet upstream of the existing Intake Diversion Dam.
- Cobbles and riprap excavated from the bypass channel would be placed upstream of the replacement weir to promote smooth flows over the weir. Riprap would also be placed downstream of the replacement weir to provide for a smooth transition between the two structures and provide stability to the replacement weir.
- Abandonment and relocation of the existing south rocking tower to the south of the new bypass channel.
- Excavation of a 11,150 foot long (2.1 miles) bypass channel that would extend from the upstream end of the existing side channel and outlet approximately 500 feet downstream of the existing diversion structure and rock rubble field on the right bank.
- The bypass channel would include riprap vertical grade control structures and riprap armoring on outside bends and a cobble substrate to maintain the desired depths and velocities for the design flows.
- Filling approximately 9,500 feet (1.8 miles) of the upstream end of the existing side channel with excavated material from the bypass channel to ensure that the bypass channel achieves 12-15 percent of the river flows at all flows above 7,000 cfs in the river.
- Stockpiling and shaping excavated materials.
- Placing and shaping fill near the upstream and downstream ends of the bypass channel to enhance attraction flows and reduce eddy formations.

Replacement Weir

The proposed replacement weir would span the entire Yellowstone River and consist of a cantilevered structural wall created by a deep foundation of driven piles (Figure 7). Because of the river water level, if drilled shafts are used, the shafts would be cased (pipe piles cleaned out and filled with reinforced concrete). The piles or shafts would be spaced such that there would be gaps between them below the cap but would be backfilled with cobbles and riprap. The top of the structure would be at approximately 1991.0 feet which is the same elevation as the rock currently placed on the existing diversion structure. The new weir would include a reinforced concrete cap to protect it and allow for a smooth crest surface for ice to pass over.

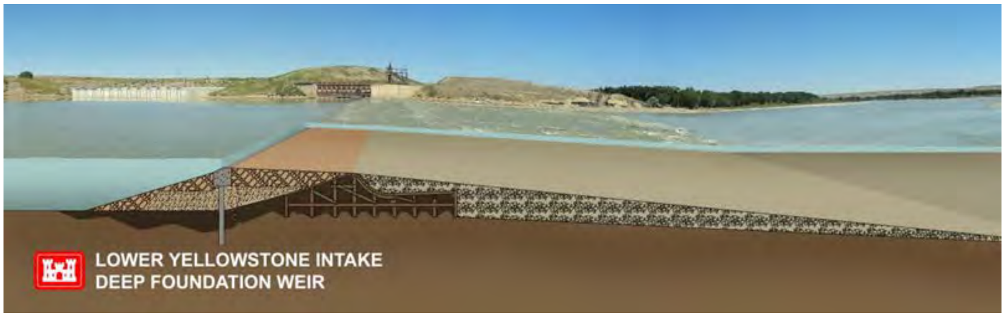

Figure 7: Proposed Replacement Weir

Construction of the replacement weir would begin on the north side of the river with approximately one-third of the weir being constructed at a time. The construction work zone for the weir would be isolated from the river using sheet pile coffer dams. Once the first weir section is complete, the coffer dam sheet piles would be removed, and then reinstalled to complete the next section of the weir.

A low flow notch at elevation 1989.0 feet in the weir crest is proposed. The notch is intended to facilitate downstream movement of adult, juvenile, free embryo, and larval pallid sturgeon and the upstream movement of stronger native fish species. The low-flow notch would be approximately 125 feet at its top width and 85 feet at its bottom width and would be located about 100 feet out from the left bank near the thalweg of the river.

Existing access roads at the headworks and on Joe's Island would be improved or extended as needed to allow access for construction of the bypass channel and replacement weir. These roads would likely remain in place for long term O&M use.

Bypass Channel

To improve fish passage, one of the primary features of the proposed action is the excavation of an engineered bypass channel from the upstream end of the existing side channel to a location immediately downstream of the existing diversion weir and associated rock rubble field (Figure 8). By locating the downstream entrance to the bypass channel in close proximity to the weir where fish congregate, fish are more likely to locate the entrance. The proposed concrete weir would provide an adequate water surface elevation to maintain Main Canal diversions and appropriate flows splits into the proposed bypass channel.

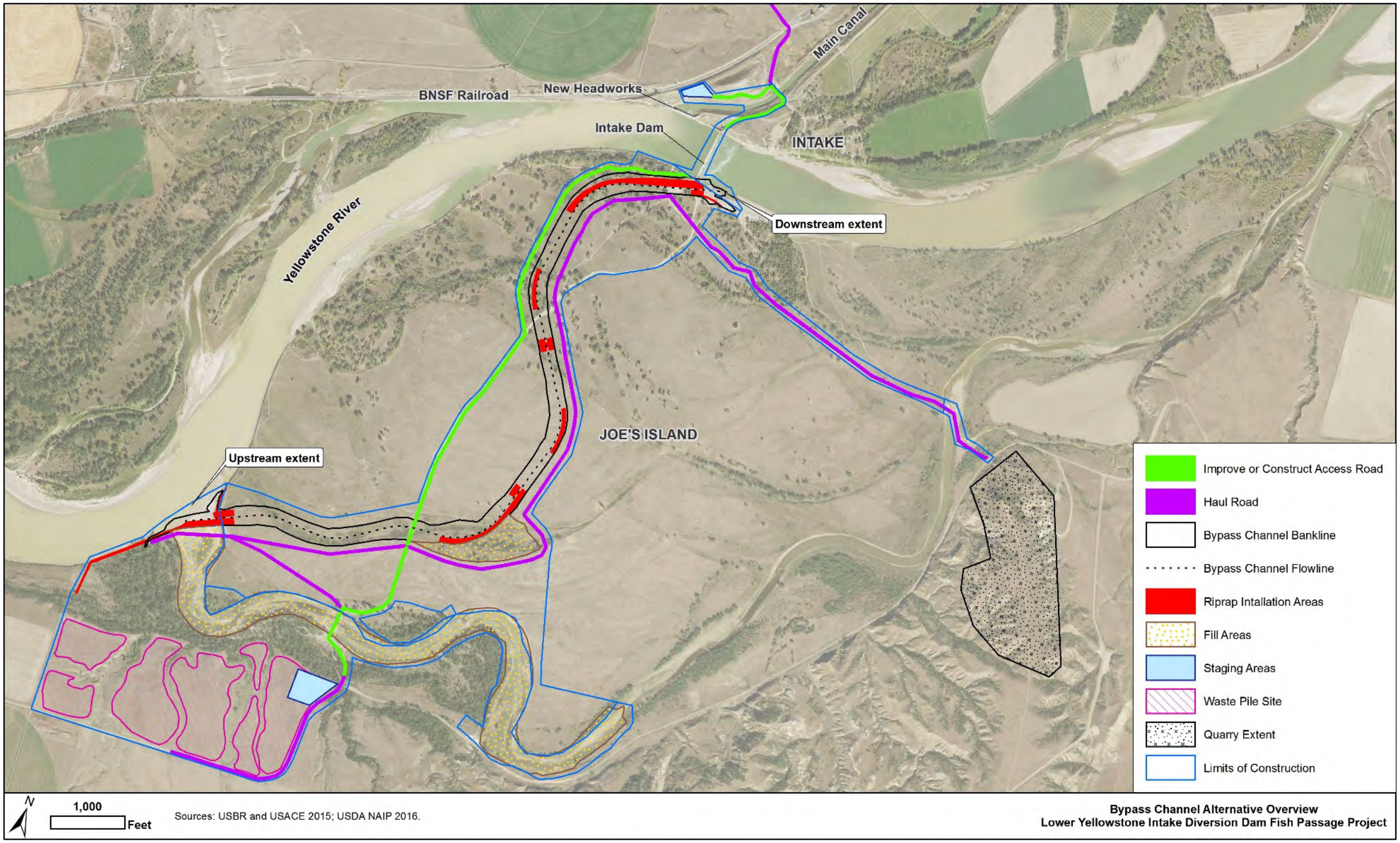

Figure 8: Proposed Bypass Channel and Associated Features

During construction of the bypass channel, coffer dams would be constructed on the upstream and downstream ends. This would allow for the excavation of the bypass channel to be isolated from the river. Once the construction of the bypass channel is complete, coffer dams would be completely removed. Some riprap armoring may need to be placed along the river bank or in water once the coffer dams have been removed.

During construction of the bypass channel, the existing side channel would also be closed off with coffer dams at the upstream end and approximately 10,000 feet downstream so that material excavated from the bypass channel can be placed in the existing side channel.

All of the features of the proposed bypass channel would be located on Joe's Island on the south side of the river. This area was acquired by Reclamation during construction of the original Intake Project and is still owned and managed by Reclamation. All construction, staging, and disposal would occur on Reclamation lands.

The bypass channel has been designed to divert 13 to 15 percent of the total Yellowstone River flow (Table 2). While the channel would typically divert 13 - 15 percent of the total flow during spring and summer discharges, diversion percentages could vary from 10 percent at extreme low flows to greater than 18 percent at higher flows. To facilitate diversion of water into the proposed bypass channel, filling in the upper portion of the existing side channel is proposed. Virtually all of the material excavated for the bypass channel would be placed in the existing side channel and then would be compacted, sloped and reseeded for stability. This fill would not allow any water to be diverted into or flow through the existing side channel under most flow conditions, but the lower end of the side channel would remain connected to the river as backwater habitat.

Table 2: Expected Flow Splits in Proposed Bypass Channel

Total Yellowstone River Flow	**Existing Side Channel Flow Split Under Existing Conditions**		**Proposed Bypass Channel Flow Spilt**	
(cfs)	(cfs)	(%)	(cfs)	(%)
7,000	0	0	940	13
15,000	0	0	1980	13
30,000	390	1	4100	14
2-yr 54,000	1,980	4	7830	14
10-yr 87,600	7,170	8	14300	16
50-yr 116,200	11,270	10	19990	17
100-yr 128,300	12,740	10	22480	18

The bypass channel would be constructed to meet pallid sturgeon passage criteria provided by the Service's Biological Review Team (BRT) based on the best available science regarding pallid sturgeon swimming abilities and preferred channel/substrate conditions (Service 2014; Table 3). The proposed bypass channel would require excavation of approximately 881,000 cubic yards of material from Joe's Island as shown in Figure 8. The proposed bypass channel alignment extends approximately 11,150 feet with a slope ranging from 0.02 to 0.07 percent. The slope of the Yellowstone River in this area is approximately 0.04 to 0.07 percent. The channel cross-section would have a bottom width of 40 feet, a top width of 150-250 feet, and side slopes varying from 1V:8H to 1V:4H. Appropriate sections of the bypass channel would be shaped to mimic natural channel sections.

Vertical grade control structures (buried rock sills) are included at the downstream and upstream ends of the bypass channel as well as at two intermediate locations to prevent channel head-cutting or other scour that would impact passage success.

The two intermediate sills are proposed for maintaining channel slope and allowing for early identification of channel movement. Similar to the upstream control structure, these would be over-excavated and buried with natural river cobble to provide a natural substrate while providing stability during extreme events.

Additionally, bank riprap is proposed at four outside bends identified as having potential for erosion. It is possible that additional protection could be required in the future if assumptions about channel stability are proven incorrect, and channel migration or degradation begins to impact fish passage effectiveness. Approximately 50,000 CY of riprap would be required within the bypass channel.

Sediment modeling conducted for the design of the bypass channel (Reclamation 2014) showed some potential for bed erosion; therefore, placement of large gravel to cobbles along the length of the channel bed is proposed. This material would be similar in size to the naturally-occurring coarse channel material found on Yellowstone River point and mid-channel bars and similar to what would be expected to occur naturally over time.

Under existing conditions, a large scour hole is present in the south half of the river just downstream of the rock rubble field. A large eddy also forms a couple of hundred feet further downstream near the proposed downstream entrance of the bypass channel. To direct flows from the bypass channel more directly into the river, rather than dropping into the scour hole, approximately 1 acre of fill along the left bank of the bypass channel is proposed (Figure 9). This also extends the flows from the bypass channel into the main channel of the river where pallid sturgeon are mostly likely to be present during upstream migration (Braaten et al. 2014). To reduce the formation of the eddy, which may reduce the attraction flows from the bypass channel, grading and bank fill along the right bank of the river is also proposed. The shape and contour of this fill was determined by physical and computer modeling efforts and is approximately 3 acres in size.

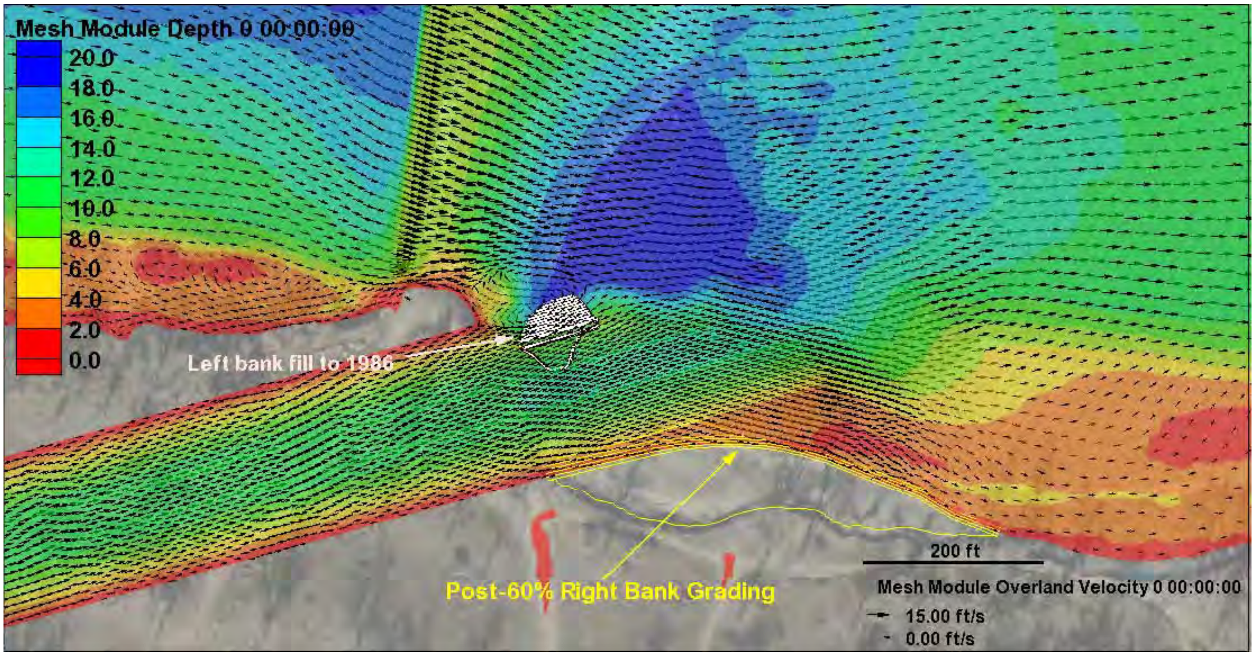

Figure 9: Computer Modeling of Downstream Fill at 63,000 cfs in the Yellowstone River

Future O&M of the Lower Yellowstone Project

Future O&M of the LYP, after completion of the bypass channel and replacement weir, would include most of the same elements that were listed for the interim O&M, except the replacement weir would not require the annual placement of rock to check water for diversions into the Main Canal. Additional new elements required for future O&M include:

- Periodic maintenance of rock upstream and downstream of the new diversion weir (less frequently than annually).
- Maintenance of the fish passage bypass channel, including maintaining the bypass channel to the Service's physical criteria, periodic replacement of riprap along the banks and bottom of the bypass channel, removal of sediment or debris from within the bypass channel, and maintenance of access roads to the bypass channel.
- Maintenance of fill near the downstream entrance of the bypass channel to enhance attraction flows and reduce eddy formation.

The LYP would continue to divert water from the Yellowstone River to provide a dependable supply of irrigation water for approximately 58,000 acres of land along the west bank of the river. The LYIP would conduct the O&M required under contract with Reclamation. Reclamation and the LYIP would need to amend the existing O&M transfer contract to address O&M of the new headworks, proposed bypass channel, and weir consistent with the authorizing legislation (Reclamation Act of June 17, 1902, as amended; Water Conservation and Utilization Act of August 11, 1939, as amended) and Reclamation policy.

Depending on weather and crop requirements, diversion of water into the Main Canal for irrigation would range from 600 to 1,374 cfs. This range of diversion is generally independent of flow volume in the river. With little or no demand, approximately 600 cfs would be diverted to maintain the saturated prism conditions in the Main Canal. Diversions over 1,100 cfs and approaching 1,374 cfs could occur approximately 50% of the irrigation season and may continue as late as the first week of September (Brower 2014).

Additional conversion of native grassland or other habitats to cropland is not proposed within the LYP boundaries (Brower 2014). Furthermore, it is not anticipated that land-use activities within the LYP will change from agricultural to other uses.

Main Canal and Laterals

The Main Canal and laterals are cleaned out with an excavator backhoe to maintain prism dimensions. The excavated materials are placed on and graded along the canal road that parallels the Main Canal for its entire length.

Turnouts, outlets, drains, and wasteways are inspected and upgraded as needed. The LYIP also performs annual inspections of the larger canals and siphons to assure correct function, with repairs and excavations being made as necessary. Automated check structures control canal flows to maintain proper head for canal efficiency. The structures are upgraded or replaced as needed.

It is anticipated that water conservation measures would continue to be implemented on the LYP over the next decade. Continued water conservation measures include:

- Converting from flood irrigation to center pivots.
- Installing canal linings to reduce loss through seepage.
- Converting open laterals to piped laterals.
- Increasing the number of check structures to improve efficiencies.

Pumps

There are five supplemental pumps within the LYP (Brower 2014). These pumps are located downstream of Sidney and pump water from both the Missouri and Yellowstone rivers to supplement canal deliveries during peak demand, with a maximum pumping capability of approximately 70 cfs. Use of these pumps is sporadic and only during high demand periods that typically occur during May, July, and August. Some pumps are not used every year. Three pumps are powered by diesel. The other two use electricity. In a typical high demand period, the pumps are operated accordingly:

- PP River Pump – 6 cfs for 21 days
- G River Pump – 12 cfs for 8 days
- K River Pump – 6 cfs for 7 days
- P River Pump – 18 cfs for 21 days
- W River Pump – 25 cfs for 23 days

During normal years, these pumps are used as little as practical due to the higher cost of pumping versus gravity flow (Brower 2014).

These pumps are fitted with two-inch trash racks to reduce entrainment of debris and larger fish. These pumps need to remain debris-free; otherwise the pumps risk cavitation and failure. Maintenance includes replacing, cleaning, or adjusting trash racks as necessary.

Weed Control

The LYIP minimizes the use of herbicides to control weeds under an Integrated Pest Management Plan (IPMP) required by Reclamation policy. Approval of the IPMP requires the use of Environmental Protection Agency-registered pesticides in accordance with product labeling.

Most of the herbicide use is to control plant growth in canals and ditches that restricts flow. Other uses include control of herbaceous and woody plants to maintain structural integrity and to minimize plugging of drain tiles. The primary herbicide used is “Unison 2-4-D.” “Glystar Plus” is used when necessary. Water is conditioned with “Quest” (Brower 2014).

Monitoring and Adaptive Management

In order to ensure the effectiveness of the already constructed headworks and screens that were designed to reduce entrainment into the Main Canal and to evaluate the effectiveness of the proposed bypass channel, Reclamation and the Corps would implement a long-term monitoring and adaptive management plan (AMP). An AMP as developed in 2015 (Reclamation 2015) and is being implemented for the monitoring of the headworks and screens. The plan developed in 2015 was designed to evaluate key project uncertainties related to the design, performance, and biological response of pallid sturgeon and other fish species. The Service has developed further biological criteria that would indicate success of the proposed bypass channel (Service 2016d) based upon the overall goal of unimpeded movement by pallid sturgeon through the free-flowing Lower Yellowstone River. Thus, a revised monitoring and adaptive management plan has been prepared (Appendix A) to address both the physical and the biological criteria that would indicate success of the project and are summarized below:

1. <u>Bypass Channel Design and Performance</u>
    - Document whether the bypass channel consistently meets the physical criteria parameters (Table 3).

Table 3: Bypass Channel Design Criteria

Criteria	7,000 – 14,999 cfs	15,000 – 63,000 cfs
Bypass Channel Flow Split	≥12%	13% to ≥15%
Bypass Channel Cross-sectional Velocities (measured as mean column velocity)	2.0 – 6.0 ft/s	2.4 – 6.0 ft/s
Bypass Channel Depth (minimum cross-sectional depth for 30 contiguous feet at measured cross-section)	≥4.0 ft	≥6.0 ft
Bypass Channel Fish Entrance (measured as mean column velocity)	2.0 – 6.0 ft/s	2.4 – 6.0 ft/s
Bypass Channel Fish Exit (measured as mean column velocity)	≤6.0 ft/s	≤6.0 ft/s

2. Pallid Sturgeon Passage Criteria
    - Document whether motivated adult pallid sturgeon pass upstream of Intake Dam during the spawning migration time period (April 1 – June 15). If ≥ 85% of telemetered fish passed upstream without substantial delay the passage way would be considered successful (Service 2016d).
    - Conduct field and laboratory swimming capability studies of juvenile pallid sturgeon to determine if upstream juvenile passage is reasonably expected to occur and if upstream passage would benefit condition, growth, and survival of juveniles.
    - Monitor adult sturgeon passing downstream of Intake Diversion Dam for injury or evidence of adverse stress to ensure that mortality of adults passing downstream does not exceed 1% during the first 10 years of project implementation.
    - Monitor the irrigation canal below the screens and the river immediately downstream of the boulder field below Intake Diversion Dam to assess potential injury and mortality to free-embryo, larvae and young-of-year sturgeon.

3. Native Fish Passage
    - In addition, it will be important to document if native fish are able to migrate upstream and downstream of the proposed weir and bypass channel.

CONSULTATION HISTORY

Since the pallid sturgeon was listed in 1990, Reclamation has been consulting with the Service related to the O&M of LYP. More recently, the Corps has been participating in this consultation. The following chronology identifies major elements in the consultation history.

1992 - 2004

The pallid sturgeon was listed by the Service in 1990 as endangered throughout its range under the ESA, as amended. In 1992, the Service initiated discussions with Reclamation regarding obligations to consult and address fish passage and entrainment issues at Intake Diversion Dam. These discussions attempted to identify the best way to resolve these issues and avoid jeopardizing the continued existence of the pallid sturgeon.

Reclamation prepared a preliminary draft BA for continued O&M of the LYP in 1993. Acknowledging comments provided by the Service stressing the importance of fish passage and entrainment protection, Reclamation began researching and evaluating options to include fish passage and entrainment protection measures in a revised BA.

As a result of the 1993 discussions, studies and evaluations were conducted at Intake to further understand the LYP's impacts on pallid sturgeon and other native fish species. These studies and other pallid sturgeon research revealed the relative importance of the Yellowstone River to pallid sturgeon recovery.

Concurrently, the Corps was consulting with the Service on the operation of their six main-stem dams and reservoirs on the Missouri River. At the conclusion of the Missouri River Master Manual ESA consultation (Service 2000), the Service recommended the Corps work with Reclamation to resolve pallid sturgeon passage issues at Intake. A value engineering study (Reclamation 2002) was the first product of this collaboration between Reclamation, the Corps, and the Service.

2005 - 2008

In 2005, the Corps, Service, Reclamation, The Nature Conservancy (TNC), and MFWP signed a memorandum of understanding agreeing to work together to resolve the passage and entrainment issues at Intake. By 2006, preliminary designs for passage and entrainment were being considered in addition to continued research on fish passage and entrainment specific to pallid sturgeon.

In 2007, Water Resources Development Act (WRDA) authorized the Corps to use funding from the Missouri River Recovery and Mitigation Program to assist Reclamation in compliance with federal laws and to design and construct modifications at Intake for the purpose of Yellowstone River ecosystem restoration. Subsequent to this authority, the Service again amended the Corps' biological opinion (BO) on the Missouri River Master Manual by letter exchange (Service, 2007) to include fish passage and entrainment protection at Intake Diversion Dam as a Reasonable and Prudent Alternative (RPA).

2008 -2010

By 2008, the Corps and Reclamation had identified alternatives to resolve the fish passage and entrainment issues and initiated the National Environmental Policy Act (NEPA) compliance process in September. During a May 12, 2009 meeting, Reclamation, the Corps, and the Service reached an agreement that informal section 7 consultation would be appropriate for construction of the proposed Intake modifications as long as concurrent formal section 7 consultation continued on the long-term O&M of the LYP.

Reclamation and the Corps submitted the NEPA Environmental Assessment (EA) and *Biological Assessment for Construction Activities Associated with the Intake Diversion Dam Modification, Lower Yellowstone Project* to the Service on March 18, 2010. On April 8, 2010, Reclamation and the Corps received written concurrence from the Service that the proposed action was not likely to adversely affect listed species.

The *Intake Diversion Dam Modification Environmental Assessment* was published by Reclamation and the Corps to analyze and disclose effects associated with construction of the proposed modifications to the diversion weir and headworks. Reclamation and the Corps signed a finding of no significant impact (FONSI) in April 2010 to complete the NEPA compliance process for construction of the fish passage and entrainment protection structures. The EA and FONSI described the anticipated effects of the selected fish passage alternative – the Rock Ramp Alternative.

In April 2010 after signing the FONSI, Reclamation and the Corps made the decision to proceed with the modifications, and a construction contract for the new headworks and fish screens was awarded in July 2010. The Corps at the same time started to proceed with the final design of the rock ramp so a construction contract could be awarded in 2011. The conceptual design level cost estimate for the rock ramp was approximately $18 million. In late 2010 and early 2011, the estimated costs for the rock ramp design significantly increased to nearly $90 million due to the detailed design analysis which indicated that: 1) significantly more rock would be required to create a longer, flatter ramp; 2) more rock was required to ensure stability of the structure in the highly variable flow and ice conditions of the river; 3) in order to place the rock with point-to-point contact, the construction would likely need to occur "in the dry" isolated from the river; and 4) obtaining such a large volume of rock would require either new/expanded local quarries or obtaining rock from further distant quarries, both of which would increase costs.

2011 -2015

In April 2011, Reclamation and the Corps determined further evaluation of other alternatives for improving fish passage was necessary to address the issues that had arisen since 2010. In addition to new cost information, new information regarding pallid sturgeon behavior also became available. Originally, because of uncertainties in pallid sturgeon movement, one of the requirements of the Service's Biological Review Team's (BRT) passage criteria was full river-width passage. Based on new information documenting pallid sturgeon use of side channels (Braaten et al. 2014), the BRT relaxed this criterion in 2011. Reclamation and the Corps believed there was merit in revisiting a bypass channel alternative that had been previously considered but eliminated from detailed study because it did not provide full channel passage. Through collaborative efforts, further data, and preliminary design reviews, Reclamation, the Corps, and stakeholders supported further analysis of a bypass alternative. Changes to the project were substantial enough to trigger preparation of supplemental EA prior to a decision on how to proceed with fish passage.

Construction of the headworks and fish screens was initiated in 2011 and completed in April 2012. Water was first delivered to the LYP using the new headworks structure in May 2012. Because the passage component was delayed while other alternatives were reconsidered, Reclamation and the Service agreed to consult on O&M of the new headworks and fish screens with the commitment to continue consultation on the overall long-term O&M of the LYP once a passage alternative had been identified.

Reclamation submitted the *Lower Yellowstone Irrigation Project Intake Headworks and Fish Screens Operations and Maintenance Biological Assessment* to the Service on February 10, 2012. On March 7, 2012, Reclamation received written concurrence from the Service that the proposed action may affect, but is not likely to adversely affect listed species with O&M of the new headworks and fish screens. At that time, there was little concern for entrainment or impingement on the screens because it was believed that there was no pallid sturgeon passage occurring. The proposed action for that consultation included increasing the height of the existing diversion weir eleven inches to account for head loss at the screens.

Following the 2011 record high flows, LYP placed rock on the diversion weir for 21 days during July 2012. This required approximately 1,500 cubic yards of rock to repair the diversion weir so the LYP could divert their full water right. It was also determined that the diversion weir needed to be maintained to an elevation of 1,991.0 feet due to the head loss through the screens. Recognizing that this rock placement action was not clearly addressed in the 2012 BA, Reclamation, in conversations with the Service, agreed to reinitiate consultation on O&M of the new headworks and fish screens.

On April 14, 2014, Reclamation submitted the *Amendment to the Lower Yellowstone Irrigation Project Intake Headworks and Fish Screens Operations and Maintenance Biological Assessment* to the Service. On May 2, 2014, Reclamation received written concurrence from the Service that the proposed action may affect, but is not likely to adversely affect listed species in light of the new information. Reclamation reaffirmed the commitment to consult on project-wide O&M once a preferred fish passage alternative was selected.

On December 14, 2014, Reclamation submitted the *Continued Operation and Maintenance of the Lower Yellowstone Irrigation Project with Entrainment Protection and Fish Passage*. This BA addressed the potential effects of the continued O&M of the LYP with the proposed bypass channel alternative for fish passage. Shortly after the submittal of this BA, Reclamation in conversations with the Service determined that an amended BA should be submitted covering construction of the replacement weir and bypass channel, interim operation of the LYP until construction was complete, and the future O&M of the LYP with fish passage and entrainment protection.

Reclamation and the Corps published the *Final Supplement to the April 2010 Final Environmental Assessment for the Intake Diversion Dam Modification Project* and FONSI. The supplemental EA analyzed and disclosed the potential effects from the additional alternatives that were considered, including the new preferred alternative, the bypass channel.

On April 14, 2015, Reclamation submitted the *Amended Biological Assessment*, *Interim and Future Operations and Maintenance of the Lower Yellowstone Irrigation Project and Construction of Fish Passage Facilities*. On July 10, 2015, Reclamation received a Biological Opinion from the Service stating that the Lower Yellowstone Irrigation Project and construction of a fish passage project would not cause jeopardy, but was likely to adversely affect pallid sturgeon due to the presence of the existing weir without an alternate passage route during the 2-3 years of construction, potential future entrainment/impingement of free embryos and larvae at the headworks/screens and physical presence of the replacement weir and bypass channel. The design of the bypass channel is based on the best available science, but as there is not a similar precedent, there are still uncertainties about the ultimate effectiveness in providing pallid sturgeon passage. Therefore, the recommended reasonable and prudent measure (RPA) to minimize effects was to implement a monitoring and adaptive management plan that would document the performance of the weir and bypass channel and take measures to improve its success if the performance did not meet desired criteria.

STATUS OF THE SPECIES

Pallid Sturgeon (*Scaphirhynchus albus*), Endangered

The pallid sturgeon was listed as endangered throughout its range in 1990 (Service 1990). Critical habitat has not been designated. A Recovery Plan was developed in 1993 (Service 1993) and was updated in 2014 (Service 2014).

LIFE HISTORY AND BEHAVIOR:

The pallid sturgeon is native to the Missouri and Mississippi rivers and is adapted to large, free flowing, warm-water, turbid rivers with a high sediment load that contributed to a shifting, dynamic, complex river morphology. Pallid sturgeon are a bottom-oriented, large river obligate fish that primarily use the main channel, side-channels, and channel border habitats and have rarely been observed in habitats without flowing water (i.e. backwaters; Service 2014). Pallid sturgeon have been documented over a variety of substrates, but are often associated with sandy and fine bottom materials, preferring that to mud, silt, or vegetated river bottoms.

ADULT LIFE STAGE:

Habitat and Migrations ─ Pallid sturgeon are benthic fish, spending the majority of their time at or near the river bottom. Depths at collection sites range from 1.9 to > 65 feet, though there may be selection for areas approximately 2.6 feet deep. Despite the wide range of depths associated with capture locations, one commonality is that pallid sturgeon are typically found in the lower one-fourth of the water column. Mean water column velocities associated with collection locations are generally 2.1 feet/second (fps), although mean bottom velocities are lower, around

1.5 fps. (Bramblett and White 2001; Gerrity 2005). Adults generally reside in habitat that may range from a patch only a few tens of feet in size or roam over a larger area (Delonay et al. 2016).

Pre-spawning migration and migration habitats of adults (fish > 750 mm FL; Delonay et al. 2016) in the Yellowstone River are well studied. Adults use the main channel and side-channel habitat to move upstream (Braaten et al. 2014). The use of main-channel, not shoal habitat, was also found for shortnose sturgeon (Kieffer and Kynard 2012), and likely indicates typical habitat of pre-spawning migrant sturgeon. Water depth used by pre-spawning migrant pallid sturgeon was 6.6 - 11 feet and mean column velocity was 2.8 – 5.6 fps.

Spawning ─ Based on wild fish, estimated age at first reproduction is 15 to 20 years for females and approximately 5 years for males. Water temperatures influence growth and maturity; colder temperatures in natural environments delay sexual maturity in females by 3 years to around age 9 years. Females spawning periodicity is 2-3 years and fecundity is related to body size with larger females producing more eggs. Present data show spawning occurs between late May-early June in the Yellowstone River (Rugg 2014, 2015; Allen et al. 2015; Elliott et al. 2015). Incubation rates depend on water temperature. In hatchery settings, fertilized eggs hatched in approximately 5-7 days; incubation rates may deviate from this in the wild.

Recent data from the Yellowstone River found spawning occurred on coarse substrate (gravel patches on the larger sand bottom; Allen et al. 2015; Elliot et al. 2015). Spawning in the lower Missouri River was documented in fast velocity water on a rocky revetment along the channel margins (velocity 1.5 – 7.4 fps; Delonay et al. 2016). A probable spawning location was identified in the Yellowstone River (~RM 6.9) in 2012 in the center of a single-threaded channel reach that while not measured, likely had high velocities and coarse substrate (Delonay et al. 2016).

<u>*EARLY LIFE STAGES:*</u>

Egg or embryo ─ Eggs are demersal, adhesive, and dark colored, adhering to rocks at the spawning site selected by a female. Eggs that do not attach but drift in contact with the bottom are damaged and do not likely survive.

Free embryo ─ Pallid sturgeon hatch within a few days (5-7 days in a hatchery setting; Keenlyne 1995) and emerge as free embryos with a yolk-sac that they continue to feed on and develop until they are capable of exogenous (outside) feeding. Free embryos are generally understood to drift downstream for 9-17 days, depending on water temperature (Kynard et al. 2007; Braaten et al. 2008). Drift distances can be very long, depending on water velocities, and have been estimated to range from 153 to 331 miles (245 to 530 km) for 11 days of drift at 1 fps or 2 fps, respectively (Braaten et al. 2008).

In a two-year study of Missouri River pallid sturgeon free embryos in an artificial stream, results indicate they are photopositive, and use swim-up and drift behavior to immediately leave rocky cover and drift downstream (Kynard et al. 2002; 2007). While Missouri River free embryos in these laboratory tests did not hide after hatching, it is not known whether free embryos from all populations behave similarly (Delonay et al. 2016). Differences in free embryo behavior exist between different populations of shortnose sturgeon, *Acipenser brevirostrum* (Parker and Kynard 2014) and subtle differences occur in larval drift duration in lake sturgeon, *A. fulvescens*, in rivers within the state of Wisconsin (B. Kynard analyzed unpublished data a). Thus, subtle differences may exist between free embryos in the Missouri vs. the Yellowstone River.

Larvae ─ As free embryos develop into larvae, they cease downstream dispersal, settle into suitable habitats, and begin to forage on the bottom (Kynard et al. 2002). Although habitat preference of larval pallid sturgeon has not been studied, some authors postulate that habitat use may be similar among *Scaphirhynchus* species. Young of year *Scaphirhynchus* species (spp.) in the lower Missouri River were found in habitats associated with the main channel border and moderate velocities, from 1.6 to 2.3 fps (Ridenour et al. 2011). Year-0 *Scaphirhynchus* sturgeon in the Middle Mississippi River were more often found in channel border and island-side channel habitats and distributions were positively associated with low velocities (~0.33 fps), moderate depths (6.6-16.4 feet), and sand substrate.

Age-0 Juveniles ─ A study of growth and diet of juveniles below Fort Peck Dam in the Missouri River indicates diet of age-0 juveniles was insect larvae (Braaten et al. 2012). Habitat preference in artificial streams found wintering age-0 Missouri River juveniles significantly preferred sand substrate rather than smooth rock substrate, and also, preferred faster velocities over a range of 0.0 – 0.75 fps (Kynard et al. analyzed unpubl. data b). Preference of fast velocity, which has been found for wintering age-0 juveniles of other sturgeon species, may be a winter foraging strategy to select a wintering habitat that brings drifting invertebrates to young sturgeon without having to expend energy to forage, when conserving energy is key to survival (Kynard et al. 2011; unpublished data b). Wintering habitat is critical to survival and recruitment because age-0 juvenile sturgeon remain in this habitat for 5-6 months (Kieffer and Kynard 2012).

Juveniles – Juvenile hatchery-reared pallid sturgeon were studied by Gerrity (2005) above Fort Peck Dam and were found in water depths from 7.4 to 8 feet (2.3 to 2.5 m), most commonly in locations at approximately 80% of the maximum channel cross-section depth, with channel bottom velocities typically about 1.6 fps (0.5 m/sec) and a sand/fine substrate. Their home range varied from about 0.6 river miles to over 45 miles (1 to 70 km). Juveniles used habitats associated with islands, alluvial bars, and main channels, but did not appear to select side channels. Seasonal movements of juveniles is poorly studied but is important for any plans for fish passage at Intake Diversion Dam.

<u>DIET:</u>

Juvenile and adult wild pallid sturgeon feed opportunistically on benthic macroinvertebrates with a trend with age toward greater piscivory (Gerrity et al. 2006). Larvae and age-0 juveniles consume brine shrimp in hatchery settings, indicating they may feed on zooplankton and other small invertebrates in the wild, but they (like other sturgeon larvae) are believed to forage on the bottom on any invertebrate or zooplankton that fits into their mouth (Buckley and Kynard 1981). Juveniles forage on a wide variety of macroinvertebrates, including Diptera, Chironomidae, Ephemeroptera, and Trichoptera, and also on fish such as sturgeon chub and sicklefin chub (Braaten et al. 2012; Gerrity 2005; Gerrity et al. 2006).

RANGE-WIDE DISTRIBUTION AND ABUNDANCE:

The historical distribution of the pallid sturgeon includes the Missouri and Mississippi River drainages (Figure 10). This included the Missouri River from its confluence with the Mississippi upstream to the Great Falls of the Missouri and the Yellowstone River (Service 2014). In the Mississippi, the distribution most likely extended from near Keokuk, Iowa downstream to New Orleans, Louisiana. Pallid sturgeon also were documented in the lower reaches of some of the larger tributaries to the Missouri, Mississippi, and Yellowstone rivers including the Tongue, Milk, Niobrara, Platte, Kansas, Big Sioux, St. Francis, Grand, and Big Sunflower rivers (see Figure 10; Service 2014).

Because the pallid sturgeon was not recognized as a species until 1905, little information is available concerning early abundance (Service 2014). Forbes and Richardson (1905) suggested that the lack of prior recognition of the species might have been attributable to scarcity, noting that pallid sturgeon accounted for about one in five hundred individuals of Scaphirhynchus connected from the central Mississippi River. However the species was reported to be much more abundant in the turbid lower Missouri River, where some fisherman reported one in every five sturgeon as pallid sturgeon.

The present distribution has been truncated and reproductive groups isolated or segmented by numerous dams and reservoirs. Since 1990, Pallid Sturgeon have been documented in the Missouri River between Fort Benton and the headwaters of Fort Peck Reservoir, Montana; downstream from Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota; downstream from Garrison Dam, North Dakota to the headwaters of Lake Oahe, South Dakota; from Oahe Dam downstream to within Lake Sharpe, South Dakota; between Fort Randall and Gavins Point Dams, South Dakota and Nebraska; downstream from Gavins Point Dam to St. Louis, Missouri; in the lower Milk and Yellowstone rivers, Montana and North Dakota; the lower Big Sioux River, South Dakota; the lower Platte River, Nebraska; the lower Niobrara River, Nebraska; and the lower Kansas River, Kansas (Service 2014).

In 1995, a preliminary estimate found about 45 wild Pallid Sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996). More recent data suggest that substantially fewer wild fish remain today. For example only three wild Pallid Sturgeon were collected during 2007 – 2013, indicating wild Pallid Sturgeon numbers in the Missouri River upstream of Fort Peck Reservoir are too low for a reliable population estimate (Service 2014a). An estimated 125 wild Pallid Sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River (Jaeger et al. 2009).

While current abundance estimates are lacking for the entire Missouri River downstream of Gavins Point Dam, Steffensen et al. (2012) generated annual population estimates for both wild and hatchery-reared Pallid Sturgeon for the reach of the Missouri River extending from the Platte River confluence downstream 80.5 Rkm (50 Rmi). Their results estimated wild Pallid Sturgeon at 5.4 to 8.9 fish/Rkm (8.7 to 14.3fish/Rmi) and hatchery produced Pallid Sturgeon at 28.6 to 32.3 fish/Rkm (46.1 to 52.0 fish/Rmi). Extrapolating these estimates to the entire lower Missouri

River suggests that the wild population may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). This population may be stabilizing as a result of the Pallid Sturgeon Conservation Augmentation Program (PSCAP), but remains neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013).

Garvey et al. (2009) generated an estimate of 1,600 (5 fish/Rkm, 0.8 fish/Rmi) to 4,900 (15.2 fish/Rkm, 24.5 fish/Rmi) Pallid Sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single Pallid Sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009). No estimates are available for the remainder of the Mississippi River. Since 1994, the PSCAP has released hatchery-reared Pallid Sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River.

The Recovery Plan (Service 2014) has classified the overall pallid sturgeon population into four management units (Figure 11) listed below. The proposed project falls within the Great Plains Management Unit, so much more information is provided on this particular unit than the others.

1) **Great Plains Management Unit (GPMU)**, extending from the Great Falls of the Missouri River in Montana downstream to Fort Randall Dam, South Dakota, and including major tributaries such as the Yellowstone, Marias, and Milk rivers;
2) **Central Lowlands Management Unit (CLMU)**, extending from Fort Randall Dam, South Dakota downstream to the confluence of the Missouri River with the Grand River, Missouri, and including major tributaries such as the Platte and Kansas rivers;
3) **Interior Highlands Management Unit (IHMU)**, extending from the Grand River, Missouri to the confluence of the Missouri River with the Mississippi River and the segment of the Mississippi River from Keokuk, Iowa to Cairo, Illinois (confluence of the Ohio River)
4) **Coastal Plain Management Unit (CPMU)**, extending along the Mississippi River from the confluence of the Ohio River to the Gulf of Mexico, and including the Atchafalaya River distributary system.

A synthesis of recent genetic studies on the pallid sturgeon was presented in Delonay, et al. (2016). There are genetic differences across the range, with three genetic groups now identified (Schrey and Heist 2007): 1) an upper Missouri River basin group; 2) a middle Mississippi and Atchafalaya basin group; and 3) an intermediate lower Missouri River group. The upper Missouri River group was the most distinct and may indicate that genetic differentiation was occurring prior to the construction of the Missouri River dams that have further isolated this population. The genetic differences generally represent the management units and can be used to support on-going and future management decisions.

Figure 10: Historical Distribution of Pallid Sturgeon (reproduced from Service 2014).

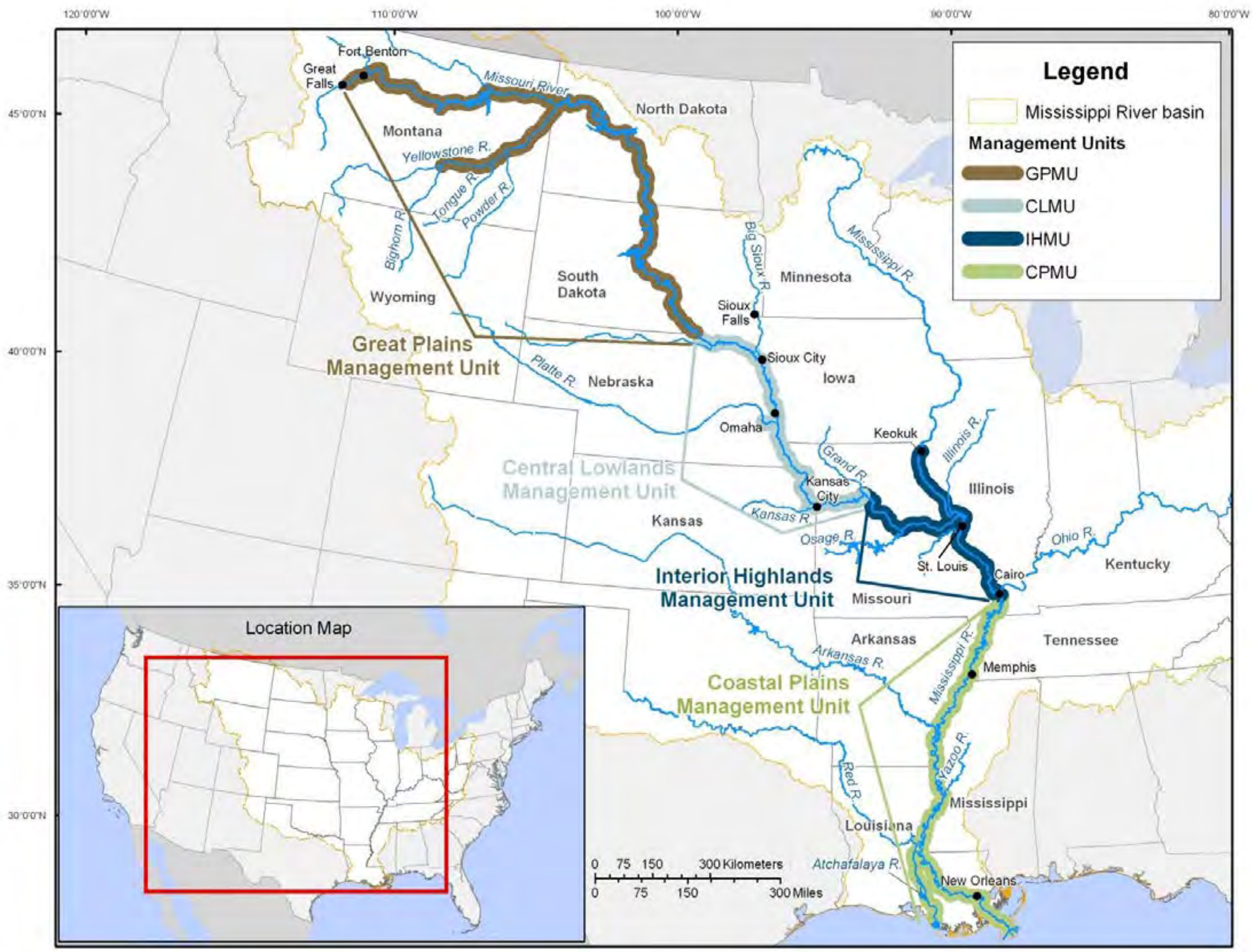

Figure 11: Pallid Sturgeon Management Units (reproduced from Service 2014).

<u>*GREAT PLAINS MANAGEMENT UNIT:*</u>

Distribution

In the GPMU, pallid sturgeon can be found in the Missouri River: 1.) from Fort Benton, Montana to the upper end of Fort Peck Reservoir; 2.) Downstream Fort Peck Dam to the upper end of Lake Sakakawea, including the lower Yellowstone River; 3) Downstream of Garrison Dam to the upper end of Lake Oahe; and 4) Downstream Oahe Dam to the upper end of Lake Sharpe (Service 2014).

Abundance

An estimate in 1995 indicated that about 45 wild pallid sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996), but more recent information indicates far fewer wild fish are present, with only three wild fish collected in recent years (Service 2014a). In 2004, an estimated 158 wild adult pallid sturgeon were reported to remain in the population from Fort Peck Dam to the headwaters of Lake Sakakawea, including the Yellowstone River (95% confidence interval = 129 - 193 adults; Klungle et al. 2005). More recently, Jaeger, et al. (2009) estimated even fewer remain, approximately 125 adult pallid sturgeon. The remaining wild adults were estimated to be 43-57 years (i.e. fish spawned before Lake Sakakawea was filled in the 1950s; Braaten et al. 2015). If the adult mortality rate is approximately 5% per year (Braaten et al. 2009), there could already be fewer than 100 wild adult fish in the GPMU.

The Pallid Sturgeon Conservation Augmentation Program (PSCAP) has been undertaken to supplement wild populations with hatchery pallid sturgeon free embryos, larvae, and juveniles (Service 2008). PSCAP has stocked over 980,000 free embryos, larvae, and juveniles below Fort Peck Dam in the GPMU from 1998 to 2015 and over 300,000 above Fort Peck Dam. The estimated number of surviving juvenile hatchery fish in the GPMU is over 50,000 fish (~7,900 above Fort Peck Dam and ~43,000 below Fort Peck Dam; Rotella 2015). From a back-calculation estimate of how many adults may have been present below Fort Peck Dam in 1969, the hatchery derived population is likely to exceed the historic population (Braaten et al. 2009). Although the hatchery derived population is surviving at these numbers recent captures in the Yellowstone River are dominated by a few year classes, predominantly 2001, 2006, 2009, 2010 and 2013 (Rugg 2014).

PSCAP was implemented due to the possibility of near-term extirpation and has demonstrated a successful increase in the number of fish, although these juveniles are only now just beginning to reach maturity and have not yet demonstrated successful reproduction. If supplementation efforts were to cease, the species could once again face local extirpation in the GPMU. The PSCAP goal for the GPMU is to stock a minimum of 5,600 yearlings or yearling equivalents annually above Fort Peck Dam and 9,000 below Fort Peck Dam and in the Yellowstone River (Service 2008).

Reproduction

Currently there is no known natural reproduction in either the Yellowstone or Missouri Rivers despite the evidence of spawning. The presence of both the main stem dams on the Missouri River and diversion structures on the Yellowstone likely contribute to the lack of recruitment by reducing the amount of available upstream spawning habitat and the needed drift distance for free embryos to mature before entering reservoir habitats.

Currently on the Yellowstone River the majority of pallid sturgeon spawning occurs in several locations from River miles 6 to 20 (Delonay et al. 2015; Fuller and Braaten 2012; Bramblett and White 2001; Bramblett 1996). However, approximately 12 to 26 percent of telemetered fish migrate up to Intake Diversion Dam in any given year and presumably would continue to migrate further upstream if not blocked by the weir (Braaten et al. 2014).

Suitable spawning habitat is presumed to be available for pallid sturgeon in the upper Missouri River below Fort Peck Dam in areas of coarse substrate. One spawning location was documented in 2011 downstream of the Milk River and one free embryo was collected in the Missouri River (Delonay et al. 2014). This was the first time pallid sturgeon spawning was documented below Fort Peck Dam and contrasts with most studies indicating the vast majority of telemetered pallid sturgeon typically move from the Missouri River upstream into the Yellowstone River, for spawning. Flows were high in the Missouri River in 2011, due to the combined high flows from the Milk River and Missouri River from a large snowpack and high spring rainfall.

Approximately 200 miles of the Missouri River were available for drifting pallid sturgeon free embryos during the 2011 season, but there is no indication that there was any recruitment. Braaten et al (2012) estimated that 160-230 river miles are necessary for 25% of drifting free embryos to settle out at a water temperature of 68°F (20°C) and at a drift speed of 2.25 fps (0.7 m/s). The flow velocities may have been higher and water temperatures were generally lower than 68°F, so 300 or more miles may be required for drifting free embryos to settle out prior to entering Lake Sakakawea.

A study of dissolved oxygen and pallid sturgeon survival conducted at the upper end of Fort Peck Reservoir (Guy et al. 2015) indicated that pallid sturgeon free embryos and 40-day old larvae experienced 100% mortality in about one hour at dissolved oxygen concentrations of 1.5 mg/L or less in laboratory studies. Dissolved oxygen levels near the bottom in the transition zone from the Missouri River to Fort Peck Reservoir were near 0 mg/L, likely due to the biological oxygen demand in the organic enriched deposition zone (Guy et al. 2015). Low levels of dissolved oxygen in Lake Sakakawea have been hypothesized as a potential key cause of recruitment failure for pallid sturgeon as the free embryos do not have sufficient drift distance in the rivers from spawning areas in order to develop into exogenously feeding larvae and settle to the substrate before they drift into reservoirs and perish (Delonay et al. 2016). Low dissolved oxygen levels just above and within fine sediments in the transition zone and upper end of Lake Sakakawea were also confirmed in 2015 (Bramblett & Scholl 2016).

Successful recruitment of wild pallid sturgeon likely will require both access to suitable spawning habitats and adequate drift distance to suitable settling and rearing habitats for larval pallid sturgeon.

