United States Department of the Interior

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Mountain-Prairie Region

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MAR 30 2015

Mr. David Ponganis, Director of Programs
U.S. Army Corps of Engineers
1125 NW Couch Street, Suite 500
Portland, Oregon 97209

Dear Mr. Ponganis:

Thank you for this opportunity to convey our current understanding regarding pallid sturgeon passage at the Intake Diversion Dam Project on the Yellowstone River. This letter follows up on a March 19, 2014 letter. Although we realize that no decision has been made on the bypass channel proposed as a component of the Intake Diversion Dam Project, we continue to believe that the bypass channel is the best alternative to recover pallid sturgeon in the upper Missouri River. As set forth below, this conclusion continues to be supported by the best available science. We support your commitment to the Lower Yellowstone Project.

This letter explains the U.S. Fish and Wildlife Service's (Service) decision to support construction of fish passage at the Intake Diversion Dam in lieu of the original 2003 Biological Opinion Reasonable and Prudent Alternative – Fort Peck elements (RPA) described below. As we have stated before, fish passage at Intake Diversion Dam is essential for pallid sturgeon recovery in the upper Missouri River. This letter is intended to answer questions about the bypass channel and to set forth the Service's rationale for why it believes the bypass channel will work as planned.

Another purpose of this letter is to describe the context of consultation requirements under Section 7 of the Endangered Species Act (ESA). As explained in more detail below, the amended 2003 Biological Opinion from the Service set forth an RPA containing numerous elements designed to avoid jeopardizing the pallid sturgeon. One of those RPA elements calls for the use of adaptive management as a tool to preclude jeopardy to the sturgeon. Adaptive management is a process that allows regular modification of management actions in response to new information and to changing environmental conditions.

As part of the adaptive management process, the Service, in October 2009, revised portions of an earlier RPA and substituted Intake Diversion Dam modifications for measures that were to be undertaken at Ft. Peck Dam. We concluded that fish passage, among other improvements, would contribute more to avoiding the likelihood of jeopardy. This document provides the biological explanation for that conclusion. To summarize, the expected success of fish passage at Intake Diversion Dam compensates for uncertainties associated with Ft. Peck Dam modifications.

Fish passage at Intake Diversion Dam will improve access to the Yellowstone River's natural temperature fluctuations and river habitat, triggering spawning movements and successful reproduction. Discharge flows into the bypass channel will exceed those from an existing natural bypass channel, increasing the ability of migrating fish to use the constructed bypass channel annually and for more days of any given year. Passage at Intake will also improve access to upriver sections of the Yellowstone, including the Tongue and Powder Rivers. Perhaps most importantly, passage will add to available larval drift distance, increasing the probability of larval survival.

Under circumstances not applicable here, a new RPA might trigger the need to reinitiate formal Section 7 consultation under 50 C.F.R. 402.16. Here, however, the Service determined that the substitute RPA did not trigger reinitiation of formal consultation. This is explained in greater detail in the Service correspondence to the Corps dated May 2, 2012.

Because the United States Army Corps of Engineers (Corps) adopted the Intake project, including the fish passage component, as an RPA element, section 7 consultation was concluded. We continues to believe that reinitiation of Section 7 consultation is not necessary. The conclusion reached in May of 2012 still applies. Additionally, as the responsible federal agency, and working collaboratively with the Corps and Service, the United States Bureau of Reclamation (Reclamation) has requested consultation under section 7 for operation and maintenance of the Lower Yellowstone Project, including Intake Diversion Dam and all other Project appurtenances, and construction of fish passage facilities. The Service and Reclamation are revising the Biological Assessment submitted by Reclamation in December 2014.

Set forth below is our analysis of the proposed project. We present a brief background of the pallid sturgeon and the history of the changes to the Missouri and Yellowstone Rivers that led to the Missouri River Biological Opinion, as amended in 2003 (2003 BiOp). We review various activities and their contributions to advancements in our scientific understanding, and how those advancements led the Service to adapt the portions of the 2003 BiOp and support the Corps and Reclamation efforts to provide fish passage at the Intake Diversion Dam.

Background:

Pallid Sturgeon

Pallid sturgeon, Scaphirhynchus albus, is a species native to the Missouri and Mississippi river systems, including large tributaries like the Yellowstone River. It was listed as an endangered species in the fall of 1990 (55 FR 36641-36647). Pallid sturgeon evolved in the naturally diverse environments of these large rivers that included backwaters, chutes, sloughs, islands, sandbars, and a dynamic main channel—all resulting from an unaltered hydrograph. This natural process formed the large-river ecosystem that met the habitat and life history requirements of pallid sturgeon and other native large-river fishes (USFWS 1993, 2014).