Threats

In the GPMU, the presence of multiple dams and reservoirs have isolated populations and prevent access to suitable habitats for multiple life history stages of pallid sturgeon including:

1) Blocking access to spawning habitats
2) Affecting genetic exchange among reaches
3) Decreasing natural turbidity levels
4) Reducing distances for free embryo/larval drift
5) Altering water temperatures
6) Altering natural hydrologic/flow regimes
7) Altering food resources/productivity (Service 2014).

The upper Missouri River has been fragmented or segmented by Fort Peck (Fort Peck Reservoir) and Garrison dams (Lake Sakakawea), filled in 1942 and 1955, respectively. Fort Peck Lake is the 5th largest reservoir in the United States and extends for 134 miles at full pool, with 245,000 surface acres and a maximum depth of 220 feet. Garrison Dam impounded Lake Sakakawea, which is the 3rd largest reservoir in the United States and extends for 178 miles at full pool, with 382,000 surface acres and a maximum depth of 180 feet (USACE 2016). Lake Sakakawea can vary from a typical minimum of about 1808 feet in elevation to a high of 1854 feet in elevation, affecting approximately 30 miles of river at the headwaters where the river can transition from flowing to backwater to headwaters of the lake depending on lake elevation. These two large dams/reservoirs have changed 312 miles of the formerly turbid, sediment-rich, and multi-channeled river with extensive bars and islands into lacustrine habitats and isolated fish populations upstream and downstream of each dam.

The operation of these dams has changed the river hydrology substantially by minimizing peak flows and increasing low flows to create a relatively stable hydrograph throughout the year (Delonay et al. 2016). The dams also have trapped sediment, substantially reducing transport of sediment downstream and reducing turbidity. The dams also typically release cold water from deep in the reservoirs (except during floods when surface flows are released from the spillways) that have changed the water temperature in the river reaches downstream. Downstream of Garrison Dam are four other major dams: Oahe, Big Bend, Fort Randall, and Gavins Point dams that collectively have impounded another 443 miles of river (USACE 2016) with only limited segments of flowing river between reservoirs.

Water levels in the reservoirs impounded by Fort Peck Dam and Garrison Dam (Lake Sakakawea) may be impediments to larval pallid sturgeon survival by limiting the amount of riverine habitat available for pallid sturgeon to complete the transition from free embryos to exogenously feeding larvae. Pallid sturgeon free embryos and larvae can passively drift as much as 245 to 530 km (152 to 329 mi) depending on water column velocity and temperature (Kynard et al. 2002; Braaten et al. 2008). Studies to assess larval Pallid Sturgeon drift dynamics (Braaten et al. 2008, 2010) released hatchery-reared Pallid Sturgeon free embryos and larvae in 2004 and 2007. Subsequent sampling has collected juvenile Pallid Sturgeon derived from these releases (Braaten et al. 2012b). Survivorship of released embryos and larvae to age-1 is related to age at release (days post-hatch) and correlated with release location; survivorship of the younger free embryos (i.e., 5 days post hatch) to age-1 was only observed from the most upstream release site (Braaten et al. 2012b). These data indicate that free embryos, as young as five days post-hatch, are able to survive to age-1 in the Missouri River between Fort Peck Dam and Lake Sakakawea, provided they have adequate dispersal distance to complete the developmental transition to feeding larvae. These observations support the hypothesis by Kynard et al. (2007) which implicates total drift distance as a limitation on natural recruitment in this reach of the Missouri River. Thus, within a given reach of river the distance required to complete the early life history requirements is dependent on reach length, river discharge, velocity, habitat complexity, and temperature.

In addition to limiting drift distance and duration, affecting spawning cues for adults, and inundating habitats, an altered hydrograph also affects downstream temperature profiles and reduces sediment transport. Cold water releases from dams have been attributed to spawning delays in several native riverine fishes and changing fish community composition downstream (Wolf 1995; Jordan 2000). Canyon Ferry, Hauser, and Holter dams are upstream of Great Falls, Montana. Though they do not impose any migratory barriers for Pallid Sturgeon, these structures, like other main-stem Missouri River dams, can affect sediment and nutrient transport and maintain an artificial hydrograph. Thus, the main-stem and tributary dams upstream of Fort Peck Dam affect downstream reaches by reducing both sediment input and transport. The results are a reduction of naturally occurring habitat features like sandbars. Discharge and sediment load, together with physiographic setting, are primary factors controlling the morphology of large alluvial rivers (Kellerhals and Church 1989). Seasonally high turbidity levels are a natural component of pre-impoundment ecological processes. Reduced sediment transport and the associated decrease in turbidity could affect Pallid Sturgeon recruitment and feeding efficiency.

The relationship between high turbidity levels and larval pallid sturgeon survival is unclear. In laboratory studies, increased predation on White Sturgeon yolk-sac larvae was observed at low turbidity levels, suggesting that high turbidity levels associated with a natural hydrograph and natural sediment transport regimes may offer concealment for free-drifting sturgeon embryos and larvae (Gadomski and Parsley 2005). Given that the diet of pallid sturgeon is generally composed of fish and aquatic insect larvae with some preference for piscivory as they mature (see *Life History* section, above), higher pre-impoundment turbidity levels may have afforded improved foraging effectiveness by providing older juveniles and adults some level of concealment. From the headwaters of Lake Sakakawea above Garrison Dam, North Dakota to Gavins Point Dam, South Dakota, the Missouri River retains little of its historical riverine habitat; most of this reach is impounded in reservoirs. However, some pallid sturgeon persist in the more riverine reaches within a few of these reservoirs, though successful spawning and recruitment is unlikely. Because of the presence of pallid sturgeon in some inter-reservoir reaches, those occupied reaches have been included in recovery efforts (Erickson 1992; Jordan et al. 2006; Wanner et al. 2007). Despite these data, most of these inter-reservoir reaches are poorly understood and further research is needed to evaluate and define their significance to species' recovery.

The Yellowstone River has only a slightly altered hydrologic, temperature, and turbidity regime as there are no major dams/reservoirs on the mainstem river. Large dams/reservoirs are present on the Bighorn River, which results in reductions to peak flows in the Yellowstone River (Corps and YRCDC 2015), but still maintains significantly more natural hydrologic fluctuations, natural water temperatures and turbidity and thus, cues for spawning migrations (Delonay et al. 2016).

At present, pallid sturgeon reside in the Missouri River downstream from the confluence of the Missouri and Yellowstone rivers during the fall and winter months (Fuller and Braaten 2012). Historically, elevated spring flows in the Missouri and Yellowstone Rivers between Fort Peck Dam and Lake Sakakawea cued adult pallid sturgeon to initiate spawning movements and migrations within this reach. As discharge increases in the spring, adult pallid sturgeon respond by migrating upstream. In most years, adult pallid sturgeon migrate into the unregulated Yellowstone River (Fuller and Braaten 2012) to spawn. Spawning adults favor the elevated spring flows and warmer temperatures of the Yellowstone River and are believed to avoid the colder, less turbid flows in the Missouri River.

The primary threat on in the Yellowstone River is the presence of multiple diversion dams, including Intake Diversion Dam, that limit upstream passage of adult pallid sturgeon, which results in: 1) failure of pallid sturgeon to access spawning habitat in areas upstream of the dams, and 2) insufficient distance for free embryo and larval drift before they enter the headwaters of Lake Sakakawea, which appear unsuitable for larval rearing and survival (Service 2014).

In particular, recent studies suggest free embryo drift distance available below Intake Diversion Dam is insufficient in length for pallid free embryos to reach suitable rearing habitat (Braaten et al. 2008; 2011). If these young fish do not have adequate distance to drift and then, to stop as they develop into larvae in suitable stream habitat, they will reach Lake Sakakawea, where rearing conditions are not likely to be suitable (Delonay et al 2016). Recent research indicates oxygen levels in the headwaters of reservoirs such as Fort Peck and Lake Sakakawea are too low for free embryos or larval pallid sturgeon to survive (Guy et al. 2015; Bramblett et al. 2016). Thus, the lack of sufficient drift distance and potentially lethal conditions in Lake Sakakawea is the current hypothesis for the lack of recruitment in the GPMU (Delonay et al. 2016).

Prior to 2014, very few adult pallid sturgeon had ever been observed upstream of Intake Diversion Dam, but in both 2014 and 2015, wild adult pallid sturgeon were tracked migrating upstream of Intake Diversion Dam via the side channel around Joe's Island (Rugg 2014, 2015). One female migrated upstream in 2014 and presumably spawned in the Powder River (tributary to the Yellowstone River upstream of Intake Diversion Dam) in June 2014 as indicated by tracking data and recapture of the female after she moved downstream that found she had lost 13% in body weight (presumably, from loss of eggs during spawning; Rugg 2014). Surveys of potential habitat for pallid sturgeon indicate that suitable spawning and rearing habitat exists upstream of Intake Diversion Dam (Jaeger et al. 2005, 2006).

CENTRAL LOWLANDS MANAGEMENT UNIT:

In the Lower Missouri River (i.e. for the CLMU and Missouri River portion of the IHMU), there is not a reliable population estimate (Delonay et al. 2016). An estimated 135,000 hatchery pallid sturgeon have been stocked in the Lower Missouri River since 1992 (Steffensen et al. 2013), and PSCAP records indicate approximately 180,000 hatchery pallid sturgeon have been stocked through 2014 (including above Gavins Point Dam). An intensive study in an 80 kilometer (50 mile) reach below the Platte River confluence estimated 5.4 to 8.9 fish/kilometer for wild pallid sturgeon and 28.6 to 32.3 fish/km for hatchery stocked pallid sturgeon (Steffensen et al 2012).

Following this study, a model of population size was developed indicating that an estimated 6,000 wild pallid sturgeon and 42,000 hatchery stocked pallid sturgeon may be present in the Lower Missouri River (Steffensen et al. 2013).

Although spawning has been confirmed in the Lower Missouri River (USGS 2007, Delonay et al. 2009), recruitment appears to be limited. If stocking were to cease, the model estimated population would decline by an estimated 8% per year, reducing the total population to 3,800 fish by 2040 (Steffensen et al. 2013). This population estimate is only based on sampling conducted in one reach, so this could be an over- or an under-estimate of the population. The PSCAP goal for the Lower Missouri River is to stock a minimum of 600 yearlings or equivalents between Fort Randall and Gavins Point Dam, and 33,560 yearlings or equivalents below Gavins Point Dam each year for the next 20 years (Service 2008).

INTERIOR HIGHLANDS AND COASTAL PLAIN MANAGEMENT UNITS:

In the Mississippi River (CPMU and Mississippi River portion of the IHMU), there is even less information on population size than in the Missouri River, and the size of the system hinders the effectiveness of sampling (Delonay et al. 2016). PSCAP records indicate that fewer than 20,000 hatchery pallid sturgeon have been stocked in the Mississippi and Atchafalaya rivers through 2014. Garvey, et al. (2009) estimated the population of adult pallid sturgeon in the Middle Mississippi River (between the Missouri River confluence and the Ohio River confluence within the IHMU) between 1,600 and 4,900 individuals. Killgore, et al. (2007) sampled the lower and middle Mississippi River for pallid and shovelnose sturgeon and had higher catch rates of pallid sturgeon in the upper and lower reaches sampled (i.e. highest catch rates were between New Orleans and the Atchafalaya River and at the Chain of Rocks near the Missouri River confluence). The oldest pallid sturgeon collected were 15 years old and a number of sub-adults were also collected, which indicates several age classes are present and could indicate that recruitment is occurring in the Mississippi River (Killgore et al. 2007). Killgore, et al. (2007) did not estimate abundance or population size. The PSCAP did not recommend additional hatchery stocking in the CPMU (Service 2008).

RECOVERY PLAN

The recently updated Recovery Plan (Service 2014) indicates that range-wide the status of the pallid sturgeon has improved and is currently stable. This is largely due to the numerous studies that have been undertaken since listing of the species in 1990 and a greater understanding of the habitat conditions, abundance and recruitment in the Mississippi and Atchafalaya rivers. However, the wild populations above Gavins Point Dam in the Missouri River are declining or have been extirpated and without the PSCAP stocking, would likely face extirpation.

Factors that have caused the decline of pallid sturgeon and are the criteria for listing include: 1) destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors (Service 2014).

Construction and operation of large dams and river channelization have eliminated and degraded historically occupied sturgeon habitat. On the Missouri River, approximately 36% of riverine habitat within the pallid sturgeon's range was eliminated by construction of six dams between 1937 and 1963 (Service 1993). Dams hinder migrations and the reservoirs likely inundated historical spawning and nursery areas. River channelization has resulted in another 40% of habitats altered. The remaining 24% has been altered due to changes in the volume and timing of flows, water temperatures, and turbidity caused by dam operation, irrigation withdrawals and other water uses. These alterations have likely affected multiple facets of the pallid sturgeon’s life cycle including the loss of access to and quantity of foraging and spawning habitats, changes in dispersal dynamics, changes in spawning cues, loss of food resources, and increased predation (Service 2014).

The age structure of wild pallid sturgeon populations in the upper Missouri River are highly skewed, with mature pallid sturgeon comprising the bulk of the population (Braaten et al. 2015). Despite recent evidence of spawning in the lower Yellowstone and Powder rivers, there are no detectable levels of natural recruitment occurring in these rivers, and extremely low recruitment detected in the lower Missouri River. In addition, the natural life history requirements of pallid sturgeon cause further difficulties in recruitment. Specifically, pallid sturgeon 1) have delayed sexual maturity, taking many years to begin spawning, 2) females do not spawn every year, with a typical periodicity of spawning every 2-3 years, and 3) larvae drift far downstream of spawning sites, often entering river reaches that have been modified into reservoirs by damming.

Overharvesting of sturgeon in the late 19th and early 20th centuries throughout the Missouri and Mississippi rivers resulted in the extirpation of lake sturgeon from the Missouri River and lower Mississippi River (Carlson & Pflieger 1981) and as sturgeons were not often differentiated during harvest, large numbers of pallid and shovelnose sturgeon were also likely taken (Carlander 1954). The intense harvest resulted in a reduction of harvest of over 95% from the peak in the 1890s to 1950 (Carlander 1954).

Hybridization with shovelnose sturgeon has been documented but it remains unclear whether hybridization is actually a threat (Service 2007).

The strategy for recovery of pallid sturgeon is to:

1. Conserve the range of genetic and morphological diversity across its historical range;
2. Fully quantify population demographics and status in each management unit;
3. Improve population size and viability within each management unit;
4. Reduce the greatest threats in each management unit;
5. Use artificial propagation to prevent local extirpation where recruitment has failed (Service 2014).

Pallid sturgeon will be considered for reclassification from endangered to threatened when the listing criteria have been adequately address to allow for self-sustaining populations to be maintained within each management unit for 2 generations (20-30 years). Delisting will be considered when the listing criteria are adequately addressed to provide reasonable assurance of long-term persistence of the species in each management unit even without ESA protections.

Least Tern (*Sternula antillarum*), Endangered

STATUS AND DISTRIBUTION:

The least tern were listed as endangered in 1985 (previously known as *Sterna antillarum*; Service 1995). A recovery plan was developed in 1990 (Service 1990), indicating riverine sandbars, river channels with appropriate channel widths and flows, and lake shorelines as essential breeding habitat (Service 1990). There is no critical habitat designated within the action area.

Interior least terns are migratory, breeding along rivers systems in the United States and wintering along the coast in Central and South America (Service 1990). Within the Missouri River system, breeding sites occur along the Missouri River and many of its major tributaries in eastern Montana and North Dakota (Service 1990). The recovery plan established a goal of 7,000 terns across the range, to be maintained for 10 consecutive years, with a recovery goal of 2,100 birds in the Missouri River system, and specifically 32 birds in Montana (Service 1990). Range-wide, the population has increased and the recovery criterion has been met for nearly 20 years (Service 2009). The only range-wide population estimate from 2005 indicated over 17,000 birds; however, only ~1,700 birds were counted on the Missouri River and its tributaries above Sioux City (Service 2013; Lott 2006).

Within Montana, least terns breed along the Yellowstone River, downstream of Miles City. Historical records are rare prior to their listing, with only two non-breeding records before 1985. In 1987, one tern attempted to nest along Fort Peck Reservoir, but the attempt failed. Targeted tern surveys were conducted along the Yellowstone River during the 1994-1996 breeding seasons, finding an average of 27 adult birds across years within the reach between Miles City and the Seven Sisters Recreation Area (Bacon 1996).

LIFE HISTORY:

Least terns typically nest in colonies. Least terns lay eggs primarily May through June, though a second attempt at nesting can occur in July and August if initial nests fail. Two to three eggs are produced per clutch and are incubated about 20-25 days before hatching. Both parents tend to the young, usually until a few weeks after fledging occurs, which is at about three to four weeks. Terns typically begin breeding at about one year old. Spring arrival times progress northward with the first birds arriving at breeding grounds in the lower Mississippi from mid-April to early May. In Montana, spring arrival of the species occurs in mid to late May, with departure in the fall generally occurring by mid-August. In general, regardless of geographic location, most breeding sites are left by early September. (NatureServe 2015)

HABITAT:

Breeding terns prefer to nest on sparsely vegetated sandbars and sandy islands but may also nest within sand/gravel pits, and on lake and reservoir shorelines. Important attributes of a nest site include the presence of suitable nesting substrate, a lack of vegetative cover, favorable water levels and proximity to food resources. Preferred nesting substrates are dry, un-vegetated sections of sand or pebble beach within a wide, unobstructed, river channel. Suitable water levels occur after peak flows recede and dry sandbars or islands are exposed. Suitable foraging sites during breeding season are most often along shorelines where shallow-water habitats are adjacent to the main channel. Foraging habitats near nest sites are preferred, usually within 300 feet of the colony. Nest sites observed along the Yellowstone River occur where increased channel sinuosity results in multiple bars and overlapping islands surrounded by irregular channel activity (MNHP 2016).

Least terns feed primarily on fish, but will also take crustaceans, mollusks, and annelids. Fish species captured by least terns tend to be surface schoolers found in shallow water, and therefore, waters of less than three feet deep are preferred forage sites. For most successful reproduction, suitable foraging habitat must be located near enough to the colony, usually within 300 feet. (NatureServe 2015)

THREATS:

The single greatest factor resulting in population reductions of the least tern is the alteration of habitat due to river engineering practices (i.e. damming, channelization; Service 1990). This results in significant changes to least tern habitat, 1) a dramatic reduction in the availability of braided river channels through inundation or removal of sediment, and 2) inappropriately timed water releases from reservoirs that inundate sandbars and drown nests prior to fledging. However, range-wide, nesting habitat does not appear to be limiting (Service 2013).

Predation on eggs and chicks may be substantial source of mortality (Service 2014), but is not necessarily a significant threat to the overall population.

OCCURRENCE IN THE ACTION AREA:

Although Montana supports one of the smallest populations of interior least terns, this species is known to be present and to be breeding along the Yellowstone River within the action area. The MNHD reports the most recent occurrence was in 2013 (MNHP 2016). Though the project area is at the limit of the terns' preferred range, it is noted as being a potentially important alternative site in years when rivers within the preferred range are at higher water levels; substantial water diversion for agriculture purposes makes the Yellowstone River unlikely to pose an inundation threat to tern nests. For these reasons, it is expected that the breeding least tern could be present in the project area during the April through September breeding season.

Whooping Crane (*Grus americana)*, Endangered

STATUS AND DISTRIBUTION:

The whooping crane was listed as endangered in 1967 (Service 1967). The whooping crane population had dropped to an all-time low of 15 cranes wintering in Texas in 1941 (CWS and Service 2007), but have slowly increased to an estimated 279 in 2011 (Service 2012). These cranes are endemic to North America and historically ranged from Canada to Mexico from the Rocky Mountains to the East Coast. The only natural population winters at Aransas National Wildlife Refuge in Texas and breeds in Canada (primarily in Wood Buffalo National Park) and migrates through the central United States (Service 2012). Three other experimental or non-migratory populations exist in Florida and Louisiana.

There are documented sightings of whooping crane along the Yellowstone River drainage, but not immediately adjacent to the river. In Montana, these cranes have been recorded in marsh habitats at Medicine Lake and Red Rock Lake NWRs and on riparian habitats on the Missouri River (MNHP 2016). In North Dakota sightings along the Missouri River have been confirmed in McKenzie County (NDNHI 2016). The whooping crane is not known to breed in either state.

LIFE HISTORY:

Whooping cranes migrate from wintering grounds at Aransas NWR on the Texas Gulf Coast to breeding grounds at Wood Buffalo National Park in Canada. The spring migration through Montana and North Dakota typically occurs in April and fall migration in September and October (CWS and Service 2007). Whooping cranes are a long-lived species with estimates for maximum longevity in the wild of at least 30 years. Captive individuals are known to live 35-40 years. Cranes begin breeding at age five on average, though as early as three. A typical clutch of two eggs are laid in April through May and hatching takes place about a month later. Chicks fledge after 33-34 days but remain with parents until the following year.

HABITAT:

Montana and North Dakota are part of the migration route for whooping cranes. Whooping cranes use a variety of habitats during migration, stopping to feed in croplands and roosting in wetlands. The whooping crane prefers freshwater marshes, wet prairies, shallow portions of rivers and reservoirs, grain and stubble fields, shallow lakes, and wastewater lagoons for feeding and loafing during migration. Areas with interspersion between habitat types are preferable. Overnight roosting sites usually have shallow water in which whooping cranes stand. Whooping cranes roost on un-vegetated sandbars, in wetlands, and in some isolated stock ponds. Whooping cranes are usually found in small groups of seven or fewer individuals. They are easily disturbed when roosting or feeding.

Whooping cranes are omnivorous and eat a variety of prey items. Studies have found that food items can include insects, frogs, rodents, small birds, crayfish, minnows, and berries. Migrating cranes were found to spend most of their foraging time within harvested grain fields. Cranes probe mud or sand in or near shallow water for prey. (CWS and Service 2007)

THREATS:

The historic decline of the species was primarily the result of conversion of native habitats to farmland and hunting. Continuing stressors that compromise the rebuilding of the population include loss of habitat, human disturbance, predation (particularly of eggs and chicks), mortality from collisions with powerlines and other structures, and low reproductive rate. Climate change could become a major threat in the coming years. (Service 2012)

OCCURRENCE IN THE ACTION AREA:

Whooping cranes are known to occur in the eastern portion of Montana and North Dakota during migration periods. Stopover habitat within wetlands along the Yellowstone River corridor is available to whooping cranes, and though the species is rare, there is potential for their presence in the project area during migration months (April, September and October).

Piping Plover (*Charadrius melodus*), Threatened

STATUS AND DISTRIBUTION:

The piping plover was listed as endangered in the Great Lakes watershed and threatened throughout the rest of its range in the U.S. (Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, Virgin Islands) in 1985 (Service 1985b), and Canada, Jamaica, and the West Indies. Three separate breeding populations have been recognized – on the Atlantic Coast, Northern Great Plains, and Great Lakes (Service 2009). Critical habitat was designated for the Northern Great Plains population in 2002 (Service 2002) and includes the Missouri River both upstream and downstream of the Yellowstone River confluence, but does not include the Yellowstone River. Since listing, it has been recognized that the Atlantic Coast population and the interior population are likely separate subspecies (*C. melodus melodus* and *C. melodus circumcinctus*, respectively). Further, in the 2009 status review (Service 2009) evidence is presented that the Northern Great Plains and Great Lakes populations are likely separate Distinct Population Segments (DPS).

The breeding range of the Northern Great Plains piping plover population includes Alberta, southern Saskatchewan, southern Manitoba, eastern Montana, North Dakota, South Dakota, Minnesota, Nebraska and Iowa. The majority of breeding pairs in this range are in North Dakota, Montana, South Dakota and Nebraska, specifically including the extreme northeastern portion of the state. Plovers were first recorded in Montana in 1967 and known to breed at Bowdoin NWR and Fort Peck Reservoir prior to 1985 (MNHP 2016). Piping plovers winter along the southern Atlantic Coast from North Carolina to the Florida Keys and along the Gulf Coast including Texas, Louisiana, Mississippi, Alabama, Florida, Mexico and the West Indies (Service 2009).

The breeding population in the Great Lakes watershed was estimated as 63 breeding pairs (126 individuals) in 2008 and the trend has been a slight increase in population (from 2002 to 2008). The recovery goal for the Great Lake population is at least 150 breeding pairs for at least 5 consecutive years with a five-year average fecundity of 1.5-2.0 fledglings per pair (Service 1988). The breeding population along the Atlantic Coast was estimated as 1,596 breeding pairs (3,192 individuals) in the U.S. in 2008 and 253 pairs in Canada (Service 2009). The recovery goal for the Atlantic Coast population is 2,000 breeding pairs maintained for five years.

The breeding population for the Northern Great Plains population was estimated as 2,959 adults and 1,212 pairs in 2006 in the U.S. and 1,703 adults in Canada (Service 2009). The recovery goal for the Northern Great Plains population is 1,300 pairs maintained for 15 years in the U.S. and 2,500 birds for the Canadian prairie portion of the population (Service 1988). The recovery goal for Montana is to have 60 breeding pairs that are stable for 15 years and 100 pairs along the Missouri River in North Dakota (Service 1988). The number of pairs in Montana has been near the goal (~56 pairs) in most years since 2005 and the number of pairs along the Missouri River has been higher than the goal since 2000 (range of 100 to 500 pairs; Service 2009). The International Piping Plover Census (conducted in 1991, 1996, 2001, and 2006) indicated a declining trend in the Northern Great Plains population from 1991 to 2001, but then a marked increase in 2006. Due to the difficulty of counting piping plovers over such a large area, it is unclear if the increase observed in 2006 is actually valid (Service 2009).

LIFE HISTORY:

In Montana, arrival of the species typically occurs from late April through early May with departure from breeding habitats for southern wintering grounds occurring by late August. Following arrival on breeding grounds, males begin establishing territories including shoreline and adjacent open ground, and courtship activities begin. A shallow depression in the sand, often lined with gravel or shells, is created by the plovers and acts as the nest for a typical clutch size of three to four eggs. Incubation requires 27-30 days and eggs begin hatching in mid-June in Montana. Chicks leave the nest quickly, within hours of hatching and begin foraging. Chicks fledge anywhere from 20-35 days after hatching. Piping plovers may try a second nest if the initial nest fails or may switch mating partners after clutches or between years. Breeding begins at one year of age and plovers may live up to 14 years. (MNHP 2016)

HABITAT:

In Montana, nesting may occur on a variety of habitat types, including along the shorelines of alkali lakes, reservoirs, or river sandbars. Along the Missouri River, nesting occurs along the shorelines of reservoirs and on river sandbars (Service 2009). Piping plovers prefer un-vegetated sand or pebble beaches on shorelines or islands, but recently have been observed in more densely vegetated areas of cottonwood seedlings or further from water around reservoirs (Service 2009), although these areas may be less desirable and only used when other more suitable habitat is not available. Nests are initiated after spring and early summer flows recede and dry areas on sandbars are exposed. Studies on specific habitat parameters preferred by nesting plovers reported preferential nest site selection on relatively large sandbars averaging 938 feet long by 180 feet wide, with vegetative cover of 0-10%, and located about 7 inches above the river surface elevation. These variables indicate that plovers prefer nest sites that provide visibility against terrestrial predators and sufficient protection from rising waters. (MNHP 2016)

There are limited studies on food preferences, but diet is generally reported to be comprised of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates. Plovers forage by pecking in sandy or muddy substrates. Adults typically forage within about 16 feet of the water's edge, while chicks remain on higher ground at greater distances from the shoreline.

THREATS:

Threats to the Northern Great Plains population of piping plover include the loss of habitat due to river engineering activities, vegetation encroachment (both native and non-native species), predation, oil and gas development, wind power facilities, powerlines, and other human disturbance. Predators include a variety of mammals, including domestic pets, and birds. As rivers have become channelized and normal flood cycles are altered, vegetation has increased in cover and density, reducing nesting habitat and providing more cover for predators. Channelization, bank stabilization, and construction of reservoirs have contributed to the degradation or loss of sandbar nesting habitat. As with least terns, piping plovers are dependent on a period of low water flows after the natural spring floods; this allows the natural flows of the river to create sandbars and sandy islands with little vegetation that can be safely nested on during naturally low water levels of later spring and summer. (MNHP 2016: Service 2009)

OCCURRENCE IN THE ACTION AREA:

The piping plover is likely to occur in the action area and there is also potential for the species to be nesting. Breeding species occurrences are confirmed for sandbar and sandy shoreline habitats within the Yellowstone River just upstream of Glendive and suitable nesting habitat is present between the Intake Diversion Dam and the Missouri River (MNHP 2016). MNHP data shows confirmed occurrences of breeding for piping plovers along the Yellowstone River near its confluence with Clear and Cedar Creeks as recently as 2013. Aerial photos of this area show several mid-channel sandbar islands with minimal vegetation during low flows. Piping plovers are also likely to be present along the Missouri River downstream of the Yellowstone River confluence.

Rufa Red Knot (*Calidris canutus rufa*), Threatened

STATUS AND DISTRIBUTION:

The Rufa red knot, also known as the red knot, was listed as threatened in 2014 (Service 2014) throughout its entire range. Within Montana, the species rank is not applicable because it is not confidently present in the state or it is only present with accidental or irregular stopovers (MFWP 2016).

Red knots are shorebirds related to dowitchers and sandpipers and are one of the longest distance migrants, breeding in the central Canadian Arctic in Nunavut and the Northwestern Territories, and wintering along the Atlantic coast of Argentina and Chile, the north coast of Brazil, the northwest Gulf of Mexico (Mexico, Texas, Louisiana) and the coast of Florida through North Carolina (Service 2014b). They migrate along corridors including the Atlantic Coast and through the Northern Plains, often flying hundreds or thousands of miles without stopping (Service 2014b). Known stop-over locations are typically coastal bays and large lakes where shoreline foraging is available. In the Northern Plains, saline lakes are used. Use of wetlands and riverine sandbars has been recorded along the Mississippi River (Service 2014b). The red knot is rarely observed in Montana wetlands, with about 50 observations since the 1970s, and only as a transient during migration in May or July through October (MFWP 2016). However, no red knots have been observed, either breeding or transient, within any of the study area counties (MNHP 2016, NDNHP 2016).

The Service determined that older population estimates are not valid for representing the current population abundance (Service 2014b), but their summary of the best available data from wintering surveys indicates that the population of red knots has declined and remained low compared to counts from the 1980s, but the decline may have leveled off since the late 2000s. In the Argentina/Chile wintering grounds, the latest counts indicate a population of about 11,000 birds (2011-2013 counts). In northern Brazil, a 2011 survey estimated 3,660 birds and a 2013 survey estimated 15,485 birds. Only limited surveys have been conducted in the northwestern

Gulf of Mexico region, with an estimate of about 3,000 birds in Texas and Louisiana. In the southeastern U.S., and estimate from 2011 indicated about 3,800 to 3,900 birds.

LIFE HISTORY:

The red knot breeds in the central Canadian Arctic nesting in dry elevated tundra. Female red knots lay only one clutch, typically including four eggs, in late May or early June. Incubation takes 22 days and young leave the nest within 24 hours of hatching and are able to forage for themselves (Service 2014c).

HABITAT:

The red knot's unique life history depends on suitable habitat, food, and weather conditions within narrow seasonal limits, as it travels such huge distances between wintering and breeding areas (Service 2014). Habitat preferences during migration are largely based upon their unique migration style and need for food items. Red knots can fly more than 9,300 miles from south to north every spring and back in the fall. They overwinter and migrate in large flocks containing hundreds of birds. Due to physical changes the bird undergoes while flying (sometimes 1,500 miles non-stop), knots arriving from long trips are not able to feed maximally until their digestive systems regenerate, a process that may take several days. This makes it necessary to locate stopover spots that are rich in easily digested food. Precise timing of stopovers with the spawning seasons of intertidal invertebrates is essential to successful migration. Some nearly double their body weights during stopovers. Red knots commonly utilize muddy or sandy coastal areas, specifically, the mouths of bays and estuaries, tidal flats, and unimproved tidal inlets during migration and overwintering. Inland saline lakes may be used as stopovers in the Northern Great Plains and best available data suggest they may also use freshwater habitats along migration routes (Service 2014c, MFWP 2016).

Red knots are shorebirds, foraging in mudflats, sandbars, and shallow water. Red knots are molluscivores, predominantly eating hard-shelled molluscs (Service 2014b). For much of the year red knots eat small clams, mussels, snails and other invertebrates, swallowing their prey whole.

THREATS:

On-going development of coastal areas has a major influence on habitat quantity and quality for shorebirds. For Arctic-breeding and shoreline wintering shorebirds, climate change could have major long-term effects, including loss of habitat from sea-level rise, changes to arctic tundra habitats from warming temperatures, timing changes in prey availability, ocean acidification effects on prey species, and storm effects on migration energetics and destruction/modification of shoreline habitats. Other threats include beach cleaning, invasive vegetation species, agriculture/aquaculture, hunting, disturbance, disease, predation, and inadequacy of international protective regulations (Service 2014b).

OCCURRENCE IN ACTION AREA:

Red knots have not been observed within the study area in Montana or North Dakota and stopovers by red knots anywhere in Montana are quite rare, with less than four sightings in Montana wetlands in any given year (MNHP 2015). Preferred primary habitats of coastal bays and inlets are not available and freshwater habitats used are typically saline lakes and not streams. The red knot is not likely to be present in the action area.

Black-footed Ferret (*Mustela nigripes*), Endangered

STATUS AND DISTRIBUTION:

The black-footed ferret was listed as endangered throughout its range in 1967 under the precursor to the ESA, the Endangered Species Preservation Act of 1966 (Service 1967). By 1987, only 18 individuals were known to exist in the world, all at one location (Meeteetse site) in Wyoming (Service 2015a). These last 18 ferrets were placed into captive breeding programs and offspring have since been reintroduced through 20 separate reintroduction projects since 1991 (Service 2013b). The International Union for Conservation of Nature and Natural Resources estimates that only 295 adults were present in the wild at the end of 2015, with breeding adults having declined 40% since 2008 (Belant et al. 2015). The majority of those individuals occur at the four most successful colonies located in Arizona, South Dakota and Wyoming. No wild populations of black-footed ferrets have been found following capture of each of the wild Meeteetse ferrets in 1987 (Service 2013b). It is considered very unlikely that any undiscovered wild populations occur (Service 2013b). There is no critical habitat designated within the action area.

LIFE HISTORY:

The black-footed ferret is the only ferret species native to the Americas and is a medium sized mustelid typically weighing 1.4 to 2.5 pounds (Service 2013). In captivity, ferrets began breeding after reaching one year of age, starting in March through early April. Gestation is 42-45 days and litters average about 3.5 kits. Young appear above ground in July typically, and disperse in the fall (MFWP 2016). These ferrets are secretive and solitary and are nocturnal predators, making them rarely observed except at night (NatureServe 2015).

HABITAT:

The black-footed ferret life history is entirely dependent on prairie dogs; the ferret relies upon prairie dogs for creating shelter in underground colonies and as their main food source (MFWP 2016). Black-tailed prairie dog (*Cynomus ludovicianus*), white-tailed prairie dog (*C. leucurus*) and Gunnison's prairie dog (*C. gunnisoni*) are all species that the black-footed ferret is dependent upon.

The close association of ferrets and prairie dogs means that it would be necessary to identify existing prairie dog colonies to determine where ferrets may occur. Prairie dog colonies are generally found on grasslands and shrub grasslands that are flat and open with low and relatively sparse vegetation (MFWP 2016). The white-tailed prairie dog occurs only in a small area in the south central portion of Montana and no known occurrences are recorded elsewhere in Montana

(MNHP 2015). The black-tailed prairie dog has two recorded occurrences in Richland County – generally a few miles away from the Yellowstone River in upland prairie habitat.

Field observations indicate that black-footed ferrets feed almost entirely on prairie dogs. Diet samples support this, although other species of vertebrate prey have occasionally been reported (MFWP 2016).

THREATS:

Threats to the ferret include the decline of prairie dogs, which have declined due to extermination by landowners, diseases such as plague and distemper, and conversion of grasslands to agricultural uses (Belant et al. 2015). The greatest impacts to ferret populations have resulted from the conversion of native prairie to cropland and the spread of native canine distemper and nonnative sylvatic plague. The greatest threat to the recovery of the black-footed ferret may lie in failure to manage prairie dog colonies properly, including continued poisoning by landowners who consider the species a pest (Service 2013b).

OCCURRENCE IN THE ACTION AREA:

The black-footed ferret may occur in McKenzie County, North Dakota and Richland County, Montana (MNHP 2015). The species list requested for the project did not indicate that black-footed ferret was likely to be present in Montana. Based on the above occurrence descriptions, it is highly unlikely that black-footed ferret is either currently present or could become established within the study area. Populations are extremely rare, well documented, and are not known to occur along the Yellowstone River. In addition, any potential habitat for the black-footed ferret, which includes existing prairie dog colonies, is found several miles from the study area.

Gray Wolf (*Canis lupus*), Endangered

STATUS AND DISTRIBUTION:

Gray wolves were listed as part of the original Endangered Species Preservation Act of 1966, but were subsequently reclassified and listed as endangered in 1978 throughout the contiguous United States and Mexico, except for the Minnesota gray wolf population, which was classified as threatened (Service 1978). Gray wolf populations in the Northern Rocky Mountains (Idaho, Montana, and Wyoming) were delisted as of 2011, due to adequate recovery (Service 2015). Wolves in Montana became a species managed solely by the state of Montana. However, gray wolves in North Dakota remain listed as endangered and protected under the ESA (Service 2016b, 2015). There is no critical habitat designated within the action area (Service 2016b).

The original range of the gray wolf included much of the northern hemisphere in every habitat where large ungulates were found (Mech 1995). The gray wolf in North Dakota is rarely seen, with only occasional confirmed sightings reported. There is no known breeding population (NDGF 2012). Wolf observations in the Dakotas were reported to begin increasing in the early 1990s, likely related to range expansion and population increases in adjacent areas, especially Minnesota (Licht et al. 1994). Most occurrences were of young individuals, which suggests that individuals are dispersing to the area instead of breeding there (Licht et al. 1994).

An estimated 1,657 wolves are present in Idaho, Montana, and Wyoming as of 2014, with another 145 estimated in Oregon and Washington (Service 2016b). The Service anticipates a long-term population of approximately 1,000 wolves to be stable in the Northern Rocky Mountains, contiguous with an estimated population of 65,000 wolves in Canada and Alaska.

LIFE HISTORY:

Wolves live in groups called packs that typically include a breeding pair and their offspring, as well as other non-breeding adults. Breeding begins by age two or three and, on average, produces five pups in early spring. Pups are reared in dens for the first six weeks and cared for by the entire pack (MFWP 2016). Young wolves disperse from the pack to find a mate and form a pack after a year or two, and can travel as far as 600 miles in search of a mate or territory (Service 2011). Territories can range in size from 50 to over 1,000 square miles. The size of the territory depends on the availability and seasonal movements of prey (Service 2011).

HABITAT:

Wolves occupy a wide range of habitat types and elevations, limited only to areas where prey sources exist, such as elk, white-tailed deer, mule deer or moose (MFWP 2016). In Midwestern states, habitats currently used by wolves range from mixed hardwood-coniferous forests in wilderness and sparsely settled areas, to forest and prairie landscapes dominated by agricultural and pasture lands (NDGF 2012).

Most ungulates such as deer, elk, and moose, as well as smaller mammals such as beavers and arctic hares, can serve as prey for wolves, and wolves may select both wild and domestic species as prey (Mech 1995, NDGF 2012). Wolves will readily scavenge and occasionally augment their diet with birds, fish, and rodents (Service 2016b, NatureServe 2015).

THREATS:

Wolves could recolonize portions of their former range on the Dakota prairies, though the widespread conversion of prairies to agriculture and relatively high densities of roads would be the greatest challenges to successful reestablishment (Licht et al. 1994). As wolves move into these agricultural areas, conflicts with humans greatly increase, resulting in a higher number of wolves killed to protect livestock and by accident when confused with coyotes (Mech 1995, NDGF 2012).

OCCURRENCE IN THE ACTION AREA:

In a survey of wildlife biologists and animal control personnel in North Dakota, one study found confirmation that gray wolves have been seen in North Dakota, though sightings are very rare and sporadic (Licht et al. 1996). There are no occurrences of gray wolves reported by the NDNHP (2016). A wolf killed in January 1992 in Dunn County, to the east of McKenzie County, is the nearest record of wolf presence to the study area (Licht et al. 1996). Due to the rarity of this species and the altered habitat and development in the action area, it is unlikely that gray wolves would be present within the action area.

Northern Long-eared Bat (*Myotis septentrionalis*), Threatened

STATUS AND DISTRIBUTION:

The northern long-eared bat was listed as endangered throughout its range in 2013 (Service 2013c). In 2015, the species was reclassified to threatened (Service 2015c) and in early 2016, the final 4(d) rule set provisional conservation protections (Service 2016c). The 4(d) rule prohibits purposeful take of northern long-eared bats throughout the species' range, as usual for most protected species, but provides for exceptions in instances of removal of the bats from human structures, when necessary for defense of human life, and when removal of hazardous trees is needed for protection of human life and property. There is no critical habitat designated within the action area.

The northern long-eared bat is a permanent resident throughout much of the north and northeastern portions of North America. Historically, eastern Montana and Wyoming marked the western limits of the range, including areas around the Yellowstone River area (MFWP 2016). A single observation of the northern long-eared bat is recorded in Montana, seen in the north central part of Richland County in 1978 (MTNHP 2015). There are no records of occurrence in North Dakota Counties within the study area (NDNHP 2016), although surveys cited in the listing (Service 2015c) indicated northern long-eared bats have been documented in the Turtle Mountains, Missouri River Valley and the Badlands in North Dakota.

The Western Range population includes South Dakota, North Dakota, Montana, Wyoming, Nebraska and Kansas and is the least abundant of all the populations, common and abundant only in the Black Hills of South Dakota (Service 2015c), with a potential population of a few hundred.

LIFE HISTORY:

Northern long-eared bats typically hibernate between mid-fall through mid-spring each year. Prior to hibernation, breeding begins in late summer or early fall as males begin swarming near hibernacula. Females store sperm during hibernation and in spring emerge from their hibernacula and the delayed fertilization finally takes place. Estimates for seasonal habitat use time periods in Montana for this bat are from Oct 1 to May 15 for hibernation season and Apr 1 to Sep 30 for the summer maternity season. Maternity colonies consisting of females and their pups can range from 7 to 100 individuals, but are most commonly 30 to 60 individuals. Pups begin to able to fly at about three weeks (MFWP 2016, NatureServe 2015).

HABITAT:

Northern long-eared bats move between varying habitats depending on season. Winter hibernation habitat, or hibernacula, typically includes underground caves or structures with similar microclimates, such as mines and railroad tunnels. Bats prefer hibernacula with large passages, cracks and crevices large enough for roosting, a relatively constant, cool temperature of about 32-48°F, high humidity and minimal air currents. During summer, suitable habitat can include forested habitats, but may also include adjacent habitats such as wetlands, agricultural fields, and pastures. Roosts may be found in rock cavities and the crevices or hollows of both live and dead trees. Suitable wooded areas have a wide range of tree densities and canopy closures. Individual trees may be considered suitable habitat when they have good roost opportunities and are within 1,000 feet of other suitable wooded habitat. This bat has also occasionally been found roosting in structures like barns, bridges, and bat houses, particularly when other suitable roosts are unavailable. Finally, suitable spring staging and fall swarming habitat is similar to that of summer habitat, but is typically within five miles of hibernacula. Spring staging and fall swarming habitats are generally used from early April to mid-May and mid-August to mid-November, respectively. Roost sites are changed every few nights during spring, summer, and fall, and bats may also change hibernacula multiple times in one winter (Service 2014, MFWP 2016, NatureServe 2015).

The northern long-eared bat emerges at dusk to forage on insects such as moths, flies, crickets, grasshoppers, and beetles, which they catch while in flight using echolocation or are able to seize from vegetation and water surfaces. In addition to insects, these bats are known to consume spiders. Foraging periods are nocturnal and binodal, with two feeding excursions each night, the first a few hours after sunset and the second seven to eight hours after sunset (MFWP 2016, NatureServe 2015).

THREATS:

The greatest single threat to the northern long-eared bat is white-nose syndrome, a fungal disease that invades deep skin tissues and causes extensive damage during hibernation. Long-eared bats with white-nose syndrome symptoms were first observed in New York in 2006 and it has spread rapidly through much of the bats' range. However, white-nose syndrome has not made its way to Montana or North Dakota. Other threats to this bat include, to a much lesser degree, human alterations to hibernacula openings, human disturbance during hibernation, removal of forest habitats, prescribed fires near hibernacula, use of pesticides or herbicides, and wind turbines that cause mortality during migration (MFWP 2016, NatureServe 2015).

OCCURRENCE IN THE ACTION AREA:

The only record of northern long-eared bat in Montana was in 1978 (Service 2015; MNHP 2015). Northern long-eared bats have been documented in the Missouri River Valley in North Dakota, however, no hibernacula are known to be present (Service 2015). However, these bats are difficult to detect, hiding in deep crevices during hibernation and mixing with larger colonies of other bats, and may be present in more areas than are known. However, it is unlikely that northern long-eared bats would be present in the action area.

Dakota Skipper (*Hesperia dacotae*), Threatened

STATUS AND DISTRIBUTION:

The Dakota skipper, a small butterfly with 1-inch wingspan, was listed as threatened in 2014 (Service 2014e) throughout its known range, including North Dakota.

The Dakota skipper has been extirpated from Illinois and Iowa and now occurs in remnants of native mixed and tallgrass prairie in Minnesota, the Dakotas and southern Canada (Service 2015d). There is one confirmed observation from 1997 in McKenzie County, North Dakota, approximately 60 miles east of the action area (NDNHP 2016). Dakota skippers do not have occurrence records in Montana (MNHP 2015).

LIFE HISTORY:

In June and July, females lay eggs on the underside of leaves. Eggs take about 10 days to hatch into larvae (caterpillar). After hatching, larvae build shelters at or below the ground surface and emerge at night to feed on grass leaves. This continues until fall when larvae become dormant. They overwinter in shelters at or just below ground level, usually in the base of native bunchgrasses. The following spring, larvae emerge to continue developing. Pupation takes about 10 days and usually happens in June. Adults emerge from pupae and live for only three weeks, at most. Females may lay up to 250 eggs if longevity is maximized and flower nectar is available (Service 2015d).

HABITAT:

The Dakota skipper is a small butterfly that lives in high-quality mixed and tallgrass prairie. Specifically, the Dakota skipper is found in moist bluestem prairie in close association with three wildflower species, usually when blooming, including wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*) and smooth camas (*Zygadenus elegans*). It can also be found in relatively dry upland prairie on ridges and hillsides where bluestem grasses and needle grasses dominate with purple coneflower (*Echinacea angustifolia*) also present (Service 2015d). Nectar provides both water and food and is crucial for survival of both sexes during the adult flight period, which often occurs during the hottest part of summer (Service 2015d).

THREATS:

Dakota skipper populations have declined due to overall conversion of native prairie to farmland, ranches, and other uses. They are almost always absent in overgrazed or otherwise degraded prairies (Service 2015d).

OCCURRENCE IN THE ACTION AREA:

Dakota skippers are not found in Montana, and only rarely occur in North Dakota (MNHP 2015, NDNHP 2016). They are not expected to be present along the Yellowstone or Missouri rivers within the action area.

ENVIRONMENTAL BASELINE

The environmental baseline is a "snap shot" of a species' health at a specific point in time. This section defines the environmental baseline that includes the effects of past and ongoing human and natural factors leading to the current status of the species, their habitats, and ecosystems in the action area.

Yellowstone River

Anthropogenic Changes to the River

The Yellowstone River is widely considered to be the last free-flowing large river in the continental United States. However, while there are no large dams with storage reservoirs on the Yellowstone River, there are six primary diversion weirs on the river and numerous smaller diversions (Figure 1).

The uppermost diversion weir is Billings Big Ditch Dam. The Huntley Diversion is Reclamation-owned and managed by the local irrigation district while the middle four (Waco, Rancher's Ditch, Yellowstone, and Cartersville) are privately-owned and managed by local irrigation districts. All six weirs present some degree of impediment to fish passage. The extent of fish blockage at these weirs depends on river stage and the swimming ability of the various species trying to negotiate the weirs. Huntley has a riprap-lined fish bypass channel built to help fish migrate around the weir when water conditions permit. Buffalo Rapids has a total of six pumping plants; five of the pumping plants pump water directly from the Yellowstone, and one re-lift pumping plant provides irrigation water for lands in the vicinity of Glendive, Fallon, and Terry, Montana.

The Yellowstone River Cumulative Effects Analysis (CEA) was recently completed (USACE and YRCDC 2015) and documented the effects of human activities on the Yellowstone River. For the Yellowstone River below the Powder River (defined as Region D in the CEA), the primary causes of changes to the river's habitat have been the changes in hydrology in the overall basin and agricultural development of the floodplain. Peak flows have been reduced due to the Bighorn River reservoirs (Yellowtail, Boysen, and Buffalo Bill); the 100-year flow has been reduced by about 12 percent and the 2-year flow has been reduced by about 22 percent. Summer low flows have been reduced by about 45 percent, primarily due to irrigation withdrawals. The reduction of peak flows has reduced channel migration rates by about 50 percent and floodplain turnover rates (an indication of natural habitat forming processes) have been reduced by about 58 percent and approximately 38 percent of the channel migration zone has been developed (agriculture). Since 1950, nearly 1,000 acres of mid-channel bars and over 30 miles of secondary channel have been lost in Region D. Region D has only about 3 percent of the total bankline of the river with armoring present (9.7 miles total) and 3.2 miles of dikes/levees. Region D has the largest remaining extent of riparian forest along the entire Yellowstone River, with over 150 acres of riparian forest per valley mile.

In the Yellowstone CEA (Corps and YRCDC 2015), the segment of river from the Bighorn River to the Powder River confluence (Region C) is similarly most affected by changes in hydrology and agricultural development in the floodplain. Hydrologic changes are more pronounced in this region due to the more pronounced effects of the Bighorn River reservoirs with reduced peak flows; the 100-year flow has been reduced by 16-19 percent and the 2-year flow has been reduced by 24 percent and channel migration rates have been reduced by nearly 50 percent. Low flows have been reduced by 53 percent. Since 1950, approximately 127 acres of mid-channel bar and 10 miles of secondary channels were lost. Region C has about 13 percent of the total bankline armored (37.3 miles).

Aquatic habitat in the Yellowstone River is affected by changes in hydrology, channel migration, loss of wood recruitment, loss of side channels, and isolation of the floodplain (Corps and YRCDC 2015). However, the Yellowstone River maintains substantially more natural hydrologic, water temperature, and turbidity regimes than the Missouri River because there are no mainstem storage reservoirs on the Yellowstone. The Yellowstone River is the third largest contributor of suspended sediment to the Missouri River, although suspended sediment concentrations have declined over time; but the median turbidity at RM 0.8 is 152 nephelometric turbidity units (NTU; Delonay et al. 2016). Recent water temperature measurements at RM 2.5 in the May to October season indicate a median temperature of 68°F (20°C; Delonay et al. 2016).

The 2014 assessment of water quality in the Yellowstone River (MDEQ 2014) shows that there are impairments to water quality, primarily issues for non-support of aquatic life. Causes for non-support of aquatic life result from the alteration in stream-side vegetation cover, presence of chromium, copper, lead, and high levels of nitrogen, phosphorous, sediment, TDS, and pH. Other causes for non-support include the presence of the Intake Diversion Dam, which is an upstream fish passage barrier. There have been no Total Maximum Daily Load allocations (TMDLs) completed for the action area.

Habitat

Instream habitats of the lower Yellowstone River include main channel pools, runs and riffles, side channels, and backwaters. Most pools are 5 ft. - 10 ft. deep, although some are at least 18 ft deep during summer flows. There are many islands and braided channels with associated backwaters, except in the reaches from Miles City to Cedar Creek and from Sidney to the confluence with the Missouri River. The lower Yellowstone River main channel riverbed upstream from Sidney is primarily gravel and cobble. Downstream from Sidney, the substrate is mainly sand and silt.

Fifty-two species of fish have been recorded in the lower Yellowstone River (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx). Of these, 31 species are native and 21 species are introduced. Native species considered abundant include the blue sucker, channel catfish, emerald shiner, flathead chub, goldeye, longnose sucker, paddlefish, river carpsucker, sauger, shortnose redhorse, shovelnose sturgeon, smallmouth buffalo, stonecat, western silvery minnow, and white sucker (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx).

Distribution

At present, pallid sturgeon reside in the Missouri River downstream from the confluence of the Missouri and Yellowstone rivers during the fall and winter months (Fuller and Braaten 2012).

Historically, elevated spring flows in the Yellowstone River have cued adult pallid sturgeon to initiate spawning movements and migrations. As discharge increases in the spring, adult pallid sturgeon respond by migrating upstream. In most years, adult pallid sturgeon migrate into the unregulated Yellowstone River (Fuller and Braaten 2012) to spawn. Spawning adults favor the elevated spring flows and warmer temperatures of the Yellowstone River and are believed to avoid the colder, less turbid flows in the Missouri River. Based on monitoring results from the Comprehensive Sturgeon Research Project (CSRP), it is estimated that approximately 60 - 90% (DeLonay et al. 2014) of the spawning ready adults migrate into the lower Yellowstone River each year. Of those 60 -90%, approximately 12-26% (up 32 adults) continue their migration up to Intake Diversion Dam.

Currently Intake Diversion Dam blocks upstream passage for pallid sturgeon and many other native fish species (White and Bramblett 1993; Hiebert et al. 2000). However, in 2014 and 2015, wild adult pallid sturgeon were tracked migrating upstream around Intake Diversion Dam via the existing side channel south of Joe's Island (Rugg 2014). In 2014, three of the five fish that successfully passed continued there upstream migration to the Power River where spawning was documented (Rugg 2014). These events are thought to be rare as pallid sturgeon have only been found upstream of Intake four previous times (1950, 1991, 2011 and 2013).

Passage through the existing side channel is very limited as the existing side channel is not accessible every year. Currently the side channel becomes active when Yellowstone River discharge reaches 20,000 – 25,000 cfs, which occurs 5 years out of 10 and approximately 7 days a year. Although the channel becomes active at 20,000 to 25,000 cfs, flows in the Yellowstone River likely needs to be greater than 30,000 cfs to have sufficient depths and attraction flows for pallid sturgeon to use it successfully as was shown in 2014 and 2015, when fish were only documented passing through the channel at flows greater than 46,000 cfs (Rugg 2014, 2015).

Passage of juvenile pallid sturgeon is largely unknown as the majority of these fish are not tagged. However, Rugg (2015) documented at least one juvenile pallid sturgeon migrating upstream through the existing side channel in 2015, so it is likely that some juveniles are blocked by the existing weir. Also, juvenile pallid sturgeon have been stocked both upstream and downstream of Intake with some of the stocked fish remaining upstream of Intake (Jaeger 2009).

The best available science suggests that Intake Diversion Dam is not a barrier to downstream migrating pallid sturgeon. All of the tagged fish that passed in 2014 and 2015 events were successful at migrating downstream over the existing weir and rubble field.

Prior to 2011, diversions into the Main Canal were not screened and Hiebert et al. (2000) estimated that about 500,000 fish of 36 species were annually entrained into the Main Canal, of which as many as 8 percent were sturgeon. A new headworks structure with fish screens designed to prevent entrainment of fish larger than 40 mm were installed in 2011. Monitoring data from 2012-2014 has indicated a change in the species composition and size of fish that become entrained with the new screens. In 2012, approximately 99 percent of the larval fish entrained into the canal belong to the Cyprinidae and Catostomidae families (predominantly minnows and carp) and are typically quite small, in the 4-8 mm total length (TL) size range (Horn and Trimpe 2012). Raw data from 2013 and 2014 monitoring indicates similar results as in

2012, with the exception that one shovelnose sturgeon free embryos or larvae was entrained in June 2013 (Reclamation, unpublished data).

Reproduction

Suitable spawning habitat is present in multiple locations in the Yellowstone River for pallid sturgeon, both upstream and downstream of Intake Diversion Dam (Jaeger et al. 2005, Rugg 2014, 2015). Spawning was documented near RM 6.9 in 2012 and 2015 and a free embryo was collected in 2011 (Delonay et al. 2014). To date, no natural recruitment is occurring, and with the exception of 2014, all spawning activity currently occurs within the first 10 miles of the lower Yellowstone River which does not allow enough distance for free embryos to mature before entering the headwaters of Lake Sakakawea.

Artificial stream experiments first indicated wild free embryo pallid sturgeon have a long dispersal, estimated to last approximately 9-17 days (depending upon water temperature), that could carry the fish anywhere from 80 to well over 300 miles (Kynard et al. 2007; Braaten et al. 2008). Artificial stream experiments also found habitat of dispersing free embryos was near the bottom (Kynard et al. 2007). Field tests found free embryos in a side channel were near the bottom (Braaten et al. 2008, 2010, 2011, 2012), drifting slightly slower than the mean column velocity, and older free embryos drifted at a slower rate than younger fish (Braaten et al. 2008; Delonay et al 2016). The general habitat used by dispersing free embryos is likely similar across the species range although verification of this is difficult due to low abundance of free embryos and the difficulty of sampling.

In particular, recent studies suggest free embryo drift distance available below Intake Diversion Dam is insufficient in length for pallid free embryos to reach suitable rearing habitat (Braaten et al. 2008; 2011). If these young fish do not have adequate distance to drift and then, to stop as they develop into larvae in suitable stream habitat, they will reach Lake Sakakawea, where rearing conditions are not likely to be suitable (Delonay et al 2016). Recent research indicates oxygen levels in the headwaters of reservoirs such as Fort Peck and Lake Sakakawea are too low for free embryos or larval pallid sturgeon to survive (Guy et al. 2015; Bramblett et al. 2016). Thus, the lack of sufficient drift distance and potentially lethal conditions in Lake Sakakawea is the current hypothesis for the lack of recruitment in the GPMU (Delonay et al. 2016).

Abundance

In 2004, an estimated 158 wild adult pallid sturgeon were reported to remain in the population from Fort Peck Dam to the headwaters of Lake Sakakawea, including the Yellowstone River (95% confidence interval = 129 - 193 adults; Klungle et al. 2005). More recently, Jaeger, et al. (2009) estimated even fewer remain, approximately 125 adult pallid sturgeon. The remaining wild adults were estimated to be 43-57 years (i.e. fish spawned before Lake Sakakawea was filled in the 1950s; Braaten et al. 2015). If the adult mortality rate is approximately 5% per year (Braaten et al. 2009), there could already be fewer than 100 wild adult fish in the GPMU.

The Pallid Sturgeon Conservation Augmentation Program (PSCAP) has been undertaken to supplement wild populations with hatchery pallid sturgeon free embryos, larvae, and juveniles (Service 2008). PSCAP has stocked over 980,000 free embryos, larvae, and juveniles below Fort

Peck Dam in the GPMU from 1998 to 2015. The estimated number of surviving juvenile hatchery fish below Fort Peck is ~43,000 (Rotella 2015). From a back-calculation estimate of how many adults may have been present below Fort Peck Dam in 1969, the hatchery derived population is likely to exceed the historic population (Braaten et al. 2009). Although the hatchery derived population is surviving at these numbers recent captures in the Yellowstone River are dominated by a few year classes, predominantly 2001, 2006, 2009, 2010 and 2013 (Rugg 2014).

PSCAP was implemented due to the possibility of near-term extirpation and has demonstrated a successful increase in the number of fish, although these juveniles are only now just beginning to reach maturity and have not yet demonstrated successful reproduction. If supplementation efforts were to cease, the species could once again face local extirpation in the GPMU. The PSCAP goal for the GPMU is to stock a minimum of 9,000 yearlings or yearling equivalents annually below Fort Peck Dam and in the Yellowstone River (Service 2008).

CLIMATE CHANGE

Climate change predictions for the Great Plains include continued warming temperatures that could increase the number of hot days in summer and also result in warmer winters with less snowpack and more rainfall (Shafer 2014). A study on climate change for the Missouri River Basin (Reclamation 2012) down-scaled the global climate models and then modeled runoff and hydrologic routing for a variety of future scenarios as compared to historical hydrology. The results indicate that a small increase in mean annual flow may occur (50^{th} percentile estimate of change in the 3-5% increase range at Garrison Dam that includes the input from the Yellowstone River; although the range from the 5^{th} to the 95^{th} percentile indicates a possibility of wider variability from -10% up to a +30% change in mean annual flow.). The predicted mean monthly flows generally indicate the potential for increased flows from January through June and decreased flows from July through December. Similar results have been presented by the Montana Department of Natural Resources and Conservation (MDNRC 2014) in their State Water Plan that identifies an overall decline in snowpack in western North American and an increased percentage of precipitation falling as rain. This could lead to earlier and lower levels of runoff for both the upper Missouri and Yellowstone rivers because the majority of runoff in the basin is a result of snowmelt runoff. However, increased spring precipitation observed in recent years has also tended to maintain overall annual discharges.

Reduced runoff or highly variable runoff from year to year could have implications for pallid sturgeon spawning as upstream migrations and passage could be restricted in low flow years. Because pallid sturgeon already do not spawn every year, this could reduce the frequency of spawning even further. However, the potential for an increase in air and water temperatures could also benefit pallid sturgeon by promoting faster growth and perhaps reduced drift distances required from lower flows. However, ultimate survival and growth will also depend on food web productivity and timing of availability of prey resources. Pallid sturgeon have been documented to migrate through existing side channels in the Yellowstone River (Braaten et al. 2014) and reduced flows could disconnect or reduce depths and velocities through some of these natural channels under future scenarios.

EFFECTS ANALYSIS

The phrase "effects of the action" refers to the direct and indirect effects of a proposed action on listed species and designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline (50 CFR 402.2). Reclamation and the Corps reviewed the action area settings, life history, habitat information, and environmental baseline for each of the federally listed species to evaluate potential effects.

The Service has identified three potential determinations of the effects on listed species or designated critical habitat:

- **No effect-** the appropriate conclusion when the action agency determines its proposed action will not affect listed species or critical habitat, or
- **Not likely to adversely affect-** the appropriate conclusion when effects on listed species are expected to be discountable, or insignificant or completely beneficial.
    - **Beneficial effects** are contemporaneous positive effects without any adverse effects to the species.
    - **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs
    - **Discountable effects** are those extremely unlikely to occur.
- **Likely to adversely affect-** the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial.

This section summarizes the potential direct and indirect effects to species from construction and operation actions identified in the description of the action, as well as the future interdependent and interrelated operation and maintenance activities. Table 4 summarizes the individual construction and O&M elements of the project and the potential for effects on listed and proposed species. The primary species that could be affected by the proposed project is pallid sturgeon and is discussed in most detail, including the potential effects on each major life history stage. For the wildlife and insect species, the only species likely to be present in the action area are whooping crane, interior least tern and piping plover and there are similarities between species on the potential effects, thus Table 4 summarizes the potential effects for all wildlife species together as a group. The specific effects to each species is included in the sections following Table 4.

Table 4: Summary of Potential Exposure and Effects from Proposed Action

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Interim O&M of the LYP			
Interim Annual Placement of Rock on Existing Weir Prior to Completion of Replacement Weir / Bypass Channel			
Excavate rock from quarry on south side of river	No exposure for any listed species	1. Quarry is located in disturbed uplands 2. Quarry is isolated from the river, sandbars, and side channel. 3. No records of occurrence of upland species within several miles.	N/A
Truck rock across existing side channel to trolley on Joe's Island at low/no flows	No exposure for any listed species	1. Access would only occur when crossing is dry or isolated from wetted segments of channel. 2. No habitat elements for wildlife species present on existing disturbed road. 3. No records of occurrence of upland species within several miles.	N/A
Place rock next to south tower and use trolley system to place in the river. Trolley carries 2-3 large boulders at a time and sets them in a straight line across the top of the existing weir. This typically occurs during low flows (Aug) for 1-2 weeks. Some years, additional rock must be placed later (Aug-Sept) if flows are extremely low.	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – potential exposure No exposure for wildlife species	1. Stockpile site is disturbed uplands. 2. No contamination potential in river from large rock. 3. Temporary increase in turbidity when placing rock due to disturbance to river sediments. 4. No sandbars or wetlands present at or immediately adjacent to existing weir. 5. No records of occurrence of upland species within several miles. 6. Eggs and free embryos/larvae only potentially present from May to mid-July, work occurs after this. 7. Juvenile pallid sturgeon unlikely to be present at weir as it is high velocity and turbulent habitat. 8. Adult pallid sturgeon unlikely to be present as activity occurs after migration season.	Rock placement occurs in-water and disturbs existing sediment where fish may be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Headworks and Screen O&M			
Raise and lower drum screens	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning is extremely unlikely upstream of Intake Diversion Dam prior to and during construction and would not occur in close proximity to weir (i.e. no eggs present). 2. Activity occurs outside of spawning migration period (April 15 – July 1), so adults unlikely to be present. 3. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Slight disturbance and sediment flushing in-river where pallid sturgeon could be present.
Adjust headgates for flow	No exposure for any species	1. Work occurs behind screens in canal.	N/A
Diversion of up to 1,374 cfs	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning and passage may occur in year prior to construction but would not occur in close proximity to weir (i.e. no eggs present). 2. Free embryos/larvae smaller than 40 mm and could be entrained into irrigation system. 3. Juveniles and adults have swimming capability well above sweeping and approach velocities so unlikely to be impinged and are too large to be entrained through screens.	Free embryos and larvae could be entrained into the Main Canal
Remove sediment/debris from headworks and screens (would close gate to prevent unscreened diversions)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning is extremely unlikely upstream of Intake Diversion Dam prior to and during construction and would not occur in proximity to weir (no eggs present). 2. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Disturbance and sediment flushing in-river where pallid sturgeon could be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Raise screens for maintenance/replacement (occasional; would close gate to prevent unscreened diversions)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning is extremely unlikely upstream of Intake Diversion Dam prior to and during construction and would not occur in close proximity to weir (i.e. no eggs present). 2. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Minor disturbance and sediment flushing/turbidity in river where pallid sturgeon may be present.
Gate maintenance (with coffer dam)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Minor disturbance in-river where pallid sturgeon could be present.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Canal and lateral ditch maintenance (sediment removal, etc.)	No exposure to any listed species	1. Work would occur outside of the irrigation season in the dry. 2. Work will occur in established canal system with no suitable habitat for wildlife species.	N/A
Operation of supplemental pumps	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Activity occurs in May, July and August. 2. Pumps are located on inside bends, along the bank, and outside of main thalweg where free embryo and larvae are known to drift. 3. Adult and Juvenile pallid sturgeon unlikely to be present at pump locations as less suitable habitat (i.e. not in bluff pools). 4. Adult and Juvenile swimming capability exceeds pump velocities.	Disturbance in-river where pallid sturgeon may be present. Unscreened pumping, possible entrainment of free embryos and larvae.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Repair and maintenance of supplemental pumps, screens, trash racks	No exposure to any listed species	1. Pumps are pulled up on bank for repair and maintenance.	N/A
Installation/removal of pumps each season	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Activity occurs in May and October. 2. Juvenile pallid sturgeon unlikely to be present at pump locations as less suitable habitat (i.e. not in bluff pools).	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Construction of Replacement Weir and Bypass Channel			
Construction of Replacement Concrete Weir with Low-Flow Notch			
Establishment of road on north (left) bank for construction and maintenance access	No exposure for any listed species	1. Work is in uplands, isolated from river. 2. North bank is already disturbed; only minor grading, placement of gravel in uplands. 3. No records of occurrence of upland species within several miles.	N/A
Staging and construction access on Joe's Island	No exposure for any listed species	1. Work is in uplands, isolated from river. 2. No species likely to be present on Joe's Island. 3. Roads and staging areas already present on Joe's Island.	N/A

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Installation/removal of coffer dams (outside of migration season from April 15 – July 1)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : potential exposure	1. Activity occurs outside of migration season so adults unlikely to be present. 2. Spawning extremely unlikely during construction as side channel would be blocked, so eggs and free embryos/larvae not likely to be present. 3. Juvenile pallid sturgeon unlikely to be present at weir as it is high velocity and turbulent habitat.	Disturbance and sediment flushing/turbidity in-water where pallid sturgeon could be present. Elevated noise levels in-water and in-air could disturb species within ½ mile of site.
Construct replacement weir segments – support pile driving, concrete pouring, placement of cobble/rock (outside of migration season from April 15 – July 1)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : potential exposure	1. Activity occurs outside of migration season so adults unlikely to be present. 2. Spawning extremely unlikely during construction as side channel would be blocked, so eggs and free embryos/larvae not likely to be present. 3. Juvenile pallid sturgeon unlikely to be present at weir as it is high velocity and turbulent habitat.	Disturbance and sediment flushing/turbidity in-water where pallid sturgeon could be present. Elevated noise levels in-water and in-air could disturb species within ½ mile of site.
Relocation of rock trolley tower on Joe's Island	No exposure for any listed species	1. Work is in uplands, isolated from river. 2. No species likely to be present on Joe's Island. 3. Roads and trolley areas already present and highly disturbed.	N/A
Construct Bypass Channel and Place Fill in Existing Side Channel			
Install coffer dams (outside of migration season from April 15 – July 1)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species: potential exposure	1. Activity occurs outside of migration season so adults unlikely to be present. 2. Spawning extremely unlikely during construction as side channel would be blocked, so eggs and free embryos/larvae not likely to be present. 3. Juvenile pallid sturgeon may be present in side channel, but no information on presence.	Disturbance and turbidity in-water where pallid sturgeon could be present. Blockage of side channel would prevent upstream migration of adults for 24 months of construction. Loss of seasonal side channel habitat that may be used by wildlife species (not known to be).

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Excavation of bypass channel	Pallid sturgeon: no exposure Wildlife species: potential exposure	1. Excavation is in uplands isolated from the river. 2. Excavation would remove trees and cause terrestrial noise/disturbance. 3. Creation of ~20 acres of new side channel habitat.	Removal of possible roost/nest trees (bats). Noise and disturbance to any species present within ½ mile. Net replacement of side channel habitat.
Placement of fill in existing side channel	Pallid sturgeon: no exposure Wildlife species: potential exposure	1. Fill would be placed when side channel is dry and isolated from the river. 2. Fill would remove trees and convert 20 acres of channel and 1 acres of wetlands to uplands.	Loss of existing side channel habitat. Noise and disturbance to any species present within ½ mile.
Install channel substrate and grade controls	Pallid sturgeon: no exposure Wildlife species: potential exposure	1. Work is isolated from the river. 2. Noise and disturbance from hauling and placing material.	Noise and disturbance to any species present within ½ mile.
Upstream/downstream grade controls	Pallid sturgeon: no exposure Wildlife species : potential exposure	1. Work is isolated from the river. 2. Noise and disturbance from hauling and placing material	Noise and disturbance to any species present within ½ mile.
Place fill and grading at right and left bank near outlet of bypass channel	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity occurs primarily in uplands with minor in-water work, but outside of migration season so adults unlikely to be present. 2. Spawning extremely unlikely during construction as side channel would be blocked, so eggs and free embryos/larvae not likely to be present. 3. Juvenile pallid sturgeon unlikely to be present near weir /rock field as high velocity and turbulent habitat. 4. Work occurs in disturbed uplands where no wildlife species present.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Open up bypass channel to flow	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity occurs outside of migration season so adults unlikely to be present. 2. Spawning extremely unlikely during construction as side channel would be blocked, so eggs and free embryos/larvae not likely to be present. 3. Juvenile pallid sturgeon may be present in downstream habitats. 4. No wildlife species present in new channel.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Future O&M of the LYP			
Replacement Weir			
Existence of Replacement Concrete Weir	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult –potential exposure Wildlife species : no exposure	1. Maintains channel spanning weir that limits upstream passage by adult and juvenile pallid sturgeon. 2. Weir present that free embryos/larvae, juvenile, and adults would pass downstream over. 3. Spawning would not occur at weir and any drift eggs would already likely be dead.	High velocities and turbulence would likely continue to limit upstream passage by adults and juveniles Downstream passage likely to be improved due to low-flow notch
Occasional rock placement at replacement weir during low flows (August; once every 3-5 years)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity occurs outside of migration, spawning, and drift seasons. 2. Juvenile pallid sturgeon not likely to be present in high velocity habitat. 3. Work does not occur in wildlife habitats.	Disturbance and sediment flushing/turbidity in-water where pallid sturgeon may be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Bypass Channel			
Existence of Bypass Channel	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Creates a channel that meets BRT criteria and is available in all years and at all flows in the river and creates 20 acres of year-round side channel habitat. 2. Adults and juveniles likely to pass both upstream and downstream in channel. 3. Free embryos/larvae may pass downstream through channel, although primary route would be over replacement weir. 4. Bypass channel net replaces acres of existing side channel filled, but would be perennial flow, could add additional habitat for wildlife species. 5. Spawning not expected to occur in the bypass channel.	Passageway for fish migration and drifting. Perennial side channel habitat for fish and wildlife.
Blockage of Side Channel	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Eliminates side channel as alternate upstream and downstream passageway during high flows. 2. Loss of existing side channel habitat (seasonal).	Loss of known occasional passageway for upstream adult migration. Loss of seasonal side channel habitat that may be used by wildlife species (not known to be).
Access road maintenance (annual)	No exposure to any listed species	1. Work occurs on existing roads in uplands.	N/A
Occasional vehicle crossing of bypass channel for inspection (annual) or maintenance (once every 3 years)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity would occur outside of migration, spawning, and drift seasons so adults would not likely be present 2. Juvenile pallid sturgeon might be present in bypass channel although less suitable habitat (not a bluff pool). 3. Wildlife species not present in bypass channel.	Disturbance and temporary placement of fill causing turbidity in-water where pallid sturgeon may be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Replacement of rock in bypass channel (every 3 years)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity would occur outside of migration, spawning, and drift seasons so adults would not likely be present 2. Juvenile pallid sturgeon might be present in bypass channel although less suitable habitat (not a bluff pool). 3. Wildlife species not present in bypass channel.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Removal of sediment and/or debris from bypass channel during low flows (every 3 years)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity would occur outside of migration, spawning, and drift seasons. 2. Juvenile pallid sturgeon might be present in bypass channel although less suitable habitat (not a bluff pool). 3. Wildlife species not present in bypass channel.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Stabilize side channel fill after floods or ice damage (rare, if ever)	Pallid sturgeon: no exposure Wildlife species: potential exposure	1. Activity occurs in uplands, isolated from the river. 2. May require tree removal or cause other disturbance to wildlife within ½ mile.	Disturbance to wildlife species within ½ mile.
Vegetation/weed maintenance	Pallid sturgeon: no exposure Wildlife species: no exposure	1. Activity occurs in uplands, isolated from the river. 2. Activity occurs in disturbed areas where wildlife species not present.	N/A
	Headworks and Screens		
Raise and lower drum screens	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning would not occur in close proximity to weir (i.e. no eggs present). 2. Activity occurs outside of spawning migration period (April 15 – July 1), so adults unlikely to be present. 3. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Slight disturbance and sediment flushing in-river where pallid sturgeon could be present.
Adjust headgates for flow	No exposure for any species	1. Work occurs behind screens.	N/A

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Diversion of up to 1,374 cfs	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning unlikely in proximity to weir, any drifting eggs would already be dead. 2. Free embryos/larvae smaller than 40 mm and could be entrained into irrigation system. 3. Juveniles and adults have swimming capability well above sweeping and approach velocities so unlikely to be impinged and are too large to be entrained through screens.	Approximately 3-6% of river flow diverted into Main Canal during June/July when free embryos/larvae may be drifting by. Potential for embryos/larvae entrained/impinged into screens.
Remove sediment/debris from headworks and screens (gates would be closed to prevent unscreened diversions)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning unlikely in proximity to weir, any drifting eggs would already be dead. 2. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Disturbance and sediment flushing in-river where pallid sturgeon could be present.
Raise screens for maintenance/replacement (occasional, would close gate to prevent unscreened diversions)	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Spawning is unlikely in proximity to weir, any drifting eggs would already be dead. 2. Juvenile pallid sturgeon unlikely to be adjacent to headworks as it is less suitable habitat (i.e. riprap pool).	Minor disturbance and sediment flushing/turbidity in river where pallid sturgeon may be present.
Gate maintenance	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Minor disturbance in-river where pallid sturgeon could be present.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Canal and lateral ditch maintenance (sediment removal, etc.)	No exposure to any listed species	1. Work would occur outside of the irrigation season in the dry. 2. Work would occur in established canal system with no suitable habitat for wildlife species.	N/A
Operation of supplemental pumps	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Activity occurs in May, July and August 2. Adult and Juvenile pallid sturgeon unlikely to be present at pump locations as less suitable habitat 3. Juvenile and adult swimming capability exceeds pump velocities.	Disturbance in-river where pallid sturgeon may be present. Unscreened pumping, possible entrainment.
Repair and maintenance of supplemental pumps, screens, trash racks	No exposure to any listed species	1. Pumps are pulled up on bank for repair and maintenance.	N/A
Installation/removal of pumps each season	Pallid sturgeon: Egg – no exposure Free embryos/larvae – no exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : no exposure	1. Activity occurs in May and October. 2. Adult and Juvenile pallid sturgeon unlikely to be present at pump locations as less suitable habitat	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.
Water conservation measures such as converting ditches to pipes or installing pivot irrigation	No exposure to any listed species	1. Work would be located on disturbed ditches or on farmlands outside of the irrigation season.	N/A

Element of the Proposed Action	Potential Exposure	Rationale for Potential Exposure	Mechanism of Exposure
Monitoring			
Monitoring and inspections by boat in river or bypass channel	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Would occur during migration, spawning, drift seasons. 2. May pass by wildlife species or nests, if present.	Disturbance in-river and to adjacent sandbars during migration and nesting seasons.
Capturing and handling of pallid sturgeon during monitoring	Pallid sturgeon: Egg – no exposure Free embryo/larvae – potential exposure Juvenile – potential exposure Adult – potential exposure Wildlife species : potential exposure	1. Monitoring would be directed at capturing free embryos/larvae, juveniles, and adults. 2. May pass by wildlife species or nests, if present.	Direct collection – mortality (larvae and free embryo). Handling stress and injury (adults and juveniles). Disturbance in-river and to adjacent sandbars during migration and nesting seasons.
Potential Adaptive Management Measures			
Rock and fill adjustments at entrance or exit to bypass channel	Pallid sturgeon: Egg – no exposure Free embryo/larvae – no exposure Juvenile – potential exposure Adult – no exposure Wildlife species : no exposure	1. Activity would occur outside of migration, spawning, or drift seasons. 2. Juvenile pallid sturgeon may be present, but less suitable habitat (i.e. not a bluff pool). 3. Work would occur in disturbed uplands or in bypass channel where wildlife species are not present.	Disturbance and sediment flushing/turbidity in-river where pallid sturgeon may be present.

Pallid Sturgeon

Direct and Indirect Effects

Interim Operations and Maintenance

Fish Passage Barrier

Interim operation of the LYP would include the annual placement of rock on the existing weir crest up to elevation 1991.0 ft. This rock is needed to maintain water surface elevations so the LYP can divert their full water right down to 3,000 cfs in the Yellowstone River. The annual placement of rock is expected to occur over the next three years, during late July and early August, until the construction of the new diversion weir is complete. The physical placement of rock would not affect adult pallid sturgeon as this activity occurs outside of pallid sturgeon migration (migration period May 15 – July 1). However, this annual placement of rock does contribute to the lack of passage for adult and juvenile pallid at the existing weir, most likely due to high velocities, turbulence, and decrease water depths across the weir.

This annual placement of rock would continue to affect the 12-26 percent (25 to 32 individuals) of spawning ready wild adult pallid sturgeon that migrate up to Intake Diversion Dam. It is likely that some or all of these fish would continue to spawn in habitats downstream of Intake Diversion Dam, but any resulting free embryos/larvae would almost certainly perish due to inadequate drift distance downstream before entering Lake Sakakawea.

The rock would also continue to prevent upstream passage by juvenile pallid sturgeon, although it is not known if juveniles are motivated to move upstream. Rugg (2014, 2015) documented three individual juvenile pallid sturgeon that had passed upstream of Intake Diversion Dam, including one documented to have passed through the existing side channel. Thus, it is presumed the annual placement of rock affects at least a small number of juvenile pallid sturgeon that are motivated to find suitable habitat upstream. It is not possible to know how many individuals this affects as a very small percentage of these juveniles are tagged and tracked each year. However this effect appears to be minor as there appears to be suitable habitat available below Intake Diversion Dam and in the Missouri River as many hatchery juvenile pallid sturgeon are surviving and maturing successfully in the GPMU (Rotella 2015).

Prior to the construction of the bypass channel, the existing side channel would continue to be available for fish passage around Intake Diversion Dam. Currently the existing side channel becomes active when Yellowstone River discharge reaches 20,000 – 25,000 cfs, which occurs 5 years out of 10 and approximately 7 days a year. Although the channel becomes active at 20,000 to 25,000 cfs, flows in the Yellowstone River likely need to be greater than 40,000 cfs to have sufficient depths and attraction flows for pallid sturgeon to use it successfully (pallid sturgeon that successfully migrated upstream in 2014 and 2015 migrated at river flows exceeding 46,000 cfs [Rugg 2014, 2015]).

Currently the best available science suggests that the rock placed on the Intake Diversion Dam is not a barrier to downstream migrating adult and juvenile pallid sturgeon. Pallid sturgeon that successfully passed upstream in 2014 and 2015 were all successful at migrating back downstream over the existing weir and rubble field. This is likely due to increased flows and depths over the weir during run off and the fact that downstream migration occurs prior to the annual replenishment of rock on the existing structure. If passage were to occur during interim operations there would be no expected effects to downstream migrating fish.

In summary, the continued effects from the annual placement of rock are:

- Adult pallid sturgeon
  - 12 to 26 percent (25 to 32 individuals) would be blocked from accessing upstream habitats for up to 3 years – Adverse Effect
- Juvenile pallid sturgeon
  - Small, but unknown, number would be blocked from accessing upstream habitats for up to 3 years – Adverse Effect
- Free embryos/larvae
  - May be present if passage and spawning occurs in year prior to construction, existing weir not a known barrier or hazard - No Effect.
- Eggs
  - Would not be present as spawning upstream may only occur in one of the years of interim O&M and would likely be many miles upstream - No Effect.

Short-Term Disturbance and Turbidity

Several of the interim O&M activities would result in short-term disturbance and turbidity in the Yellowstone River, including lowering and raising screens, screen cleaning/maintenance, gate maintenance, inspections, installing/removing supplemental pumps, and placement of rock on the existing timber structure of Intake Diversion Dam. These activities typically all occur outside of the pallid sturgeon migratory and spawning season (i.e. either before April 15 or after July 1), thus adult pallid sturgeon are unlikely to be present and would be unlikely to experience disturbance.

Although spawning upstream of Intake Diversion is unlikely, there is a chance that passage could occur through the existing side channel prior to the start of construction. If this were to occur, it is likely to be many miles upstream of Intake Diversion Dam so there would be no eggs present in the action area during interim O&M.

Free embryos/larvae might be present during the one year when passage around Intake Diversion Dam might be possible, but the interim O&M activities would generally occur before or after drifting occurs, thus, effects to free embryos/larvae are not likely.

Juveniles may be present as they have been documented in Yellowstone River both upstream and downstream of Intake Diversion Dam, but not in immediate proximity to the weir (Jaeger et al. 2006, 2008; Rugg 2014, 2015). As the immediate work areas at the headworks and on the existing weir are likely to be unsuitable habitat due to high velocities, turbulence, and do not include bluff or terrace pools, there are not likely to be any juvenile pallid sturgeon present that could be disturbed by localized and short-term in-water work. Further, any short-term turbidity generated from these activities is likely to be well within the naturally high turbidity levels of the Yellowstone River which pallid sturgeon are adapted to.

In summary, the potential effects from short-term disturbance and turbidity are:

- Adult pallid sturgeon
    - Unlikely to be present as work would occur outside of the spawning migration period and short-term turbidity levels would be within natural conditions - No Effect.
- Juvenile pallid sturgeon
    - Unlikely to be present in vicinity of work area and short-term turbidity levels would be within natural conditions - No Effect.
- Free embryos/larvae
    - Unlikely to be present as spawning upstream may only occur in one of the years of interim O&M and work would occur before or after drifting period - No Effect.
- Eggs
    - Would not to be present as spawning upstream may only occur in one of the years of interim O&M and would likely be many miles upstream and work would occur before or after spawning period - No Effect.

Irrigation Diversions, Supplemental Pumps, and Entrainment

Irrigation diversions of up to 1,374 cfs would continue to occur from approximately April 15th to October 15th. The screens at the headworks were designed to minimize entrainment of fish, including pallid sturgeon, larger than 40 mm into the Main Canal. As spawning upstream of Intake Diversion Dam is very unlikely to occur, or may occur in the year prior to construction, there would be very few, if any, pallid sturgeon free embryos or larvae drifting past the headworks. If any were present, a small percentage of pallid sturgeon less than 40 mm, could potentially be impinged on the screen or entrained through the screen into the Main Canal.

If spawning occurs near or upstream of the Powder River, similar to spawning that occurred in 2014 (approximately 80 miles upstream from Intake), the free embryos would be approximately 9-12 mm in size when drifting through the Intake area (P. Braaten, personal communication 2015). Work done by Mefford and Sutphin (2008) showed that pallid sturgeon free embryos (13-18 mm) could pass directly through a 1.75 mm wedgewire screen, which is the current design of these screens. Thus, if free embryos encounter the screen at Intake, they could be impinged or entrained.

Information from drift studies (Kynard et al., 2002, 2007; Braaten, 2008, 2010, 2012), indicates that most pallid sturgeon free embryos drift in the lower 0.5 m (1.6 feet) of the water column, but a few will be caught in the upper portions of the water column, depending on turbulence and secondary currents (Braaten, personal communication 2015). When in use, the headworks screens are located approximately 2 feet above the river bottom and have an approach velocity of 0.4 meters per second (1.3 feet/second) and a sweeping velocity of 2-4 feet/second, which helps sweep small non-swimming fish past the screens and reduces the chance of free embryos, larvae and small fish being impinged upon the screens or entrained into the canal.

The vast majority of pallid sturgeon free embryos drift in or adjacent to the thalweg where velocities are high. Although a few free embryos will drift in regions of lower velocity (for example, along inside bends), most will be concentrated in the higher velocity regions. On river bends (similar to where the Intake screens are located), very high concentrations of drifting free embryos can be found in the region that extends from about mid-channel through the thalweg to the outside bend of the channel (Braaten et al. 2012).

Free embryo pallid sturgeon drift occurs during mid-June through mid-July each year, which is typically the peak run off months for the Yellowstone River. During June the average discharge is 38,200 cfs and in July is 22,000 cfs (Table 5). Because the LYP is diverting only 3- 6 percent of the average total river flows during this time, a small percentage of the total number of pallid sturgeon free embryos could be impinged or entrained.

Based on 2D modeling results, the area of influence from the screen extends approximately 50 feet into the Yellowstone River during river flows of 24,000 to 25,000 cfs (Figure 12; C. Svendson personal communication 2016). This is a relatively small area of influence as the Yellowstone River is approximately 700 feet wide at this location. As flows increase in the Yellowstone River during runoff conditions, this area of influence would be expected to decrease, decreasing the likelihood of entrainment. Additionally the thalweg is located approximately 100 -150 feet away from the headworks which is outside of the area of influence further reducing that chances of entrainment or impingement.

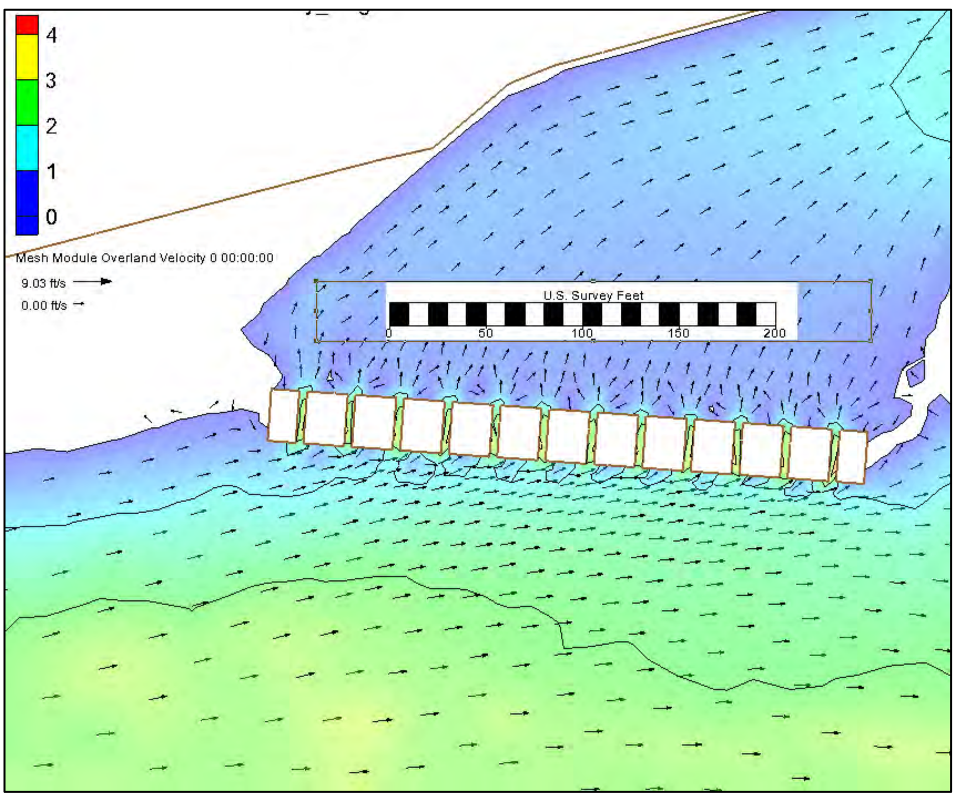

Figure 12: Area of Influence – Yellowstone River Flow of 24,000 cfs

Overall, the screens appear to have minimized the potential for entrainment of sturgeon larvae and predominantly only very small larvae (<10 mm) are being entrained; only one shovelnose sturgeon larvae has been collected to date since the screens were installed (Horn and Trimpe 2012, Reclamation unpublished data). Since mortality of pallid sturgeon from egg to age-0 juveniles is estimated at greater than 99.9 percent (Caroffino et al. 2010; Rotella 2012; Delonay et al. 2016) from many factors, a small level of entrainment at this location is not likely to have a major effect on pallid sturgeon.

Adult and juvenile pallid sturgeon have swimming capabilities much greater than the approach or sweeping velocities of the screens and are thus unlikely to be impinged and are much too large to be entrained. Further, neither adult or juvenile pallid sturgeon are likely to be present in the vicinity of the headworks during interim O&M, thus the diversions are unlikely to affect adult and juvenile pallid sturgeon.

During initial start-up of the Main Canal, sediment may need to be sluiced away from the headworks so the fish screens can be lowered into place. This would be accomplished by allowing unscreened water to flow through the open head gates. This would occur during the beginning of April, outside of pallid sturgeon migration period, so no entrainment of adults is expected to occur. As mention previously, the area around the headworks does not contain habitat that is preferred by juvenile pallid sturgeon, so this action is also not expected to have an effect on juvenile pallid sturgeon.

Diversions of 1,374 cfs from the Yellowstone River into the Lower Yellowstone Main Canal do not have a substantial impact on instream flows within the Yellowstone River. Table 5 shows the diversion percentages compared to annual flows in the Yellowstone. Further, during low flows (August and September) when diversion percentages are a greater proportion of Yellowstone River flows, the majority of pallid sturgeon are found in the Missouri River near the headwaters of Lake Sakakawea.

Table 5: Average Yellowstone River Discharge vs. Headworks Diversion Percentages
USGS Data, Sidney Montana: http://waterdata.usgs.gov

Month	Average Runoff	Headworks Diversions	% of Yellowstone River Being Diverted
May	18,400 cfs	1,374 cfs	7.5%
June	38,200 cfs	1,374 cfs	3.6%
July	22,600 cfs	1,374 cfs	6.0%
August	8,460 cfs	1,374 cfs	16.0%
September	7,000 cfs	1,374 cfs	19.7%
October	8,170 cfs	1,374 cfs	16.8%

The LYP uses five small surface water pumps to supplement diversions in the Main Canal during peak demand times. Four pumps are located on the Yellowstone River downstream of Sidney and one is located on the Missouri River. Currently, these pumps have two–inch wide trash racks and operate occasionally during May, July, and August. The trash racks largely eliminate the chances of adult and juvenile pallid sturgeon from becoming entrained. There would still be potential for free embryo and larval sturgeon in both the Missouri and Yellowstone rivers to be entrained in these pumps, but the likelihood is quite small as these pumps are only operated intermittently, divert a small portion of the Yellowstone and Missouri rivers, and do not occur on outside bends or near the thalweg where free embryos and larvae are most likely to be concentrated. Further, free embryo and larval sturgeon would only likely be present in the river in July and these surface pumps are used least frequently in this month when flow diversions at the headworks are typically high.

In summary, the potential effects from irrigation diversions, supplemental pumps and entrainment are:

- Adult pallid sturgeon
    - No entrainment would occur – No Effect.
- Juvenile pallid sturgeon
    - No entrainment would occur – No Effect.
- Free embryos/larvae
    - Only present if passage occurs in the one year prior to construction, could potentially be impinged or entrained – Adverse Effect
- Eggs
    - Not present as passage upstream may only occur one year prior to construction, also spawning would take place many miles upstream - No effect.

Construction of Proposed Replacement Weir and Bypass Channel

Upstream and Downstream Fish Passage

The proposed concrete weir would be constructed approximately 40 feet upstream from the existing Intake Diversion Dam and would have a top elevation of 1991.0 feet, which is the same elevation as the current structure after rock has been placed during the late summer/fall of each year. The replacement weir would eliminate the need for the annual placement of rock on the existing structure. The new weir structure would allow the LYP to divert their full 1,374 cfs water right into the Main Canal down to a flow of 3,000 cfs in the Yellowstone River. The replacement weir would include a low flow notch located approximately 100 feet out from the left bank that would allow for more effective downstream passage of adult, juvenile, and larval pallid sturgeon and native species, as well as potentially improving upstream passage for stronger swimming native species due to the deeper depths, less turbulent flows, and lower velocities. The low-flow notch would also be aligned closely with the existing river thalweg, where pallid sturgeon would generally be located. The low-flow notch would have a top width of 125 feet and a bottom width of 85 feet. The bottom elevation would be set at 1989.0 feet which would be two feet lower than the top elevation of the replacement weir and the same elevation as the existing timber structure (without rock on top). The riprap placed downstream of the replacement weir would be graded appropriately to continue the low-flow notch through the existing Intake Diversion Dam.

As mentioned above, the existing Intake Diversion Dam would be maintained by the annual placement of rock. This activity is only expected to occur until the replacement weir is complete. The effects of this action have been analyzed and accounted for above (Interim Operations, Fish Passage).

During construction of the bypass channel, the existing side channel would be blocked off with coffer dams and would not be accessible to adult or juvenile pallid sturgeon for upstream or downstream passage for up to 24 months. The existing side channel is not accessible every year, currently the side channel becomes active when Yellowstone River discharge reaches 20,000 – 25,000 cfs, which occurs 5 years out of 10 and approximately 7 days a year. Although the channel becomes active at 20,000 to 25,000 cfs, flows in the Yellowstone River likely need to be greater than 40,000 cfs to have sufficient depths and attraction flows for pallid sturgeon to use it successfully (Passage in 2014 and 2015 occurred at river flows greater than 46,000 cfs [Rugg 2014, 2015]).

As these conditions do not occur every year, the blockage of the side channel would likely only prevent fish passage around Intake Diversion Dam in one year during construction. Of the telemetered wild adult pallid sturgeon that migrate to Intake Diversion Dam, (estimated 12 to 26 percent of total wild adults, up to 32 fish; Braaten et al. 2014), 14 to 50 percent passed through the existing side channel in 2014 or 2015. This could translate to 5 to 16 fish being blocked from migrating upstream through the existing side channel during construction in the estimated one year when passage could be possible. This would be considered a short-term adverse effect during the two years of construction.

The new bypass channel would be approximately 11,150 feet (2.1 miles) in length with a slope that varies between 0.02 to 0.07%, and a bottom width of 40 feet and side slopes varying from 1H:8V to 1H:4V. The bypass channel is designed to meet the Service's BRT criteria (Table 6), which includes a 13% to 15% flow split from the Yellowstone River into the bypass channel. Although design criteria ranges from 7,000 to 63,000 cfs, the bypass channel would carry water at all flows with splits ranging from <10% at extreme low flows and >15% at extreme high flow events. Splitting the flow between the main channel and a side channel is a natural condition that occurs throughout the lower Yellowstone River. Flow splits between the main Yellowstone River channel and the bypass channel are shown for a range of conditions in Table 7.

Table 6: Summary of BRT Design Criteria versus Modeled Results for the Bypass Channel

Design Criteria and Modeled Alternative Results	Discharge at Sidney, Montana USGS Gage	
	7,000-14,999 cfs	**15,000-63,000 cfs**
Flow Split Design Criteria	≥12% (840 to1800 cfs)	13% to ≥ 15% (1,950 cfs to 9,450 cfs)
Bypass Channel Results	940 – 1,950 cfs	1,950 to 8,610 cfs
Cross-sectional Velocities (mean column velocity) Design Criteria	2.0 - 6.0 ft/sec	2.4 - 6.0 ft/sec
Bypass Channel Results	2.8 – 3.5 ft/sec	3.5 – 5.2 ft/sec
Depth (minimum cross-sectional depth for 30 contiguous feet at measured cross-sections) Design Criteria	≥ 4.0 ft	≥ 6.0 ft
Bypass Channel Results	4.5 – 6.3 ft	6.3-12.6 ft
Fish Entrance Velocity (measured as mean column velocity) Design Criteria	2.0 - 6.0 ft/sec	2.4-6.0 ft/sec
Bypass Channel Results	3.1 – 3.8 ft/sec	3.8 – 5.8 ft/sec
Bypass Channel Fish Exit Velocity (measured as mean column velocity) Design Criteria	≤ 6.0 ft/sec	≤ 6.0 ft/sec
Bypass Channel Results	3.3 – 3.5 ft/sec	3.5 – 5.0 ft/sec

Table 7: Proposed Flow Conditions in the Bypass Channel

Discharge at Sidney, Montana USGS Gage (return period) cfs	Split Flows			
	Flow into the bypass channel (cfs)	**Flow remaining in the Yellowstone River (cfs)**	**Percent of flow in the bypass channel versus Yellowstone River (percent)**	**BRT criteria (percent)**
7,000	1,100	5,900	16	≥12
15,000	2,200	12,800	15	13 to ≥ 15
30,000	4,100	25,900	14	13 to ≥ 15
54,200 (2-yr)	7,500	46,700	14	13 to ≥ 15
63,000	8,700	54,300	14	13 to ≥ 15
74,400 (5 yr)*	10,700	53,700	14	N/A
87,600 (10 yr)*	12,900	74,700	15	N/A
128,300 (100 yr)*	20,000	108,300	16	N/A

*No criteria established for these flows.

As mentioned above, the existing side channel would be permanently blocked to ensure the bypass channel entrance is stable during high river flows and allows the bypass channel to meet the BRT's criteria for volume of flow during all years. Although filling the existing side channel would eliminate about 1.5 miles of the channel and change the lower end to a backwater condition, the lower half of the side channel would still be backwatered and provide habitat for prey species and other native aquatic and terrestrial organisms. Modeling indicates that almost the entire side channel up to the channel plug would be subject to backwater effects during spring runoff and other higher flows.

Although blocking the existing side channel would be a long-term adverse effect, it would be considered offset by the construction of the proposed bypass channel. Data on the 2014/2015 passage events indicate that the proposed bypass channel should provide a much better passage opportunity with greater flows, depths, and velocities. Under existing conditions approximately 2-6 percent of the flow goes down the existing side channel as compared to the proposed bypass channel that would convey 13-15 percent of the flow. The proposed bypass channel would convey water in all years and at all flow levels in the Yellowstone River. This would allow for increased attraction flows at the bypass entrance likely improving the fish passage potential, not only for pallid sturgeon, but for other native species as well.

Further, the downstream end of the existing side channel (entrance for upstream migrating fish) is approximately 2 miles downstream from Intake Diversion Dam. Adult pallid sturgeon have been tracked in several years to migrate past the existing side channel to Intake Diversion Dam, but the majority move back downstream and either do not find the existing side channel or do not choose to use it to migrate upstream around the weir (Rugg 2014, 2015; Delonay et al. 2015; Fuller et al. 2008). By locating the downstream end (fish entrance) of the bypass channel immediately downstream of the existing weir and rock field, the channel entrance would be in close proximity to where the migrating adult pallid sturgeon aggregate when blocked by the weir and begin searching for a route upstream. Thus, the majority of sturgeon motivated to migrate upstream are likely to find the entrance. The downstream entrance would also be in much closer proximity to the thalweg of the river, where most adult pallid sturgeon migrate (Braaten et al. 2014, 2015), thus also likely being much easier for sturgeon to find.

To meet the Service's BRT criteria within the bypass channel, velocities would be approximately 2-6 feet/second over the range of flows assessed, with depths greater than 4 feet for all flows above 7,000 cfs. Further, elements in the design to ensure attraction flows at the downstream end of the bypass channel include the placement of fill at the left bank corner (facing downstream) and grading at the right bank corner. The right bank grading would help maintain velocities through and out of the bypass channel and into the river, reducing the eddy that currently forms along the right bank, which would minimize sediment deposition at the entrance as well. Physical and computer modeling have both indicated that the right bank grading eliminates the formation of eddy and provides a smoother transition of flow back into the Yellowstone River.

In summary, the potential effects on upstream and downstream fish passage during construction are:

- Adult pallid sturgeon
  - Blockage of 32 adult pallid sturgeon. Of those 32, 5 to 16 adults are the fish that might use the existing side channel for upstream passage and the remaining would be blocked by the annual rocking activities on the existing weir - Adverse Effect.
- Juvenile pallid sturgeon
  - Blockage of few juveniles that might use the existing side channel for upstream passage in the one year during construction when flows are sufficiently high and from the rocking activities on the existing weir - Adverse Effect.
- Free embryos/larvae
  - Would not be present due to no passage or successful upstream spawning - No Effect.
- Eggs
  - Would not be present due to no passage or successful upstream spawning - No Effect.

In-Water Elevated Noise Levels

For construction of the proposed replacement weir and bypass channel, sheet pile coffer dams would be installed to isolate the work areas from the Yellowstone River. For the construction of the replacement weir, the coffer dams would block off approximately one-third of the river at a time. For the bypass channel, the coffer dams would be located in the upstream and downstream entrances allowing excavation to be conducted in the dry. At this time it is unknown if vibratory equipment could be used, so this analysis is assuming that impact driving equipment would be deployed instead.

Pile driving generates in-water noise levels that are higher than any natural sounds in a river (i.e. waterfalls, rapids, ice breakup). Noise attenuates through water and dissipates when it encounters land. Thus, in a meandering river, the distance that noise would propagate is limited to the first bend upstream and downstream of the pile driving area. Impact pile driving generates sound levels up to 205 dB (peak) that could cause behavioral impacts to fish for over ½ mile from the work zone (CalTrans 2007). It is anticipated that any fish within ½ mile to the in-water work zone would immediately move away from the area once construction equipment was mobilized to the site and activities such as moving rocks began to occur. To further reduce impacts to pallid sturgeon, the installation and removal of coffer dams, and the construction of the weir would occur outside of the time period of migration for pallid sturgeon (April 15 to July 1) to avoid potential effects to adult pallid sturgeon. Coffer dam installation and removal would likely occur 2-3 times during construction of the replacement weir and could take several weeks to install.

Juvenile pallid sturgeon occur in the Yellowstone River both upstream and downstream of Intake Diversion Dam, so there is a potential for juveniles to be present in proximity to the weir construction. However, the habitat within ½ mile to 1 mile of the construction site is not likely to be preferred by juveniles (not bluff or terrace pools), so few, if any, are likely to be present. Eggs and free embryos/larvae would not be present upstream of Intake Diversion Dam as passage would be completely precluded once construction begins and there is no known spawning likely to occur within 1 mile downstream of the weir.

In summary, the potential effects from elevated noise levels are:

- Adult pallid sturgeon
    - Unlikely to be present as work would occur outside of the spawning migration period - No Effect.
- Juvenile pallid sturgeon
    - Unlikely to be present in vicinity of work area, but if present, would be disturbed and move away from the work area – Discountable Effect.
- Free embryos/larvae
    - Would not be present due to no passage or successful upstream spawning - No Effect.
- Eggs
    - Would not be present due to no passage or successful upstream spawning - No Effect.