One of the described listing factors was habitat fragmentation and loss, including alteration to morphology, hydrology, temperature regime, cover, and sediment/organic matter transport of the Missouri River resulting from construction of six mainstem dams (USFWS 1993). In the upper Missouri River between Fort Peck Dam and the headwaters of Sakakawea Reservoir and the Yellowstone River (Upper Missouri River) almost all remaining wild pallid sturgeon are adults (USFWS 2007). The absence of younger fish in this population is indicative of spawning or recruitment failure. There continues to be no evidence of natural recruitment within the Missouri and Yellowstone rivers in Montana and North Dakota (USFWS 1993, 2014) and only an estimated 125 wild adult pallid sturgeon remain in the pallid sturgeon population inhabiting the Upper Missouri River (Jaeger et al. 2009).

As currently understood, pallid sturgeon require habitat conditions that include natural flow and temperature regimes to cue pre-spawning migrations and elicit spawning behavior (USFWS 1993). Spawning and recruitment failure of pallid sturgeon in general are attributed to a combination of disruption of natural spawning cues, obstruction of migration routes, and inundation of spawning and nursery areas caused by mainstem impoundments (USFWS 1993; USFWS 2007). After hatching, larval pallid sturgeon drift downstream for about 11 days, which requires several hundred kilometers of free-flowing river downstream of spawning areas (Kynard et al. 2007; Braaten et al. 2008). Accordingly, for successful pallid sturgeon spawning and recruitment to occur, habitat conditions must include 1) intact migration and spawning cues, 2) suitable physical spawning habitats, 3) adequate larval drift distances, and 4) suitable rearing habitats. An inadequate larval drift distance is currently the leading hypothesis to explain pallid sturgeon recruitment failure in the Upper Missouri River (Upper Basin Pallid Sturgeon Workgroup 2009).

Missouri River

Destruction and alteration of big-river ecologic functions and habitat once provided by the Missouri and Mississippi Rivers is believed to be the primary cause of declines in reproduction, growth, and survival of pallid sturgeon (USFWS 1993). The physical and chemical elements of channel morphology, flow regime, water temperature, sediment transport, turbidity, and nutrient inputs once functioned within the big-river ecosystem to provide habitat for pallid sturgeon and other native species. Today on the main stem of the Missouri River, approximately 36 percent of riverine habitat within the pallid sturgeon's range has been transformed from river to lake by construction of six massive earthen dams between 1926 and 1952 (USFWS 1993). Another 40 percent of the river downstream of dams has been channelized. The remaining 24 percent of river habitat has been altered by changes in water temperature and flow caused by dam operations. The channelized reach of the Missouri River downstream of Ponca, Nebraska, once a diverse assemblage of braided channels, sandbars, and backwaters, is now confined within a narrow channel of rather uniform width and swift current.

Morris et al. (1968) found that channelization of the Missouri River reduced the surface area by approximately 67 percent. Funk and Robinson (1974) calculated that the length of the Missouri River between Rulo, NE, and its mouth (~500 RM) (310 km) had been reduced by 8 percent, and the water surface area had been reduced by 50 percent following channelization.

Missouri River aquatic habitat between and downstream of main stem dams has been altered by reductions in sediment and organic matter transport/deposition, flow modification, hypolimnetic releases, and narrowing of the river through channel degradation. Those activities have adversely impacted the natural river dynamics by reducing the diversity of bottom contours and substrate, slowing accumulation of organic matter, reducing overbank flooding, changing seasonal flow patterns, severing flows to backwater areas, and reducing turbidity and water temperature (Hesse 1987). The Missouri River dams also are believed to have adversely affected pallid sturgeon by blocking migration routes and fragmenting habitats (USFWS 1993).

Yellowstone River

The near-natural hydrograph and associated temperature and sediment regimes characteristic of the Yellowstone River (White and Bramblett 1993) combine to provide one of the best habitat templates and opportunities to support pallid sturgeon recovery in the upper Missouri River basin. Current habitat conditions include intact migration and spawning cues and habitats; most extant adult pallid sturgeon in the Upper Missouri River migrate into the lower Yellowstone River each spring (Bramblett and White 2001) and subsequent spawning has been documented (Fuller et al. 2008). However, adequate larval drift distances between known spawning reaches and the present headwaters of Sakakawea Reservoir may not exist. Lower Yellowstone Diversion Dam (Intake Diversion Dam), has likely impeded movements of pallid sturgeon in the Yellowstone River since construction in 1907 and currently serves as a barrier to wild adult (Backes et al. 1994; Bramblett and White 2001; Fuller et al. 2008) and hatchery-reared juvenile pallid sturgeon (Jaeger et al. 2006; Jaeger et al. 2007). Pallid sturgeon were historically documented at least 180 kilometers upstream of Intake Diversion, which is about 430 kilometers above the present headwaters of Sakakawea Reservoir, during times of the year when spawning is known to occur (Brown 1955; Brown 1971).