Short-Term Disturbance and Turbidity

Several of the construction activities would result in short-term disturbance and turbidity in the Yellowstone River, including installing/removing coffer dams, dewatering work areas, placing rock and cobble in the river, moving rock around in the river, and allowing flow through the bypass channel for the first time. These activities would all occur outside of the pallid sturgeon migratory and spawning season (i.e. either before April 15 or after July 1), thus adult pallid sturgeon are unlikely to be present and would be unlikely to experience disturbance or turbidity. As spawning upstream of Intake Diversion would be completely precluded during the construction and there is no known spawning occurring within one mile downstream of the weir, there would be no eggs or free embryos/larvae present in the action area during construction.

Juveniles may be present as they have been documented in the Yellowstone River both upstream and downstream of Intake Diversion Dam, but not in immediate proximity to the weir (Jaeger et al. 2006, 2008; Rugg 2014, 2015). As the immediate work areas at the weir are likely to be unsuitable habitat due to high velocities and turbulence, there are not likely to be any juvenile pallid sturgeon present that could be disturbed by localized and short-term in-water work. Further, any short-term turbidity generated from these activities is likely to be well within the naturally high turbidity levels of the Yellowstone River which pallid sturgeon are adapted to.

In summary, the potential effects of short-term disturbance and turbidity are:

- Adult pallid sturgeon
    - Unlikely to be present as work would occur outside of the spawning migration period and short-term turbidity levels would be within natural conditions - No Effect.
- Juvenile pallid sturgeon
    - Unlikely to be present in vicinity of work area and short-term turbidity levels would be within natural conditions - No Effect.

- Free embryos/larvae
    - Would not be present due to no passage or successful upstream spawning - No Effect.
- Eggs
    - Would not be present due to no passage or successful upstream spawning - No Effect.

Temporary Increased Velocities and Depths in Yellowstone River

While each of the coffer dams are in place for the construction of the replacement weir, all of the Yellowstone River flow would be diverted from one side of the channel to the other, causing a slight increase in water depths and velocities across the range of flows. For example, during a flow of 15,000 cfs, the existing depth and velocity over Intake Diversion Dam is 2.6 feet and approximately 8 feet/second, respectively; if the width was reduced by up to 350 feet (1/2), depths could potentially be 4 feet and the velocity could be approximately 10 feet/second (similar to depths and velocities at a flow of 30,000 cfs under existing conditions). This condition would exist during the two years of constructing the replacement weir. There would likely be some erosion and scour of the channel substrate and/or banks, primarily along the right bank on Joe's Island as a result of confining the flows. These increases in depths and velocities during construction would not further reduce either adult or juvenile pallid sturgeon upstream passage as there is currently no known passage occurring over the existing structure. As no fish are anticipated to move upstream past the weir, there would be no adult pallid sturgeon moving downstream and the increases in depths and velocities should not affect downstream juvenile passage, if any occurs.

The coffer dams could also cause additional head for the Main Canal. It is likely that velocities at the headworks and screens could decrease when the coffer dam is on the north side of the river, but could increase when the coffer dam is on the south side of the river. The potential for increased velocities at the headworks and screens would not affect the potential for entrainment of pallid sturgeon free embryos/larvae as there would not be any present upstream of Intake Diversion Dam during construction.

In summary, the potential effects from temporary increases in depths and velocities are:

- Adult pallid sturgeon
    - Continues existing barrier to adult passage upstream over the existing weir - No Effect.
- Juvenile pallid sturgeon
    - Continues existing barrier to juvenile passage upstream over the existing weir and would not hinder downstream passage - No Effect.
- Free embryos/larvae
    - Would not be present due to no passage or successful upstream spawning – No Effect.
- Eggs
    - Would not be present due to no passage or successful upstream spawning - No Effect.

Future Operation and Maintenance

Upstream and Downstream Passage

The future O&M of the LYP would include maintaining the replacement weir and new bypass channel. The bypass channel would be maintain to the Service's BRT criteria, to ensure effective fish passage through the Project Area. The bypass channel is expected to improved fish passage at Intake Diversion Dam, which would open up approximately 165 miles of upstream habitat for spawning, rearing and drifting. This would be considered a major beneficial effect to pallid sturgeon as only a few adults (estimated 14 to 50 percent) have use the existing side channel, when it have been available, to continue their upstream migration. The increased potential drift distance could allow some free embryos/larvae to settle out in the lower Yellowstone River or free-flowing portion of the Missouri River upstream of Lake Sakakawea, thus benefitting survival and potentially leading to natural recruitment.

For those pallid sturgeon that fail to find or use the proposed bypass channel, the new concrete weir, existing diversion structure, and rock field would continue to be an upstream barrier in the main stem of the Yellowstone River. However, velocity and depth conditions with the proposed replacement weir and low-flow notch would be an improvement compared to existing conditions (Table 8). Also, the smooth surface of the replacement weir would not cause turbulent flows, although the continued presence of the rock field downstream of the weir would still create turbulent conditions. It is still unlikely that adult or juvenile pallid sturgeon would pass upstream over the existing weir, rock field and replacement weir, but other native fish species may have improved passage.

Table 8: Comparison of Depths and Velocities over Existing vs. Proposed Weir.

Structure	Depths and Velocities at 15,000 cfs	Depths and velocities at 30,000 cfs
Existing Intake Diversion Dam	2.1-2.9 feet, 8 ft/sec	4 feet, 10 ft/sec
Replacement Weir Notch	3.5 feet, 5 ft/se	5.4 feet, 6.8 ft/sec

The bypass channel and replacement weir would allow two suitable pathways for downstream drifting/passage of all pallid sturgeon life stages. For adults and juveniles, downstream passage over the replacement weir, existing weir, and rubble field would be improved by the placement of fill upstream and downstream of the new weir and the presence of the low flow notch. The fill upstream and downstream of the new weir would provide a smooth transition over the new structure and the weir notch would provide an area of greater depths to facilitate passage during low flows (Table 8). Some adults could also utilize the bypass channel for downstream passage.

The majority of free embryos/larvae would be expected to pass through the low-flow notch, over the existing weir, then downstream through the rock field. As describes above the placement of fill and the presence of the low flow notch would facilitate the drift of free embryos and larvae through the area.

It is anticipated that there would be limited potential for injury or mortality of free embryos/larvae passing downstream. The new weir, existing weir and rubble field would be similar to bluff pools and rapids that drifting embryos encounter naturally on the Yellowstone River. A preliminary laboratory evaluation of the potential effects of riprap on white sturgeon larvae indicated no differences in injury or mortality to fish drifting past riprap versus a control group (Kynard et al. 2014). Intuitively, considering that free embryos and larvae are neutrally buoyant and are present in the lower part of the water column where velocities are lower, it is less likely they would adversely affected when drifting through the Project Area.

Improving fish passage at Intake Diversion Dam would accomplish several benefits for pallid sturgeon:

- It would provide spawning adults access to approximately 165 miles of Yellowstone River habitat upstream of the Intake Diversion Dam and additional habitat on tributaries such as the Powder River that are currently inaccessible to the pallid sturgeon;
- If 165 more river miles were accessible for spawning, it would provide longer drift distances and a larger area available for larvae to stop dispersal and seek rearing habitat before reaching Lake Sakakawea (i.e. there would be approximately 250 miles (400 km) of drift distance available if fish spawned near Cartersville Dam). This is longer than the drift distance available between Fort Peck Dam and Lake Sakakawea (a little over 200 miles [340 km]).
- The bypass channel would allow improved upstream and downstream passage of juveniles.

There are uncertainties associated with how many and how often pallid sturgeon would use the bypass channel. To address these uncertainties Reclamation and the Corps would implement a Monitoring and Adaptive Management Plan (AMP, Appendix A). This AMP takes into account the physical and biological criteria that were provided by the Service's Biological Review Team (Service 2013, 2016) and potential adaptive management measures that could be implemented if a problem was identified. The AMP and uncertainties are discussed in later sections.

In summary, the potential effects on upstream and downstream fish passage are:

- Adult pallid sturgeon
  - Unimpeded access to upstream and downstream habitats – Major Beneficial Effect
- Juvenile pallid sturgeon
  - Unimpeded access to upstream and downstream habitats – Major Beneficial Effect
- Free embryos/larvae
  - Improved depths and velocities for downstream drift – Beneficial Effect
- Eggs
  - Not likely to be present, spawning would occur upstream - No effect.

Short-Term Disturbance and Turbidity

Several of the future O&M activities would result in short-term disturbance and turbidity in the Yellowstone River, including lowering and raising screens, screen cleaning/maintenance, gate maintenance, inspections, installing/removing supplemental pumps, replacement of rock in various locations in the bypass channel, removal of sediment or debris from the bypass channel and infrequent replacement of rock at the replacement weir. The majority of these activities would occur outside of the pallid sturgeon migratory and spawning season (i.e. either before April 15 or after July 1), thus adult pallid sturgeon are unlikely to be present and would be unlikely to experience disturbance.

Even though there should be substantially improved adult passage and spawning upstream, it would be highly unlikely that eggs would be present during future O&M as it would occur after eggs have hatched and any drifting eggs would already be dead. Free embryos/larvae could be present, but the future O&M activities would occur before or after drifting occurs, thus, effects to free embryos/larvae are not expected or discountable.

Juveniles may be present as they have been documented in the Yellowstone River both upstream and downstream of Intake Diversion Dam, but not in immediate proximity to the weir (Jaeger et al. 2006, 2008; Rugg 2014, 2015). As the immediate work areas at the headworks and on the replacement weir are likely to be unsuitable habitat due to higher velocities and do not include bluff or terrace pools, there are not likely to be any juvenile pallid sturgeon present that could be disturbed by localized and short-term in-water work at the headworks or weir.

A temporary blockage of the bypass channel may be required for major maintenance activities such as sediment removal, channel realignment or riprap replacement. These activities would all occur during low summer flows and outside of the pallid sturgeon migration and spawning period and last only a couple of weeks. Juveniles could be present in the bypass channel, but as work would occur at low flows, it is likely that any juveniles would have moved upstream or downstream prior to the work. Any short-term blockage of the bypass channel would not affect adults, but may have a short-term discountable effects on juveniles.

Further, any short-term turbidity generated from these activities is likely to be well within the naturally high turbidity levels of the Yellowstone River which pallid sturgeon are adapted to.

In summary, the potential effects from short-term disturbance and turbidity associated with future O&M are:

- Adult pallid sturgeon
  - Unlikely to be present as work would occur outside of the spawning migration period and short-term turbidity levels would be within natural conditions – No Effect
- Juvenile pallid sturgeon
  - May be present in vicinity of work area and short-term turbidity levels would be within natural conditions – No Effect

- Free embryos/larvae
    - Would not be present as work would occur after drifting period – No Effect
- Eggs
    - Would not be present as work would occur after spawning/hatching period – No Effect

Irrigation Diversions, Supplemental Pumps and Entrainment

Irrigation diversions of up to 1,374 cfs would continue to occur from approximately April 15th to October 15th. The screens at the headworks were designed to minimize entrainment of fish, including pallid sturgeon, larger than 40 mm into the Main Canal. A small percentage of pallid sturgeon less than 40 mm, could potentially be impinged on the screen or entrained through the screen into the Main Canal. If spawning occurs near or upstream of the Powder River, similar to spawning that occurred in 2014 (approximately 80 miles upstream from Intake), the free embryos would be approximately 9-12 mm in size when drifting through the Intake area (P. Braaten, personal communication 2015). Work done by Mefford and Sutphin (2008) showed that pallid sturgeon free embryos (13-18 mm) could pass directly through a 1.75 mm wedgewire screen, which is the current design of these screens. Thus, if free embryos encounter the screen at Intake, they can be impinged or entrained.

Information from drift studies (Kynard et al., 2002, 2007; Braaten, 2008, 2010, 2012), indicates that most pallid sturgeon free embryos drift in the lower 0.5 m (1.6 feet) of the water column, but a few will be caught in the upper portions of the water column, depending on turbulence and secondary currents (Braaten, personal communication 2015). When in use, the headworks screens are located approximately 2 feet above the river bottom and have an approach velocity of 0.4 meters per second (1.3 feet/second) and a sweeping velocity of 2-4 feet/second, which helps sweep small non-swimming fish past the screens and reduces the chance of larvae and small fish being impinged upon the screens or entrained into the canal.

The vast majority of pallid sturgeon free embryos drift in or adjacent to the thalweg where velocities are high. Although a few free embryos will drift in regions of lower velocity (for example, along inside bends), most will be concentrated in the higher velocity regions. On river bends (similar to where the Intake screens are located), very high concentrations of drifting free embryos can be found in the region that extends from about mid-channel through the thalweg to the outside bend of the channel (Braaten et al. 2012).

Free embryo pallid sturgeon drift occurs during mid-June through mid-July each year, which is typically the peak run off months for the Yellowstone River. During June the average discharge is 38,200 cfs and in July is 22,000 cfs (Table 9). Because the LYP is diverting only 3- 6 percent of the average total river flows during this time, a small number of pallid sturgeon free embryos could be impinged or entrained.

Based on 2D modeling results, the area of influence from the screen extends approximately 50 feet into the Yellowstone River during river flows of 24,000 to 25,000 cfs (Figure 12; C. Svendson Personal Communication 2016). This is a relatively small area of influence as the Yellowstone River is approximately 700 feet wide at this location. As flows increase in the

Yellowstone River during runoff conditions, this area of influence would be expected to decrease, decreasing the likelihood of entrainment. Additionally the thalweg is located approximately 100 -150 feet away from the headworks which is outside of the area of influence further reducing that chances of entrainment or impingement.

It is impossible to estimate the number of pallid sturgeon free embryos that could be entrained but some factors are reasonable to predict: the number of free embryos that could be impinged or entrained would increase with the number of females spawning upstream of Intake (and the number of fertilized eggs hatching). Thus, in the first years after the completion of the bypass channel, only a few free embryos could be impinged or entrained. This number could increase with time and if carefully monitored and correlated with river flow, the data may provide an annual index of spawning to early rearing success.

Overall, because free embryo or larval pallid sturgeon would likely be present drifting in the river from mid-June to mid-July, when typically less than 5% of the river flow is being diverted into the headworks, it can be anticipated that a very small number of drifting free embryos or larvae could be entrained. However, these fish have evolved to produce very large numbers of eggs to compensate for the low survival of eggs/free embryos (i.e. R-selection), so the potential entrainment of pallid sturgeon larvae would be a minor adverse effect.

Adult and juvenile pallid sturgeon have swimming capabilities much greater than the approach or sweeping velocities of the screens and are thus unlikely to be impinged and are much too large to be entrained. Thus, the diversions into the Main Canal are unlikely to affect adult and juvenile pallid sturgeon.

If the LYP is not able to divert their entire water right due to debris in or near the headworks, plugged screens, or gate failure, they may lift screens one at a time until they are able divert their full water right down to river flows of 3,000 cfs measured at the Sidney gage. Under such circumstances, adult and juvenile pallid sturgeon are subject to entrainment into the Main Canal, resulting in an increased risk of potential injury or mortality. This action would only be undertaken in an emergency situation and would require coordination with the Service. Also, before any screens are lifted, the Service and MFWP would be contacted and methods to minimize effects to sturgeon would be identified.

Also, it is very likely that the LYP would need to divert unscreened water into the Main Canal during the start of the irrigation season to sluice sediment away from the gates and screens. This action would occur during early April, which is outside of pallid sturgeon migration and spawning, so no effects to adult pallid sturgeon are expected.

Table 9: Average Yellowstone River Discharge vs. Headworks Diversion Percentages
USGS Data, Sidney Montana: http://waterdata.usgs.gov

Month	Average Runoff	Headworks Diversion	% of Yellowstone River Being Diverted
May	18,400 cfs	1,374 cfs	7.5%
June*	38,200 cfs	1,374 cfs	3.6%
July*	22,600 cfs	1,374 cfs	6.0%
August	8,460 cfs	1,374 cfs	16.0%
September	7,000 cfs	1,374 cfs	19.7%
October	8,170 cfs	1,374 cfs	16.8%

* Expected months for free embryo and larvae downstream drifting

The LYP uses five small surface water pumps to supplement diversions in the Main Canal during peak demand times. Four pumps are located on the Yellowstone River downstream of Sidney and one is located on the Missouri River. Currently, these pumps have two–inch wide trash racks and operate occasionally during May, July, and August. The trash racks largely eliminate the chances of adult and juvenile pallid sturgeon from becoming entrained. There would still be potential for free embryo and larval sturgeon in both the Missouri and Yellowstone rivers to be entrained in these pumps, but the likelihood is quite small as these pumps are only operated intermittently, divert a small portion of the Yellowstone and Missouri rivers (Tables 10 and 11), and do not occur on outside bends where free embryos and larvae are most likely to be concentrated. Further, free embryo and larval sturgeon would only likely be present in the river in July and these surface pumps are used least frequently in this month when flow diversions at the headworks are typically high.

Table 10. Average Yellowstone River Discharge vs. Supplemental Pumps
USGS Data, Sidney Montana: http://waterdata.usgs.gov

Month	Average Runoff	Pump PP (6 cfs)	Pump G (12 cfs)	Pump K (6 cfs)	Pump P (18 cfs)
May*	18,400 cfs	0.03%	0.07%	0.03%	0.10%
July*	22,600 cfs	0.03%	0.05%	0.03%	0.08%
August*	8,460 cfs	0.07%	0.14%	0.07%	0.21%

Table 11. Average Missouri River Discharge vs. Supplemental Pump W
USGS Data, Culbertson Montana: http://waterdata.usgs.gov

Month	Average Runoff	Pump W (25 cfs)
May*	10,100 cfs	0.25%
July*	11,000 cfs	0.23%
August*	9,940 cfs	0.25%

In summary, the potential effects of diversions and potential entrainment from future O&M are:

- Adult pallid sturgeon
  - Under normal operations no entrainment would occur – No Effect.
  - Diversion of unscreened water during drought or low water – Potential Adverse Effect
- Juvenile pallid sturgeon
  - Under normal operations no entrainment would occur – No Effect.
  - Diversion of unscreened water during drought or low water – Potential Adverse Effect
- Free embryos/larvae
  - A small number drifting past the headworks could potentially be impinged or entrained – Adverse Effect
- Eggs
  - Not present as spawning would likely be many miles upstream and any drifting eggs would already be dead - No effect.

Monitoring and Adaptive Management

Fish Capture and Handling

Reclamation and the Corps would monitor the long-term success of the bypass channel to make sure it is meeting the Service's BRT physical and biological criteria. This would include the implementation of a long-term monitoring and adaptive management plan (AMP, Appendix A) that would require capturing, collecting, and tagging adult, juveniles, and free embryo pallid sturgeon. This would result in mortality and injury to individuals. However, similar research and monitoring has been on-going for many years in order to understand more clearly the physical and biological requirements of pallid sturgeon and these effects would be considered minor. Further, all monitoring would occur in compliance with scientific collection permits and reporting of injuries and mortality would occur continuously.

In summary, the potential effects from monitoring are:

- Adult pallid sturgeon
  - Capture, tagging, release, and stress – Minor Adverse Effect
- Juvenile pallid sturgeon
  - Capture, tagging, release, and stress – Minor Adverse Effect

- Free embryos/larvae
    - Capture – Minor Adverse Effect
- Eggs
    - Not sampled or collected - No Effect.

Table 12. Summary of Potential Effects to Pallid Sturgeon

Element of the Proposed Action	Mechanism of Effect	Summary of Effects
Interim Operation and Maintenance	**Fish Passage**	**Adult pallid sturgeon** - 12 to 26 percent (25 to 32 individuals) would be blocked from accessing upstream habitats for up to 3 years – Adverse Effect **Juvenile pallid sturgeon** - Small, but unknown, number would be blocked from accessing upstream habitats for up to 3 years – Adverse Effect **Free embryos/larvae** - Unlikely to be present as spawning upstream may only occur in one of the years of interim O&M, existing weir not a known barrier or hazard - No Effect. **Eggs** - Would not be present as spawning upstream may only occur in one of the years of interim O&M and would likely be many miles upstream - No Effect.
	Short-term Disturbance and Turbidity	**Adult pallid sturgeon** - Unlikely to be present as work would occur outside of the spawning migration period and short-term turbidity levels would be within natural conditions - No Effect. **Juvenile pallid sturgeon** - Unlikely to be present in vicinity of work area and short-term turbidity levels would be within natural conditions - No Effect. **Free embryos/larvae** - Unlikely to be present as spawning upstream may only occur in one of the years of interim O&M and work would occur before or after drifting period - No Effect. **Eggs** - Would not to be present as spawning upstream may only occur in one of the years of interim O&M and would likely be many miles upstream and work would occur before or after spawning period - No Effect.

Element of the Proposed Action	Mechanism of Effect	Summary of Effects
	Irrigation Diversions, Supplemental Pumps, and Entrainment	**Adult pallid sturgeon** - No entrainment would occur – No Effect. **Juvenile pallid sturgeon** - No entrainment would occur – No Effect. **Free embryos/larvae** - Only present if passage occurs for the one year prior to construction, a small number drifting past the headworks could potentially be impinged or entrained – Adverse Effect **Eggs** - Not present as passage upstream may only occur one year prior to construction, also spawning would take place many miles upstream - No effect.
Construction of Replacement Weir and Bypass Channel	**Upstream and Downstream Fish Passage**	**Adult pallid sturgeon** - Blockage of 32 adult pallid sturgeon. Of those 32, 5 to 16 adults are the fish that might use the existing side channel for upstream passage and the remaining would be blocked by the annual rocking activities on the existing weir - Adverse Effect. **Juvenile pallid sturgeon** - Blockage of few juveniles that might use the existing side channel for upstream passage in the one year during construction when flows are sufficiently high and from the rocking activities on the existing weir - Adverse Effect. **Free embryos/larvae** - Would not be present due to no passage or successful upstream spawning - No Effect. **Eggs** - Would not be present due to no passage or successful upstream spawning - No Effect.

Element of the Proposed Action	Mechanism of Effect	Summary of Effects
	In-Water Elevated Noise Levels	**Adult pallid sturgeon** - Unlikely to be present as work would occur outside of the spawning migration period - No Effect. **Juvenile pallid sturgeon** - Unlikely to be present in vicinity of work area, but if present, would be disturbed and move away from the work area – Discountable Effect. **Free embryos/larvae** - Would not be present due to no passage or successful upstream spawning - No Effect. **Eggs** - Would not be present due to no passage or successful upstream spawning - No Effect.
	Short-term Disturbance and Turbidity	**Adult pallid sturgeon** - Unlikely to be present as work would occur outside of the spawning migration period and short-term turbidity levels would be within natural conditions - No Effect. **Juvenile pallid sturgeon** - Unlikely to be present in vicinity of work area and short-term turbidity levels would be within natural conditions - No Effect. **Free embryos/larvae** - Would not be present due to no passage or successful upstream spawning - No Effect. **Eggs** - Would not be present due to no passage or successful upstream spawning - No Effect.

Element of the Proposed Action	Mechanism of Effect	Summary of Effects
	Temporary Increased Velocities and Depths in Yellowstone River	**Adult pallid sturgeon** - Continues existing barrier to adult passage upstream - No Effect. **Juvenile pallid sturgeon** - Continues existing barrier to juvenile passage upstream over the existing weir and would not hinder downstream passage - No Effect. **Free embryos/larvae** - Would not be present due to no passage or successful upstream spawning – No Effect. **Eggs** - Would not be present due to no passage or successful upstream spawning - No Effect.
Future Operation and Maintenance	**Upstream and Downstream Passage**	**Adult pallid sturgeon** - Unimpeded access to upstream and downstream habitats – Major Beneficial Effect **Juvenile pallid sturgeon** - Unimpeded access to upstream and downstream habitats – Major Beneficial Effect **Free embryos/larvae** - Improved depths and velocities for downstream drift – Beneficial Effect **Eggs** - Not likely to be present, spawning would occur upstream - No effect.
	Short-term Disturbance and Turbidity	**Adult pallid sturgeon** - Unlikely to be present as work would occur outside of the spawning migration period, turbidity levels would be within natural conditions – No Effect **Juvenile pallid sturgeon** - May be present in vicinity of work area turbidity levels would be within natural conditions – No Effect **Free embryos/larvae** - Would not be present as work would occur after drifting period – No Effect **Eggs** - Would not be present as work would occur after spawning/hatching period – No Effect

Element of the Proposed Action	Mechanism of Effect	Summary of Effects
	Irrigation Diversions, Supplemental Pumps, and Entrainment	**Adult pallid sturgeon** - Under normal operations no entrainment would occur – No Effect. - Diversion of unscreened water during drought or low water – Potential Adverse Effect **Juvenile pallid sturgeon** - Under normal operations no entrainment would occur – No Effect. - Diversion of unscreened water during drought or low water – Potential Adverse Effect **Free embryos/larvae** - A small number drifting past the headworks could potentially be impinged or entrained – Adverse Effect **Eggs** - Not present as spawning would likely be many miles upstream and any drifting eggs would already be dead - No effect.
Monitoring and Adaptive Management	**Fish Capture and Handling**	**Adult pallid sturgeon** - Capture, tagging, release, and stress – Minor Adverse Effect **Juvenile pallid sturgeon** - Capture, tagging, release, and stress – Minor Adverse Effect **Free embryos/larvae** - Capture – Minor Adverse Effect **Eggs** - Not sampled or collected - No Effect.

Uncertainties

There are still many uncertainties over whether a majority of pallid sturgeon would actually pass through the bypass channel as there are no other examples of similar low-gradient natural-type channels designed for non-jumping benthic fish. However, because it would mimic many of the characteristics of the existing side channel and other natural side channels in the Yellowstone River, albeit with much more attraction flow, it is reasonable to assume that a majority of fish that migrate up to Intake Diversion Dam would find and use the channel.

The project team researched available literature and data for proposed or constructed fishways in other locations.

The Potential for Successful Passage in a Bypass Channel by Pallid Sturgeon

Research on adult pallid sturgeon in controlled flume conditions, which provides critical information on fish behavior and swimming ability under real scale velocity and structural configurations (Kynard 1993) is lacking. Thus, designing a fish passage facility to pass pallid sturgeon upstream of Intake Diversion Dam must rely on all available relevant information on both shovelnose and pallid sturgeon, even though there are obvious differences between the two species for passage ability (for example: shovelnose sturgeon ascend over Intake Diversion Dam in small numbers (Rugg 2016), but there is no evidence that any pallid sturgeon ascend over Intake Diversion Dam). Because, to date, no successful upstream fish passage facility of any type has been built for shovelnose or pallid sturgeon, the use of available information on behavior or swimming ability on these species during migration or in a fishway environment is the best available science that can be used to evaluate the probability of success for a fishway design.

Swimming Ability and Passage of Pallid Sturgeon

Information on swimming ability relative to fish passage comes from research on behavior and swimming ability of juveniles during fish passage in an artificial flume (Kynard et al. 2002, 2008) and from tracking wild adults in side channels of the Yellowstone River (Braaten et al. 2014). During fish passage observations, 22 4-year old juveniles (mean FL= 1.5 feet; range= 1.1-1.7 feet FL) were observed while swimming in laminar flow over an open bottom channel 11 inches wide x 11.7 feet long. Fish were also observed ascending a side-baffle fish ladder built in a section 9 feet 8 inches long x 1 foot 6 inches wide with three side baffles, each 39 inches apart, positioned perpendicular to flow and extending halfway across the channel and alternating from the left to right side of the channel.

Swim speed of the 22 pallid sturgeon with the fastest swim speed against a water velocity of 1.02 feet/second swam at 0.9-2.0 body lengths/second (1.35 – 3 feet/second) for long time periods (20 seconds to 200 minutes). Fish swam for much longer than 200 minutes at 1 body length/second (~1.5 feet/second) using sustained swim mode. Twelve of the 22 fish (55%) ascended 2.0-2.4 feet/second velocity using a prolonged swimming mode of 1.3-1.6 body length/second (1.9 – 2.4 feet/second). Thus, adults that are 3 feet longer should be able to ascend a water current of 4 feet/second using a prolonged swim speed of 1.3 body lengths/second.

Behavioral observations on the hatchery juvenile pallid sturgeon navigating the fish ladder indicated they quickly learned to adapt to changing velocity and turbulence created by structures and always swam within 2-3 inches of the bottom. The bottom in the artificial flume contained no large rocks or other features, so nothing was learned about pallid sturgeon use of bottom structure. However, in all observations, swimming juveniles were always approximately 2-3 inches above the bottom, so bottom structure is likely important in determining whether a fish passage facility is acceptable for passage or not. Fish swam through a slot created by the baffles in only 2 seconds. The major finding of observations on juveniles was that they could swim in complex flows using a swimming speed of 1-1.6 body lengths/sec or greater.

In the Yellowstone River (Braaten, et al. 2014), 58 wild adults were telemetry tracked to reveal the following information during migration: fish used the main channel or side channels up to 2.3 miles long, fish used water depths of 7.7-11.2 feet deep, and used mean water column velocities of 2.9-6.0 feet/second (excluding the lower 0.8 feet of the water column). Mean size of fish was 4.6 feet FL; thus, most fish were swimming in a prolonged swim mode of ≤ 1.3 body lengths/second (if they were in the mean water column depth). However, the observations of juveniles in the flume suggested most wild adults were swimming nearer the bottom in the lower 5% of the water column, where water velocity is slower than the mean column velocity. If correct, the data may overestimate the actual swimming speed of tagged fish. Even if there is an error in water velocity actually used by adults, the data indicates adults should be able to ascend a current of 4 feet/second using prolonged swimming. The study did not record tagged adults using or avoiding bottom structure.

Other Fish Bypass Channels

The semi-natural design for fish passage around dams originated in Germany and Austria in the 1980s and 1990s with hundreds of small bypasses built to provide stream habitat for lotic fishes, and almost secondarily, to provide fish passage (Jungwirth et al. 1998). American Rivers is active with nature-like fishways including bypasses in the eastern USA (see Illustrative Handbook on Nature-like Fishways by Wildman et al. 2011). The Handbook shows the wide range of bypass designs in Europe and in the eastern US, although most of these channels are on small streams. Project team member, B. Kynard, participated in the design of a bypass channel for shortnose sturgeon at Lock & Dam #1 on the Cape Fear River in North Carolina and another similar channel was designed for the Savannah Bluff Lock and Dam in South Carolina.

However, neither of these channels have been built. Based on B. Kynard’s extensive experience with flume and field studies of shortnose sturgeon, the Cape Fear Bypass Channel would likely have successfully passed shortnose sturgeon and other migratory fish. A short bypass channel for non-sturgeon fishes was designed for a dam in Minnesota (Aadland 2010). However, design of this bypass does not seem suitable for pallid sturgeon because of the small size of the bypass, abundant large boulders, and shallow slow water flow (B. Kynard pers. observation).

Muggli Bypass Channel on the Tongue River

This bypass channel was constructed in 2007 around the T&Y Diversion Dam on the Tongue River and has been shown to pass many native migratory fish species, but has not yet been shown to pass shovelnose sturgeon, one of the primary target species for passage (McCoy 2013). Shovelnose sturgeon is the only species observed in abundance below the dam that have not been observed successfully ascending the bypass.

No detailed evaluation of this bypass channel has been done but water velocity, boulder placement, and attraction flow are hypothesized to play a role in preventing sturgeon from entering and using the bypass. Water velocities in the lower third of the bypass were rarely less than 7 feet/second during periods of high flow (when shovelnose sturgeon are migrating). The high water velocities in the bypass channel may be attributed to the steep gradient in the lower third of the bypass. Recommended water velocity for shovelnose sturgeon passage is 3-4 feet/second (White and Mefford 2002). Also, spacing of the boulders in the channel may also be a problem. Many of the boulders were placed with a gap of only 8-10 inches, which may be a barrier to the passage of large fish, like shovelnose (or pallid sturgeon) that remain in contact with or just above the bottom most of the time, even when ascending fish passage structure (Kynard, et al. 2002). The recommended boulder spacing for shovelnose sturgeon is 24 inches (White and Mefford 2002). Because boulder spacing is important for shovelnose sturgeon, it is also likely important for pallid sturgeon, but unfortunately, no data on acceptable spacing of boulders for pallid sturgeon are available. One might reasonably expect the acceptable boulder spacing to be much greater for adult pallid sturgeon, which are always longer than adult shovelnose sturgeon.

Further, attraction flow of 2 feet/second from the Muggli bypass channel entrance to the thalweg of the river was masked by turbulent flow of water passing over the T&Y Diversion Dam when discharge levels exceeded 800 cfs. Thus, during periods of high discharge (and peak sturgeon migration) shovelnose may have difficulty finding the bypass fish entrance. To address velocity issues in the lower third of the bypass and masking of attraction water flow, the channel was extended out into the river. Increasing the spacing between boulders should also be done as recommended by White and Mefford (2002). A fish passage efficiency study could provide critical research information to correct the Muggli bypass channel and to inform the design of future bypasses for shovelnose (and pallid) sturgeon.

Side-channel Ascent by Pallid Sturgeon

Adults ascend side channels in the Yellowstone River, including the existing side channel that bypasses Intake Diversion Dam (Braaten et al. 2014). These monitoring results suggest a bypass channel with the general geomorphic and flow characteristics of existing side channels in the river could best pass adult pallid sturgeon. Mean velocity from HEC-RAS modeling for this study of the existing side channel at Intake Dam is 2-3 feet/second even at 54,000 cfs river flow, which would have been similar to flows and conditions present when pallid sturgeon were tracked successfully passing through the side channel (Rugg 2014, 2015). The proposed Bypass Channel Alternative design has been modeled to have mean velocities of 3 feet/second at lower flows (7,000 cfs river flow) and 4-5 feet/second at higher river flows (15,000, 30,000, and 54,000 cfs river flow).

The HEC-RAS modeling of the proposed bypass channel shows that mean column velocity is greatest (4-5 feet/second) in the center section of the bypass channel, velocities on the bypass channel sides are reduced and usually are 2-3 feet/second. The bypass channel provides this slower velocity habitat (< 4 ft/s) on the channel sides during the range of river flows from 7,000 to 54,000 cfs. All observations on swimming of pallid sturgeon in artificial flumes or in the Yellowstone River, show adult pallid sturgeon should be able to ascend a bypass channel with these velocities. The slower velocities along the sides of the channel would likely also be used by other migratory fishes ascending the channel. Also, many observations on adult pallid sturgeon swimming around a 15 foot diameter circular tank or juveniles in the artificial flume show this species, like all other North American sturgeons, have no problem swimming on a slope, even on a vertical slope, as long as there is no structure attached to the bottom or slope (B. Kynard pers. obs.). Finally, adult pallid sturgeon, like other North Temperate Zone sturgeon migrating to spawn, do so after 5-6 months of wintering, so during migration they attempt to conserve energy by using slow velocity on the channel bottom (or slopes) during ascent (Kynard et al. 2012).

Bottom Type and Movements by Pallid and Shovelnose Sturgeon.—

Little information is available on bottom type selected by wild adult pallid sturgeon yet this information is important to design any fish passage facility for these bottom cruising swimmers. Adult shovelnose sturgeon will use a bottom with large rocks, but spacing is important for fish to accept the habitat and ascend a flume (White and Medford 2002). Also, during artificial stream tests that gave juveniles (6 months to 10 months old of seven species of N. American sturgeons) a choice of two water velocities (fast vs. slow) and between two bottom types, smooth vs. structured (sand vs. cobble), shovelnose and pallid had the strongest preference of all species for sand substrate (Kynard et al. unpubl. analyzed data). Further, juvenile and adult shortnose sturgeon use of bottom habitat, water depth, and river habitat are similar, indicating no change in preference for bottom type during ontogenetic development (Kynard et al. 2008). Thus, if bottom preference is set early in life like for shortnose sturgeon, pallid and shovelnose juveniles and adults may prefer a similar bottom type (sand) and they may avoid river bottom reaches with a high density of rocks. Shortnose sturgeon avoid rocks during their entire life history except for two periods: 1) spawning, and 2) swimming over short rapids during upstream migrations, even though their two ventral lateral rows of scutes can be severely damaged (Kynard et al. 2012). All evidence suggests the bypass channel bottom should be rather smooth and devoid of large rocks that extend into the water column.

Timing of Implementation

Earlier estimates had indicated that with the current population of wild adult pallid sturgeon numbering as few as 125 in 2008, that they might be functionally extinct by 2018. That is still a concern as the number of wild adult pallid sturgeon may now be fewer than 100 individuals that are all old >40 years. The PSCAP program has been undertaken to supply as genetically diverse population of juvenile pallid sturgeon as is possible and these fish are surviving at fairly high numbers (~43,000 juveniles present below Fort Peck Dam in the GPMU, Rotella 2015). However, intuitively, it seems to make sense that implementing a fish passage option at Intake Diversion Dam while the wild adult population is still motivate to migrate upstream is preferable to waiting longer until these fish may no longer be capable of finding mates or spawning successfully. There is no knowledge about whether the hatchery pallid sturgeon will be motivated to migrate upstream above Intake Diversion Dam, particularly because so few have been stocked as juveniles above Intake.

If other fish passage options such as dam removal were instead selected, it is likely that it would take many years for implementation, thus reducing the number of wild adult pallid sturgeon that might still be available to spawn. Further, no matter what fish passage option is provided, there are still uncertainties about what percentage of fish would be motivated to pass upstream (current best estimate is 12 to 26 percent; Braaten et al. 2014) and regardless of passage option, it is still not known if the drift distance from spawning that could occur upstream of the dam is sufficient for survival of free embryos/larvae. Thus, implementing the bypass channel that has been designed based on the best available science and that can be implemented quickly is the best way to allow for upstream spawning of the remaining motivated wild adults and to monitor and quickly understand if the drift distance is adequate for survival of free embryos and larvae.

This project is not required to be the only solution or contribution to pallid sturgeon recovery in the GPMU and other actions must continue to be implemented in both the Yellowstone and Missouri rivers to support recruitment and recovery. Due to the lack of recruitment of wild pallid sturgeon in the GPMU, a key objective for recovery is to increase recruitment of pallid sturgeon to age-1 (Service 2014). This objective increases the importance of the Yellowstone River because it retains the most natural riverine habitats and offers the best chance of potentially successful spawning and recruitment for the GPMU

Determination of Effects

The proposed actions are intended to and likely would benefit pallid sturgeon and other native fish substantially and begin to contribute to recovery by improving passage at Intake Diversion Dam. However, construction activities and both interim and future O&M of the project are likely to have short-term adverse effects to pallid sturgeon, including:

- Interim Operation and Maintenance
    - Adult pallid sturgeon – 12 to 26 percent would continue to be blocked from accessing upstream suitable habitats for up to 3 years (up to 32 individuals each year). **Adverse effect**.
    - Free embryo/larvae – a small number could be potentially entrained or impinged on the screens if passage and spawning occurred in the year prior to construction. **Adverse effect**

- Construction of Replacement Weir and Bypass Channel, Upstream and Downstream Fish Passage
    - Adult pallid sturgeon – Blockage of 5 to 15 adults that might use the existing side channel for upstream passage in the one year during construction when flows are sufficiently high. **Adverse effect.**

- Future Operation and Maintenance
    - O&M of the bypass channel that has similar depths and velocities to side channel and main channel habitats used by adults for upstream migration in the Yellowstone River would allow upstream passage of the majority of adults motivated to migrate up to Intake Diversion Dam in all future years after construction is complete for the entire migration season. **Beneficial effect.**
    - Downstream passage over the replacement weir would be enhanced over passage at the existing weir. **Beneficial effect.**
    - The completion of the bypass channel and replacement weir would allow for the presence of free embryos/larvae from successful spawning of adults upstream. The increased potential drift distance may allow some free embryos/larvae to

  - settle out in the lower Yellowstone River or free-flowing portion of the Missouri River upstream of Lake Sakakawea, thus benefitting survival and recruitment. **Beneficial effect.**
  - Some impingement or entrainment of larval and free embryos at the headworks. **Adverse effect.**
- Monitoring, Fish Capture, Collection, and Tagging
  - Adult pallid sturgeon – Capture, tagging, release, and stress. **Discountable adverse effect.**
  - Free embryos/larvae – Fish entrained or impinged already dead or injured. **Discountable adverse effect**.

Conservation Measures

In order to further avoid and minimize adverse effects to pallid sturgeon from the proposed actions, the following conservation measures are proposed:

1. Use a "ramp up" procedure for pile driving using lower energy and a short duration at the start of each day's pile driving effort to allow fish in proximity to the work zone to move away before sound levels reach maximum levels. This was not previously identified as a conservation measure in the 2015 BA (Reclamation 2015) or Biological Opinion (Service 2015), but now that construction methods have been more clearly identified, this is a feasible way to avoid injury to fish and allow them to move away from further disturbance.

2. No "In water" work conducted from April 15 – July 1 during construction or operation and maintenance.

3. Minimize the duration that coffer dams are in place in the river.

Whooping Crane

Direct Effect and Indirect Effects

Whooping cranes are known to occur in the eastern portion of Montana and North Dakota during migration periods. Stopover habitat within wetlands along the Yellowstone River corridor is available to whooping cranes, and they have occasionally been observed during migration months (April, September and October). However, in the construction area, there is only limited habitat available (wetlands or sand bars) and it is highly unlikely that whooping cranes would be present in the vicinity of any construction activities. Construction activities are not expected to have any effect on whooping cranes.

Interim and future O&M of the project would include work in the bypass channel and the river and would not affect any potential habitats that whooping crane would be likely to use. O&M activities are not expected to have any effect on whooping cranes. Overall, the project would have no effect on whooping cranes.

Conservation Measures

In order to ensure no effect to whooping cranes, monitoring during construction in the months of April, September and October should be conducted, and if any whooping cranes are observed, the Service should be contacted immediately to identify if any action should be taken to avoid and minimize potential effects on whooping cranes.

Interior Least Tern

Direct and Indirect Effects

Although the Yellowstone River is at the outer limit of the interior least tern's preferred range, this species is known to be present in small numbers and to be breeding along the Yellowstone River within the action area. The MNHD reports the most recent occurrence was in 2013 (MNHP 2016). Thus, it is expected that the least tern could be present in the action area during the April through September breeding season.

During construction, there would only be very limited work conducted on or in the vicinity of any un-vegetated sand bars (only at the upstream end of the bypass channel) and there are no records of nesting terns at this location. Thus, it is anticipated that while there might be an individual term present in the vicinity of construction activities that could be disturbed, overall, construction activities are not likely to adversely affect interior least terns or disrupt any potential nest sites.

Interim and future O&M of the project would not include any work on sand bars and would typically be conducted during late summer low flows (i.e. August, September) when nesting is completed or nearly complete. Similarly, while an individual tern may be present in the vicinity of O&M activities and could be disturbed, overall, O&M activities are not likely to adversely affect interior least terns or disrupt any potential nest sites.

Conservation Measures

To ensure that there is no potential to disturb nesting terns, monitoring should be conducted in April and May each year of construction, and if any interior least tern nests are observed, they should be protected with fencing and all surface-disturbing activities should be prohibited to within 0.25 mile, or within line of site, of any active interior least tern nest from May 15 to August 15. In the event of an emergency, a nest with eggs may need to be moved or be subject to destruction if human life or infrastructure is in danger. The Service would be immediately contacted if any such action were required in order to identify any additional actions that should be taken to protect interior least terns.

Piping Plover

Direct and Indirect Effects

The piping plover is likely to be present in the action area and there is also potential for the species to be nesting. Nesting has been confirmed for sand bar and sandy shoreline habitats within the Yellowstone River just upstream of Glendive and suitable nesting habitat is present between the Intake Diversion Dam and the Missouri River (MNHP 2016). MNHP data shows confirmed occurrences of breeding for piping plovers along the Yellowstone River near its confluence with Clear and Cedar Creeks in 2013. Thus, it is expected that the least tern could be present in the action area during the April through September breeding season.

During construction, there would only be very limited work conducted on or in the vicinity of any un-vegetated sand bars (only at the upstream end of the bypass channel) and there are no records of nesting plovers at this location. Thus, it is anticipated that while there might be an individual plover present in the vicinity of construction activities that could be disturbed, overall, construction activities are not likely to adversely affect piping plovers or disrupt any potential nest sites.

Interim and future O&M of the project would not include any work on sand bars and would typically be conducted during late summer low flows (i.e. August, September) when nesting is completed or nearly complete. Similarly, while an individual plover may be present in the vicinity of O&M activities and could be disturbed, overall, O&M activities are not likely to adversely affect piping plovers or disrupt any potential nest sites.

Conservation Measures

To ensure that there is no potential to disturb nesting plovers, monitoring should be conducted in April and May each year of construction, and if any piping plover nests are observed, they should be protected with fencing and all surface-disturbing activities should be prohibited to within 0.25 mile, or within line of site, of any active piping plover nest from May 15 to August 15. In the event of an emergency, a nest with eggs may need to be moved or be subject to destruction if human life or infrastructure is in danger. The Service would be immediately contacted if any such action were required in order to identify any additional actions that should be taken to protect piping plovers.

Rufa Red Knot

Direct and Indirect Effects

Red knots have not been observed within the action area in Montana or North Dakota and stopovers by red knots anywhere in Montana are quite rare. Preferred primary habitats of coastal bays and inlets are not available and freshwater habitats used are typically saline lakes and not streams. The red knot is not likely to be present in the action area. Thus the proposed action would have no effect on rufa red knots.

Black-Footed Ferret

Direct and Indirect Effects

The black-footed ferret is unlikely to be present in the action area. Populations are extremely rare, well documented, and are not known to occur along the Yellowstone River. In addition, any potential habitat for the black-footed ferret, which includes existing prairie dog colonies, is not within the action area. Thus, the proposed action would have no effect on black-footed ferret

Gray Wolf

Direct and Indirect Effects

There are no recorded sightings of gray wolf in the action area and they would be unlikely to occur in the vicinity of any construction or O&M activities. Thus, the proposed action would have no effect on gray wolf.

Northern long-eared bat

Direct and Indirect Effects

The only record of a northern long-eared bat in Montana was in 1978 (Service 2015; MNHP 2015). Northern long-eared bats have been documented in the Missouri River Valley in North Dakota; however, no hibernacula are known to be present (Service 2015). However, these bats are difficult to detect, hiding in deep crevices during hibernation and mixing with larger colonies of other bats, and may be present in more areas than are known. However, it is unlikely that northern long-eared bats would be present in the action area.

During construction, both living and dead deciduous trees, primarily cottonwoods, would be removed for excavation of the proposed bypass channel. Thus, the project may affect, but is not likely to adversely affect northern long-eared bats during construction.

Interim and future O&M may affect northern long-eared bats if insecticide use by individuals significantly reduces the insect prey base in the area or if large trees and buildings are removed. O&M activities may affect, but are not likely to adversely affect northern long-eared bats.

Conservation Measures

To ensure there are no adverse effects to northern long-eared bats, the following conservation measures are proposed:

- Monitor trees to be removed for project construction to identify if there is any evidence of bat usage. If bats are present, they should be identified to determine if they are northern long-eared bats. If any northern long-eared bats are present, they should be relocated to suitable habitat downstream of Joe’s Island.
- Minimize use of pesticides in O&M activities.
- Minimize removal of trees in O&M activities.

Dakota Skipper

Direct and Indirect Effects

Dakota skippers are not found in Montana, and only rarely occur in North Dakota (MNHP 2015, NDNHP 2016). They are not expected to be present along the Yellowstone or Missouri rivers within the action area. Thus, the proposed action would have no effect on Dakota skippers.

DETERMINATION OF EFFECTS SUMMARY

Table 13 summarizes the determination of effects for listed and proposed species in the Intake Diversion Dam Fish Passage Improvement Project action area.

Table 13. Determination of Effects Summary

Common Name	Scientific Name	Determination of Effects
Pallid sturgeon	*Scaphirhynchus albus*	Likely to Adversely Affect
Least tern	*Sternula antillarum*	Not Likely to Adversely Affect
Whooping crane	*Grus americana*	No Effect
Piping plover	*Charadrius melodus*	Not Likely to Adversely Affect
Red knot	*Calidris canutus rufa*	No Effect
Black-footed ferret	*Mustela nigripes*	No Effect
Gray wolf	*Canis lupus*	No Effect
Northern long-eared bat	*Myotis septentrionalis*	Not Likely to Adversely Affect
Dakota skipper	*Hesperia dacotae*	No Effect

Cumulative Effects

Cumulative effects under the ESA are defined as "…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 activities that are not inter-related or interdependent to the proposed action are not considered because they would be subject to separate future consultation under the ESA.

No specific State or private activities have been identified in the action area that are reasonably certain to occur. However, ongoing trends that are likely to occur include bank armoring along the Yellowstone River, further expansion of oil and gas development, small-scale water conservation measures such as conversions to pivot irrigation, road and railroad maintenance, spills at pipeline crossings, and increased development.

These ongoing trends would generally tend to incrementally increase groundwater withdrawals (i.e. oil and gas development and increased development) or potentially reduce groundwater levels in the shallow aquifer (i.e. water conservation measures). This is likely to only cause minor effects on river hydrology. Bank armoring, pipelines, road and railroad maintenance and development would contribute to a cumulative reduction in channel migration and the natural formation of riverine and floodplain habitats. The Yellowstone River Cumulative Effects Assessment (USACE and YRCDC 2015) have indicated that channel migration and floodplain turnover/habitat formation in the lower river has cumulatively declined by about 50 percent since 1950. Further bank armoring and development would add to this trend.

Terrestrial habitats would continue to be disturbed and degraded through removal of natural vegetation with ongoing development from a variety of sources. However, threatened and endangered species do not use the action area in substantial numbers and there is no critical habitat for any of the wildlife or insect species in the action area. Species such as least tern and piping plover are occurring regularly each year and may be selecting Yellowstone River habitats when the hydrographs of other rivers in the area are not suitable. Overall, the proposed project when combined with other future reasonably certain to occur activities would have only a negligible cumulative effect on listed wildlife or insect species.

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APPENDIX A –MONITORING AND ADAPTIVE MANAGEMENT PLAN

Lower Yellowstone Intake Diversion Dam Fish Passage Project

Monitoring and Adaptive Management Plan

August 2016

U.S. Department of the Interior
Bureau of Reclamation
Billings, Montana

Table of Contents

1.0 Introduction

The Lower Yellowstone Intake Diversion Dam Fish Passage Project (Project) is a proposal to improve pallid sturgeon fish passage at Intake Diversion Dam, a feature of the Lower Yellowstone Project which provides irrigation water to approximately 58,000 acres of cropland in eastern Montana and western North Dakota. The Lower Yellowstone Intake Diversion Dam Fish Passage Project Environmental Impact Statement (EIS) was developed based on the best available scientific information for pallid sturgeon and identifies the Bypass Channel Alternative as the preferred alternative, which is the focus of this Monitoring and Adaptive Management Plan (AMP).

This AMP has been prepared by Reclamation in cooperation with the Corps of Engineers (Corps) consistent with the Memorandum of Agreement between the two agencies (See Section 7 – Agency Roles, Responsibilities and Funding) to provide a structured framework for decision making that can adjust Project features and operations if monitoring results indicate the Project is not meeting performance objectives as contemplated in the Final Environmental Impact Statement (FEIS). This AMP has been prepared in a manner consistent with the processes described in the report, *Adaptive Management, The U.S. Department of Interior Technical Guide* (Department Guide) (Williams et al. 2012). The Department Guide frames adaptive management within the context of structured decision making, with an emphasis on uncertainty about resource responses to management actions and the value of reducing that uncertainty to improve management.

The Department Guide describes implementing projects in two phases. The first phase sets up the AMP's key components. This phase was essentially completed through project planning and the development of the EIS. The second phase is an iterative phase in which the components are linked in a sequential iterative decision process of monitoring, assessment, and decision-making, that is repeated at least annually to advance and improve the process and Project over time. This is being developed as part of this AMP.

2.0 Scope and Timeline

The scope of this AMP is limited to the immediate area surrounding the Lower Yellowstone Project Intake Diversion Dam. This area includes three miles upstream and downstream of the existing weir structure. All adaptive management measures are specific to the bypass channel, replacement weir, existing weir, rubble field, and headworks. All potential changes to these structures are considered modifications of features or operations.

This AMP is a living document that will evolve over time as research and knowledge of pallid sturgeon expands. However, this plan is only intended to last for the first 8 years of the Project. After 8 years, Reclamation will initiate discussions with the U.S. Fish and Wildlife Service (Service) to determine if the existing AMP should continue or if significant modifications to the

AMP are necessary. Final monitoring requires and timelines are subject to change following completion of appropriate NEPA and ESA compliance.

3.0 Project Overview

3.1 Description of the Lower Yellowstone Project

Reclamation's Lower Yellowstone Project (LYP) is an irrigation project located in eastern Montana and western North Dakota operated by the Lower Yellowstone Irrigation Project Board of Control (LYIP), Reclamation's authorized agent. The LYP includes the Intake Diversion Dam, which is a rock-filled timber crib weir crossing the Yellowstone River about 70 miles upstream of its confluence with Missouri River and 18 miles downstream of Glendive, Montana. The Intake Diversion Dam raises the river water elevation to divert water from the Yellowstone River through the recently constructed headworks to the LYP's Main Canal on the north side of the river.

River ice and high flows can cause rocks in the Intake Diversion Dam to be displaced. Such displaced rocks have been transported downstream over the years, creating a boulder field on the downstream side of the dam. A side channel on the south side of the Yellowstone River diverges from the main channel upstream of the Intake Diversion Dam and reconnects with the main channel downstream of the dam. The side channel holds water through its entire length when the Lower Yellowstone flow exceeds 20,000 cfs, but does not effectively provide passage until flows exceed 40,000 cfs.

3.2 Project Purpose

The purpose of the Project is to improve fish passage for pallid sturgeon and other native fish at the Intake Diversion Dam, continue the viable and effective operation of the LYP, and contribute to ecosystem restoration.

3.3 Bypass Channel Description

The bypass channel is intended to improve fish passage by creating a 2.1 mile long, low-gradient channel around the weir. The primary features of this alternative are shown in Figure 1 and described below. The effectiveness of these features to provide passage will be monitored, and if needed, modifications will be made in an effort to achieve Project objectives as outlined under Section 4.2.

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure is approximately 300 feet in length and is equipped with 12 rotating drum screens that reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Bypass Channel. The bypass channel would be excavated from the inlet of the existing side channel to just downstream of the existing weir and boulder field. The proposed bypass

channel alignment is approximately 11,150 feet long at a slope of 0.07 percent. The channel cross section has a 40-foot bottom width with side slopes varying from 1V:8H to 1V:4H. The bypass channel would divert on average 13-15% of the total flow of the Yellowstone River.

3. Upstream Control Structure. A riprap control structure designed to control flow split and stabilize the upstream end of the bypass channel.
4. Existing Side Channel Plug. Fill will be placed in the existing side channel to keep all split flows within the proposed bypass channel.
5. Vertical Control Structures. Two vertical control structures (riprap sills) are proposed within the bypass channel to maintain channel slope and allow for early identification of channel migration.
6. Downstream Vertical Control Structure. A riprap sill is proposed at the downstream end of the bypass channel to maintain channel elevations.
7. Armor Layer. The bed of the bypass channel would be armored with sorted sands, gravels and cobbles to reduce the risk of bed degradation. The proposed armor layer would be similar to naturally-formed bed material in the Yellowstone River.
8. Replacement Concrete Weir. To maintain irrigation and bypass channel diversion capabilities, a replacement concrete weir would be constructed approximately 40 feet upstream of the existing rock weir and to an elevation of 1990.5 feet. The new weir would preclude the necessity of adding large rock to the crest of the existing diversion structure to maintain diversion capabilities.
9. Weir Notch. A low-flow notch would be constructed in the new weir with a bottom elevation of 1989 feet, with an 85 foot bottom width and approximately 125 foot top width.
10. Downstream Fill. Fill is proposed near the downstream entrance of the bypass channel to reduce eddy formation and to increase attraction flows

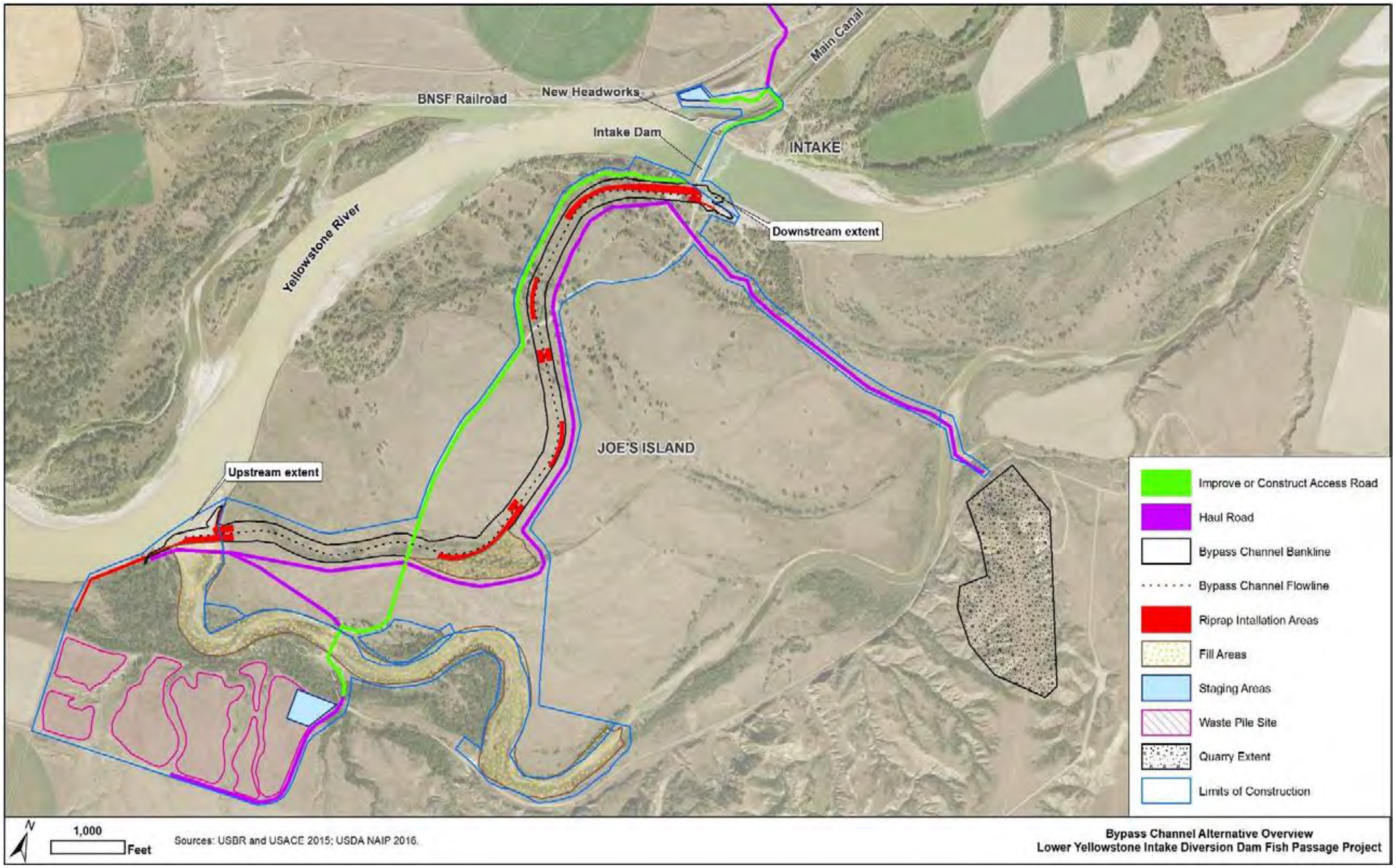

Figure 1: Proposed Layout of Bypass Channel

4.0 Project Goal and Objectives

4.1 Project Goal

The Project goal is to improve pallid sturgeon fish passage at the Intake Diversion Dam. This would make approximately 165 miles of additional habitat available for pallid sturgeon migration and spawning in the Yellowstone River upstream of Intake Diversion Dam. Under current conditions, the majority of the spawning activity takes place within the lowest 10 to 20 miles of the Yellowstone River (Delonay et al 2016; Bramblett 1996), which does not allow for adequate drift distance for free embryos and larval pallid sturgeon to mature and settle out before they reach the headwaters of Lake Sakakawea, where larvae are believed to succumb to hypoxia (Bramblett et al 2016; Guy et al. 2015).

By improving passage at Intake Diversion Dam, the majority of adult pallid sturgeon that migrate up to the weir would be able to migrate and spawn further upstream, increasing the available drift distance.

The following specific objectives are based on the physical and biological criteria developed by the Service's Biological Review Team (BRT) for a bypass channel.

4.2 Project Objectives

Objective 1: Construct and maintain appropriate physical criteria parameters that allow pallid sturgeon passage. The physical criteria are:

- **Depth**
    1) Minimum depths in fish passageway measured at the lower discharge range of 7,000 cfs to 14,999 cfs at any sampled cross-section must be greater than or equal to 4.0 feet across 30 contiguous feet of the measured channel cross section profile.
    2) Minimum depths in the fish passageway measured at the discharge range of 15,000 cfs to 63,000 cfs at any sampled cross-section must be greater than or equal to 6.0 feet across 30 contiguous feet of the measured channel cross sectional profile.
- **Velocities**
    1) Mean cross-sectional velocities must be equal or greater than 2.0 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 7,000 cfs to 14,999 cfs.
    2) Mean cross-sectional velocities must be equal or greater than 2.4 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 15,000 cfs to 63,000 cfs.

Objective 2: Upstream and downstream passage of pallid sturgeon

- **Objective 2a - Upstream Adult Passage**
    1) Greater than or equal to 85% of motivated adult pallid sturgeon (fish that move up to the weir) annually pass upstream of the weir location during the spawning migration period (April 1 to June 15) within a reasonable amount of time without substantial delay (≥0.19 miles/hour).

- **Objective 2b - Upstream Juvenile Passage**
    1) No Criteria Set - Develop decision criteria to trigger adaptive management options to improve passage for juveniles if the lack of juvenile passage is demonstrated to result in negative population level effects.
- **Objective 2c - Downstream Passage**
    1) Mortality of adult pallid sturgeon that migrate downstream of the weir location cannot exceed 1% annually during first 10 years. Document any injury or evidence of adverse stress.
- **Objective 2d – Pallid Sturgeon Free Embryo and Larval Downstream Passage**
    1) Assess impingement and entrainment of free-embryo, larval, and young-of-year sturgeon at headworks/screens, irrigation canal and downstream of the weir location.

Objective 3: Upstream and Downstream Passage of Native Fish

1) Determine if native fish are migrating upstream and downstream of the weir location.

5.0 Monitoring Plan

Monitoring is used in adaptive management to track resource system behavior and, in particular, the responses to the management actions over time. Monitoring is an ongoing activity, producing new data after each monitoring period to evaluate management actions and ensure that goals and objectives are being met. Monitoring also includes a means to validate assumptions and prioritize management actions during follow-up monitoring periods. In general, monitoring provides data in adaptive management for three key purposes:

- Evaluate progress toward achieving Project goals and objectives.
- Track resource behavior in response to management actions.
- Increase understanding of resource dynamics via the comparison of predictions against monitoring results.

Project monitoring included in this AMP is designed to be coordinated with existing and proposed monitoring programs conducted by the Corps' Missouri River Recovery Program, State of Montana Fish, Wildlife and Parks (MFWP), and the U.S. Geological Survey (USGS). The monitoring program commitments in this AMP are designed to be inclusive of the monitoring commitments between the Corps and Reclamation as described in the Memorandum of Agreement signed April 7, 2015 (see section 8.0 - Agency Roles, Responsibilities and Funding).

Biological monitoring is expected to take place from April 1 – July 15 of each year. This covers the expected time frame for pallid sturgeon upstream migration, spawning, and downstream migration through the Project. Monitoring of the physical criteria and the biological responses to these criteria would begin the first migration season after construction is complete. Once the field season is complete, Reclamation will work with field crews to compile monitoring results for the Technical Team's assessment (Section 6.0).

The monitoring included in this AMP is presented in Table 1.

Table 1: Monitoring Plan

<table>
<tr><th>Year
(Post Const.)</th><th>Monitoring Activity</th><th>Responsible Entity</th></tr>
<tr><td colspan="3"><u>Bypass Channel Physical Criteria Monitoring (Objective 1)</u></td></tr>
<tr><td>1</td><td>An Acoustic Doppler Current Profiler (ADCP) will be deployed at 5 cross-sections across the bypass channel to analyze depths and velocities. These locations include:

1. Downstream entrance to the bypass channel.
2. Cross-sections at 1,000, 5,000 and 10,000 feet up from the downstream entrance or representative cross-sections at rock sills and at intermediate sections.
3. Upstream outlet to the river.

The ADCP unit will be deployed by line across the bypass channel during the spring moderate (April - May) and high runoff (June - July) conditions and summer low flow baseline (August). This will document depth and velocity conditions during three different flow conditions.

If pallid sturgeon are tracked in the bypass channel during a particular river flow regime, ADCP sampling will be done during the time period of highest fish use of the channel. This will help determine which hydraulic conditions upstream migrating pallid sturgeon prefer.</td><td>Corps of Engineers</td></tr>
<tr><td>2-3</td><td>Same as year one.</td><td>LY Irrigation Project Board of Control</td></tr>
<tr><td>4-6</td><td>The ADCP unit will be deployed in the same locations as described above. Monitoring will take place in the spring before peak runoff (April - May) and then again during summer baseline (August) flows to provide data on pre-migration and post-migration conditions.</td><td>LY Irrigation Project Board of Control</td></tr>
<tr><td>7+</td><td>Once a baseline and an understanding of how the bypass channel performs under different hydraulic scenarios have been established, the monitoring program will be scaled back. The primary concern will be to determine if a severe or unique event occurs (major flooding or ice jam) and changes the physical and hydraulic characteristics, in which case the ADCP will be deployed.</td><td>LY Irrigation Project Board of Control</td></tr>
</table>

<table>
<tr><th colspan="3"><u>Adult Pallid Sturgeon Upstream Passage (Objective 2a)</u></th></tr>
<tr><td>1-8</td><td>Eight telemetry stations will be positioned at strategic locations to track the movement of radio tagged fish. These stations will be located at:
1. One mile downstream of the Project on the Lower Yellowstone River
2. The downstream entrance to the bypass channel
3. Two locations within the bypass channel
4. The upstream outlet of the bypass channel
5. One mile upstream of the project on the Lower Yellowstone River
6. The downstream entrance to the existing side channel
7. The old headworks structure

Currently, the USGS, Service, Reclamation, and MFWP capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year.

Because the LYP does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only radio tagged pallid sturgeon that come within one mile of the project will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry station located one mile downstream of the project will be used to establish the number of pallid sturgeon migrating upstream in any given year. The telemetry station(s) at the bypass channel entrance, within the bypass channel (two locations), and at the upstream outlet of the bypass channel will determine if pallid sturgeon try and succeed in using the bypass channel. The station located at the existing side channel will document if pallid sturgeon try to use the side channel after it no longer has flows. The station located one mile upstream from the project will confirm how many radio tagged fish successfully migrated through the bypass channel and continued migrating upstream.

Because telemetry station data only indicates when a fish was present near the station, mobile tracking would be used to supplement the stations once fish are detected at the downstream station to provide supplemental information on the route that fish use in the Project area to better understand what particular depths, velocities, and other physical factors influence passage.</td><td>Reclamation</td></tr>
<tr><td>8+</td><td>Reclamation, in consultation with the Service, will determine the long-term need and scope of adult pallid sturgeon upstream passage monitoring.</td><td>Reclamation, Fish and Wildlife Service</td></tr>
</table>

Juvenile Pallid Sturgeon Upstream Passage (Objective 2b)		
1-3	Monitoring plan is the same as Adult Pallid Sturgeon Upstream Passage (Object 2a) Conduct field and laboratory swimming capability studies of juvenile pallid sturgeon to determine if upstream juvenile passage is reasonably expected to occur and if upstream passage would benefit condition, growth, and survival of juveniles.	Reclamation
3	Establish upstream juvenile passage criteria if possible	Fish and Wildlife Service
4-8	Continue monitoring juvenile upstream passage	Reclamation
8+	Reclamation, in consultation with the Service, will meet to determine the long-term need and scope of juvenile pallid sturgeon upstream passage monitoring.	Reclamation, Fish and Wildlife Service
Adult Pallid Sturgeon Downstream Passage (Objective 2c)		
1-8	Downstream monitoring will begin with the station located one mile upstream of the Project. This will provide a base number of radio tagged pallid sturgeon attempting to move downstream over the weir. If pallid sturgeon attempt to move back downstream over the weir they will be monitored using that station located on the old headworks structure. The stations within the bypass channel will detect pallid sturgeon using the bypass channel to migrate downstream. The station located one mile downstream of the Project will detect the total number of pallid sturgeon successfully migrating downstream for either pathway. Mobile tracking via boat would be used to supplement the land based stations once fish are detected at the upstream station to provide supplemental information on the route that fish use in the Project area to better understand what particular depths, velocities and other physical factors influence passage. This will also help determine whether mortality or injury occurred during downstream migration through the Project area.	Reclamation
8+	Reclamation, in consultation with the Service, will meet to determine the long-term need and scope of adult pallid sturgeon downstream passage monitoring.	Reclamation, Fish and Wildlife Service

Pallid Sturgeon Free Embryo and Larval Downstream Passage (Objective 2d)		
1-8	The existing headworks monitoring will continue. This consists of hanging entrainment nets behind headworks gates in the Main Canal for 3 weeks during late June and early July. This effort will identify any entrainment of free embryo or larval pallid sturgeon into the Main Canal. Free embryos and larval pallid sturgeon will also be monitored downstream of the new weir to ensure these organisms are successfully passing downstream. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluate larval drift. Experiments could be undertaken including the release of free-embryo pallid or shovelnose sturgeon upstream of the dam to assess entrainment or impingement at the screens and injury from drift over the diversion weir and through the boulder field.	Reclamation
8+	Reclamation, in consultation with the Service, will meet to determine the long-term need and scope of free embryo and larval pallid sturgeon downstream passage monitoring.	Reclamation, Fish and Wildlife Service
Native Species Upstream and Downstream Passage (Objective 3)		
1-3	Currently, Reclamation and MFWP capture and tag native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate eight land based telemetry stations at strategic locations to track the movement of radio tagged native fish. Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the Project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing dam. The telemetry stations located one mile upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area. The telemetry stations within the bypass channel will be used to determine whether these native species are using the bypass channel. If native species are migrating over the weir, they will be monitored using the stations located one mile upstream and downstream of the project.	Reclamation

6.0 Assessment

This step includes the process of determining whether unanticipated changes to the bypass channel or responses by pallid sturgeon and native fish have occurred. Modeling indicates that the bypass channel will meet BRT criteria under all flow conditions, but it is important to validate this modeling, along with pallid sturgeon and native fish passage, and identify adaptive measures if appropriate.

Data collected from physical and biological monitoring would be evaluated and compared to each other as well as the modeling, objectives, assumptions, and anticipated results contained in the EIS and Biological Opinion. Assessment will be conducted through annual consultation with a Technical Team/Adaptive Management Work Group (Technical Team) in the winter/spring of each year. The Technical Team will consist of qualified engineers and fisheries biologists. The Technical Team will use their findings from assessment of the monitoring data to recommend monitoring changes or adaptive management measures to the Executive Team.

6.1 Technical Team

Below are the agencies and disciplines to be represented on the Technical Team. Additional support and disciplines would be added as necessary to address specific team needs.

- **Bureau of Reclamation (Lead)**
  - Project Manager
  - Fisheries Biologist
  - Engineer
- **Army Corps of Engineers**
  - Project Manager
  - Fisheries Biologist
  - Engineer
- **U.S. Fish and Wildlife Service**
  - Fisheries Biologist
- **U.S. Geological Survey**
  - Fisheries Biologist
- **Montana Fish, Wildlife, and Parks**
  - Fisheries Biologist

6.2 Adaptive Management Measures

To address any potential problems with the proposed bypass channel, Reclamation has identified some potential modifications that could be implemented. Table 2 contains potential measures that could be implementated in response to various findings related to the physical performance of the bypass channel and Table 3 outlines potential measures for implementation based on pallid sturgeon biological performance related to passage success. The decision to implement any of the below actions will be a joint effort between the Technical Team (6.3) and the Executive Team (7.1) as described later in this document.

In accordance with authorities, contracts, formal agreements, and Endangered Species Act consultations, the Corps would be responsible for monitoring and implementing measures to ensure the bypass channel operates consistent with the physical criteria during the warranty period (one year) following completion of construction. The Lower Yellowstone Irrigation Project Board of Control would generally be responsible for operation and maintenance related adaptive management measures after the Corps' warranty period, and Reclamation would generally be responsible for measures that contribute to research or scientific investigation.

Table 2: Physical Criteria - Potential Adaptive Management Measures

Finding	Principal Measure	Secondary Measures	Responsible Party
Minimum depths in bypass channel do not meet criteria.	Modify upstream or downstream control structures – these structures are critical to flows in the bypass channel and are therefore the first physical feature that would be modified to achieve the criteria; modification would consist of either excavation to lower the control structure(s) or excavation in the bypass channel.	Modify vertical control structures	- Corps during warranty period - Lower Yellowstone Irrigation Project Board of Control in out-years.
Water velocities in bypass channel do not meet criteria.	Modify upstream or downstream control structures – these structures are critical to flows in the bypass channel and are therefore the first physical feature that would be modified to achieve the criteria; modification would consist of either excavation to lower the control structure(s) or excavation in the bypass channel).	Modify vertical control structures	- Corps during warranty period - Lower Yellowstone Irrigation Project Board of Control in out-years.
Flows splits do not meet criteria	Modify upstream control structure – this structure controls the amount of flow that is allowed into the bypass channel; modification would consist of excavating the channel invert to a lower elevation.	Modify upstream control structure	- Corps during warranty period - Lower Yellowstone Irrigation Project Board of Control in out-years.

Table 3: Biological Criteria – Potential Adaptive Management Measures

Pallid Sturgeon Response	Year (Post Const.)	Adaptive Management Measures*
Upstream Passage of Adult and Juvenile Pallid Sturgeon		
No use of bypass channel	1-3	1) Conduct additional ADCP monitoring at fish entrance 2) Adjust locations of land based telemetry stations 3) Continue active tracking via boat and land based telemetry stations
	3-5	1) Inadequate attraction flows likely; implement modifications based on ADCP findings: ● Boulders – during low flows, use tracked equipment to remove or relocate ● Sand/gravel bar – dredge material ● Guidance structure – construct jetty, wing wall or similar structure to aid location of bypass channel fish entrance ● Channel invert - excavation of the bypass channel deeper to provide increased flow splits into the bypass channel. 2) Shear flows or eddy formation determined to be a problem; implement modification based on ADCP findings: ● Boulders - during low flows, use tracked equipment to remove ● Fill - remove or add additional fill near the entrance to smooth out transitions zone between the bypass channel and the Yellowstone River 3) Sediment build up or rock displacement into bypass channel entrance ● Boulders - during low flows, use equipment to remove ● Sediment - dredge material 4) Entrance location and design determined to be cause ● Entrance angle - adjust the entrance angle to the bypass channel to provide better transition into Yellowstone River. ● Entrance width - adjust the entrance to be larger or smaller to increase passage success. ● Entrance location - move entrance upstream or downstream 5) Conduct additional ADCP monitoring at fish entrance
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation

Use of a portion of the bypass channel; no passage	1-3	1) Conduct additional ADCP monitoring within bypass channel 2) Change location of land based telemetry stations to better determine where the potential passage barrier occurs 3) Continue active tracking via boat and land based telemetry stations
	3-5	1) Issues meeting physical criteria likely; ● Depths - change channel invert, removal of sediment or excavate bypass channel deeper ● Velocities - change channel invert, change control structures, increase depths in bypass channel ● Flow Split - change channel invert or change control structures 2) Passage barrier at control structure or low water crossing, implement modification based on ADCP Data ● Control Structure - add fill to bypass channel to provide better transition over control structure
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation
Upstream passage occurs; less than 85% of motivated adult pallid sturgeon	1-3	1) Conduct additional ADCP monitoring at fish entrance 2) Adjust locations of land based telemetry stations 3) Continue active tracking via boat and land based telemetry stations
	3-5	1) Inadequate attraction flows likely; implement modifications based on ADCP findings: ● Boulders – during low flows, use tracked equipment to remove or relocate ● Sand/gravel bar – dredge material ● Guidance structure – construct jetty, wing wall or similar structure to aid location of bypass channel fish entrance ● Channel invert - excavation of the bypass channel deeper to provide increased flow splits into the bypass channel. 2) Shear flows or eddy formation determined to be a problem; implement modification based on ADCP findings: ● Boulders - during low flows, use tracked equipment to remove ● Fill - remove or add additional fill near the entrance to smooth out transitions zone between the bypass channel and the Yellowstone River 3) Conduct additional ADCP monitoring at fish entrance
	6 - 8	1)Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation

Upstream passage occurs, but does not occur annually;	1 - 3	1) Conduct additional ADCP monitoring within bypass channel 2) Change location of land based telemetry stations to better determine where the potential passage barrier occurs 3) Continue active tracking via boat and land based telemetry stations
	3-5	1) Issues meeting physical criteria in all years likely; ● Depths - change channel invert, removal of sediment or excavate bypass channel deeper ● Velocities - change channel invert, change control structures, increase depths in bypass channel ● Flow Split - change channel invert or change control structures
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation
Upstream passage occurs	1-8	No adaptive management measures required.
Downstream Passage of Adult and Juvenile Pallid Sturgeon		
No downstream passage occurs	1-3	1) Continue active tracking via boat and land based telemetry stations
	3-5	1) Inadequate depth over weir or through the notch ● Fill - Removal or placement of additional fill material to provide better transition over new weir structure, existing weir structure and rubble field ● Wing wall or jetty - placement of wing wall or jetty to direct pallid sturgeon towards the weir notch ● Weir notch - modification of weir not, could be increased in size or depth
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation

Downstream passage occurs but greater than 1% mortality	1-3	1) Continue active tracking via boat and land based telemetry stations
	3-5	1) Inadequate depth over weir, or through the notch ● Fill - removal or placement of additional fill material to provide better transition over new weir structure, existing weir structure and rock field ● Wing wall or jetty - placement of wing wall or jetty to direct pallid sturgeon towards the weir notch ● Weir notch - modification of weir not, could be increased in size or depth 2) Rock field a potential hazard ● Rock - removal of a portion of the downstream rock field
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation
Successful downstream passage - no observed mortality	1-8	No adaptive management measures required
Downstream Drift of Free Embryo and Larval Pallid Sturgeon		
No successful passage of free embryo/larval pallid sturgeon post spawning events	1-3	1) Conduct Larval Drift Study 2) Continue entrainment study on the headworks fish screens 3) Utilize 3-D mapping unit to determine route of free embryos and larvae through the project area
	3-5	1) Inadequate depth over weir or through the notch ● Fill - removal or placement of additional fill material to provide better transition over new weir structure, existing weir structure and rock field ● Wing wall or jetty - placement of wing wall to direct free embryo and larvae towards the weir notch ● Weir notch - modification of weir not, could be increased in size or depth 2) Rock field a potential hazard ● Rock - removal of a portion of downstream rock field
	6-8	1) Conduct modeling and value engineering study to identify further adaptive management measures; reinitiate consultation

Successful passage of free embryo/larval pallid sturgeon	1-8	No adaptive management measures required
		Upstream Passage of Native Fish
Less than baseline upstream passage	1-3	1) Conduct additional ADCP monitoring at fish entrance 2) Adjust locations of land based telemetry stations 3) Continue active tracking via boat and land based telemetry stations
	3-5	1) Inadequate attraction flows likely; implement modifications based on ADCP findings: ● Boulders – during low flows, use tracked equipment to remove or relocate ● Sand/gravel bar – dredge material ● Guidance structure – construct jetty, wing wall or similar structure to aid location of bypass channel fish entrance ● Channel invert - excavation of the bypass channel deeper to provide increased flow splits into the bypass channel. 2) Shear flows or eddy formation determined to be a problem; implement modification based on ADCP findings: ● Boulders - during low flows, use tracked equipment to remove ● Fill - remove or add additional fill near the entrance to smooth out transitions zone between the bypass channel and the Yellowstone River 3) Conduct additional ADCP monitoring at fish entrance
Same as baseline or improvement	1-8	No adaptive management measures required
		Downstream Passage of Native Species
Less than baseline condition	1-3	1) Conduct additional ADCP monitoring at fish entrance 2) Adjust locations of land based telemetry stations 3) Continue active tracking via boat and land based telemetry stations

	3-5	1) Inadequate depth over weir, or through the notch ● Fill - Removal or placement of additional fill material to provide better transition over new weir structure, existing weir structure and rock field ● Wing Wall - placement of wing wall to direct free embryo and larvae towards the weir notch ● Weir Notch - modification of weir not, could be increased in size or depth 2) Rock field a potential hazard ● Rock - removal of a portion of downstream rock field
Same as baseline or improvement from baseline	1-8	No adaptive management measures required

*This table is not intended to be wholly inclusive of all potential adaptive management measures. Management measures not previously analyzed may require additional NEPA and ESA compliance.

6.3 Technical Team Recommendations

The Technical Team will make recommendations on implementation of adaptive management measures to the Executive Team. Consensus recommendations are desirable but not required. Recommendations from Technical Team members that differ from the majority recommendation shall be noted in the Technical Team recommendations.

In order for the Technical Team to make recommendations to the Executive Team, the following questions (which may be revised based upon Technical Team input) need to be considered and addressed during this assessment stage:

1. **Is the Project meeting Physical Criteria?**
    a. If yes, move onto #2
    b. If no, identify potential reason why
        i. If enough information is available, identify a potential adaptive management measure
        ii. If not enough information is available, identify modifications to the monitoring plan that will help gather further information needed to identify the problem.

2. **Is the Project meeting Biological Criteria?**
    a. If yes, move on to #3
    b. If no, identify potential reasons why
        i. If enough information is available, identify a potential adaptive management measure
        ii. If not enough information is available, identify modifications to the monitoring plan that will help gather further information needed to identify the problem.

3. **Does the current monitoring effort need to be intensified or modified?**
    a. If yes, what are they?
    b. If no, continue with current monitoring plan

4. **Does an adaptive management measure need to be implemented?**
    a. If yes, what are they?
    b. If no, no measure is identified

5. **What is the Technical Team's recommendation to the Executive Team?**

7.0 Decision-Making

This step in the process represents adaptive management decision-making based on the current level of understanding and anticipation of the consequences of decision. Once the Technical Team has had a chance to review the results and make recommendations (continue monitoring or implement an adaptive management measure) they will brief the Executive Team. The Executive Team will be responsible for making decisions about the proposed path forward and funding. Reclamation's Regional Director or his delegate will be the final decision-maker on implementation of continued or new monitoring and adaptive management measures stemming from this AMP.

7.1 Executive Team

- Bureau of Reclamation – Regional Director or Delegated Official
- Army Corps of Engineers – Northwest Division Commander or Delegated Official
- U. S. Fish and Wildlife Service – Regional Director or Delegated Official

8.0 Agency Roles, Responsibilities and Funding

Reclamation and the Corps signed a Memorandum of Agreement (April 7, 2015) outlining agency roles and responsibilities as it pertains to this AMP. The Memorandum of Agreement states the following:

8.1 Bureau of Reclamation

Using its own funds, or funding identified through partnerships or contractual agreements, Reclamation shall perform the following activities:

1. Develop an action specific Adaptive Management and Monitoring Plan in consultation with the Corps, the Service, and Montana Fish, Wildlife and Parks.
2. Provide funding and coordinate post-construction adaptive management and monitoring consistent with applicable success criteria specified by the BRT, conferred by the Service, and agreed upon by Reclamation for any Adaptive Management and Monitoring plan modifications.
3. Provide Reclamation staff to lead and execute implementation of any Adaptive Management and Monitoring Plan. Implementation will consist of establishing a Technical Team, and Adaptive Management Workgroup, and Executive Managers who will coordinate and recommend appropriate strategies for any actions as a result of implementing the Adaptive Management and Monitoring Plan. Such recommended action may be carried out with the approval of the parties.
4. Coordinate the execution of operation and maintenance activities consistent with Reclamation's obligations through ESA consultation with the Service for continued

operation of the Lower Yellowstone Project. Operation and maintenance of the new headworks and screens; as well as the fish passage, will commence on each feature as the physical construction of each feature is completed or at the date that feature is deemed substantially complete and put in service and the one year construction warranty on the feature starts. Warranty covers issues related to construction defects. If the defect is caused by O&M activities, then it would not be covered under warranty. Operation and maintenance activities will be conducted concurrent with and Adaptive Management and Monitoring Plan.

5. Provide Reclamation staff to participate in the Environmental Review Team tasked to ensure successful implementation of any environmental commitments.
6. Addition responsibilities as designated and described further in any Adaptive Management and Monitoring Plan, to the extent not inconsistent with the MOA dated April 7, 2015.

8.2 U.S. Army Corps of Engineers

Consistent with its authority under Section 3109 of WRDA 2007, P.L. 110-114, and using its own funds, the Corps shall:

1. Demonstrate and ensure that project design and hydraulic performance criteria have been met. In coordination with the Service and Reclamation, develop the monitoring and measurement plan that will be used to verify that the completed construction project meets the design and hydraulic performance criteria. The plan shall include measurement of flow split to the bypass channel, bypass channel depth, and bypass channel velocity within the range of specified in the design criteria. Additionally, the plan shall account for uncertainty and inherent variability of flow conditions in the bypass channel.
2. The Corps, in coordination with Reclamation, will complete any construction modifications required to meet the design and hydraulic performance criteria (i.e. correction of any design and/or construction related deficiencies) identified within the one year warranty period after substantial completion.
3. Provide Corps' staff to participate in the Environmental Review Team tasked to ensure successful implementation of any environmental commitments.
4. Addition responsibilities as designated and described further in any Adaptive Management and Monitoring Plan, to the extent not inconsistent with the MOA dated April 7, 2015.

9.0 Reporting

Reclamation will provide annual reports to the Service documenting monitoring results and previous management actions. Recommendations for changes to monitoring or management actions will be proposed as necessary and this document may be updated and reissued.

For each monitoring element, the report will document the methods and results. Results will be evaluated with respect to the goals and objectives of the adaptive management program, and may indicate that changes in monitoring priorities and management activities are warranted.

10.0 Data Management

All monitoring data will be stored electronically on a secured server maintained by Reclamation and will comply with Reclamation's proposed data stewardship guidelines. All data collected by contractors will be provided to Reclamation in an agreed upon electronic format. Additionally, contractors will provide hard copies of any field notes or data sheets. Upon completion of the Monitoring and Adaptive Management Program, all data, results of analyses, and reports will be archived.

11.0 References

Bramblett, R. G. 1996. Habitats and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota. PhD dissertation. Montana State University, Bozeman.

Delonay, A.J., K.A. Chojnacki, R.B. Jacobson, J.L. Albers, P.J. Braaten, E.A. Bulliner, C.M. Elliott, S.O. Erwin, D.B. Fuller, J.D. Haas, H.L.A. Ladd, G.E. Mestl, D.M. Papoulias, and M.L. Wildhaber. 2016. Ecological Requirements for Pallid Sturgeon Reproduction and Recruitment in the Missouri River – A Synthesis of Science, 2005 to 2012. U.S.G.S. Scientific Investigations Report 2015-5145.

Guy, C., H.B. Treanor, K.M. Kappenman, E.A. Scholl, J.E. Ilgen, and M.A.H. Webb, 2015. Broadening the Regulated-River Management Paradigm: A Case Study of the Forgotten Dead Zone Hindering Pallid Sturgeon Recovery. Fisheries 40(1)

Kynard, B; Kieffer, M.; Horgan, M.; Burlingame, M.; Vinogradov, P.; Kynard, B. E. 2012: Seasonal movements among river reaches, migration strategies, and population structure of the divided Connecticut River shortnose sturgeon population: The effects of Holyoke Dam. WSCS Spec. Publ. No. 4. pp. 1−49.

Williams, B. K., and E. D. Brown. 2012. Adaptive Management: The U.S. Department of the Interior Applications Guide. Adaptive Management Working Group, U. S. Department of the Interior, Washington, DC.

APPENDIX B – SPECIES LIST
MONTANA AND NORTH DAKOTA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Montana Ecological Services Field Office
585 SHEPARD WAY, SUITE 1
HELENA, MT 59601
PHONE: (406)449-5225 FAX: (406)449-5339

Consultation Code: 06E11000-2016-SLI-0118 January 19, 2016
Event Code: 06E11000-2016-E-00041
Project Name: Yellowstone River Environmental Impact Statement

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

Official Species List

Provided by:

Montana Ecological Services Field Office
585 SHEPARD WAY, SUITE 1
HELENA, MT 59601
(406) 449-5225

Expect additional Species list documents from the following office(s):

North Dakota Ecological Services Field Office
3425 MIRIAM AVENUE
BISMARCK, ND 58501
(701) 250-4481
http://www.fws.gov/northdakotafieldoffice/endspecies/endangered_species.htm

Consultation Code: 06E11000-2016-SLI-0118
Event Code: 06E11000-2016-E-00041

Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Name: Yellowstone River Environmental Impact Statement
Project Description: Preparation of an Environmental Impact Statement for modifications to existing instream features on the Yellowstone River. The U.S. Army Corps of Engineers and Bureau of Reclamation are joint lead agencies for the NEPA process. This project includes proposed modifications for entrainment reduction and fish passage improvement on the Yellowstone River.

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

United States Department of Interior
Fish and Wildlife Service

Project name: Yellowstone River Environmental Impact Statement

Project Location Map:

Project Coordinates: The coordinates are too numerous to display here.

Project Counties: Dawson, MT | Richland, MT | Wibaux, MT | McKenzie, ND

Endangered Species Act Species List

There are a total of 5 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Birds	**Status**	**Has Critical Habitat**	**Condition(s)**
Least tern *(Sterna antillarum)* Population: interior pop.	Endangered		
Piping Plover *(Charadrius melodus)* Population: except Great Lakes watershed	Threatened	Final designated	
Sprague's Pipit *(Anthus spragueii)*	Candidate		
Whooping crane *(Grus americana)* Population: except where EXPN	Endangered	Final designated	
Fishes			
Pallid sturgeon *(Scaphirhynchus albus)* Population: Entire	Endangered		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Dakota Ecological Services Field Office
3425 MIRIAM AVENUE
BISMARCK, ND 58501
PHONE: (701)250-4481 FAX: (701)355-8513
URL:
www.fws.gov/northdakotafieldoffice/endspecies/endangered_species.htm

Consultation Code: 06E15000-2016-SLI-0095 January 19, 2016
Event Code: 06E15000-2016-E-00192
Project Name: Yellowstone River Environmental Impact Statement

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Yellowstone River Environmental Impact Statement

Official Species List

Provided by:

North Dakota Ecological Services Field Office
3425 MIRIAM AVENUE
BISMARCK, ND 58501
(701) 250-4481
http://www.fws.gov/northdakotafieldoffice/endspecies/endangered_species.htm

Expect additional Species list documents from the following office(s):

Montana Ecological Services Field Office
585 SHEPARD WAY, SUITE 1
HELENA, MT 59601
(406) 449-5225

Consultation Code: 06E15000-2016-SLI-0095
Event Code: 06E15000-2016-E-00192

Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Name: Yellowstone River Environmental Impact Statement
Project Description: Preparation of an Environmental Impact Statement for modifications to existing instream features on the Yellowstone River. The U.S. Army Corps of Engineers and Bureau of Reclamation are joint lead agencies for the NEPA process. This project includes proposed modifications for entrainment reduction and fish passage improvement on the Yellowstone River.

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

Project Location Map:

Project Coordinates: The coordinates are too numerous to display here.

Project Counties: Dawson, MT | Richland, MT | Wibaux, MT | McKenzie, ND

Endangered Species Act Species List

There are a total of 10 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Birds	Status	Has Critical Habitat	Condition(s)
Least tern *(Sterna antillarum)* Population: interior pop.	Endangered		
Piping Plover *(Charadrius melodus)* Population: except Great Lakes watershed	Threatened	Final designated	
Red Knot *(Calidris canutus rufa)*	Threatened		
Sprague's Pipit *(Anthus spragueii)*	Candidate		
Whooping crane *(Grus americana)* Population: except where EXPN	Endangered	Final designated	
Fishes			
Pallid sturgeon *(Scaphirhynchus albus)* Population: Entire	Endangered		
Insects			
Dakota Skipper *(Hesperia dacotae)*	Threatened	Final designated	
Mammals			
Black-Footed ferret *(Mustela nigripes)* Population: U.S.A. (WY and specific portions	Experimental Population, Non-		

of AZ, CO, MT, SD, and UT)	Essential		
Gray wolf *(Canis lupus)* Population: U.S.A.: All of AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, and WV; and portions of AZ, NM, OR, UT, and WA. Mexico.	Endangered		
Northern long-eared Bat *(Myotis septentrionalis)*	Threatened		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

United States Department of the Interior
BUREAU OF RECLAMATION
Great Plains Region
Montana Area Office
P.O. Box 30137
Billings, Montana 59107-0137

IN REPLY REFER TO:
MT-100
ENV-7.00

SEP 9 2016

MEMORANDUM

To: Assistant Regional Director, Michael Thabault
Ecological Services, U.S. Fish and Wildlife Service, Lakewood, Colorado

From: Steve Davies
Area Manager

Subject: Amendment to the Biological Assessment for the Intake Diversion Dam Fish Passage Project, Lower Yellowstone Project, Montana

The Bureau of Reclamation, Montana Area Office (Reclamation) amends the Biological Assessment for the Intake Diversion Dam Fish Passage Project, submitted to your office on August 29, 2016. Based on conversations during formal consultation, Reclamation and the Fish and Wildlife Service determined additional language regarding funding would be beneficial in the Monitoring and Adaptive Management Section of the Biological Assessment and Section 8.0 of the Monitoring and Adaptive Management Plan found in Appendix A.

Reclamation believes this language supports our commitment to this project and clarifies how Reclamation intends to respond to near-term issues that may arise with operation of the proposed bypass channel.

The new language is as follows:

> Reclamation recognizes there may be adaptive management measures or additional monitoring that the Technical and Executive teams believe are beneficial to implement in response to monitoring or other data, which are not planned in Reclamation's budget (i.e., actions that should be implemented with some immediacy). To address this, Reclamation plans to provide additional funding for these measures through transfers or other means within existing authorities.
>
> Historically, Reclamation's annual appropriations bill has included authority to perform fund transfers. Based on current authority, a fund transfer may be performed to provide "up to $300,000 for any program, project or activity for which less than $2,000,000 is available at the beginning of the fiscal year". The Lower Yellowstone Project (Project) falls into this category and could benefit from this authority in the year of execution.
>
> Reclamation has used its authority to fund these types of unanticipated monitoring and investigations associated with pallid sturgeon entrainment monitoring and passage planning activities over the last several years. As an example, Reclamation used the fund transfer authority in FY 2016 to provide an additional $229,000 to the Project's enacted level of $380,000, resulting in total funding of $609,000 for Project use. Because the benefits of this monitoring, data gathering, and analysis are not limited to the Project, expenditure of these funds is considered non-reimbursable.

If you have any questions or require additional information, please contact David Trimpe at 406-247- 7717.

cc: U. S. Fish and Wildlife Service
Montana Ecological Services Field Office
Attn: Jodie Bush, Brent Esmoil
585 Shepard Way, Suite 1
Helena, MT 59601

U.S. Fish and Wildlife Service
Attn: Doug Laye
134 Union Boulevard, Suite 650
Lakewood, CO 80228

U.S. Army Corps of Engineers Omaha District Headquarters
Attn: Tiffany Vanosdall
1616 Capitol Avenue Suite 9000
Omaha, NE 68102

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
FWS/R6/ES
DTS
In Reply Refer To:
FWS/R6/ES/TAILS #
06E00000-2017-F-0001

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134 Union Boulevard
Lakewood, Colorado 80228-1807

NOV 18 2016

Memorandum

To: Area Manager, Billings, Montana
Bureau of Reclamation

From: Assistant Regional Director, Ecological Services

Subject: Consultation on Effects from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project

This memorandum responds to the Bureau of Reclamation's (Reclamation) and the U. S. Army Corps of Engineers (Corps) request for consultation with the Fish and Wildlife Service (Service) on effects of the subject project to species and habitats listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; [Act]). The request dated August 29, 2016, and received electronically the same day included a biological assessment entitled *Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project (*Assessment), dated August 2016. Through the Assessment, the Reclamation and Corps determined that the subject project may affect several listed species. The final effects determinations are presented below.

Species	Listing status	Determination
Pallid sturgeon (*Scaphirhynchus albus)*	endangered	likely to adversely affect
Interior least tern (*Sterna antillarum athalassos*)	endangered	not likely to adversely affect
Whooping crane (*Grus Americana*)	endangered	no effect
Piping plover (*Charadrius melodus*)	threatened	not likely to adversely affect
Red knot (*Calidris canutus*)	threatened	no effect
Black-footed ferret (*Mustela nigripes*)	Experimental, non-essential population	no effect
Gray wolf (*Canis lupus*)	endangered	no effect
Northern long-eared bat (*Myotis septentrionalis*)	threatened	not likely to adversely affect
Dakota skipper (*Hesperia dacotae*)	threatened	no effect

The Service has prepared a biological opinion with a finding that the proposed project is not likely to jeopardize the pallid sturgeon and has attached it to this memo. We also concur (below) with Reclamation's and the Corps determinations for the Interior least tern, piping plover and Northern long-eared bat.

For the remainder of the species, we acknowledge your determinations, but neither 7(a)(3) of the Act, nor implementing regulations under section 7(a)(2) of the Act require the Service to review or concur with the remaining effect determinations; therefore the Service will not address them further. However, we do appreciate you informing us of analysis for these species even if not required to do so under the Act.

Concurrence for Interior least tern

Terns are known to occur in the action area, though the action area is at the limit of the tern's preferred range (Assessment, p. 40). Terns would most likely be present during their breeding season which is April through September. If terns were nesting on the river, changes in water elevation could flood nests. The proposed action will not result in any significant change from baseline of the amount of flow or water elevations in the action area, thus even if terns nests were present, the likelihood of effects from the action are discountable.

The bypass channel construction would include very limited work near any tern habitat and there are no records of terns nesting in that area (Assessment, p. 101). Therefore likelihood of exposure of terns to construction activities is discountable. In the remote chance that nesting terns are found, Reclamation and the Corps will buffer them from activities by 0.25 miles or line of sight (Assessment p. 101) thereby minimizing any effects to an insignificant level.

Annual project operation and maintenance activities are not likely to have any impact on tern habitat along the Yellowstone River, because the majority of the activities are within the Lower Yellowstone Irrigation Project lands off of the river. These areas are not likely to have habitat for terns and likelihood of effects is discountable.

Based on Service review of the Assessment, we concur with the determination that the project outlined in the Assessment and this memorandum, may affect but is not likely to adversely affect the Interior least tern.

Concurrence for piping plover

Piping plovers are likely to be in the action are and nesting has been confirmed below the Intake Diversion Dam (Assessment, p. 101-102). Like terns, plovers would most likely be present between April and September. The construction activities are planned in areas that have little nesting habitat and there are no nesting records for that area (Assessment, p. 102). As with terns, if plovers were nesting on the river, changes in water elevation could flood nests. The proposed action will not result in any significant change from baseline of the amount of flow or water elevations in the action area, thus even if terns nests were present, the likelihood of effects from the action are discountable.

Construction on the bypass channel is not anticipated to degrade any existing plover habitat around the project site. Therefore likelihood of exposure of plovers to construction activities is discountable. In the remote chance that nesting plovers are found, Reclamation and the Corps will buffer them from activities by 0.25 miles or line of sight (Assessment p. 102) thereby minimizing any effects to an insignificant level.

Annual project operation and maintenance activities are not likely to have any impact on plover habitat along the Yellowstone River, because the majority of the activities are within the Lower Yellowstone Irrigation Project lands off of the river. These areas are not likely to have habitat for plovers and likelihood of effects is discountable.

Based on Service review of the Assessment, we concur with the determination that the project outlined in the Assessment and this memorandum, may affect but is not likely to adversely affect the piping plover.

Concurrence for Northern long-eared bat

The Lower Yellowstone Irrigation Project is on the very western edge of the species range with only one known sighting in Montana in 1978 (Assessment, p. 103). The bats have been documented in North Dakota, but no hibernacula have been documented (Assessment, p. 103). Suitable habitat in the form of large hardwood trees in the area of construction is very limited.

Because the likelihood of the species even occurring in the action area is very low, the likelihood of an effect to the bat is discountable. Therefore the Service concurs with the determination that the project outlined in the Assessment and this memorandum, may affect but is not likely to adversely affect the Northern long-eared bat.

This concludes consultation for the Interior least tern, piping plover and northern long-eared bat. Further consultation pursuant to section 7(a) (2) of the Act is not required. Reinitiation of consultation on this action may be necessary if new information reveals effects of the action that may affect listed species or designated habitat in a manner or to an extent not considered in the assessment, the action is subsequently modified in a manner that causes an effect to listed species that was not considered in the analysis, or a new species is listed or critical habitat is designated that may be affected by the proposed action.

Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; [FWCA])

Reclamation and the Corps have coordinated extensively with the Service on this project and have included many measures to reduce impacts to fish and wildlife. The Service has no additional measures to recommend and will not be providing a report under the FWCA.

Attachment

cc: Montana FWS Field Office, Helena, Montana
Army Corps of Engineers, Omaha, Nebraska

BIOLOGICAL OPINION
On effects to the pallid sturgeon from the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project

TAILS No. 06E00000-2017-F-0001

Pallid sturgeon (*Scaphirhynchus albus)*

FISH AND WILDLIFE SERVICE
Mountain Prairie Region
Denver, Colorado

Assistant Regional Director for Ecological Services ______________________

Date November 18, 2016

Introduction

The pallid sturgeon is a large river fish that can reach six feet in length, weigh up to 80 pounds and live 50 years, perhaps longer. For thousands of years it has lived, fed, and bred in the large rivers of the West – the Missouri, Yellowstone, and Mississippi. Just over 100 years ago, humans began placing barriers in many of these rivers to collect and manage water to control flooding, support navigation, irrigate crops as well as other uses. This greatly impeded, and in some cases entirely blocked the sturgeon from free movement in the rivers, which in turn, impaired the sturgeon's ability to carry out its full complement of biological functions necessary for its long term survival. The existing Intake Diversion Dam, which supplies water to the Lower Yellowstone Project, is one of those barriers.

The barriers in the large rivers led to a precipitous decline in the numbers of pallid sturgeon; so much so that in 1990 they were listed as endangered under the Endangered Species Act of 1973. Fish raised in hatcheries have been introduced and there are now thousands that have survived and hundreds of them are just now reaching spawning age. As for wild (non-hatchery) sturgeon, only 125 are believed to inhabit the area downstream of Intake Diversion Dam, and none currently inhabit the Yellowstone River above the weir. Every year adult sturgeon swim up to the weir from farther down the Yellowstone and the Missouri River in an attempt to pass upriver to their likely historical spawning grounds, but the weir blocks movement of the adults including the maturing hatchery fish. As time passes, the number of wild, spawning adults grows older and some die, causing the already small wild portion of the population to dwindle to even lower numbers.

Now, the United States Bureau of Reclamation (Reclamation) and the United States Army Corps of Engineers (Corps) are proposing to construct a bypass channel and alter the Intake Diversion Dam, allowing sturgeon to move upstream of the structure and again have access to an additional 162 miles of the Yellowstone River. The habitat above Intake was likely used by the sturgeon for many life history behaviors. If this project is successful, it will be the first time in approximately one hundred years that the sturgeon will have the consistent ability to move beyond the weir and access this additional habitat. This would be a substantial step forward in assisting the long term survival and recovery of the sturgeon in the Upper Missouri River because it is expected to allow access to spawning habitat and potentially provide sufficient drift distance for developing larvae.

As perhaps a harbinger of that future condition, in 2014 there was an unusually high run-off flood event and five tagged sturgeon were able to find their way past the weir by using the existing, but rarely flowing high-flow channel. One of those fish was a female with eggs. Three of these fish, the female and two males, were later located in the Powder River, a tributary to the Yellowstone River. The female was captured shortly after her return to the Yellowstone, and her lack of eggs confirmed that she had likely spawned upriver of the Intake Diversion Dam, perhaps in or near the Powder River. After spawning, the fish returned to the Yellowstone River below the weir. This is the first time the likelihood of spawning has been documented above the weir. In 2015 a juvenile sturgeon also used this channel to pass upstream of Intake Diversion Dam.

A necessary step in the process of implementing this important passage project is meeting a consultation requirement from the Endangered Species Act. In that Act, Congress required that every federal agency must insure that any action "*...authorized, funded, or carried out...is not likely to jeopardize the continued existence of any endangered or threatened species...*". To meet this requirement, Congress required that the action agencies request assistance from the United States Fish and Wildlife Service and seek their biological opinion regarding whether the proposed action is likely to jeopardize the continued existence of a listed species.

This document, then, is the Fish and Wildlife Service's biological opinion on Reclamation's and Corps' proposed action at the Intake Diversion Dam and its effects to the pallid sturgeon. In this document, the Fish and Wildlife Service finds that though there are some limited minor adverse effects to the sturgeon, the action is not likely to jeopardize the continued existence of the pallid sturgeon. And in fact, we believe the proposed action implements a high priority goal of the recovery plan and constitutes a substantial improvement to the outlook for the survival and recovery of this ancient fish in the Upper Missouri River.

Purpose of this Consultation and the Service's Biological Opinion

In section 7 of the Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.* (ESA or Act), Congress required that every federal agency must insure that any action "*...authorized, funded, or carried out...is not likely to jeopardize the continued existence of any endangered or threatened species...*". 16 U.S.C. §§ 1536(a)(2). This is known as a section 7(a)(2) finding under the ESA. To meet this requirement, Congress required that the action agencies request assistance from the United States Fish and Wildlife Service (Service) and seek their biological opinion (BO) regarding whether the proposed action is likely to jeopardize the continued existence of a listed species. Agency responsibilities are further set forth in regulations implementing the ESA at 50 CFR Part 402. The definition of "Jeopardize the continued existence of" is "*...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.*" 50 CFR § 402.02.

The Service's BO is not a review of the prudency of the proposed action or judgment regarding its value or effectiveness relative to other potential projects, or of the action agency taking no action. Rather, the task of the Service is to offer a BO as to whether the proposed action of creating a fish passage channel around the Intake Diversion Dam and the operation and maintenance of the Lower Yellowstone Project (Irrigation Project) is likely to jeopardize the continued existence of the pallid sturgeon. This biological opinion does not address critical habitat for pallid sturgeon because none has been designated.

How the Service develops a biological opinion

To address the threshold question of whether an agency action is likely to jeopardize the continued existence of a listed species, the Service evaluates the following four categories of information.

Status of the Species - This category represents the biological or ecological information relevant to formulating a BO and focuses on the current condition of the species (i.e. numbers, reproduction, distribution, etc.). The information is a broad and general examination of the species biology and condition at the scale of its range as described in its listing. This also includes a review of any factors that have, and are, influencing the species status.

Environmental Baseline - This category is similar to the status of the species in that it describes the condition of the species and its habitat, but is focused and limited to the action area (the areas where the proposed action will modify the land, water or air.) Information also includes a review of any factors that have and are influencing the species condition at the scale of the action area.

Effects of the Action - This category of information is the Service's review of the action agency's analysis and discussion of how the proposed action (modifications to land, water, and air) are likely to result in an effect to the species. The analysis is the responsibility of the action agency and is required as part of the materials submitted to the Service when requesting formal consultation (CFR 402.14). It describes how the proposed action modifies the environment, whether listed species will be exposed to those modifications, what the species' response will likely be if exposure occurs and then what biological effect (if any) is likely to result from the response.

Cumulative effects - This category describes the effects to the species (if any) from any future non-federal actions that are reasonably certain to occur in the action area.

The synthesis of all this information forms the Service's opinion on the 7(a)(2) finding. The Service examines the effects from the proposed action and whether those effects resonate at the scale of the listed entity in such a way as to be likely to meet the elements in the definition of Jeopardy (*... to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.*" 50 CFR § 402.02). If the opinion of the Service is that the proposed action is not likely to jeopardize the continued existence of the species, then consultation is complete and this will inform the action agencies' decision on whether to move forward with the action.

If the Service finds that the proposed action is likely to jeopardize the species, the Service, working with the action agency, must develop a reasonable and prudent alternative (RPA) to the proposed action. However, the options for developing this RPA are not unlimited. By regulation (CFR 402.02), it must meet the following criteria.

1) The alternative action can be implemented in a manner consistent with the intended purpose of the action.
2) The alternative action can be implemented in a manner consistent with the scope of the Federal agency's legal authority and jurisdiction.
3) The alternative action is economically and technologically feasible.
4) It must avoid the likelihood of jeopardizing the continued existence of listed species.

In all cases where discretionary Federal involvement or control over the action has been retained or is authorized by law, the action agency is responsible for monitoring the progress of its action and re-initiating the consultation if any of the following four conditions are met.

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
4) If a new species is listed or critical habitat designated that may be affected by the identified action. 50 CFR § 402.16.

History of Coordination and Consultation to Provide Fish Passage at the Intake Diversion Dam

The following information is drawn directly from Reclamation's and Corps' 2016 biological assessment (Assessment), pages 22 through 25. A more detailed discussion of this history can be found there.

Background - For over 25 years Reclamation, the Corps and the Service have engaged in studies, coordination and consultations regarding providing fish passage at the Intake Diversion Dam. Most recently, in 2015 Reclamation requested 7(a)(2) consultation on a similar project as the one analyzed in this BO. The Service found that the proposed action in that consultation was not likely to jeopardize the pallid sturgeon (Service 2015b). Subsequent court action regarding consistency with the National Environmental Policy Act 42 U.S.C. §§ 4321 *et seq*. (NEPA) led the action agencies to reevaluate their proposed action. As part of this reevaluation, the action agencies reinitiated consultation with the Service. The Service, Reclamation and Corps staffs have worked closely to share information on the project, sturgeon life history, monitoring and associated topics. Records of that coordination are included in our consultation file.

History -The pallid sturgeon was listed by the Service in 1990 and as early as 1992, the Service initiated discussions with Reclamation regarding obligations to consult and address fish passage and entrainment issues at Intake Diversion Dam.

Service comments on a preliminary draft biological assessment for continued O&M of the Lower Yellowstone Project (LYP) in 1993 emphasized the importance of fish passage and entrainment protection at the Intake Diversion Dam. At the same time, the Corps was consulting with the Service on the operation of their six main-stem dams and reservoirs on the Missouri River. At the conclusion of that consultation, the Service recommended the Corps work with Reclamation to resolve pallid sturgeon passage issues at the Intake Diversion Dam.

In 2005, the Corps, Service, Reclamation, The Nature Conservancy, and Montana Fish Wildlife and Parks signed a memorandum of understanding agreeing to work together to resolve the passage and entrainment issues at Intake. By 2006, preliminary designs for passage and entrainment were being considered in addition to continued research on fish passage and entrainment specific to pallid sturgeon.

In 2007, Water Resources Development Act authorized the Corps to use funding from the Missouri River Recovery and Mitigation Program to assist Reclamation in compliance with federal laws and to design and construct modifications at Intake for the purpose of Yellowstone River ecosystem restoration.

By 2008, the Corps and Reclamation had identified alternatives to resolve the fish passage and entrainment issues and initiated the NEPA compliance process in September. The *Intake Diversion Dam Modification Environmental Assessment* was published by Reclamation and the Corps to analyze and disclose effects associated with construction of the proposed modifications to the diversion weir and headworks. The EA described the anticipated effects of the selected fish passage alternative – the Rock Ramp Alternative.

In April 2010, Reclamation and the Corps made the decision to proceed with the modifications, and a construction contract for the new headworks and fish screens was awarded in July 2010. At the same time, the Corps started with the final design of the rock ramp so a construction contract could be awarded in 2011. The conceptual design level cost estimate for the rock ramp was approximately $18 million. In late 2010 and early 2011, the estimated costs for the rock ramp design significantly increased to nearly $90 million due to the detailed design analysis.

In April 2011, Reclamation and the Corps determined further evaluation of other alternatives for improving fish passage was necessary to address the issues that had arisen since 2010. In addition to new cost information, new information regarding pallid sturgeon behavior also became available. Originally, because of uncertainties in pallid sturgeon movement, one of the requirements of the Service's Biological Review Team's (BRT) passage criteria was full riverwidth passage. However, based on new information documenting pallid sturgeon use of side channels (Braaten et al. 2014), the BRT relaxed this criterion in 2011. Reclamation and the Corps believed there was merit in revisiting a bypass channel alternative that had been previously considered but eliminated from detailed study because it did not provide full channel passage. Through collaborative efforts, further data, and preliminary design reviews, Reclamation, the Corps, and stakeholders supported further analysis of a bypass alternative. Changes to the project were substantial enough to trigger preparation of supplemental EA prior to a decision on how to proceed with fish passage.

Construction of the headworks and fish screens was initiated in 2011 and completed in April 2012. Water was first delivered to the LYP using the new headworks structure in May 2012. Because the passage component was delayed while other alternatives were reconsidered, Reclamation and the Service agreed to consult on O&M of the new headworks and fish screens with the commitment to continue consultation on the overall long-term O&M of the LYP once a passage alternative had been identified. Reclamation submitted the *Lower Yellowstone Irrigation Project Intake Headworks and Fish Screens Operations and Maintenance Biological Assessment* to the Service on February 10, 2012. Consultation on this action was completed through informal consultation and issuance of a concurrence letter on March 7, 2012.

Following the 2011 record high flows, approximately 1,500 cubic yards of rock were needed to repair the weir so the LYP could divert its full water right. It was also determined that the diversion weir needed to be maintained to an elevation of 1,991.0 feet due to the head loss through the screens. Consultation on this aspect of rock placement action was initiated with the Service and completed through a concurrence letter from the Service on May 2, 2014.

On December 14, 2014, Reclamation submitted a biological assessment to address the potential effects of the continued O&M of the LYP with the proposed bypass channel alternative for fish passage. Shortly after the submittal of this BA, Reclamation in conversations with the Service determined that an amended BA should be submitted covering construction of the replacement weir and bypass channel, interim operation of the LYP until construction was complete, and the future O&M of the LYP with fish passage and entrainment protection.

In April of 2015 an amended biological assessment was submitted to the Service for formal consultation. On July 10, 2015, Reclamation received a BO from the Service stating that the Lower Yellowstone Irrigation Project and construction of a fish passage project would not cause jeopardy, but was likely to adversely affect pallid sturgeon due to the presence of the existing weir without an alternate passage route during the 2- 3 years of construction, potential future entrainment/impingement of free embryos and larvae at the headworks/screens and physical presence of the replacement weir and bypass channel.

As part of the 2015 consultation, the corps requested that their role in the proposed action at the Intake Diversion Dam be considered as "*...a substitute for the relevant RPA elements from the 2003 biological opinion.*" The Service granted this request. However, when the Corps reinitiated consultation on the Intake project in 2016, the Corps did not request that its proposed action at Intake substitute for RPA elements on the Missouri as it had in 2015. Reclamation and the Corps' proposed action at Intake is independent from the 2003 biological opinion and the consultation that is now occurring on the Missouri. With respect to the consultation on the Missouri, currently the Corps of the Kansas City and Omaha Districts are preparing the Missouri River Recovery Management Plan to develop a range of alternatives for management of the Missouri River. This federal action is organized around an adaptive management approach that is intended to be consistent with the purposes of the Act and enhance recovery of the pallid sturgeon. Impacts of river management to pallid sturgeon, management actions to reduce effects to the pallid sturgeon, and actions to support recovery of the pallid sturgeon will be considered as part of the consultation on that plan. The Corps has reinitiated consultation on the Missouri River Recovery Management Plan and coordination between the Corps and the Service for that consultation has already begun. Thus, the Service has conducted a separate consultation on the Intake project while another consultation proceeds on the Missouri. Although these are now two separate consultations, the Service has nevertheless analyzed the effects of the relevant Missouri operations that had originally been part of the 2003 biological opinion in the present Intake biological opinion. This was done to ensure that the Service had adequately captured the context and status of the species as well as future and historical effects.

On August 29, 2016 the Service received Reclamation's and the Corps' request for consultation and a biological assessment entitled *Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project.*

1.0 PROPOSED ACTION

The proposed action includes four components.

" • *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 (Section 10) by the Corps (Corps action);*

• *Construction of a bypass channel and replacement weir to improve upstream and downstream fish passage at the Intake Diversion Dam (Corps action);*

• *Operation and maintenance of the LYP after implementation of the fish passage project (Reclamation action); and*

• *Implementation of an adaptive management and monitoring plan (Corps and Reclamation action).*"

These components are often implemented by Reclamation and the Corps through contracts, agreements, and permits. For example, Reclamation retains ownership of the facilities of the Lower Yellowstone Project, but Operation and Maintenance is carried out by the Lower Yellowstone Irrigation Project Board through contracts with Reclamation. Similarly, permits authorized by the Corps for under Section 10 are carried out by the permittee.

For simple organization, the four main components were broken into additional elements (Assessment pp. 9-21).

1. Operation and maintenance prior to and during construction of the proposed fish passage improvements

    Existing headworks
    Existing diversion weir (including continued placement of rock)
    Supplemental pumps
    Main canals and lateral canals
    Weed control

2. Construction of replacement weir and bypass channel for fish passage
    Replacement weir
    Bypass channel

3. Future operation and maintenance of the Irrigation Project
    Existing headworks
    Replacement weir
    Bypass channel
    Main canals and lateral canals

Supplemental pumps
Weed control

4. Monitoring and adaptive management
   Bypass channel design and performance
   Pallid sturgeon passage criteria
   Native fish passage

For clarity in assessment and analysis, the Assessment deconstructed the four main components and associated elements into a total of 47 elements (pp. 58-69). During all these activities, general conservation measures such as working behind coffer dams, doing instream work outside of the pallid sturgeon's migration and spawning period, and "ramping up" activities that create high levels of noise will be employed to reduce the likelihood and significance of effects to all life stages of the pallid sturgeon (Assessment p. 100).

1.1 Action Area

The description of action area is informed by the following definitions.

Action – "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 – "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." 50 CFR 402.02

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..."

The Service finds that the Assessment's described action area is appropriate and finds no need to modify it for this BO.

2.0 STATUS OF THE SPECIES

Introduction

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, its habitat and distribution, and other data on factors necessary to its survival, is included to provide the background for analyses in later sections (Service 1998 p. 4-19). The scale of the Status section is at the scale of the listed entity or range of the species. The Environmental Baseline section (Section 3.0 below) will provide similar types of information, but at the action area scale (50 CFR § 402.02, Service 1998 p. 4-22).

Information in this section is drawn largely from the Service's Environmental Conservation Online System http://ecos.fws.gov/ecos/home.action, Reclamation's 2016 assessment, Service's Revised Pallid Sturgeon Recovery Plan (Service 2014). Reclamation's 2014 biological assessment (pp. 29-36), and Reclamation's 2010 Environmental Assessment (Reclamation 2010).

2.1 Legal status

The sturgeon was listed as endangered under the ESA on September 6, 1990. No critical habitat for this species has been designated under the Act.

2.2 Description

The sturgeon is a large river fish that can reach six feet in length, weigh up to 80 pounds and can live 50 years and perhaps much longer. For thousands of years it has lived, fed, and bred in the large rivers of the West – the Missouri, Yellowstone, and Mississippi. They are a bottom-oriented, large river obligate fish. They are similar in appearance to the more common shovelnose sturgeon. Both species inhabit overlapping portions of the Missouri and Mississippi river basins. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters formed the large-river ecosystem that met the habitat and life history requirements of sturgeon and other native large-river fishes. Sturgeon have been documented over a variety of available substrates, but are often associated with sandy and fine bottom materials.

2.3 Habitat

Research into habitat use produced useful insights for many portions of the sturgeon's range. However, much of these data are based on habitat characterizations in altered environments, in some cases substantially altered environments, including an altered hydrograph and temperatures, suppression of fluvial processes, stabilized river banks, loss of natural meanders and side channels, fragmented habitats, and increased water velocities. Thus, information and current understanding of habitat use may not necessarily reflect preferred habitats for the species, but rather define suitable habitats within an altered ecosystem.

Sturgeon primarily utilize main channel, secondary channel, and channel border habitats throughout their range. Juvenile and adult sturgeon are rarely observed in habitats lacking flowing water which are removed from the main channel (i.e., backwaters and sloughs). Specific patterns of habitat use and the range of habitat parameters used may vary with availability and by life stage, size, age, and geographic location. In the upper portions of the species' range, juvenile hatchery-reared sturgeon select main-channel habitats (Gerrity 2005). In the Yellowstone and Platte rivers, adult sturgeon select areas with frequent islands and sinuous channels while rarely occupying areas without islands or with straight channels (Bramblett and White 2001; Snook et al. 2002; Peters and Parham 2008). In the middle Mississippi River, sturgeon select for areas downstream from islands that are often associated with channel border habitats and select against main-channel habitats (Hurley et al. 2004). Other Mississippi River capture locations tend to be near the tips of wing-dikes (an engineered channel training structure), steep sloping banks, and channel border areas (Killgore et al. 2007b; Schramm and Mirick 2009).

2.5 Food

Data on food habits of age-0 sturgeon are limited. In a hatchery environment, exogenously feeding fry (fry that have absorbed their yolk and are actively feeding) will readily consume brine shrimp suggesting zooplankton and/or small invertebrates are likely the food base for this age group. Data available for age-0 Scaphirhynchus indicate mayflies and midge larvae are important. Juvenile and adult sturgeon diets are generally composed of fish and aquatic insect larvae with a trend toward eating fish as they increase in size. Based on the above diet data and habitat utilization by prey items, it appears that sturgeon will feed over a variety of substrates, however, the abundance of Trichoptera (insect group including caddis flies) in the diet suggests that harder substrates like gravel and rock material may be important feeding areas.

2.6 Life cycle

Spawning

Between March and July, reproductive adult sturgeon (15-20 years old) swim upstream in search of a suitable areas to spawn, carry out spawning and return downriver. The environmental cues for this movement are the rising and peaking river hydrograph and water temperature. Spawning movement occurs in approximately late May – early June in the Yellowstone River. Spawning areas tend to be where firm river bottom substrates occur in deeper water with relatively fast turbulent water flow (without the correct conditions spawning success is reduced). Sturgeon do not create a redd (or nest) in the gravel for the eggs. Spawning takes place when the female sturgeon releases eggs into the river current and nearby males immediately fertilize the eggs by releasing milt directly into the flowing current of the river containing the eggs. The largest upper Missouri River fish can produce as many as 150,000-170,000 eggs, whereas smaller bodied females in the southern extent of the range may only produce 43,000-58,000 eggs. Female sturgeon appear to spawn every two or three years (Service 2014, p. 9).

Eggs and Free Embryos

Once released, the eggs float downstream, sink and stick to objects on the river bed to incubate. Eggs that do not stick to the river bed are unlikely to survive. The incubation period for sturgeon eggs is about 5-7 days. The exact period is determined by water temperature. The warmer the water temperature the shorter the time it takes for the eggs to hatch. At hatching, newly hatched free embryos are less than ½ inch in length and have a yolk sac attached to their stomach which provides food for approximately the first week (depending on water temperature).

Free embryos drift downstream for 9-17 days and in that time can drift long distances depending on water velocity. Braaten et al. (2008) estimated that at water velocities of 1 to 2 feet per second, free embryos could drift from 153 to 331 miles in 11 days. During this time, the hatched free embryo are predominantly pelagic with very weak swimming ability. Free embryos need to have enough distance to drift and become larvae, so that they are mobile and can seek out suitable habitat. Without enough drift distance, they can be passively swept into unsuitable habitat and die. Drift distance is critically important for survival. Once the free embryos completely absorb their yolk sac, they start to feed on tiny aquatic animals and plants. At this point in their development they are typically referred to as larvae.

Larvae

As free embryos develop into larvae, downstream dispersal ceases, they settle into suitable habitats, and begin to forage on the bottom. Specific habitat use by larvae largely remain undescribed, probably due to the low numbers in the wild for study and observation (Service 2014, p. 7). Similar species appear to prefer main channel border habitat with low velocities. Diets of larvae are not well known, but zooplankton and or small invertebrates are likely eaten. Mayflies and midge larvae may also be important. About 20-30 days after hatching, sturgeon larvae are considered "Age-0 juveniles" (also young of the year) and look like miniature adult fish.

Juveniles/Adults

After about a year, the young sturgeon are referred to as juveniles until they reach sexual maturity. Diet is made up of fish and aquatic insect larvae then trending toward more fish as the fish increase in size. Adults can be found using main, secondary and side channels in the river environment. They don't appear to use backwaters or sloughs. They prefer habitats with relatively smooth surfaces, but preference can be related to season, and they can be found in a variety of water velocities and levels of turbidity

Sexual maturity for females is estimated at 15 years of age, while males reach sexual maturity at age 5. Temperature can influence age of sexual maturity (Service 2014, p.9). Pallid sturgeon in the lower Missouri River reached sexual maturity at 9 to 7 years, while sturgeon in the upper Missouri appear to be slower.

2.7 Reproductive Strategy

The sturgeon has evolved a breeding strategy where the reproducing adult commits no parental care to eggs or offspring. This results in a naturally high mortality of the early life stages (egg, free embryo and larvae). Under normal conditions, this strategy is successful and can tolerate a high level of mortality, because the large spawning adults produce as many as 170,000 eggs and can be reproductive for decades. Thus as long as the regular opportunity exists for spawning, and an opportunity for larval drift to allow for transformation of a free embryo into larvae or young of the year, the success rate for a particular single egg or free embryo or larvae can be extremely low and still support a population capable of long term survival.

This strategy allows for long term success under widely variable natural conditions. However, having the capability to migrate to desired spawning areas and then having a long enough drift distance for free embryos to transform is key to reproductive success. This breeding strategy is thwarted when its migration routes are routinely (or completely) blocked. This also degrades the sturgeon's long term viability.

2.8 Population Distribution

2.8.1 Historic distribution

The historic distribution of the sturgeon includes the Missouri and Yellowstone rivers in Montana downstream to the Missouri-Mississippi confluence and the Mississippi River possibly from near Keokuk, Iowa downstream to New Orleans, Louisiana. Sturgeon also were documented in the lower reaches of some of the larger tributaries to the Missouri, Mississippi, and Yellowstone rivers including the Tongue, Milk, Niobrara, Platte, Kansas, Big Sioux, St. Francis, Grand, and Big Sunflower rivers (Assessment, p. 30). The total length of the sturgeon's range historically was about 3,500 river miles.

2.8.2 Present distribution

Since listing in 1990, wild sturgeon have been documented in the Missouri River between Fort Benton and the headwaters of Fort Peck Reservoir, Montana; downstream from Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota; downstream from Garrison Dam, North Dakota to the headwaters of Lake Oahe, South Dakota; from Oahe Dam downstream to within Lake Sharpe, South Dakota; between Fort Randall and Gavins Point Dams, South Dakota and Nebraska; downstream from Gavins Point Dam to St. Louis, Missouri; in the lower Milk and Yellowstone rivers, Montana and North Dakota; the lower Big Sioux River, South Dakota; the lower Platte River, Nebraska; the lower Niobrara River, Nebraska; and the lower Kansas River, Kansas. The contemporary downstream extent of sturgeon ends near New Orleans, Louisiana. Additionally, the species has been documented in the lower Arkansas River (Kuntz in litt., 2012), the lower Obion River, Tennessee (Killgore et al. 2007b), as well as navigation pools 1 and 2, downstream from Lock and Dam 3, in the Red River, Louisiana (Slack et al. 2012).

2.9 Population numbers

In 1995, a preliminary estimate found about 45 wild sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996). More recent data suggest that substantially fewer wild fish remain today. An estimated 125 wild sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River (Jaeger et al. 2009).

Since 1994, the Sturgeon Conservation Augmentation Program (augmentation program) has released hatchery-reared sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River (Service 2013). Hatchery-reared sturgeon are the offspring of wild sturgeon that have been captured. Hundreds of thousands of fish have been released since augmentation began. In Recovery Priority Management Areas 1, 2 and 3 (upper Missouri and Yellowstone Rivers) of the Great Plains Management Areas, as many as 52,000 fish (greater than 1 year of age) are reported to be present (Rotella 2015, p. 104).

While current abundance estimates are lacking for the entire Missouri River downstream of Gavins Point Dam, Steffensen et al. (2012), generated annual population estimates for both wild and hatchery-reared sturgeon for the reach of the Missouri River extending from the Platte River confluence downstream (50 river miles). Their results estimated wild sturgeon at 8.7 to 14.3 fish/river miles and hatchery produced sturgeon at 46.1 to 52.0 fish/river miles. Extrapolating these estimates to the entire lower Missouri River suggests that the wild population may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). The total population in the lower Missouri River may be larger as a result of the augmentation program, but is currently neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013), because limited spawning is not resulting in young of the year fish recruitment into the population.

Garvey et al. (2009) generated an estimate of 1,600 (0.8 fish/river miles) to 4,900 (24.5 fish/river miles) sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009). No estimates are available for the remainder of the Mississippi River.

2.10 Recovery and Management

The primary strategy for recovery of 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).

In 1993, the Service established six recovery priority management areas to focus recovery efforts at locales believed to have the highest recovery potential (Service 1993). Since that time, the understanding of the species has improved and warranted redefining those management areas into four management units. The management units identified in the revised Pallid Sturgeon Recovery Plan (Service 2014) are described below.

The Great Plains Management Unit 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 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 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 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 Action area for the proposed action is located in the Great Plains Management Unit.

Figure 1. Map depicting Pallid Sturgeon management units (from Service 2014, p.49)

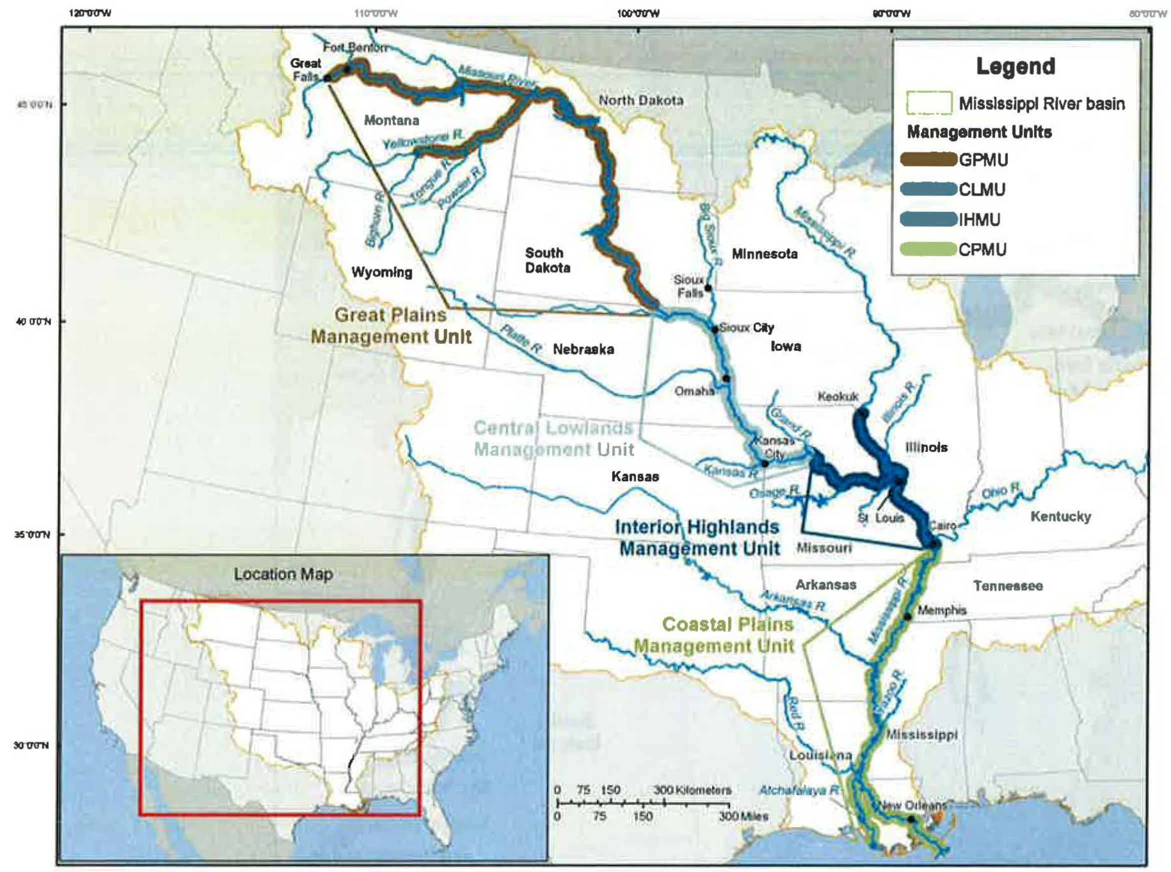
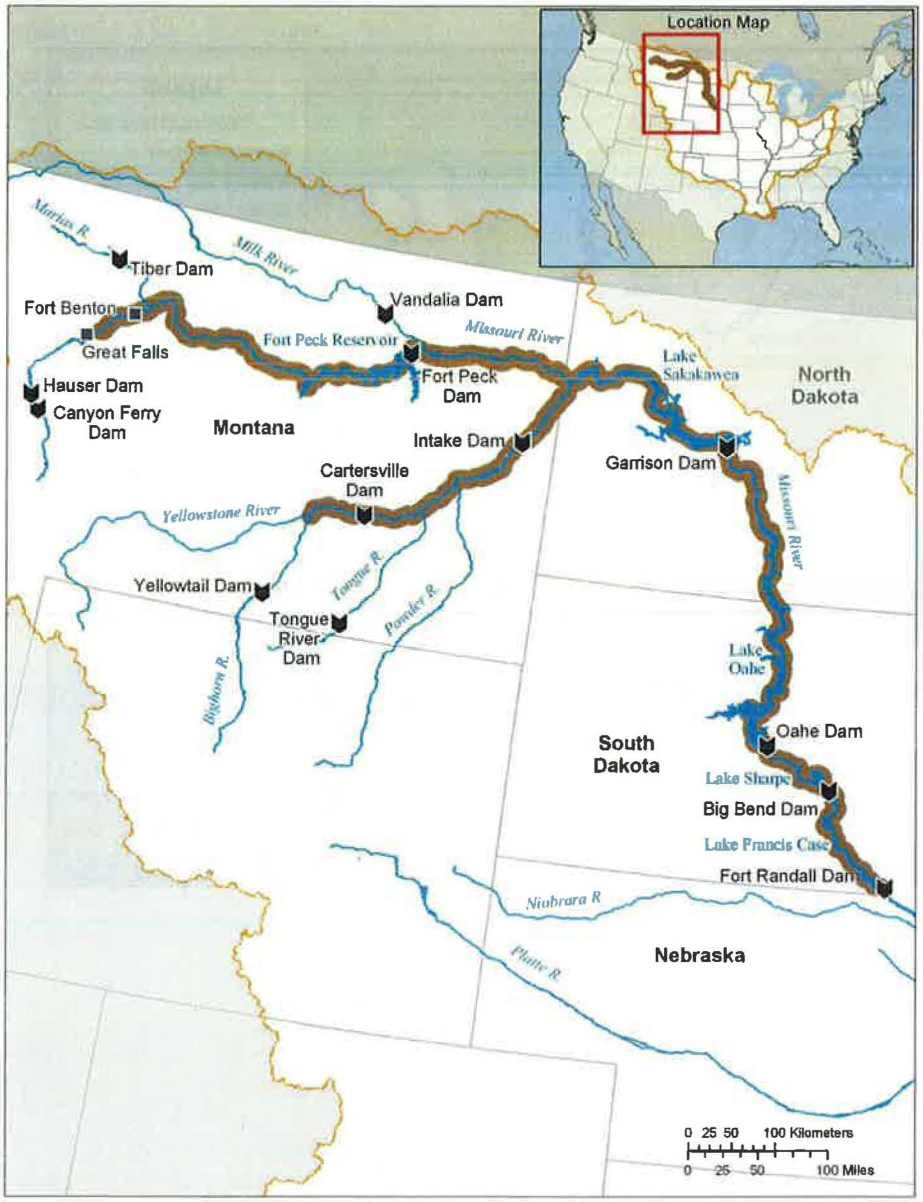


Figure 2. Map depicting Great Plains Management unit (from Service 2014, p. 50)



Currently the Corps of the Kansas City and Omaha Districts, are preparing the Missouri River Recovery Management Plan to develop a range of alternatives for management of the Missouri River. This federal action is organized around an adaptive management approach that is intended to be consistent with the purposes of the Act and enhance recovery of the pallid sturgeon. As a federal action, it will be subject to 7(a)(2) consultation with the Service. The Corps has reinitiated consultation on its Management Plan and the Service continues to work with the Corps on this consultation.

2.11 Climate Change

The potential impact of climate change on the sturgeon's environment is very difficult to assess. We reviewed the National Oceanic and Atmospheric Administration's (NOAA), Technical Report Regional Climate Trends and Scenarios for the U.S. National Climate Assessment (NOAA 2013). Specifically, we examined Part 4 of that report which focused on climate of the U.S. Great Plains. The action area and a large portion of the species range is within that geographic area.

The report makes it clear that the scientific information available and used for the report is **not** predictive. "*The future climate scenarios are intended to provide an internally consistent set of climate condition that can serve as inputs to analysis of potential impact of climate change. The scenarios are not intended as projections as there are no established probabilities for their future realization.*" (NOAA 2013, p. 1). However, the scenarios presented give us our best glimpse at whether models agree in showing a significant change from the past and if they agree in the direction of that change.

For the first period reported by the report (2021-2050) more than 50% of the models show a significant difference in temperature and more than 67% agree that the change is to a higher temperature in the action area and larger surrounding areas. The difference expressed is 1.5 to 2.5 degrees Fahrenheit (NOAA 2013, p. 37).

For the same period changes in average annual precipitation are more mixed with less than 50% of the models showing a statistically significant change (NOAA 2013, p. 55). As the models are pushed out into periods 2041-2070 and 2071-2099, they generally show increased annual average precipitation in the northern Great Plains and decrease in the southern part of the region (NOAA 2013, p. 55).

Given that the sturgeon lives in river systems influenced by winter precipitation (snow pack), we examined the report's information regarding differences in annual and seasonal precipitation. Less than 50 % of the models showed statistically significant change to annual precipitation in our area of interest in the Great Plains region for 2021-2050. For the period 2041-2070 as with the annual precipitation change, less than 50% of the models show a statistically significant change in any of the seasons (NOAA 2013, p. 57).

Under the scenarios produced by the models, the Service's assessment is that a change in temperature consistent with the scenarios does not represent changes that can be reasonably expected to impact the status of the sturgeon. Sturgeon are not cold water dependent fish and in fact if air temperatures were to increase the temperature of the water, one could hypothesize a quicker maturation time of the free embryos. An increase of the maturation rate would reduce the distance needed to drift before maturation. Fewer than 50% of the models showed scenarios of a statistically significant change that would alter the precipitation rate and therefore no effect to the sturgeon can be reasonably inferred.

2.12 Condition of pallid sturgeon within the Great Plains management Unit

As mentioned earlier, we use a large scale, that of the listed entity or species for the discussion in the Status section (Service 1998, p. 4-19). The Environmental Baseline section then captures information at a smaller scale, that of the action area (50 CFR 402.02 and Service 1998, p. 4-22). Because the Great Plains Management Unit (GPMU) is intermediate in scale to those two sections, the Service will describe the condition of the species more specifically in the GPMU. In this way the Service can provide information at an intermediate scale to help better set the context for the BO while still remaining consistent with the regulations and policy regarding scale noted above. The Assessment contains a detailed discussion of the condition of the pallid sturgeon and its habitat (pp. 32-36). We draw heavily from that section in presenting the discussion below.

2.12.1 Pallid sturgeon distribution (GPMU)

In the GPMU, pallid sturgeon can be found in the Missouri River: 1) from Fort Benton, Montana to the upper end of Fort Peck Reservoir; 2) Downstream of Fort Peck Dam to the upper end of Lake Sakakawea, including the lower Yellowstone River; 3) Downstream of Garrison Dam to the upper end of Lake Oahe; and 4) Downstream of Oahe Dam to the upper end of Lake Sharpe (Service 2014).

2.12.2 Pallid Sturgeon Abundance (GPMU)

Missouri River (upstream of Fort Peck Dam) - An estimate in 1995 indicated that about 45 wild pallid sturgeon existed in this area (Gardner 1996), but more recent information indicates far fewer wild fish are present, with only three wild fish collected in recent years (Service 2014a). Between 1998 and 2015, over 300,000 free embryos, larvae, and juveniles were released in this area of the GPMU. The estimated number of surviving hatchery fish in this area is 7,900 juveniles (Rotella 2015).

Missouri River (downstream of Fort Peck Dam to headwaters of Lake Sakakawea including lower Yellowstone River) - In 2004, an estimated 158 wild adult pallid sturgeon were reported to remain in this area (Klungle et al. 2005). More recent estimates were 125 fish (Jaeger et al. 2009). Between 1998 and 2015, over 980,000 free embryos, larvae and juveniles have been released). The estimated number of surviving hatchery fish in this area is 43,000 (Rotella 2015). Based on a calculation of total number of adult sturgeon that may have been present in this area in 1969, the current hatchery population is likely to exceed the estimated, historic population of pallid sturgeon (Braaten et al. 2009).

The wild fish described above were estimated to be 43-57 years of age because they are likely to be fish spawned before Lake Sakakawea was filled in the 1950s (Braaten et al. 2015). A current estimate of 85-112 extant adults has been made for the GPMU (Upper Basin Workgroups 2016, p.23). Hatchery fish monitoring data indicates that the current populations in these areas are dominated by the 2001, 2006, 2009, 2010 and 2013 year classes (Rugg 2014). These fish are now reaching reproductive age, but no reproduction has been observed yet.

2.12.3 Pallid sturgeon reproduction (GPMU)

Missouri River - Suitable spawning habitat is presumed to be available for pallid sturgeon in the river below Fort Peck Dam in areas of coarse substrate. One spawning location was documented in 2011 downstream of the Milk River and one free embryo was collected in the Missouri River (Delonay et al. 2014). This was the first time pallid sturgeon spawning was documented below Fort Peck Dam and contrasts with most studies indicating the vast majority of telemetered pallid sturgeon typically move from the Missouri River upstream into the Yellowstone River, for spawning.

Yellowstone River - Currently on the Yellowstone River the majority of pallid sturgeon spawning occurs in several locations from River miles 6 to 20 (Delonay et al. 2015; Fuller and Braaten 2012; Bramblett and White 2001; Bramblett 1996). However, approximately 12 to 26 percent of telemetered fish migrate up to Intake Diversion Dam in any given year and presumably would continue to migrate further upstream if not blocked by the weir (Braaten et al. 2014).

There is evidence of pallid sturgeon spawning in the Yellowstone and Missouri Rivers, but that spawning has not produced evidence of recruitment into the population. The most likely reasons for this are the effects from the presence of both the dams on the Missouri River and diversion structures on the Yellowstone River. These structures segment those rivers into shorter pieces than historical conditions. This segmentation blocks adults from accessing upstream historical spawning areas and also means that even if spawning occurs at the upstream end of those segments, the drift distance is shortened and likely inadequate for free embryos to drift and mature before entering anoxic reservoir habitat (See Drift distance and Temperature discussion below).

In 2011 when a spawning location was documented and a free embryo collected in the Missouri River (Delonay et al. 2014) flows were high in the Missouri River, due to the combined high flows from the Milk River and Missouri River from a large snowpack and high spring rainfall. Even though approximately 200 miles of the Missouri River were available for drifting pallid sturgeon free embryos during the 2011 season, there is no indication of any recruitment. This could be a result of the large snowpack causing high flow velocities (moving the free embryos faster) and low water temperature (from snow melt) slowing free embryo maturation before reaching anoxic conditions at Lake Sakakawea.

For example, Braaten et al (2012) estimated that 160-230 river miles are necessary for 25% of drifting free embryos to settle out at a water temperature of 68°F and at a drift speed of 2.25 fps. The flow velocities may have been higher and water temperatures were generally lower than 68°F, so 300 or more miles may be required for drifting free embryos to mature and settle out prior to entering Lake Sakakawea rather than the available 200 miles.

2.12.4 Influences of dams and reservoirs (GPMU)

The effects described below regarding the presence of other dams and reservoirs and their management, are not part of the proposed action. . However, the impacts are discussed to describe the condition of the species and its habitat. As stated at the beginning of this BO, the Status of the Species section is one of the four components reviewed to help inform the Service's biological opinion regarding whether the proposed action in combination with all the other components is likely to jeopardize the species. In that way the effects from the presence and management of the dams and reservoirs and all other environmental impacts are considered in the final conclusion.

Though dams and reservoirs affect almost every physical or biological feature of the sturgeon's habitat and life history, the most immediately observable features are blocking access to spawning habitats, reducing drift distances, negative changes to hydrology and turbidity, negative changes to water temperature, and creating habitats with depleted oxygen. These are discussed individually below.

Blocking access to spawning habitats - The upper Missouri River has been fragmented or segmented by Fort Peck (Fort Peck Reservoir) and Garrison dams (Lake Sakakawea), filled in 1942 and 1955, respectively. These two large dams/reservoirs have changed 312 miles of the formerly turbid, sediment-rich, and multichanneled river with extensive bars and islands into lake-like habitats and isolated fish populations upstream and downstream of each dam. The Intake Diversion Dam on the Yellowstone River segments 255 miles (Cartersville Dam to the mouth of the Yellowstone) into a 73 mile segment below Intake Diversion Dam and 165 mile segment above Intake Diversion Dam. In all these situations historical spawning habitats and migration corridors were blocked from access.

In recent decades, very few adult pallid sturgeon had ever been documented upstream of Intake Diversion Dam, but in both 2014 and 2015, pallid sturgeon were tracked[1] migrating upstream of Intake Diversion Dam via the high water channel around Joe's Island (Rugg 2014, 2015). One adult female and four adult males migrated upstream in 2014 and the female presumably spawned in the Powder River (tributary to the Yellowstone River upstream of Intake Diversion Dam). Tracking data and recapture of the female after she moved downstream found she had lost 13% in body weight (presumably, from loss of eggs during spawning; Rugg 2014). Surveys of potential habitat for pallid sturgeon indicate that suitable spawning and rearing habitat exists upstream of Intake Diversion Dam (Jaeger et al. 2005, 2006). A juvenile pallid passed above Intake Diversion Dam in 2015 (Assessment, p. 54).

Reducing drift distance - Water levels in the reservoirs impounded by Fort Peck Dam (Fort Peck Reservoir) and Garrison Dam (Lake Sakakawea) may be impediments to larval pallid sturgeon survival by limiting the amount of riverine (vs. reservoir) habitat available for pallid sturgeon to complete the transition from free embryos to exogenously feeding larvae. Studies to assess larval Pallid Sturgeon drift dynamics (Braaten et al. 2008, 2010) released hatchery-reared Pallid Sturgeon free embryos and larvae in 2004 and 2007. Subsequent sampling has collected juvenile Pallid Sturgeon derived from these releases (Braaten et al. 2012b). Survivorship of released embryos and larvae to age-1 is related to age at release (days post-hatch) and correlated with release location. Survivorship of the younger free embryos (i.e., 5 days post hatch) to age-1 was

[1] Pallid sturgeon are tracked using electronic telemetry devices inserted into their body cavities. The devices are then tracked using sensors placed throughout the river system.

only observed from the most upstream release site (Braaten et al. 2012b). These data indicate that free embryos, as young as five days post-hatch, have adequate dispersal distance to complete the developmental transition to feeding larvae. These observations support the hypothesis by Kynard et al. (2007) which implicates total drift distance as a limitation on natural recruitment in this reach of the Missouri River.

In 2013, the Corps, working with the Missouri River Recovery Implementation Committee and following the recommendation of its Independent Science Advisory Panel, initiated a detailed analysis to evaluate efficacy of its management actions on listed species (Service 2015, p. 11) Alterations to timing and amounts of release flows from Ft. Peck Dam were considered as a way to increase the effective drift distance below the dam. Changed flows would have the effect of slowing drift distance speeds and reducing the upstream extent of Lake Sakakawea, which would result in an extension of the riverine segment (drift distance). Intensive modeling efforts using multiple variables demonstrated recruitment failure for free embryos and larvae was still likely unless pool levels in Lake Sakakawea approached historic minimums (Service 2015, p.12). Therefore, this method of changing drift distance below Ft. Peck Dam was rejected. No other alternatives for Ft. Peck management to increase effective drift distance before entry to Lake Sakakawea have emerged.

Negative influence on hydrology and turbidity - The operation of Fort Peck and Garrison Dams has changed the river hydrology substantially by minimizing peak flows and increasing low flows to create a relatively stable hydrograph throughout the year (Delonay et al. 2016). The dams also have trapped sediment, substantially reducing transport of sediment downstream and reducing turbidity.

Canyon Ferry, Hauser, and Holter Dams are upstream of Great Falls, Montana. Though they do not impose any migratory barriers for Pallid Sturgeon, these structures, like other main-stem Missouri River dams, can affect sediment and nutrient transport and maintain an artificial hydrograph. Thus, the main-stem and tributary dams upstream of Fort Peck Dam affect downstream reaches by reducing both sediment input and transport. The results are a reduction of naturally occurring habitat features like sandbars. Discharge and sediment load, together with physiographic setting, are primary factors controlling the morphology of large alluvial rivers (Kellerhals and Church 1989). Seasonally high turbidity levels are a natural component of pre-impoundment ecological processes. Reduced sediment transport and the associated decrease in turbidity could affect Pallid Sturgeon recruitment and feeding efficiency.

The relationship between high turbidity levels and larval pallid sturgeon survival is unclear. In laboratory studies, increased predation on White Sturgeon yolk-sac larvae was observed at low turbidity levels, suggesting that high turbidity levels associated with a natural hydrograph and natural sediment transport regimes may offer concealment for free-drifting sturgeon embryos and larvae (Gadomski and Parsley 2005). Given that the diet of pallid sturgeon is generally composed of fish and aquatic insect larvae with some preference for piscivory as they mature (Assessment, p. 27), higher pre-impoundment turbidity levels may have afforded improved foraging effectiveness by providing older juveniles and adults some level of concealment. From the headwaters of Lake Sakakawea above Garrison Dam, North Dakota to Gavins Point Dam, South Dakota, the Missouri River retains little of its historical riverine habitat; most of this reach is impounded in reservoirs.

However, some pallid sturgeon persist in the more riverine reaches within a few of these reservoirs, though successful spawning and recruitment is unlikely. Because of the presence of pallid sturgeon in some inter-reservoir reaches, those occupied reaches have been included in recovery efforts (Erickson 1992; Jordan et al. 2006; Wanner et al. 2007). Despite these data, most of these inter-reservoir reaches are poorly understood and further research is needed to evaluate and define their significance to species' recovery.

Negative influence on spawning cues and water temperature - The dams are designed with water release structures that release water from deep in the reservoirs (except rarely during flooding emergencies when surface flows are released from the spillways). Water from the lower portion of reservoirs is several degrees colder than that at the surface, or what the water would be in a typical free-moving river. These releases reduce the temperature of the water in the river reaches below the dams. A change in downstream water temperature from dam releases, has been associated with spawning delays in several native riverine fishes and changing fish community composition downstream (Wolf 1995; Jordan 2000).

Water temperature is also important in the development of free embryos (and in turn affects the drift distance needed to transition to larvae). The cooler water can delay free embryo maturation. When combined with the already artificially shortened segment available for drift, this results in very low likelihood that free embryos will have transitioned into larvae before drifting into anoxic reservoir environments downstream.

In 2009, the Corps studied ways to improve downstream temperatures (Service 2015, p. 13) with their Fort Peck Dam Temperature Control Device Reconnaissance Study (Corps, 2009). Ten alternatives for structural or water management changes at Ft. Peck Dam were considered as potential methods to reduce or eliminate the temperature impacts downstream. The only one that survived evaluation for further examination was a flexible curtain suspended behind the dam and anchored to the lake bottom with anchors and ballast to pass surface water over the crest into the intake area rather than releasing cold water from the dam's engineered water discharge (Service 2015, p. 13). After further analysis, this change was rejected due to short lifespan of the curtain, uncertainty that it would meet temperature targets, and significant dam operation safety concerns (Service 2015, p. 14). Alternatives for changing the downstream temperatures through structural changes at Ft. Peck were exhausted.

Compared to the Missouri River, the Yellowstone River has only a slightly altered hydrologic, temperature and turbidity regime as there are no major dams/reservoirs on the mainstem river. Large dams/reservoirs are present on the Bighorn River, which results in reductions to peak flows in the Yellowstone River (Corps and YRCDC 2015), but still maintains significantly more natural hydrologic fluctuations, natural water temperatures and turbidity and thus, cues for spawning migrations (Delonay et al. 2016).

Historically, discharge increases in the spring flows in the Missouri and Yellowstone Rivers between Fort Peck Dam and Lake Sakakawea and the elevated flows cued adult pallid sturgeon residing in this reach to initiate spawning movements. In most years, adult pallid sturgeon migrate into the unregulated Yellowstone River (Fuller and Braaten 2012) to spawn. Spawning adults favor the elevated spring flows and warmer temperatures of the Yellowstone River and are believed to avoid the colder, less turbid flows in the Missouri River.

Reducing dissolved oxygen to lethal levels - The level of dissolved oxygen in the water column plays a major role in the health and survival of most fish species, including pallid sturgeon. A study of dissolved oxygen and pallid sturgeon survival conducted at the upper end of Ft. Peck Reservoir (Guy et al. 2015) indicated that pallid sturgeon free embryos and 40-day old larvae experienced 100% mortality in about one hour at dissolved oxygen concentrations of 1.5 mg/L or less.

Low levels of dissolved oxygen below Ft. Peck Dam, in Lake Sakakawea, have been hypothesized as a potential key cause of recruitment failure for pallid sturgeon below the Ft. Peck Dam and Intake Diversion Dam because free embryos do not have sufficient drift distance from spawning areas to develop into exogenously feeding larvae and settle to the substrate before they drift into reservoirs and perish (Delonay et al. 2016).

Recent research supports this hypothesis. For example, dissolved oxygen levels near the bottom in the transition zone from the Missouri River to upper end of Fort Peck Reservoir were near 0 mg/L, likely due to the biological oxygen demand in the organic enriched deposition zone (Guy et al. 2015). And below Fort Peck Dam, low dissolved oxygen levels just above and within fine sediments in the transition zone and upper end of Lake Sakakawea were also confirmed in 2015 (Bramblett & Scholl 2016). These conditions have led to the current hypothesis that the lack of sufficient drift distance and potentially lethal conditions in Lake Sakakawea are responsible for the lack of recruitment in the GPMU (Delonay et al. 2016).

2.13 Summary of Status of the Sturgeon

2.13.1 Status (rangewide)

Since listing, the status of the species appears to have stabilized. While the numbers of wild sturgeon collected in the Missouri, Mississippi and Atchafalaya rivers are higher than initially documented when listed and evidence for limited recruitment exists for the lower Missouri and Mississippi rivers, the population has not been fully quantified. Population estimates for wild sturgeon within some inter-reservoir reaches of the Missouri River indicate the extant wild populations are declining or gone. Natural recruitment of young (from limited natural spawning) into the population in the lower Yellowstone River and the upper Missouri River below Fort Peck is non-existent. Augmentation of the wild fish with hatchery raised sturgeon is supporting continued presence of sturgeon in many reaches of the Missouri River. Hundreds of the thousands of the fish released through augmentation are reaching the age where they are expected to begin spawning, while existing wild adult fish are reaching an age of increased mortality.

2.13.2 Status in the (GPMU)

Approximately 100-125 wild fish (spawning age) and 52,000 hatchery fish (reaching spawning age currently and through now and over the next 14 years) reside in the GPMU. All of these fish are blocked from large stretches of potential spawning habitat. These blockages also serve to reduce the necessary drift distance for free embryo before reaching lethal reservoir environments. Based on a calculation of total number of adult sturgeon that may have been present in this area in 1969, the current hatchery population is likely larger than the historic population (Braaten et al. 2009).

Temperature and hydrology influences from Ft. Peck Dam reduce spawning cues in the Missouri River and effectively elongate the needed drift distance (which is already limited) before drifting free embryos reach likely lethal conditions in Lake Sakakawea. The Corps has evaluated many changes to structures and management at Ft. Peck Dam to eliminate those negative impacts and extend effective drift distance, but to date, none have proven feasible or compatible with the most recent science on drift behavior.

Warmer water temperatures and elevated spring flows (Service 2015, p. 5) in the Yellowstone River create an apparent preference for spawning pallids. From 60-90 percent of telemetered adult fish leave the Missouri River and enter the Yellowstone during spawning season (Assessment, p. 54). Many swim 70 miles up the Yellowstone River where they are blocked by the Intake Diversion Dam from using another 162 miles above the structure. If pallids spawn below Intake Diversion Dam, free embryos face a peril from shortened drift distance similar to free embryos in the Missouri River below Ft. Peck Dam.

Because the Yellowstone has a more natural hydrograph favorable for spawning, further temperature control and flow studies at Fort Peck do not seem likely to increase survival and recovery. Although this will be more closely examined in the Missouri consultation, these tests do not currently appear to be beneficial for pallids because if they were pursued, they may increase the likelihood that a small percentage of adults pallids will choose to spawn in the Missouri rather than the Yellowstone. As explained above, there appears to be insufficient drift distance for recruitment below Fort Peck dam. Thus, these tests could have the effect of diverting spawning pallids away from the more promising Yellowstone, and if there is successful passage at Intake, diminishing potential recruitment.

In 2014, a few of the remaining wild fish made it past Intake Diversion Dam using an ephemeral high-water channel. In 2014, they moved up that segment of the Yellowstone River 78 miles, and then 20 miles up the Powder River. There is circumstantial evidence of egg release (in 2014), but no current evidence of free embryo survival. In 2015 a hatchery juvenile moved above Intake Diversion Dam.

The number of wild fish in the GPMU are slowly declining due to age, but thousands of augmented fish are reaching the age where spawning is likely. Even with a growing number of spawning age fish over the next decade, shortened drift distances for free embryos are likely to result in their death as they reach reservoir influenced water with low oxygen content.

Successful recruitment of wild pallid sturgeon in the GPMU likely will require both access to greater amounts of suitable spawning habitat and greater drift distance to suitable settling and rearing habitats. At this time the Yellowstone River above Intake Diversion Dam provides the most likely area to provide the greatest combined drift distance.

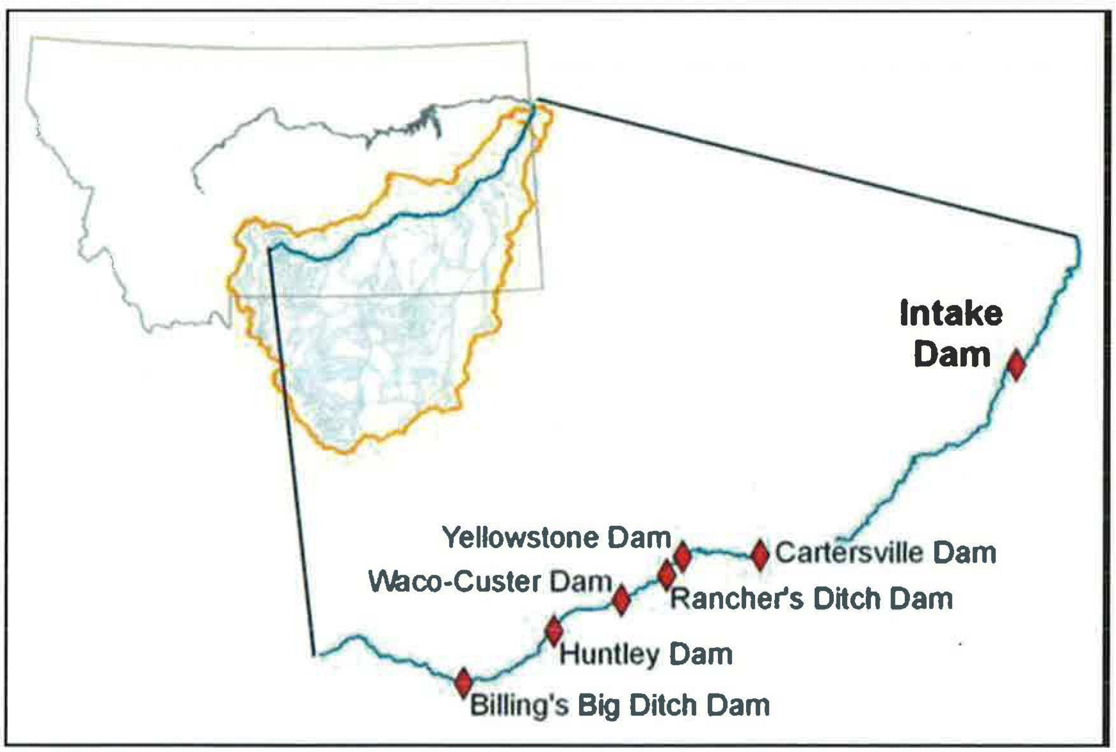
3.0 ENVIRONMENTAL BASELINE (Action Area)

The Environmental Baseline section presents a review of the past and present human and natural factors leading to the current state of the species, including its habitat and ecosystem within the action area (CFR 402.02; Service 1998, p. 4-22). The scale of the Environmental Baseline section is at the scale of the action area. Most of the information below was drawn directly from Reclamation's 2010 EA, Reclamation's 2015 Assessment (Reclamation 2015) and Reclamation's 2016 Assessment (Assessment).

3.1 General Description of Yellowstone River Basin Condition

The Yellowstone River is not impounded by storage reservoirs, and the mainstem of the river is not regulated. Therefore, it is considered to be essentially free-flowing. However, there are six diversion dams upstream of Intake Diversion Dam on the Yellowstone River.

Figure 3. Diversion Dams along the Yellowstone River (Reclamation 2015, p. 26)



The uppermost diversion dam is Billings Big Ditch Dam. The next dam downstream is the Huntley diversion and is Reclamation-owned and managed by the local irrigation district, while the middle four (Waco, Rancher's Ditch, Yellowstone, and Cartersville) are privately-owned and managed by local irrigation districts. Intake Diversion Dam is Reclamation-owned and managed by the local irrigation district. All six dams present varying degrees of impediment to fish passage. The extent of fish blockage at these dams depends on river stage and the swimming ability of the various species trying to negotiate the dams.

The Bighorn and Tongue Rivers are major tributaries to the Yellowstone River. Reclamation currently operates Yellowtail Dam and Afterbay Dam on the Bighorn River while the Montana Department of Natural Resources and Conservation operates the Tongue River Dam on the Tongue River. Yellowtail Dam was constructed for the production of power, flood control, and the storage of water for irrigation. The Tongue River Dam was constructed primarily for irrigation purposes.

Bank stabilization projects have proliferated over the years, and the action area contains some of these projects. In the immediate area of Intake Diversion Dam there are a total of five man-made structures that stabilize the river channel. These structures are the old headworks, the new headworks, the Intake Diversion Dam (also referred to below as weir), a boat ramp, and a field of boulders extending about 300 feet downstream of the weir. The boulders originally served as a means to raise the water surface elevation for diversion into the Lower Yellowstone Project Main Canal, but have been pushed downstream due to ice and high flows.

Conservation groups have been working with landowners to conserve and restore riparian areas. The Natural Resource Conservation Service continues to work with landowners adjacent to the Yellowstone River on a wide variety of conservation efforts including water and natural resource conservation. Recently, the Corps has been requiring screening to minimize fish entrainment in irrigation intakes on the Yellowstone River. However, many older irrigation projects have unscreened intakes (Reclamation 2015, p. 28).

3.2 Habitat in the action area

Instream habitats of the lower Yellowstone River include main channel pools, runs and riffles, side channels, and backwaters. Most pools are 5 ft. - 10 ft. deep, although some are at least 18 ft. deep during summer flows. There are many islands and braided channels with associated backwaters, except in the reaches from Miles City to Cedar Creek and from Sidney to the confluence with the Missouri River. The lower Yellowstone River main channel riverbed upstream from Sidney is primarily gravel and cobble. Downstream from Sidney, the substrate is mainly sand and silt (Reclamation 2010, p. 3-19).

Fifty-two species of fish have been recorded in the lower Yellowstone River (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx). Of these, 31 species are native and 21 species are introduced. Native species considered abundant include the blue sucker, channel catfish, emerald shiner, flathead chub, goldeye, longnose sucker, paddlefish, river carpsucker, sauger, shortnose redhorse, shovelnose sturgeon, smallmouth buffalo, stonecat, western silvery minnow, and white sucker (Montana Fisheries Information System, http://fwp.mt.gov/fishing/mfish/default.aspx) (Assessment, p. 53).

Based on the information reported above, aquatic habitat in the action area appears to be in adequate condition to generally support all the life history needs of the sturgeon, except successful reproduction (due to migration barrier at the weir and short free embryo/larva drift distance below Intake Diversion Dam).

3.2.1 High water channel at Intake Diversion Dam

There is an existing side channel at the Intake Diversion Dam. Its downstream mouth is approximately two miles downstream of the weir and its upstream mouth is approximately two miles upstream of the weir. This channel only becomes active when the Yellowstone River is flowing at 20,000 to 25,000 cfs (Assessment p. 76). Otherwise it does not form a continuous channel. Once active, if the flow is great enough, it can allow for fish to pass around the weir.

When the first fish was documented using the channel in 2014, the Yellowstone River was flowing at approximately 47,000 cfs (D. Trimpe, Bureau of Reclamation, pers. Comm. May 22, 2015). However, in 2016 when flows peaked at 34,000 cfs, no pallid sturgeon were detected by telemetry using the side channel (D. Trimpe, Bureau of Reclamation, pers. Comm. October 4, 2016).

If flows of 47,000 cfs are needed to pass pallid sturgeon in the existing channel during the May 15 – June 15 spawning season, then based on the historical record of river flow - this condition would be expected to occur only 7 days in 5 out of 10 years (Service 2015). This means that in only 5 out of every 10 years, the channel would support pallid sturgeon passage, but then only 7 days out of the 30 day spawning season.

3.3 Reproduction, numbers and distribution

3.3.1 Reproduction in the action area

Spawning – The first necessary step for successful recruitment young fish into the population is spawning. The significance is highlighted by the 2009 Science Review Report. "*...Without the resumption of natural spawning there is no real possibility that the naturally produced (i.e., non-stocked) pallid sturgeon population in RPMA2 will recover from its endangered status...*". (Reclamation 2009, p.15). Except as described below, spawning above the weir is currently thought to be sporadic to nonexistent because adult wild fish are typically unable to move above the Intake Diversion Dam and spawn. Below Intake Diversion Dam, two spawning sites were found in 2015 at approximately river miles 6 and 8). Three free embryos were captured below those sites (Upper Basin Workgroups 2016, p. 23), but there are no detectable levels of recruitment occurring (Assessment p. 55).

In a recent unusual event, an egg-bearing adult female and four adult males used a four and a half mile long high water channel to migrate around and upstream of Intake Diversion Dam in June 2014 (Assessment, p. 36). Three of these fish – the gravid female (egg bearing) and two males - were later located in the Powder River. The gravid female moved approximately 20 miles up the Powder River and spent approximately six days there (D. Trimpe, Bureau of Reclamation, pers. Comm. March 5, 2015). The two males moved between five and eight miles up the Powder River. The other two males moved upstream of the Intake Diversion Dam where one stayed in the general vicinity and the other moved upstream to near Glendive, Montana. The female was captured shortly after her return to the Yellowstone River and no longer had eggs. Telemetry data regarding her movements (and percentage of time spent in the Powder River) suggest that she is likely to have spawned in or near the Powder River. Later, all three fish passed the Intake Diversion Dam, (telemetry data indicates they did not use the high water channel, but passed safely over the weir and rubble field) and returned to the lower Yellowstone River (Assessment, p. 54). The observations of these fish entering the Yellowstone River, swimming 73 miles to Intake, finding the natural channel and swimming 4½ miles up the channel, then 98 miles further upstream to spawn, demonstrates the strong motivation for some wild fish to pass above Intake Diversion Dam if circumstance allows. When conditions were right, a total of 41% of the motivated fish used the high water channel in 2014 (Rugg 2014) and one hatchery juvenile (14%) passed in 2015 (Rugg 2015).

Recruitment – Recruitment of young fish into the population is the key to a healthy population. Though successful recruitment is dependent on many environmental variables, the first necessary step is spawning. Currently, despite some spawning below the weir and the capture of three free embryos below those sites, no pallid sturgeon recruitment has been detected in the action area. Braaten et al. (2008) suggests larval drift distance presently available below the weir is insufficient in length and settling habitat (Assessment, p. 55). The known spawning sites in the Yellowstone River (RM 6-20) results in only 21-72 miles of larval drift distance (depending on low or high pool) before the anoxic habitat of Lake Sakakawea. As a result of this short available distance, larvae could drift into Lake Sakakawea and die due to unsuitable habitat conditions there (Assessment, p. 55). The potentially lethal conditions include lack of food, predation and low oxygen levels. Even if spawning took place, as far up as the weir at the Intake Diversion Dam the larval drift distance would only be 97 miles which is still a far shorter distance than necessary for larval survival.

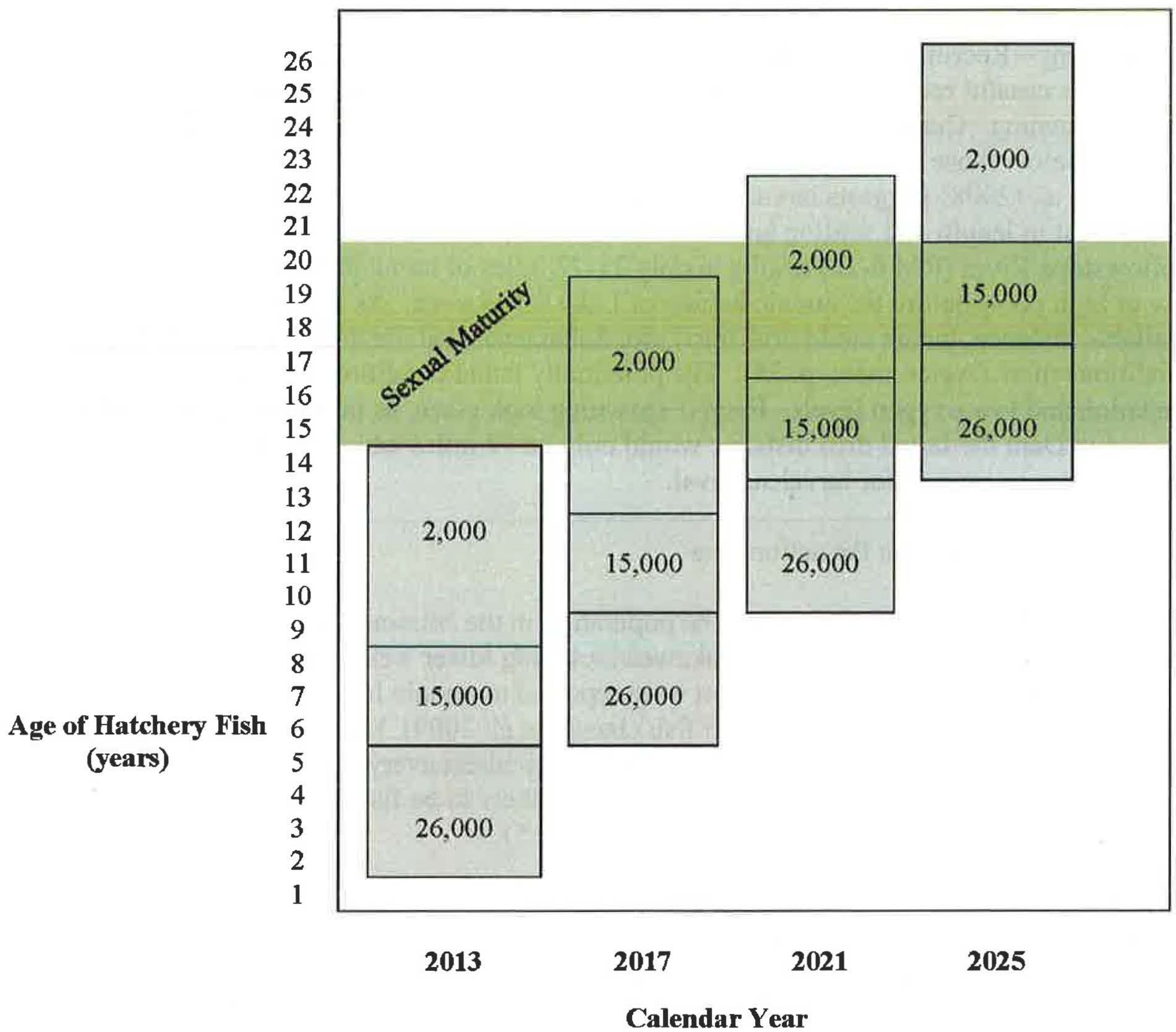
3.3.2 Numbers in the action area

The fish in the action area come from the population in the Missouri River (downstream of Fort Peck Dam) to headwaters of Lake Sakakawea including lower Yellowstone River. In 2004, an estimated 158 wild adult pallid sturgeon were reported to remain in this area (Klungle et al. 2005). More recent estimates were 125 fish (Jaeger et al. 2009). Members of this number are aging and natural mortality is slowly reducing their numbers every year. The wild fish were estimated to be 43-57 years of age because they are likely to be fish spawned before Lake Sakakawea was filled in the 1950s (Braaten et al. 2015).

Since 1994, the augmentation program has released thousands of hatchery-reared pallid sturgeon within the Missouri River and portions of the Yellowstone River. Early stocking included some broad stocking of hatchery larvae greater than 1 ½ inches above the Intake Diversion Dam, but most limited stocking now takes place below the weir. Stocking typically took place in the fall (September and October) of the year (Reclamation 2015, p. 13).

The estimated number of surviving hatchery fish in this area is 43,000 (Rotella 2015). Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. Assuming no large mortality event or an unexpected increase in the natural mortality rate, this means that over the next 14 years, almost 18,000 pallid sturgeon in this group will be reaching maturity (at age 15-20 years) and the capacity to reproduce (Figure 4).[2] Hatchery fish monitoring data indicates that the current populations in these areas are dominated by the 2001, 2006, 2009, 2010 and 2013 year classes (Rugg 2014). Based on a calculation of total number of adult sturgeon that may have been present in this area in 1969, the current hatchery population likely exceeds the historic population (Braaten et al. 2009).

Figure 4. Number of hatchery fish reaching sexual maturity over the next decade



[2] In 2016, 18 telemetered pallid sturgeon were identified at Intake. Seven were hatchery fish and two of these (one a female), were 20 years old (D. Trimpe, Bureau of Reclamation, pers. Comm. October 17, 2016).

In 2011 fish screens were installed on the Intake Diversion Dam headgates to reduce the number of fish (all species) entrained into the Lower Yellowstone's Project's Main Canal.[3] Before the current screens were in place, it was estimated that about 500,000 fish of 36 species were annually entrained into the main canal, of which as many as 8% were sturgeon sp. (Assessment, p. 54). This substantially decreased mortality of fish in those populations.

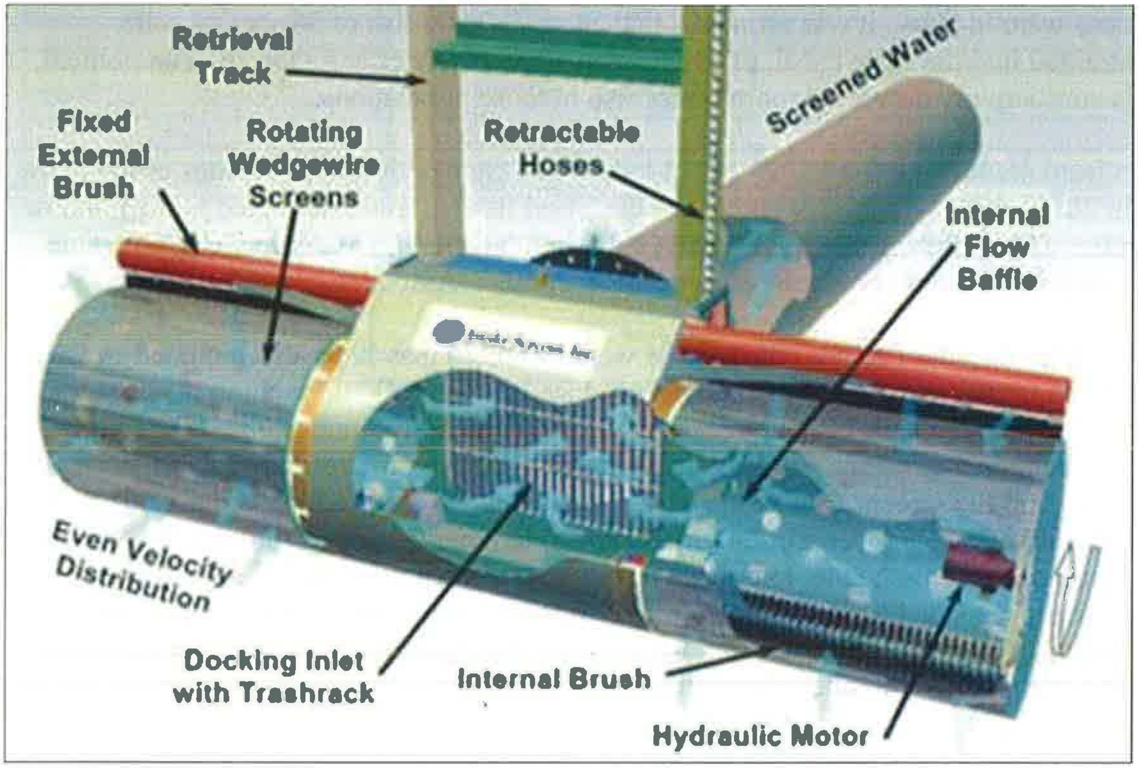
Information from monitoring from 2012 to 2014 showed a change from the previous estimate for sturgeon. In 2012, approximately 99 percent of the larval fish entrained belonged to the minnow or carp families and were typically quite small (4-8 mm total length) (Assessment, p. 54). One shovelnose sturgeon free embryo/larva was entrained in 2013 (Assessment, p. 55).

The loss of fish for decades (up until the screens were installed) may have also included any life stage of pallid sturgeon, including free embryos produced sporadically throughout the decades, juveniles that happened to have been above the weir, and potentially some adults. The screens perform two functions that reduce fish loss. They are designed to prohibit passage of fish larger than 1 ½ inches and the screens change the characteristics of the approaching water velocity so it is less likely for small fish (even for fish small enough to potentially pass through the screens) to be drawn near the screen-channel interface. Using a 2D modeling program, at 24,000 to 25,000 cubic feet per second (cfs), the extent of the water column where diversion flow influence could be detected at all is 50 feet away from the screens. At higher flows the influence distance into the river current is even smaller (Assessment, p. 73).

The installation of the screens has all but eliminated loss of fish (greater than 1 ½ inches in length) through entrainment and will substantially improve the survival of any fish in the future that are exposed to the area near the headgates and screens. This may have eliminated a long-existing source of loss of pallid sturgeon larvae from the rare spawning pallids that made it up river past the weir. The screens significantly improved the current environmental baseline condition for fish of all species including the pallid sturgeon. In the future, when adult sturgeon are able to move upriver beyond the replacement weir and spawn, some free embryos may be entrained by the screens. Given monitoring results for shovelnose sturgeon (a much more numerous species) the number of pallid free embryos entrained should be a very small portion of the total resulting in higher survival rates for embryos that without screens.

[3] Consultation on the effects of installation of the screens was completed in April 2010 with a concurrence letter from the Service. As such it has been included in the environmental baseline.

Figure 5. Diagram of removable drums screen (from Assessment p. 12)



3.3.3 Distribution, timing, and life history in the action area

Currently the distribution of adult and hatchery fish is limited to about a 70-mile stretch of Yellowstone below Intake Diversion Dam and the area of the Missouri River below Fort Peck Dam. Wild and hatchery fish are mixed and spend July through April in the lowest part of the Yellowstone and Missouri rivers. As mentioned above, estimates are that approximately 43,000 augmentation fish (various age classes) currently exist in this area.

As the river rises due to snowmelt, the ascending limb of the hydrograph apparently cues the adults in the Missouri River and Yellowstone River to move upstream to spawn. Due to preferable temperatures and hydrology, 60-90 percent migrate into the lower Yellowstone River (Assessment, p. 36 and p. 54). Of those motivated fish (fish demonstrating desire to migrate up the Yellowstone River during spawning period), approximately 12-26 percent of the telemetered wild adults) continue up the river to Intake Diversion Dam (Assessment, p. 54). These fish arrive at the weir in late May or early June; historically they would probably have moved beyond the area of the weir and spawned in or near the tributary rivers (Tongue, Powder, etc.).

Adult sturgeon migrate upstream to the weir each year, however, very few sturgeon have been documented above the weir (see previous section for sturgeon above the weir in 2014) (Assessment, p. 36). Before the passage in 2014, there were four additional confirmed observations of wild adult pallid sturgeon collected upstream of Intake Diversion Dam; one in 1950 in the mouth of the Tongue River and one in 1991 near Fallon, Montana (Brown 1955, Watson and Stewart 1991). In addition, one hatchery released fish was found above the weir in 2011 and 2013. It is unknown if these fish migrated upriver over Intake Diversion Dam or around it in the natural existing side channel (Service 2015, p. 14). Given the water velocity, debris field and the weir it seems unlikely that they passed up over the weir structure, however shovelnose sturgeon, sauger, and paddlefish have been documented moving up over the weir (Upper Basin Work Groups 2015, p. 23). The high water channel and conditions that allowed documented passage in 2014 are relatively rare and short-lived. The Service estimates that it occurs only for about 7 days, every 5 out of 10 years (Service 2015 p. 14). No telemetered adults used the channel in 2015 (Upper Basin Work Group 2016, p. 23) and no pallid sturgeon were documented passing Intake in 2016 probably due to low flows in the high water channel (D. Trimpe, Bureau of Reclamation, pers. Comm. October 4, 2016). However, 18 telemetered pallid sturgeon were observed at Intake in 2016. Seven were of hatchery origination, seven were wild and four from unreported origin. The number of wild is consistent with Braaten's (2014, p. 9) estimate regarding the number of adult wild fish that may desire to migrate beyond Intake (D. Trimpe, Bureau of Reclamation, pers. Comm. October 17, 2016). The rarity of passage and passage conditions means the current weir presents what is essentially a complete barrier to upstream movement of sturgeon.

Juveniles are unlikely to move upstream to the area near the weir due to a lack of sexual maturity to respond to natural spawning cues. However, in 2015 a juvenile was detected moving upstream through the natural channel (Assessment, p. 54). And again in 2016 juveniles were detected at the weir (D. Trimpe, Bureau of Reclamation, pers. Comm. October 17, 2016). After spawning, sturgeon head back down river. The one example from 2014 showed a spawned female and a few males at the upstream side of the weir on June 20. After passing the weir they returned to the lower Yellowstone and Missouri Rivers.

Free embryos from a spawning area (for example the Powder River) would drift downstream to the replacement weir area in approximately 2-4 days (D. Trimpe, Bureau of Reclamation, pers. comm. March 24, 2015) then drift further down the river and transition to larvae and later life stages in the lower Yellowstone and Missouri rivers.

3.3.4 Climate change in the action area

The Service discussed various scenarios for climate change in the Status section (2.11). Those scenarios included the action area. In that section we found that the climate change scenarios do not present changes that would be reasonably expected to impact the status of the sturgeon. There are no more specific or refined scenarios for the action area, therefore that conclusion holds for the action area also.

3.4 Role of the action area for the conservation needs of the sturgeon

Recruitment is the key to conservation of the pallid sturgeon in the action area, but recruitment cannot occur without pallid sturgeon spawning in an area that allows for a long enough period of drift (anywhere from 160 – 329 miles depending on velocity and water temperature) for free embryo's to survive and find suitable rearing habitat. Currently below the Intake Diversion Dam, there is not enough distance for that to occur.

The lower Yellowstone River upstream of the weir contains what is expected to be some of the best remaining habitat for successful spawning (Service 2000a, Service 2003) and provides the greatest effective drift distance (approximately 250 miles) in the GPMU. Passage at the weir is crucial to take advantage of the river's habitat and unregulated flow.

Providing passage at the weir would open approximately 165 miles of additional habitat (between Intake Diversion Dam and Cartersville Dam – the next potential barrier) in the Yellowstone River to sturgeon, as well as providing access to the confluences of the Powder and Tongue rivers (Reclamation 2010). Combined with the approximately 90 miles of current habitat below Intake Diversion Dam the total habitat available for drift would be approximately 250 miles.[4] That distance is significant because it is believed to provide sufficient time for a portion of the embryos to drift, mature, and find suitable habitat before reaching Lake Sakakawea (Assessment, p. 82), which is likely lethal for free embryos and larvae.

Motivated, spawning adults reach the weir every spawning season, but cannot reliably pass upstream. When a few adults did in 2014, spawning was documented at least 98 miles above the Intake Diversion Dam (Assessment, p. 54). This indicates the drive for spawning sturgeon to move substantial distance above the weir to find appropriate spawning areas.

Restoring habitat connectivity where barriers to fish movement occur is considered priority level 1 in the pallid sturgeon recovery plan (Service 2014, p. 77). Priority 1 actions are considered "... actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." (Service 2014, p. 75). Passage for pallid sturgeon at the Intake Diversion Dam is an example of a priority level 1 action for recovery of the pallid sturgeon in the Upper Missouri River.

By creating opportunity for fish passage every year at the Intake Diversion Dam to spawning habitat above the weir, the larval drift distance (before Lake Sakakawea) is increased to approximately 250 miles (calculated from the Cartersville Dam). This distance makes it much more likely that a portion of larva fish will survive to one year of age (an age class that is currently missing and is thought to be a main cause for lack of recruitment). The potential impact of this new habitat to the sturgeon population is significant. The significance is highlighted by the 2009 Science Review Report. "*...Without the resumption of natural spawning there is no real possibility that the naturally produced (i.e., non-stocked) pallid sturgeon population in RPMA2 will recover from its endangered status...*". (Reclamation 2009, p.15)

3.5 Summary of baseline condition

Currently there are approximately 125 wild pallid sturgeon adults and 43,000 hatchery fish (including 15,455 aged 6-8 years and 1,981 greater than 9 years of age) distributed below the Intake Diversion Dam in the lower Yellowstone and Missouri Rivers. Approximately 125 wild adults of spawning age are currently available to migrate upriver to spawn. Based on telemetry

[4] The first potential impediment in the Tongue River is twenty miles from its confluence with the Yellowstone. The Powder River is largely unblocked and several hundred miles long, but it is unknown how much of this is potential sturgeon habitat. Pallid sturgeon were observed twenty miles up the Powder River in 2014.

data, 60 to 90 percent of the telemetered wild adults enter the lower Yellowstone River likely due to preferable water conditions compared to the Missouri River. Those that continue up river are essentially blocked from passing by the existing weir. However, the fish that passed above the weir via a side channel in 2014 appear to have spawned. Sturgeon that spawn below the weir in the Yellowstone or Missouri rivers have produced free embryos, but recruitment of fish into the population is non-existent. This lack of success is likely a result of not enough larval drift distance below the weir before free embryos or larvae would reach Lake Sakakawea. Fish screens at Intake Diversion Dam have largely eliminated the risk of any fish upstream of the weir being entrained. The large group of hatchery fish below the weir is reaching potential spawning age. If passage can be built around the weir, and spawning age fish pass above it, the condition is set for a population response and potential for recovery in the Upper Missouri River.

4.0 EFFECTS OF THE ACTION

Effects of the action are defined as the "*...direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdepended with that action that will be added to the environmental baseline.*"(50 CFR 402.02)

In this section, is the Service's review of the action agency's analysis and discussion of how the proposed action (modifications to land, water, and air) are likely to result in an effect to the species. This analysis is the responsibility of the action agency and is required as part of the materials submitted to the Service when requesting formal consultation (50 CFR 402.14). It describes what modifications to the environment from the proposed action the species will be exposed to, what the species' response will likely be if exposure occurs, and then what biological effect (if any) is likely to result from the response.

Effects of the action are a reasonable prediction of the likely reaction of, and biological effect to, individuals of a species to the environmental changes brought about by implementation of the chosen proposed action. It is not an exploration of alternatives to the proposed action. As with any prediction of an animal's response to environmental impacts, there are many uncertainties associated with it. The prediction must be a reasoned prediction that is informed by science (if available). But because scientific literature reports on the results of controlled experiments and purposefully restricts its findings to the conditions and circumstances of the study, its findings can only be used to inform a predicted result from a future proposed action – it cannot determine the outcome with certainty. Therefore, additional information from observations on other species, from other environments and professional judgment from biologists familiar with the species also play a role in arriving at a reasoned prediction.

4.1 Analytic Approach

One of the most effective techniques for arriving at the effects of an action on a listed species is to follow the logic chain of Exposure – Response – Effect. In other words, the first evaluation is whether the species will be exposed to modifications of land, water or air from the proposed action. Then, if exposed, what is the likely physiological response to that exposure. And then (understanding the biology of the species) what biological effect results from that physiological response. Following that chain of logic, Reclamation and the Corps first deconstructed the proposed action into four major components (Assessment, p. 9).

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 Irrigation Project
4. Monitoring and adaptive management

Then to reduce the likelihood of missing an impact, those four major components were further deconstructed into 47 elements or tasks (Assessment, p. 58-69). Using that deconstruction, Reclamation and the Corps examined each element against each life stage of the pallid sturgeon to look for the potential of that life stage to be exposed to changes in the environment caused by the elements (Assessment Table 4). This table also provided a rationale for the finding regarding the potential exposure and the mechanism for how that exposure could occur. Therefore, the table represents determinations where no exposure exists; where exposure is possible, but its likelihood is discountable; where exposure is probable and the effect is insignificant; and where exposure is probable and effects are not insignificant. If a response and effect was unlikely to occur, the effect was considered to be discountable. If the effect was considered to be small enough that its effects to the species could not be meaningfully measured, detected, or evaluated it was considered insignificant. The rationale for the determinations included consideration of the spatial arrangement of the activity and the species in the action area, the life history of the species, timing of the element, and implementation of any conservation measures or best management practices.[5]

The components or elements that were likely to result in effects that are discountable or insignificant are incorporated by reference as a part of the effects of the action section, but will not be discussed individually below. These include noise, turbidity, disturbance, pumps and temporary increased velocities due to coffer dams. The remaining components and elements, where exposure, response and effects were likely and NOT insignificant, will be discussed further in this effects section.

Those components and elements are 1) the continued operation of the fish screens, 2) the physical presence of the replacement weir (with notch) in the river, and bypass channel, including closure of the high water channel, 3) maintenance of the existing weir structure for approximately two-three years until the replacement weir and bypass are operational, and 4) monitoring and adaptive management. These are discussed individually below.

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[5] During all these activities, general conservation measures such as working behind coffer dams and doing instream work outside of the pallid sturgeon's migration and spawning period will be employed to reduce the likelihood and significance of effects to all life stages of the pallid sturgeon (Assessment p. 100).

4.2 Components and elements that are likely to have adverse effects

4.2.1 Continued presence of the current weir with rocking

The current weir is used to deliver specified amounts of water to the Irrigation Project as originally authorized (Assessment, pp. 7, 9). To provide water and allow for fish passage, the proposed action is to build a replacement weir and fish bypass channel. The construction timing and phasing of a complex project in a river environment is driven by many environmental considerations such as ice, high water, irrigation season, access, etc. Reclamation and the Corps have determined that it will take 2-3 years to complete the project. In the intervening period of time, Reclamation, acting through its authorized agent the Lower Yellowstone Irrigation District, will continue to maintain the current weir to provide water to the irrigation project. Part of the proposed action is the Corps' permitting additional rock placement on the existing weir until the new weir is constructed. The Corps issuance of the permitting for placement of rock is done under the authority of Section 10 of the Rivers and Harbors Act of 1899. Though the permitting and physical action of maintaining the weir (adding rock to the existing weir) is not likely to produce adverse effects (Assessment p. 58), its presence in the river will.[6] Those effects are that any spawning adult sturgeon that attempts to pass above the weir will be thwarted. (Observations from 2014 and 2015 suggest that both adults and juveniles passed downstream safely over the weir indicating that it is not a downstream barrier.) This will be the situation for 2-3 years and is similar to the situation that has existed for decades. After the replacement weir and fish passage channel are built, any spawning sturgeon that attempts to pass the replacement weir will have the opportunity to pass upriver every year through the new bypass channel and downstream through the bypass channel or weir notch (see discussion in later section).

Data on approximately how many sturgeon are likely to be adversely affected by the weir as a barrier does not exist, but can potentially be inferred from data from the Comprehensive Sturgeon Research Project (CSRP). The CSRP is a multiyear, multiagency collaborative research framework developed to provide information to support pallid sturgeon recovery and Missouri River management decisions (DeLonay et. al. 2014, p. 1). The research consists of several interdependent and complementary tasks that engage multiple disciplines.

The CSRP have developed effective telemetry tagging and tracking methodology to track and relocate individual fish over long periods of time. Fish selected for tagging are male and female sturgeon in reproductive condition. Between 2006-2010 approximately 70 pallid sturgeon were tagged (DeLonay et. al. 2014, p. 15). Monitoring stations at the confluence of the Missouri and Yellowstone Rivers identify tagged fish that move into the Yellowstone River from the Missouri River and another monitoring station at the Intake Diversion Dam identifies individuals that are in the immediate area of the weir and rubble field.

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[6] The proposed action does not include building the Intake Diversion Dam, so its presence would typically be a part of the environmental baseline of the action area and not a part of the proposed action. It is part of the proposed action to add rock to it as a maintenance action. However, if the maintenance were not completed as necessary, at some distant point in time the weir would cease to exist. Though that time is probably decades off, for simplicity of analysis, and to ensure that its effects in the interim are recognized and assessed, the Service has analyzed the maintenance of the weir as effectively resulting in its continued presence.

The 2014 report showed that between 2005 and 2011 the percentage of total telemetered fish that migrated into the Yellowstone River ranged from 60 to almost 90 percent (DeLonay et. al. 2014, p. 64). Specific to the migrating upstream to the Intake Diversion Dam, Braaten et. al. (2014. p. 6) reported that eight pallid sturgeon were recorded in the vicinity of the Intake Diversion Dam in 2011, and five in 2012. In those years, this represented 25.8 and 12.2 percent of the telemetered population respectively (Braaten et. al. 2016, p. 6). Braaten et. al. (2014, p. 9) infers from their study that "...12-26% of the population may possess the motivation to migrate beyond the reach."

Additional information shows seven pallid sturgeon (12 percent of the tagged population) at the Intake Diversion Dam in 2013 and five (unknown percentage) in 2014 (D. Trimpe, Bureau of Reclamation, pers. comm. June 22, 2015). Those in 2014 are the ones that passed above the weir via the high water channel. The additional numbers reported from 2013 and 2014 and 2016 are reasonably consistent with Braaten et. al. previous numbers and percentages D. Trimpe, Bureau of Reclamation, pers. Comm. October 17, 2016).

The tagging effort for wild pallid sturgeon continues each year as a part ongoing monitoring, but because of battery loss, fish mortality and difficulty in capturing individuals in a small population, approximately 45 individuals (wild) carry active telemetry at any given time (D. Trimpe, Bureau of Reclamation, pers. comm. June 23, 2015).

If we assume that on average approximately 36 percent of the wild population (45 of 125) are telemetered this means that approximately 64 percent are not telemetered. That implies that for every 1 telemetered fish known to have reached the Intake Diversion Dam, it can be extrapolated to represent 2 others that have also reached the weir, but are not detectable. Using the current wild population estimate, the past number of detected fish at the weir and without any more specific or conclusive data, this suggests that in any given year, the 12- 26% represents approximately 15-32 fish of the total wild adult population (telemetered and not telemetered). These fish migrate from the lower Yellowstone River up to Intake Diversion Dam and are kept from passing above the structure. In 2014 the only female sturgeon that was observed to pass above Intake through the temporary high flow channel, appears to have spawned. Given that observation, the Service considers an inability to pass to be an injury to those individuals by impairment of their reproduction for that year.

4.2.2 Operation and maintenance of fish screens

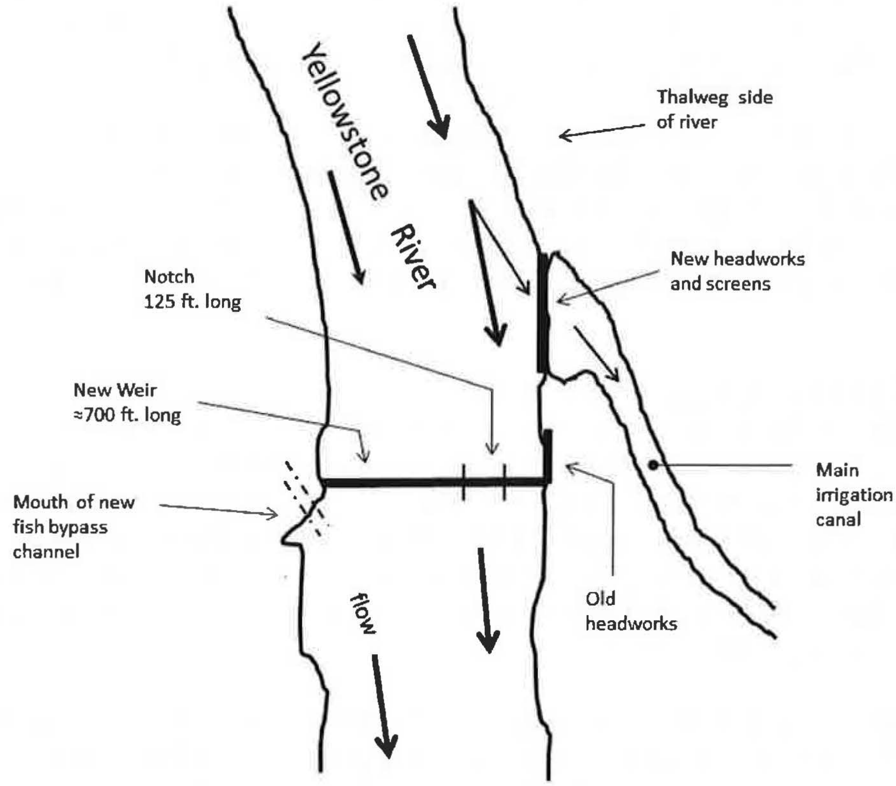
As part of the proposed action the fish screens on the headgates will be in operation reducing entrainment of fish into the irrigation project's canals. The current fish screens are expected to all but eliminate entrainment of fish larger than 40 mm (approximately 1½ inches). Depending on maturity, some sturgeon embryos are smaller than this size and therefore some may be entrained. Information from monitoring from 2012 to 2014 showed that in 2012, approximately 99 percent of the larval fish entrained belonged to the minnow or carp families and were typically quite small (4-8 mm total length) (Assessment, p. 54). One shovelnose sturgeon free embryo/larva was entrained in 2013 (Assessment, p. 55). Given that shovelnose sturgeon are common spawners above the Intake Diversion Dam, this is a very small number.

The adverse effects from the screen presence are likely to occur to only very small fish (less than approximately 1 ½ inches) that can pass through the screen and be entrained into the canal, or small fish that become trapped against the screen by mild suction and then are brushed off the screen by the screen wipers (Assessment, p. 54-55).

Once the fish bypass channel is operational, sturgeon are predicted to pass by the weir and spawn many miles upstream.[7] (For example, in 2014 a spawning female that passed the weir spent several days 20 miles up the Powder River – approximately 98 river miles above the weir.) Though adult fish will be at no risk of effect from the screens, free embryo drifting downstream after hatching may be. If spawning takes place in the Powder River, within about 2-4 days free embryo would arrive at the weir. Because free embryo are weak swimmers and generally are moved by the river current, there will only be a short period of days when free embryo are passing through the portion of the river that contains the weir, headgates and screens. The screens are located slightly upstream of the weir and to the side of the river channel. This position is influenced by the thalweg of the channel. (The thalweg is the deepest part of the channel in cross section and is typically found on outside bends of the river.) Free embryo will be distributed throughout the width of the river, but because of hydraulic flow of the river, are likely to be disproportionally prevalent in the thalweg and screen side of the river (Assessment, p. 73). See Figure 6 below.

[7] The discussion, regarding probable effects from the screens, is focused on future effects, after the bypass is complete and spawning pallid sturgeon are likely to pass the weir and spawn. However, the discussion applies equally to any pallid sturgeon with opportunity to spawn above the weir in the interim before the bypass channel is complete.

Figure 6. Schematic of project area (approximately to scale).



At the time of the free embryo's downstream drift, the portion of water being withdrawn from the river is approximately 3-6 percent of the river's total volume (Assessment, p. 73). This circumstance reduces the likelihood for the water withdrawal to have a disproportionate physical "draw" for the free embryo passing by the screens. Based on modeling, the area where any flow influence exists is approximately 50 feet of the River's 700 foot width (Assessment, p. 73). The screens are 150 feet from the thalweg and thus its zone of influence does not extend to the thalweg area (Assessment, p. 73). In addition, the screens were designed to meet National Marine Fisheries Service salmonid screen standards and have a very low "approach velocity" at the screen interface, further reducing the area within that 50 foot zone which could draw fish and free embryo passing by.[8] Only one shovelnose sturgeon larva has been collected during monitoring in 2012 and 2013 (Assessment p. 73). Given that shovelnose sturgeon are fairly common spawners above the weir, finding only one larva so far supports a finding that the screens are very effective.

[8] Approach velocity is determined by taking the flow of the river, the diversion amount at that flow and designing the screens such that both the angle of the flow toward the screen and the strength of that flow act in concert to reduce the "draw" toward the screen – making an interaction with the screen much less likely. It also lowers the flow's energy at the screen, so that fish interacting with the screen are more likely to move across the face of the screen without becoming impinged.

For all these reasons, the Service expects the number of pallid free embryo exposed to the screens to be relatively low, and the number killed or injured by that exposure to be small compared to the total number of free embryo in the water column. However, if free embryo come into direct contact with the screen, they are likely to be killed or injured by the trauma of passing through the screen or being impinged against it and then wiped off.

Although the likelihood of embryos being impinged or killed is low, the Service cannot predict the exact number of free embryos that will be exposed to the screens. This is due to the size of the free embryo as it develops, the volume of water passing through the screens, and the withdrawal of water for the Main Canal. Likewise, the Service cannot estimate the number of those free embryos exposed to screens that will be injured or killed. We discuss this issue later in section 4.3.

4.2.3 Closure of the high water channel

As part of creating a stable bypass channel, the upstream mouth of the existing high flow channel must be filled during construction, blocking potential access to fish. This is a necessity to prevent the uncontrolled water in the high flow channel from potentially undermining the construction of the new channel. As noted by the Service earlier, this high flow channel passed 5 adult fish in 2014, and 1 juvenile in 2015, but the channel is not a dependable passage (no pallid sturgeon passed in 2016) because it does not occur every year and may not have adequate flows for the entire spawning period.

Currently the high flow channel becomes active at 20,000 to 25,000 cfs flows (Assessment p. 76). In 2014, the Yellowstone River was flowing at approximately 47,000 cfs when the first fish was documented using the existing high flow channel (D. Trimpe, Bureau of Reclamation, pers. Comm. May 22, 2015). If flows of this magnitude are needed to pass pallid sturgeon in the existing high flow channel during May 15 – June 15, then this condition would be expected to occur only 7 days in 5 out of 10 years (Service 2015).

Even though the natural high flow channel does not flow enough water to pass fish every year, in the 2-3 year construction period it is reasonable to assume that in one year the channel would be passable (Assessment, p. 76). The effect of the construction blockage for that year would be that 5-16 fish [9] that would have been able to pass – will not pass. This represents an impairment of their reproduction that year from the closure of the natural high flow channel. These fish represent a subset of the fish discussed earlier in section 4.2.1.

4.2.4 Physical presence of the replacement weir and bypass channel

The physical presence of the replacement weir in the river potentially affects adult sturgeon in two ways -- by impeding upstream migration for spawning and impeding downstream migration following spawning.

[9] In 2014, 41% (5 of 12) fish detected at the weir passed above the weir. In 2015, 14%, (1 of 7) fish detected at the weir passed above. Extrapolating that 32 adult fish from the wild population (Section 3.3.3) would be present at the weir, 14-41 percent potentially using the side channel represents 5-16 adult wild fish.

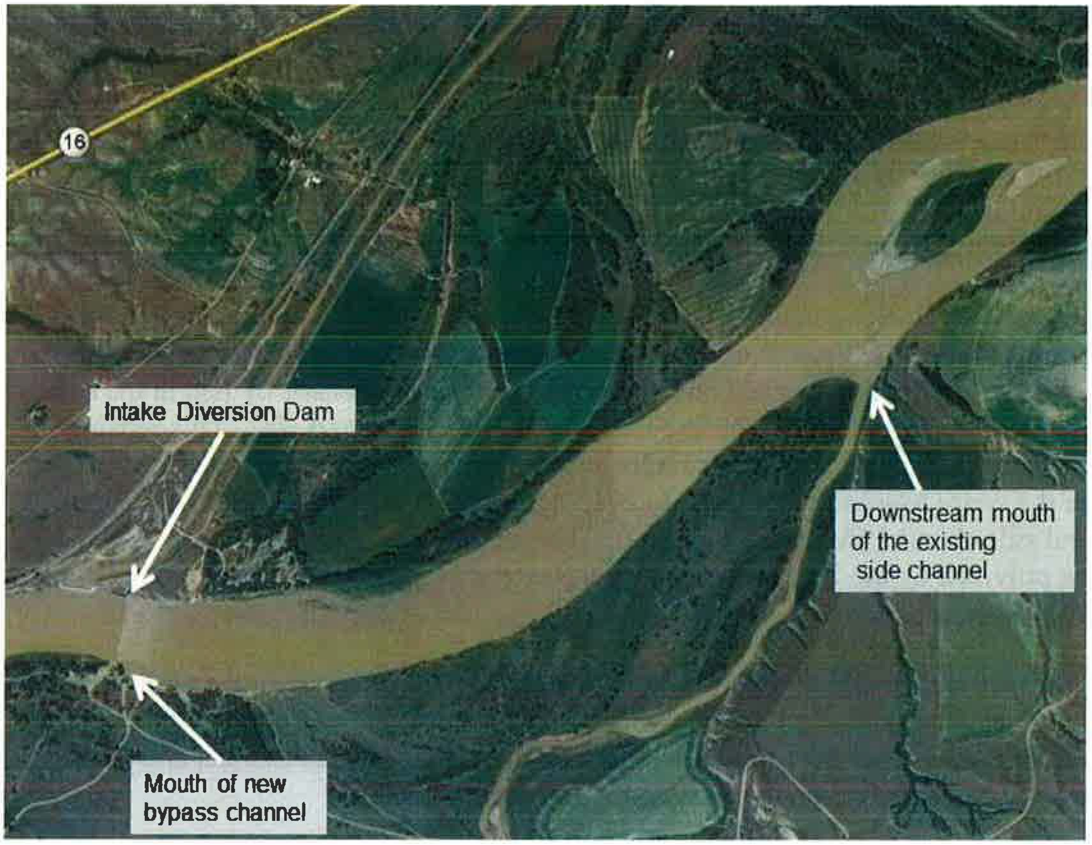
Upstream effects to adults from presence of replacement weir and bypass channel – For moving upstream, the replacement weir will have a constructed bypass channel on the south side of the river. Adult pallid sturgeon are known to use side channels when moving up the Yellowstone River (Braaten et al. 2014). In two instances, adult and juvenile sturgeon have been observed using an existing, (but ephemeral) high water channel to pass around the Intake Diversion Dam (Assessment, p. 78). Though little information exists for channel bottom type, there appears to be a preference for a relatively smoother surface rather than a surface with large rocks extending into the water column (Assessment, p. 98). The bypass channel has been designed for a smoother bottom surface to meet the Service's Biological Review Team's recommendations.

Water flow volume and velocity can affect likelihood of fish use of channels (Assessment, p. 97). This channel was specifically designed with appropriate flow volume and velocity to allow for a fish to move up and around the weir, and also a flow that can be sensed by fish in the area of the weir and serve as an attractant to the bypass channel (Assessment, p. 78). This sensing ability was demonstrated in 2014 when five adults found a natural side channel and moved upstream above the weir (Assessment p. 36). In 2015 a juvenile fish was observed finding and using this natural side channel (Assessment, p. 70). The design of the bypass channel followed physical criteria provided by the Service's Biological Review Team specifically to facilitate sturgeon passage (Assessment, p. 83).

Based on observations with the existing highwater channel, studies of swimming pallid sturgeon in artificial flumes, and careful design of this bypass, it is expected that fish cued to move up the river to spawn, if they encounter the replacement weir, will find the bypass channel and move upstream. The Service's expectation is based on the following points.

The new bypass channel design improves on the existing ephemeral highwater channel in several ways. The new bypass channel entrance will be located about 8,555 feet upstream from the current existing channel mouth (Figure 7).

Figure 7. Position of new bypass channel mouth.



This position puts it much closer to the barrier represented by the replacement weir. This also shortens the passage around the weir from 4.45 miles to 2.17 miles (Assessment, p. 13). To make it even more likely for the sturgeon to find the bypass channel, the engineered channel will carry 13-15 percent of the total river flow as opposed to the approximately 2-6% carried sporadically by the natural channel (Assessment, p. 78). The new bypass channel is also being designed to pass pallid sturgeon when the flows are as low as 15,000 cfs in the Yellowstone River. From May 15 to June 15 the Yellowstone River is expected to flow 15,000 cfs or greater for 25 days in 10 out of 10 years greatly increasing passage success around the weir. Over a 10 year period, this means a comparison of 250 total days of passage conditions vs. 35 days for the natural channel.)

Unlike a novel or new fish passage project around a complete barrier, this one mimics and substantially improves on an ephemeral channel that is already being successfully used (when available) by pallid sturgeon at this site. The new channel's entrance is closer to the barrier, will be shorter, will flow every year, pass more water than the high flow channel, pass it longer, provide greater depths, be more stable, is of known design, and can be more easily modified for performance if monitoring indicates modification is needed. For these reasons it is reasonable to expect that the new bypass channel will pass spawning and juvenile fish every year, and for a longer period than the current ephemeral channel.

The Service expects motivated spawning sturgeon to be fully able to move upriver beyond the weir. Any delay to moving upriver is expected to be temporary and not represent an impairment of breeding or reproduction that leads to actual injury or death. (See section 4.2.5 for monitoring this aspect of the project and adaptive management approach to act on observations.) The ability to pass upstream through the bypass channel is the first necessary step in improving spawning opportunities. With greater spawning opportunities, and substantially longer drift distances, successful reproduction and recruitment of young fish is possible; without passage (status quo), recruitment has not been observed and is unlikely to occur.

With the new bypass channel, the Service expects motivated fish to pass above the Intake Diversion Dam via the passage channel every year. However, the Service recognizes that not all fish that are detected at the weir will pass upstream. We have little information to form an estimate for passage in the future; and passage can be influenced by many biological or environmental factors that may not be related to the presence of a weir.[10] The only example the Service has of spawning adults passing upstream of the weir is from 2014. That year 41% of the fish detected at the Intake Diversion Dam passed upstream using the high flow channel (Rugg 2014). Based on that one event, and the design of the new bypass channel, we believe it is reasonable to expect the percentage of fish that passes using the bypass channel will be much greater than that observed in 2014. We also believe that passage will occur annually, (rather than sporadically with the existing channel), but we do not have additional information that would allow for a more precise prediction. Therefore, using the past passage data, we estimate that up to 59 % of the fish detected at the weir may not pass upstream through the new bypass channel. The only other estimate we are aware of comes from the Service's Biological Review Team. Based on decades of experience with the movement of pallid sturgeon, they have set an expectation that the channel will pass 85% of the spawning adults that move up to the weir (Assessment Appendix A, p. 6). For fish that do not use the bypass channel, the Adaptive Management Plan and monitoring are designed to try and identify causes and implement changes to ensure efficient passage.

Downstream effects to adults – At a river flow 15,000 cfs, the water depth and velocity over the current weir is 2.1 – 2.9 feet and 8 feet per second. The replacement weir at the same flow would have a depth of 3.5 feet and 5 feet per second (Assessment, p. 82). This should make passage downstream for all life stages easier than the current condition. The weir design also includes a gradually sloping approach to the replacement weir (from upstream) making the hydraulics less likely to impede passage (Assessment, p. 82). In addition, fish can use the bypass channel (that the sturgeon would have likely used to pass above the replacement weir) to travel downstream.

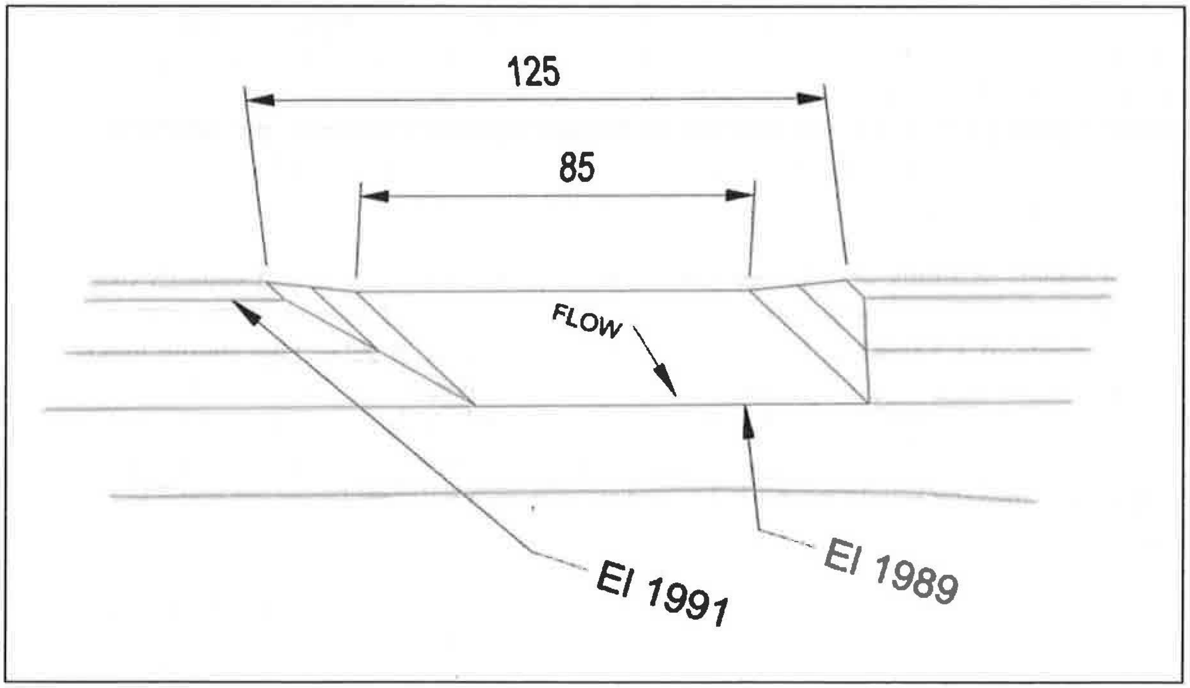
To further facilitate downstream movement, the weir is constructed with a tapered notch in the weir (125 foot at the top and 85 feet at the bottom) which is not centered in the weir but is

[10] In addition to environmental and biological conditions, the ability to differentiate in the future between telemetered spawning adults and telemetered maturing juveniles will be impossible based just on detection. While a juvenile may swim upstream to the weir, it may not be sexually mature and desirous of passing above the weir. This further complicates assessing what percentage of the "motivated" fish are influenced by the weir and don't pass vs. fish that meet the weir and pass upstream. Future research and monitoring efforts and the adaptive management approach will allow for better understanding of this situation.

oriented about 100 feet from the thalweg side of the river (Assessment, p. 14, and Figure 8). The current weir has a wooden structure that is at an elevation of 1989 feet. For appropriate irrigation flow, an additional two feet of rock are added for a total elevation of 1991. The replacement weir top will be built to the same elevation (1991 feet). The bottom of the replacement weir's notch will be the same elevation as the old structure without the additional rock height (1989 feet) (Figure 8). In addition, the rock fill immediately downstream from the notch will also be at 1989 feet providing a slight channel downstream of the replacement weir notch (Assessment p. 75). At the typical time of passage (high water) the water is approximately 7.5 feet over the bottom of the notch (D. Trimpe, Bureau of Reclamation, pers. comm. May 5, 2015 – email including *Lower Yellowstone – Intake Bypass Channel ADH (2-D) Downstream Focus Model, Summary of Initial Results – Notch Comparison*). Given that in 2014 and 2015 sturgeon that moved upstream beyond the weir found their way safely back down over the existing weir and rocks below (Assessment, p. 54), it is expected that future passage downstream over an improved weir and notch will occur and be even easier.

Again, any delay to moving downstream is expected to be temporary (even less than when moving upstream) and will not likely represent an impairment of breeding or reproduction that leads to actual injury or death for adult sturgeon.

Figure 8. Notch dimensions (in feet) and elevations (above sea level).



Downstream effects to free embryo - Recently hatched free embryo will also meet the replacement weir as they drift downstream. The weir is not constructed like a weir where water flow is stalled by an abrupt vertical wall. The weir is more of an instream "hump" that checks the flow in such a way as to create a slightly higher water surface elevation. This "bulge" of water behind the weir acts as a very small pool to assist in supplying the correct amount of water to the screens and headgates.

Free embryos moving downstream are not capable of swimming well and are largely dependent on the current. Since the weir is designed for smooth water flow over the top of the weir (Assessment, p. 82) it seems unlikely to trap or significantly stall free embryo. At the time of passage (late June and early July), the water is predicted to be greater than 3.5 feet deep over the top elevation of the weir.

Free embryos may also pass through the bypass channel or the notch in the weir (described above). Given this information, the Service expects the free embryo to encounter the weir, and associated water bulge, and pass over the weir without great delay. (Arguably, if they were delayed slightly by the weir without incurring injury, it could be advantageous by acting as additional maturation time before moving down river.) Free embryos passing over this replacement weir, which is designed for smooth flow, will be less likely to be injured than if they had to pass over the current weir/rock structure. Also, since it is likely that the free embryos will be somewhat disproportionately distributed more toward the thalweg side of the river (Assessment, p. 72), they are more likely to drift through the notch. This further reduces the impact of moving downstream.

Upon floating over the weir crest, the free embryo will encounter faster flowing and more turbulent water immediately below the weir (though not a drop typical of a weir). This condition will vary along the weir depending on location and water level. Also, they may encounter scattered rocks (debris from the current weir) in the river current directly downstream of the weir. It is possible that some of the free embryo moving over the weir will be unfortunate enough to encounter the worst of the turbulence, and then also strike rocks. If they strike the rocks hard enough, there is potential to be injured or killed. (In the future, since rocks will not simply be piled to produce the necessary water elevation, the high water and ice will disperse the existing debris field and potential for injury will be further reduced.) The Service knows of no information to inform us as to the likelihood of injury or death of free embryos that encounter rocks. The Assessment notes a preliminary evaluation of white sturgeon larvae injury rates when drifting past rip rap (p. 83). In that study, no differences in injury rate (with a control group) due to rip rap were noted.

Sturgeon have evolved in river systems that often have rock, riffles, tree debris, etc. in them and it seems unlikely that through adaptation these would have caused mortality risks beyond the sturgeon's breeding strategy. Regardless, it is reasonable to assume some very small level of mortality. However, given the distribution of the free embryo in the water column, the height of the water over the weir, and the variability of the turbulence and obstructions, it seems reasonable that it would be only a very small portion of the total free embryo in the water.

Unfortunately, like the earlier discussion on estimates for impacts from the fish screens, the Service does not have information to allow for an accurate approximation of the number of free embryo killed or injured by exposure to the weir. Later in section 4.3 we explore this issue regarding estimating impacts.

4.2.5 Uncertainties related to fish passage

As discussed in the introduction to this section, the effects of the action are a reasoned prediction of how the species will respond to the proposed action informed by scientific literature (if available) and the professional judgment by biologists familiar with the species.

The most obvious uncertainty regarding the proposed replacement weir and engineered fish bypass channel is whether it is likely to pass fish above Intake. Though there are varying views on likelihood of passage (Corps 2013 and Corps 2016), at this time it is impossible to prove whether fish will, or will not, use the new bypass channel. To create the most likely condition for fish passage, the action agencies reviewed information on swimming ability of pallid sturgeon, characteristics of similar species, performance of other fish bypass channels, potential causes for bypass channels failures, the use of side channels for upstream movement, and potential preference for type of river or channel bottom during movements (Assessment, pp. 95-99). The current design for the proposed bypass channel is informed by that review including examples of potential causes for unsuccessful fish passage. The current design follows recommendations from the fish biologists on the Service's Biological Review Team made specifically to make pallid sturgeon passage likely. These factors, suggest it is reasonable to expect the proposed bypass channel will pass fish more often and in greater numbers than the current ephemeral channel did in the only year of the last three that passage occurred.

Additionally, concern has been raised that even if passage occurs it may not lead to recruitment of young into the population (Corps 2013 and Corps 2016). Though recruitment is the key to expanding a population, recruitment cannot occur without spawning. And in the pallid sturgeon's case, spawning is ineffective without hundreds of miles of larval drift distance (Braaten et. al. 2008). Insufficient drift distance, causing the death of free embryos is the fate for spawning pallid sturgeon below Ft. Peck Dam and the Intake Diversion Dam (Braaten et.al. 2015, p. 827). Therefore, the first step in increasing the likelihood of recruitment in the Yellowstone River is passage of spawning adults at the Intake Diversion Dam. After passage and successful spawning, survival of free embryos and recruitment can be assessed, but currently there is no evidence that any recruitment has occurred since 1950 under the status quo (Braaten, 2015).

In the next section, Monitoring and Adaptive Management, is a discussion of the action agency's commitment to monitoring the proposed action and actions that would be taken if predicted behavior of the structure or fish passage does not occur.

4.2.6 Monitoring and adaptive management [11]

Though the weir and bypass channel, are well engineered for fish passage, there are uncertainties regarding their performance and passage consequences. Therefore, Reclamation, in cooperation

[11] We discuss the predicted effects the monitoring and adaptive management plan could have to individual pallid sturgeon. This plan is an important tool to gain information on the physical and biological performance of project; however, it is not relied upon in our eventual conclusion regarding the likelihood of whether this proposed action is likely to jeopardize the pallid sturgeon. That conclusion is based on the described probable effects of the proposed action.

with the Corps, has established a monitoring and adaptive management plan (AMA) to monitor that performance and provide a structure for making decisions to correct any deficiencies that are discovered (Assessment-Appendix A). This adaptive management plan is a commitment to take appropriate action based on explicit monitoring goals. The plan is consistent with the Department of Interior's technical guide to adaptive management, with an emphasis on reducing uncertainty and achieving the proposed action's goals (Appendix A, p. 1). Reclamation have committed to funding and support of the AMA (Reclamation 2016a).

Specific future actions proposed through adaptive management (and their effects) are not adequately foreseeable at this time, therefore any discussion or analysis would be speculative. The adaptive management plan has listed the most probable types of management measures to be implemented should elements fail to meet criteria and expectations (Appendix A, p. 14-19). To the maximum extent possible, those measures will use conservation measures such as project timing, work site exclusion, and sediment control to reduce effects to the pallid sturgeon. However, it is possible that future proposed changes to structures or management will result in effects to the pallid sturgeon. In those instances, the action agency(s) will consider whether reinitiation of consultation is required.

The monitoring is designed to provide information on two important, but different, aspects of the project – physical performance and biological performance. The effects from the monitoring activities and potential adaptive management measures are discussed below.

1) Do the physical features produce the expected hydraulic characteristics in the channel and at the upstream and downstream mouths?
Monitoring to determine if water velocity and depth meet established criteria (Appendix A, p.5) will use standard observation, inspection, and measuring techniques for structures and water flow (Appendix A, p. 8). These are not intrusive and the probability of any effects to sturgeon is discountable. Alternatively, any effects that do occur are expected to be insignificant.

2) Are adult and juvenile sturgeon able to pass upstream past the replacement weir?
The expectation is that motivated fish will pass above the Intake Diversion Dam through the bypass channel every year. The target for passage of motivated adult pallid sturgeon is 85 percent annually (Appendix A, p. 6). Monitoring designed to answer this question will be done by capturing and tagging adult sturgeon, and monitoring their movements with radio telemetry tags (Appendix A, p. 9). There are no specific expectation or target for juvenile passage, but juveniles will be tagged and tracked similar to adults (Appendix A, p.10). The tagging of sturgeon will require capture and handling of fish. This is an adverse effect, and though rare, capture, handling, tagging and release of large adult fish can result in the death of captured fish. The current program of capture, transport, tagging and release is performed according to strict handling protocol (Service 2012) and the Service knows of no mortalities from this program to date. However the Service cannot dismiss the possibility that injury or death is possible. No information is available to predict with certainty how many fish will be injured or die. To enable the Service to assess the impact from the effects of handling during monitoring, the Service is using an estimate of t 2 adults and 5 juveniles. (We estimate more juveniles due their smaller size and larger number likely to be handled.) Given the past performance of the monitoring program, we believe this is probably an over estimate of injury or death, but the

estimate does have value for a sense of the likely magnitude of effects and establishes a threshold for reassessment should it be met.

Currently a monitoring and tagging program is performed by the Service, U.S. Geological Survey (USGS) and Montana Fish, Wildlife and Parks (MTFWP). Impacts and take (under section 9 of the ESA) of individual pallid sturgeons is authorized through a take permit under 10(a)(1)(A) of the ESA, and an agreement (pursuant to section 6 of the ESA) with the state of Montana. The rate of death incidental to capture outlined above is in addition to any expected loss already considered in the issuance of the existing 10(a)(1)(A) permit or section 6 agreement.

3) <u>Are adult sturgeon able to pass downstream past the replacement weir?</u>
The expectation and target for adult sturgeon passage downstream past the replacement weir is passage of motivated adults with a mortality from passage of less than or equal to 1 percent during the first ten years (Appendix A, p. 6).[12] The fish monitored will be the same fish already tagged under number 2 above. No effects from radio telemetry for downstream passage are expected.

4) <u>Do sturgeon free embryos and larvae pass downriver past the weir?</u> As described earlier, the replacement weir is designed specifically to allow for smooth water flow over the top which will facilitate movement of free embryos (and other life stages) of sturgeon over the weir rather than potentially impairing their movement or stalling them behind the weir. Also, the notch in the weir and the bypass channel provide additional avenues for free embryos to pass the weir. When telemetry monitoring indicates that spawning sturgeon have moved past the weir, Reclamation will arrange monitoring at fish screens and below the weir to detect presence of free embryos (Appendix A, p. 11). In addition to monitoring for sturgeon, other fish with similar life histories may be caught. If so, this would indicate that the weir is likely not impairing movement of fish (including sturgeon). In the process of netting and capturing free embryos, some may be injured or killed. This monitoring effort will be performed in cooperation with the Service, USGS and MTFWP and effects are analyzed and anticipated through existing Service section 10(a)(1)(A) permits and a section 6 agreement with the state of Montana.

In addition to weir monitoring, the monitoring and adaptive management plan also includes the possibility of using live pallid or shovelnose free embryos to test movement downstream (Assessment, p. 11). The live pallid free embryos will be supplied from excess hatchery stock and the effects is anticipated and in the existing permits and agreements mentioned above.

5) <u>What is the impact of the fish screens to sturgeon free embryos</u>? Data from monitoring of fish and free embryos will inform Reclamation and the Service on the hydraulic performance of the screens and their screening effectiveness. This information could inform potential implementation of screening criteria on other diversions in the Yellowstone and Missouri Rivers. As described earlier, the fish screens are designed to exclude fish greater than about 1 ½ inches from passing through the screen to the network of irrigation channels and ditches. Past monitoring by Reclamation in 2012 and 2013 has shown effectiveness at screening large fish out of the canal behind the screens and only one sturgeon larvae (shovelnose) has been detected

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[12] Adult or juvenile mortality from passage over the weir has not been documented and is not expected. Therefore the Service's Biological Review Team suggested a 1% as a protective limit.

(Assessment, p. 73). Adverse effects from the screens are anticipated (see section 4.2.2 and 4.3). The free embryos or larvae observed and collected from the screens or canal behind the screens have already been considered in the effects from the screens. No additional effects from monitoring at the screens is anticipated.

4.3 Estimating number of free embryos injured or killed in the future by screens and weir

4.3.1 Uncertainty and lack of information

We find that it is likely that some sturgeon free embryos will be entrained through the screens and injured or killed passing over the replacement weir. As a part of the effects analysis, typically the Service is able to enumerate the number of a particular life stage of the affected species that will be affected. This number can be useful in making a conclusion regarding the likelihood of the effects resulting in jeopardy to the species. In this case, the effects are in the future after the weir and fish bypass are constructed and the Service has no information that would allow for making a reasonable estimate. However, we do know that the reproductive strategy of sturgeon generally accepts very high mortality of eggs and early life forms without detriment at a population level. Also, in 2009, Reclamation convened a scientific panel to review the available science surrounding the Lower Yellowstone Intake Project. In their final report (Reclamation 2009, p.25) they concluded that "*the net benefit of passage and spawning upstream from Intake Dam is likely to be significant even if a portion of the reproduction is the subject to entrainment losses as long as associated diversion fractions are not excessive.*"

Even without specific information, the Service believes that by using a surrogate species we may be able to assess the magnitude of impact to determine any changes to the population. The Service's Endangered Species Handbook (Service 1998) outlines the Service's policy for use of surrogates when describing effects and incidental take.

"*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 surrogate species in the community) serve as a measure of take, e.g., impacts to listed mussels may be measured by an index or other censusing technique that is based on surveys of non-listed mussels. ... Similarly, if a sufficient causal link is demonstrated (i.e. the number of burrows affected or a quantitative loss of cover, food, water quality, or symbionts), then this can establish a measure of the impact on the species or its habitat and provide the yardstick for reinitiation.*" Service 1998, p 4-47

In addition, the Service recently promulgated regulations (Service 2015a) confirming the use of surrogate species for describing the amount or extent of take.

50 C.F.R. §402.14 (i)(1)(i) – " *Specifies the impact, i.e., the amount or extent, of such incidental taking on the species (A surrogate (e.g., similarly affected species or habitat or ecological conditions) 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.)"

4.3.2 Surrogacy

We use the shovelnose sturgeon as a surrogate for describing (and in the future measuring) the scale of impact to pallid sturgeon free embryos, which informs our view on what the impact means to the population. Below, we outline the assumptions and rationale for use of this surrogate. There are inherent risks with making simple assumptions, but without more specific information, or a more practical manner of approximating the scale of impacts, we feel it is the most reasonable biological approach at this time. We discuss below why the shovelnose sturgeon is the best biological surrogate available. During the 2-3 years between now and when the weir and bypass channel are in place and the impacts to pallid sturgeon actually occur, the Service will work with Reclamation to explore whether a more accurate or precise method for approximating impacts exists.

The shovelnose sturgeon is considered abundant in the Yellowstone River and there is no information that suggests the population is not stable and self-sustaining.

In the context of a 7(a)(2) analysis and monitoring of effects, we believe shovelnose sturgeon will work as an effective surrogate for pallid sturgeon based on the following assumptions:

Assumption 1 – the life history, reproduction strategy and free embryo drift characteristics of shovel nose sturgeon are more similar to those of the pallid sturgeon than any other species in the action area.

Assumption 2 – the shovelnose sturgeon population in the area above the current weir is relatively stable and self-sustaining.

Assumption 3 - this assumed stability of the shovelnose sturgeon population occurs in an environment that included an open diversion at Intake Diversion Dam (before 2012 screen installation) and the presence of the current weir and rubble field, which presents greater hazard than will exist after the replacement weir and passage channel are constructed. Therefore, shovelnose will present a steady surrogate in a changing environment.

Based on these assumptions we predict that the scale or magnitude of impacts likely to be experienced by the future pallid free embryos is similar (proportionally to the population densities) to what has been experienced by shovelnose sturgeon and that like the shovelnose sturgeon, these impacts will not result in a negative population response.

In order to confirm the reasonableness and validity of these assumptions, Reclamation has committed to monitoring impacts from the screens and the replacement weir to pallid sturgeon embryos and larvae. Their monitoring and adaptive management plan has monitoring actions for both areas. In the incidental take statement we characterize the goal and approach of that monitoring. This information could also help in developing information regarding screening criteria for other diversions in the Yellowstone and Missouri Rivers.

4.4 Effects of Interrelated or Interdependent Actions

The implementing regulations for section 7 consultations define interrelated actions as *"...those [actions] that are a part of a larger action and depend on the larger action for their justification."* 50 CFR § 402.02. Interdependent actions "...*are those [actions] that have no independent utility apart from the action under consideration."* 50 CFR § 402.02. Interrelated or interdependent actions (such as the maintenance of canals and ditches, withdrawal of water, operation of the fish screens, maintenance of the current weir, etc.) have already been incorporated into the proposed action and are analyzed in the effects of the action section (or incorporated by reference from the Assessment (Table 4, 12 and p. 99-100).[13]

4.5 Summary of Effects from the Action

Most elements or tasks described in table 4 of the Assessment present a discountable likelihood of an effect occurring or, alternatively, an effect that is likely to be insignificant (Assessment, p. 90-94 and 99). As discussed above, until the replacement weir is complete with the notch and bypass channel (2-3 years), the Service estimates that up to 32 wild adult sturgeon (approximately 26% of the current wild adult population, - section 4.2.1) moving to the weir, each year, will be blocked from moving above the weir to spawn. This is a temporary, but significant impairment of breeding and is considered an "injury" to the sturgeon. Because the impairment represents the status quo, it does not actually change the current reproduction, numbers or distribution of pallid sturgeon in the action area.

After the replacement weir and bypass channel are complete, spawning adult pallid sturgeon will have the opportunity for passage every year, for the entire spawning period around the Intake Diversion Dam. Some percentage of the spawning adults at the weir will not pass above using

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Pursuant to the regulations for consultation, the effects of the action include effects of any additional interrelated or interdependent actions. Interrelated actions are "... *those actions that are part of the larger action and depend on the larger action for their justification"*. The word "larger" in the definition of interrelated can cause confusion (Handbook 4-26-28). It does not relate to size, but actually refers to the proposed action being consulted on. In this case the "larger" action is the proposal for LYP and fish passage. The Missouri River Management Plan does not depend on the Intake Diversion Dam project for its justification; therefore it is not an interrelated action for this consultation.

Interdependent actions are actions that "...*have no independent utility apart from the action under consideration.*" The Missouri River Management Plan clearly has utility apart from the LYP and fish passage; therefore it is not an interdependent action to the Intake Diversion Dam project being consulted on in the BO.

Though not meeting the definition of an interrelated or interdependent action, currently the Corps of the Kansas City and Omaha Districts, are preparing the Missouri River Recovery Management Plan to develop a range of alternatives for management of the Missouri River. This federal action is organized around an adaptive management approach that is intended to be consistent with the purposes of the Act and enhance recovery of the pallid sturgeon. That management plan may impact environmental conditions in the action area considered in this consultation. If that occurs, the Corps, Reclamation, and Service will evaluate whether reinitiation of this consultation is warranted.

the bypass channel. Others are likely to be temporarily delayed at the weir as they seek and find the bypass channel to move above and below the weir. Although there may be adverse effects to sturgeon from temporary delays at the weir, or not passing, there will be a considerable net gain for sturgeon that do pass because of access to 162 miles of river upstream of the Intake Diversion Dam via the new bypass channel.

Increased drift distance will allow pallid sturgeon free embryo/larvae more time to mature and become mobile (and able to seek suitable habitat) before encountering the less suitable (potentially lethal) conditions in Lake Sakakawea (Assessment p. 55). Current observations show that 60-90 percent of the wild telemetered fish enter the lower Yellowstone River. Twelve to twenty six percent of telemetered adult fish migrate to the Intake Diversion Dam. If that pattern is repeated by the thousands of fish that are maturing, then hundreds of maturing fish will be migrating to Intake Diversion Dam in the next decade. Overall, this represents an appreciable potential improvement in the sturgeon's reproduction, overall numbers (through potential recruitment) and distribution in, and near, the action area.

For free embryos, the Service described the potential injury or death of a portion of the individuals exposed to the headgate screens, and also a portion of the individuals that move over the weir. We also described (using both simple explanation and a surrogate species) our rationale for why we believe the number of that life stage injured or killed is likely to be small compared to the number in the river and why the breeding strategy of the sturgeon allows for survival even in the face of early life stage mortality. Given that discussion, the Service believes that the loss of free embryo described earlier is not likely to have a discernable negative effect on recruitment of fish into the population and thus will not negatively change the reproduction, numbers or distribution of the sturgeon population in the action area.

Overall, the proposed action is consistent with the recovery plan's goal of improving passage. Passing these spawning adults upstream of the Intake Diversion Dam greatly improves the likelihood of survival of drifting free embryos. That survival is the key to recruitment of young fish in to the population and would substantially improve the likelihood of not just survival, but recovery in the upper Missouri River area.

5.0 CUMULATIVE EFFECTS

The implementing regulations for section 7 define cumulative effects as "*...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 We have identified no activities fitting the cumulative effects definition for pallid sturgeon. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation.

6.0 JEOPARDY DISCUSSION AND CONCLUSION

6.1 Introduction

In section 7 of the Endangered Species Act, Congress required that every federal agency must insure that any action "*...authorized, funded, or carried out...is not likely to jeopardize the continued existence of any endangered or threatened species...*".

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

As described in detail earlier, to address the threshold question of whether a proposed agency action is likely to jeopardize the continued existence of a listed species, the Service evaluates the status of the species, the environmental baseline of the action area, the effects of the action and any cumulative effects. The synthesis of all this information forms the Service's opinion as to whether the proposed action's negative effects resonate at the scale of the listed entity in such a way as to be likely to meet the elements in the definition of Jeopardy (... *to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.*" 50 CFR § 402.02).

The Service's BO is advisory and is not a review of the prudency of the proposed action or judgment regarding its value or effectiveness relative to other potential projects, or of the action agency taking no action.

6.2 Discussion

6.2.1 Negative effects

The baseline reproduction condition of pallid sturgeon in the action area is poor, but contains potential. While the habitat is generally supportive of feeding and sheltering, the current weir blocks spawning in the tributary rivers above the weir. The total population of pallid sturgeon near the action area is estimated to be approximately 43,000. Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. However, the number of wild fish in the action area, that are known to be mature enough to spawn, is small (approximately 125) and aging. Where spawning occurs below the weir, there is not enough drift distance for the free embryos and larvae to become mature enough to seek out suitable habitat before entering Lake Sakakawea. Because the lake is very poor habitat for larval survival, if embryos do not mature enough to be able to swim on their own and find suitable habitat before reaching the lake, few if any, will survive. Though recruitment is subject to many environmental factors, lack of sufficient larval drift distance is thought to be the main reason that young fish are not being recruited into the population and the most likely impediment to survival and recovery of pallid sturgeon in this area.

Most impacts (e.g. noise, turbidity, disturbance, pumps and temporary increased velocities due to coffer dams, etc.) from components and elements of this proposed action (described in Assessment, Table 4) present a discountable likelihood of an effect occurring (low probability of sturgeon being exposed to the impact), or an effect that is likely to be insignificant (type of physiological response results in an effect that cannot be meaningfully measured, detected or evaluated). The Service estimates that two adults and five juveniles may be injured or killed through capture and handling. The remaining effects described in detail in the effects section of this biological opinion do not actually kill adult pallid sturgeon. However, for the next 2-3 years, the existing weir will be maintained in the river until the replacement weir, notch, and bypass channel are constructed. The weir currently and for the next 2-3 years will impair up to 26 percent of the adult, wild pallid sturgeon from passage and spawning above the weir, annually, during the 2-3 year construction schedule. This can be considered an "injury" to the potential breeding success of the sturgeon. However, it is not actually a change to the sturgeon's condition because the baseline condition is for no passage around the current weir. This is a 2-3 year continuation of a degraded reproduction condition that applies to pallid sturgeon in the action area. In addition, the high water channel with intermittent suitable flow conditions to move fish upstream beyond the weir will also be closed off. Assuming that the natural high water would flow enough water for passage in one of those years, a subset of 5-16 spawning wild adults (Section 4.2.3) will be impaired through blocked access to the natural channel during construction.

The effects from impacts of this proposed action are likely to result in injury and death of a small portion of sturgeon free embryo. This is likely to occur as a result of injury at the fish screens and from passing through the rubble field below the weir. As described in the effects summary, those effects are not likely to cause an appreciable reduction in the reproduction, numbers, or distribution of the sturgeon in or near the action area. We base that conclusion on our prediction that the loss will represent a small portion of the total number of that life stage present, and sturgeon have a reproductive strategy that tolerates extremely high mortality of early life stages. We are also using successful surrogate species and monitoring to help confirm that conclusion.

6.2.2 Beneficial effects

The potential beneficial effect of the action on the long-term survival and recovery of the sturgeon is very high. Recruitment is the key to conservation of the pallid sturgeon in the action area, but recruitment cannot occur without pallid sturgeon spawning in an area that allows for a long enough period of drift for free embryo's to survive and find suitable rearing habitat. Currently below the Intake Diversion Dam, there is not enough distance for that to occur. The action creates the opportunity (and likelihood) of pallid sturgeon spawning above the replacement weir every year. The observations that in 2014 telemetered fish swam to the Intake Diversion Dam area and used the ephemeral natural channel, swam 4½ miles up the channel, then 98 miles further upstream to spawn, demonstrates the strong motivation for wild fish to pass above Intake Diversion Dam if circumstance allows. Because of design, length, position (along with flow depth and velocity, and longer period of availability) the new bypass channel is expected to pass motivated fish every year, for the entire spawning period, and at a greater percentage than the existing high water channel.

Currently, the known spawning sites in the Yellowstone River (RM 6-20) result in only 21-72 miles of larval drift distance before the anoxic habitat of Lake Sakakawea (depending on low or high pool). By creating opportunity for fish passage every year at the Intake Diversion Dam to spawning habitat above the weir, the larval drift distance (before Lake Sakakawea) is increased by as much as 235 miles (calculated from the Cartersville Dam to the current spawning sites in the Yellowstone River) to a total of 269 miles (from Cartersville to Lake Sakakawea. This distance makes it much more likely that a portion of larva fish will survive to one year of age (an age class that is currently missing and is thought to be a main cause for lack of recruitment). The potential impact of this new habitat to the sturgeon population is significant. The significance is highlighted by the 2009 Science Review Report. "*...Without the resumption of natural spawning there is no real possibility that the naturally produced (i.e., non-stocked) pallid sturgeon population in RPMA2 will recover from its endangered status...*". (Reclamation 2009, p.15)

A circumstance that acts as a potential multiplier for improvement is the presence of a large cohort of fish from the augmentation program. Estimates are that 15,455 of these fish are aged 6-8 years and 1,981 are greater than 9 years of age. This means that over the next 15 years, almost 18,000 pallid sturgeon in this group will reach maturity and become capable of reproducing (Figure 4). A few of these older (20 years of age) hatchery fish have already demonstrated the same patterns of wild fish and been tracked to the Intake Diversion Dam in 2016). If that trend follows patterns of wild fish, approximately 2,800 to 4,200 of them will migrate to the Intake Diversion Dam. The bypass channel, replacement weir and fish screens will allow this biological potential to be expressed in a pattern of migration and spawning which is the first necessary step to recruitment and recovery in the upper Missouri River.

6.2.3 Synthesis of effects

In the short term (2-3 years during construction) passage above the weir will not occur. Given the long lived nature of the sturgeon, their reproduction strategy, and the thousands of augmentation fish now reaching potential spawning age, the Service does not believe that the short term impacts of maintaining the weir will appreciably reduce the sturgeon's likelihood of survival and recovery.

In addition, the replacement weir, notch, and fish bypass channel will provide annual opportunities for passage and spawning for decades to come, unlike the sporadic and brief availability of the high flow channel. The largest direct negative impact of the future condition is anticipated to occur to a portion of free embryos as they move past the screens and over the weir. However, as we described earlier, these losses are expected to be small, and the reproduction strategy of the sturgeon is a strategy that tolerates heavy mortality in the early life stages.

Therefore, taken as a whole, the proposed action of creating fish passage and the opportunity for successful spawning and recruitment, represents a great potential for increasing reproduction, numbers and distribution of the wild pallid sturgeon in the action area. This action implements an identified priority 1 action from the pallid sturgeon recovery plan "Restoring habitat connectivity where barriers to fish movement occur." (Service 2014, p. 77). Priority 1 actions are considered "... actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." (Service 2014, p. 75).

6.2.4 Conclusion

The status of the pallid sturgeon is stable, but largely due to the support from the augmentation program. The Missouri River has been altered and those alterations have negatively affected the river below Fort Peck Dam through changes to temperature, hydrology and flow effectively reducing drift distances before reaching anoxic waters at Lake Sakakawea. Many management actions to correct or mitigate those effects have been examined by the action agencies, but none have proven to be feasible. No additional or new methods for reducing those impacts have been proposed. Therefore, in the Upper Missouri River, no change to the status of the pallid sturgeon is expected in the next several years.

Likely as a result of the negative changes to the Missouri River, and a largely unregulated hydrology in the Yellowstone River, 60 to 90 percent of the current wild adults migrate into the Yellowstone River during spawning season. Recently, some spawning has been confirmed miles below the Intake Diversion Dam and that spawning has produced free embryos, but none have recruited into the population. The most likely reason is that the drift distance from those spawning areas to Lake Sakakawea is too short. Up to 26 percent of the wild adults have been observed swimming further up the Yellowstone River, up to the Intake Diversion Dam. Beyond the weir are hundreds of miles of historical habitat including areas of known spawning habitat. In years with high enough flow a temporary side channel can provide limited access around the weir, but the channel does not flow enough water for passage every year and does not flow for the whole spawning period. Therefore, Intake Diversion Dam is effectively a complete barrier to further upstream movement.

Thousands of hatchery fish, produced from wild stock are present in the action area and will be reaching sexual maturity in the next few years and on into the next decade. In fact, this number of fish may represent a population larger than ever historically occurred in the Missouri and Yellowstone River near Intake Diversion Dam. As this large cohort of pallid sturgeon mature, they will naturally seek out spawning opportunities. Hatchery fish of spawning age have already been detected at the Intake Diversion Dam.

The proposed project is to provide a passage channel around Intake Diversion Dam to allow motivated fish to gain access to hundreds of miles of habitat above the weir. Because of design, length, position, flow depth and flow velocity, and longer period of availability the new bypass channel is expected to consistently pass an even greater percentage of fish than the temporary natural side channel is able to. This project is consistent with the goals of the recovery plan for the Yellowstone River and passage would eliminate the most evident barrier to potential successful spawning in the Yellowstone River.

Once spawning fish have access to spawning habitat above the Intake Diversion Dam, free embryos produced will have approximately 235 more miles of drift distance (than drift distance from current spawning sites below the weir) to mature before reaching potentially deadly conditions in Lake Sakakawea. This represents a substantial improvement for larval drift (and recruitment) than the current condition.

The Service finds that the total effect from the proposed action (water diversion, operation and maintenance of the current weir for 2-3 years, construction of an improved weir and a new fish passage channel and post-construction monitoring) to adult or early life stages of sturgeon is not likely to cause reduction in the reproduction, numbers, or distribution of the sturgeon in or near the action area. In fact, the project is likely to substantially improve the likelihood of survival and recovery of the species in the action area over the status quo, improving the likelihood of survival and recovery of the listed species. It follows then, that the proposed action will not appreciably reduce the likelihood of survival and recovery of the pallid sturgeon, at the listed entity scale.

Therefore, the Service finds that the proposed action is not likely to jeopardize the pallid sturgeon.

7.0 REINITIATION OF CONSULTATION

This concludes formal consultation on Reclamation's and the Corps' proposed action for the Lower Yellowstone Project: Intake Diversion Dam Fish Passage Project. As provided in 50 CFR §402.16, reinitiation of formal 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: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) 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; (c) 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 (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

If, during implementation of the proposed action, changes in circumstances, situation, or information regarding this proposed action occur, Reclamation and the Corps will assess the changes and any potential impacts to listed species, review the re-initiation triggers above, coordinate with the Service's Prairie Mountain Regional Office (if needed) and make a determination as to whether re-initiation is necessary.

CONSERVATION RECOMMENDATIONS

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.

- The Service recommends that Reclamation and the Corps partner with the Montana Fish, Wildlife and Parks, Upper Basin Pallid Working Group, and the Service to identify and investigate other opportunities to improve fish passage or reduce entrainment at other Reclamation facilities.

- The Service recommends exploring particle-modeling efforts (such as recent USGS effort for the Fairview reach of the Yellowstone River), to examine transport and fate of pallid sturgeon free embryos in the Yellowstone River above the Intake Diversion Dam. Results might contribute information on impacts and success of fish passage at Intake.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, as amended, and federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or 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 such as breeding, feeding, or sheltering.

In those cases where the Service concludes that an action and the resultant incidental take of listed species will not violate section 7(a)(2) of the Act, the Service provides an "incidental take statement" with the biological opinion. The incidental take statement exempts the take anticipated as a result of the action. Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be a 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 for any operation and maintenance activities implemented by the Lower Yellowstone Irrigation Project Board of Control, or other permittees for the exemption in section 7(o)(2) to apply. Reclamation and the Corps have a continuing duty to regulate the activities covered by this incidental take statement. If Reclamation or the Corps 1) fails to assume and implement the terms and conditions, or 2) fails to require the Lower Yellowstone Irrigation Project Board of Control or other permittees to adhere to the terms and conditions of the incidental take statement, 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 impacts on the species as specified in the incidental take statement. 50 CFR § 402.14(i) (3).

Incidental Take Anticipated

Prior to completion of weir and bypass channel

Impairment of reproduction - All adult spawning sturgeon blocked from passing and spawning are taken in the form of harm (injury) by having their reproduction potential temporarily impaired. We estimate this harm to occur to up to 32 adult wild pallid sturgeon (or approximately 26% of the current estimated population of adult wild fish - See section 4.2.1). This harm is not expected to cause the death any individual sturgeon. It will occur annually for the next 2-3 years. A subset of 5-16 spawning adults (Section 4.2.3) will be impaired through blocked access to the natural channel during construction of the fish passage channel.

Monitoring - All juvenile and adult sturgeon captured, and tagged as part of the proposed monitoring for the proposed action are taken in the form of capture and harm. The capture occurs through the use of nets or other capture devices. The harm occurs through temporary injury of handling and invasive marking procedures. Though rare, the Service anticipates that up to two adults and five juveniles (Section 2.4.6) may be injured or die as a result of handling and tagging. This take is separate from any purposeful or incidental take anticipated and permitted by existing 10(a)(1)(a) permits or the section 6 agreement with the state of Montana.

Following completion of weir and bypass channel

Note: The incidental take described below for free embryos will only occur in the future after the weir and bypass channel are complete and then only after successful passage of spawning adults and successful spawning above the weir.

Passage – Incidental take is anticipated in the form of harm. Harm (non-lethal) will result from motivated spawning adults that swim to the Intake Diversion Dam and do not pass through the bypass channel. Not passing above the weir will impair the breeding for those adults for that year.

Entrainment -Incidental take of sturgeon free embryo is anticipated. It will be in the form of harm from injury and death by free embryo passage through the screens.

Downstream drift - Incidental take of free embryos will occur during downstream drift past the screens and weir. This take will be in the form of harm from injury or death from passing over the weir and impacting rocks below and by impingement of sturgeon free embryos from the river side of the screens.

Monitoring - Incidental take of sturgeon free embryos is anticipated by capture and harm during monitoring for level of incidental near the front of screens and at the weir. Harm will result from temporary injury during capture and some mortality from capture and handling. Incidental take of adults and juveniles may occur during capture and marking (see previous subsection).

Amount or Extent of Incidental Take

Adult

Based on past monitoring results, the Service estimates that annually for the next 2-3 years, up to 32 sturgeon (or 26% of the adult wild population) will be taken, in the form of harm by injury through impairment of reproduction (non-lethal). In the effects section (4.2.1) we explained that this number was extrapolated from information for the percentage of the population that has been detected through telemetry at the Intake Diversion Dam and its numerical relationship to the current estimated total wild adult population.

For take monitoring during the construction phase, because the population may change, the 32 sturgeon will be represented by a percentage of the telemetered population. Based on past observation we assume that up to 26 percent of the telemetered population (assumed to also represent 26 percent of the total current wild adult population) could be detected at intake in any given year. A detected portion of the telemetered population at the weir greater than 26 percent would mean that a larger portion of the population is present and are impeded from passing above the weir. This would represent greater take (non-lethal) of pallid sturgeon than anticipated.

During the post-construction phase, take of adult spawning pallid sturgeon from failure to use the bypass channel and pass upstream to spawn is likely to occur. The Service estimates that of the total number of telemetered fish detected at the Intake Diversion Dam, annually up to 59% of those may not pass upstream and may be taken through impairment of breeding. In the effects section we explain that this estimate of fish not passing is likely an overestimate because the bypass channel characteristics will be better than the natural channel for passing fish. We also recognize that fish not passing is likely due to many different factors, not just the presence of the new weir, however the Service does not have a way to ascribe amounts to all of the possible factors and thus cannot reduce the total estimate. The Service also notes the difficulty in accurately monitoring this percentage due to the number of telemetered maturing juveniles that may be detected at the Intake Diversion Dam, but not have a desire to pass above the weir.

Take of adult pallid sturgeon from monitoring the effects of the Intake project is expected to be rare. The Service has estimated a maximum of up to two adults taken in the form of harm from death during capture, handling and tagging.

Juveniles

Take of juvenile pallid sturgeon from monitoring the effects of the Intake project is expected to be rare. The Service has estimated a maximum of up to five juveniles taken in the form of harm from death during capture, handling and tagging.

Free embryos

Free embryos of the pallid sturgeon are the only age class that the Service has predicted will be killed or injured during the proposed action. Calculating the exact number of free embryos taken by an action in the future is extremely difficult and even speculative. This is because the free embryos are less than an inch long, the amount of water moving past the project site is millions of cubic feet, and the pallid sturgeon free embryos will be mixed with millions of shovelnose free embryos. Pallid free embryos cannot be differentiated from shovelnose sturgeon in the field. Likewise in the field, it would be nearly impossible to count all the free embryos injured, killed, or alive after passage over the weir. For example, it would take 700 feet of fine mesh nets arranged below the weir, held in place against the current, and then monitored for at least a week to count the number of free embryos that pass over the weir. Such comprehensive netting attempts are logistically impractical and potentially dangerous to monitoring crews operating in boats below the weir. For this reason we will use a sampling methodology.

In the effects section the Service explained that rather than speculate about specific pallid numbers, we would instead use the shovelnose sturgeon as a surrogate to approximate a magnitude or scale of loss. We chose the shovelnose sturgeon because it is the most biologically similar fish to the pallid sturgeon in the action area and because its population appears stable even without the benefit of a replacement weir, weir notch, or bypass channel.

We believe that impacts to shovelnose sturgeon from the screens, weir, and bypass channel are likely to represent the same type of effects experienced by the pallid sturgeon. Though the sampled shovelnose sturgeons will be more numerous, we believe that impacts to shovelnose and pallid will be proportionally similar. This is why the shovelnose sturgeon can act as a reasonable surrogate for pallid sturgeon.

Capture and monitoring of shovelnose and pallid sturgeon free embryos (and opportunistically other life stages) will establish a rate of occurrence, injury and death from the screens and new weir structure. After project completion, when pallid sturgeon are confirmed to pass above the replacement weir and spawn, capture and monitoring data on rate of occurrence, injury and death of pallid sturgeon will be compared to data on shovelnose. Based on our assumptions described earlier regarding surrogacy, we expect the rate to be similar and consistent with our predicted level of effects. Stated another way, we expect the occurrence of pallid sturgeon free embryos (dead, injured or alive) at the monitoring sites to be proportionally the same as the shovelnose sturgeon.

For example if a monitoring site's samples produced 130 shovelnose free embryos and they were distributed as 100 live, 10 dead and 20 injured, then we would expect the total number of pallid free embryos at that site to be distributed very similarly (i.e. a total of 20 pallid free embryos, would be expected to be distributed as 15 live, 2 dead, and 3 injured).

A statistically significant deviation in the survival, death or injured rates between pallid and shovelnose would indicate that the Service's rationale may be invalid and exceed the ITS requiring reinitiation of consultation. We also believe that using a comparative rate of impact, rather than a specific number will accommodate year to year changes in environmental conditions and changing numbers of spawning individuals.

Effect of Incidental Take

The Service believes that the effects to free embryos and adults, resulting in the described level of anticipated incidental take, is not likely to jeopardize the continued existence of the pallid sturgeon. Our rationale for this conclusion can be found in the jeopardy discussion and conclusion section.

REASONABLE AND PRUDENT MEASURES AND THEIR IMPLEMENTING TERMS AND CONDITIONS

The Service has identified the following reasonable and prudent measures and their implementing terms and conditions to reduce the impacts of the incidental take identified above. In order to be exempt from the prohibitions of section 9 of the Endangered Species Act, Reclamation or the Corps must comply with the following, non-discretionary terms and conditions. The Service realizes Reclamation and the Corps may develop alternative methods to meet the goal of the reasonable and prudent measures outlined below. In the event of that occurring, Reclamation and the Corps may request that the Service amend this document.

Reasonable and Prudent Measure 1

Work with appropriate parties (including the Service) to establish monitoring plan for incidental take monitoring.

Term and condition 1

Before February 1, 2017, Reclamation and the Corps will meet with the Service to discuss goals, strategy and logistics of monitoring shovelnose and pallid sturgeon

Monitoring will include.

- Monitoring behind the headworks screens to sample shovelnose and pallid sturgeon
- Monitoring within the influence of the river side of the screen to sample shovelnose and pallid sturgeon
- Monitoring below the future weir to sample shovelnose and pallid sturgeon
- Sampling each monitoring site with techniques appropriate to enumerate species and injury, death rate.

Term and condition 2

Based on the monitoring in term and condition 1, if the impacts are different than anticipated, Reclamation and the Corps shall immediately convene an interdisciplinary group (biologists, engineers, etc.) to examine and implement actions from the adaptive management plan to reduce those impacts and will evaluate whether they need to reinitiate consultation.

Term and condition 3

Reclamation will compile information enumerating how many telemetered pallid sturgeon are present at the Intake Diversion Dam.

Term and condition 4

Reclamation will compile information from partner agencies enumerating how many telemetered pallid sturgeon pass into the Yellowstone River from the Missouri River.

Term and condition 5

Report results of monitoring and project progress to the Service on an annual basis by March 1, beginning March 1, 2018.

Reasonable and Prudent Measure 2 [14]

As part of the monitoring program for interim operations, Intake Diversion Dam fish passage construction, and until the bypass channel is finished, relocate motivated adult and juvenile pallid sturgeon above the current weir.

Term and condition 1

Before February 1, 2017, Reclamation and the Corps will meet with the Service to discuss goals, strategy and logistics of moving motivated spawning adults and juveniles above Intake Diversion Dam.

The plan will include.

- Developing a rule set to determine how and when to safely capture, transport and release motivated spawning adults above Intake Diversion Dam
- Developing a rule set to determine how and when to safely capture, transport and release motivated juveniles above Intake Diversion Dam
- Monitoring released individuals to determine movements up and down river (including path past Intake Diversion Dam)
- Monitoring to detect evidence of spawning by adults
-
- Monitoring to detect free embryos at the fish screen and weir

Term and condition 2

Report results of monitoring and project progress to the Service on an annual basis by March 1, beginning March 1, 2018.

[14] The Service realizes that by implanting the RPM to reduce the take of spawning sturgeon, any free larvae produced by spawning above the weir will be subject to exposure to the fish screens and weir. Any take resulting from this exposure is consistent with that already analyzed in the biological opinion and is considered exempt from section 9 of the ESA. Monitoring pursuant to RPM 1 will be implemented if adults are transported above the weir in the interim before bypass channel completion. Knowledge gained from the transport and release will be valuable information in implementing this proposed action and potential for recruitment.

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PERSONAL COMMUNICATIONS

Trimpe, David. March 5, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachment) to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Draft Ba

Trimpe, David. March 24, 2015. Natural Resource Specialist for Bureau of Reclamation, Billings Montana. Email (with attachments) to Doug Laye, U.S. Fish and Wildlife Service, Region 6. Subject: Information on several questions including drift speed of sturgeon.

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ATTACHMENT D

ADVISORY COUNCIL ON HISTORIC PRESERVATION APPROVAL OF THE MEMORANDUM OF AGREEMENT

Preserving America's Heritage

October 21, 2016

Mr. Rick Hanson
Bureau of Reclamation
Great Plains Region
Montana Area Office
P.O. Box 30137
Billings, MT 59107-0137

Ref: *Filing of New Memorandum of Agreement (MOA) regarding the Modification of the Intake Diversion Dam, Lower Yellowstone Project, Dawson County, Montana*

Dear Mr. Hanson:

The Advisory Council on Historic Preservation (ACHP) has received the Memorandum of Agreement (MOA) for the above referenced project. In accordance with Section 800.6(b)(1)(iv) of the ACHP's regulations, the ACHP acknowledges receipt of the MOA. The filing of the MOA, and execution of its terms, completes the requirements of Section 106 of the National Historic Preservation Act and the ACHP's regulations.

We appreciate you providing us with a copy of the MOA and will retain it for inclusion in our records regarding this project. Should you have any questions or require additional assistance, please contact John Eddins, Ph.D., at (202) 517- 0211 or via e-mail at jeddins@achp.gov.

Sincerely,

LaShavio Johnson

LaShavio Johnson
Historic Preservation Technician
Office of Federal Agency Programs

ADVISORY COUNCIL ON HISTORIC PRESERVATION

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