Intake Diversion Dam (Figure 1) was constructed as part of a Bureau of Reclamation (Reclamation) irrigation project during the period 1905-1908. The Intake Diversion Dam is a 12-foot high wood and stone weir that spans the Yellowstone River and raises the water level for diversion of irrigation water into the main canal. It is located near Glendive, Montana, approximately 70 river miles upstream from the confluence of the Yellowstone River with the Missouri River. The Lower Yellowstone Irrigation District #1, Lower Yellowstone Irrigation District #2, Intake Irrigation District, and Savage Irrigation District are responsible for operation and maintenance of the Intake Diversion Dam under contracts with Reclamation. In addition to being a barrier for upstream migration of pallid sturgeon for over a century, at least 32 other fish species may be affected by Intake Diversion Dam (White and Bramblett 1993; Hiebert et al. 2000).

Evidence of restricted passage at Intake Diversion Dam exists for many native Yellowstone River fishes. Sauger catch rates in the reach downstream of this structure are four times greater than those in upstream reaches (Jaeger 2005), juvenile shovelnose sturgeon are much more abundant downstream of the diversion than upstream (Backes et al. 1994), and movements of paddlefish are impeded at low flows.

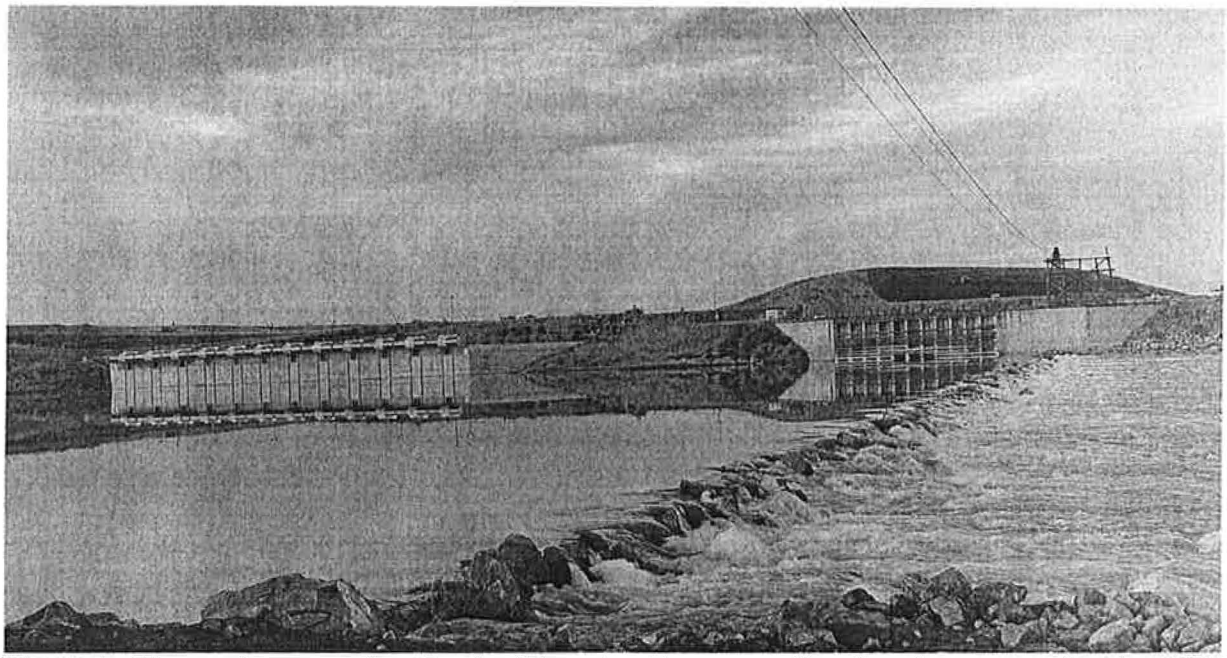

Figure 1. Photo of stone weir at Intake Diversion Dam near Glendive, Montana. October 2012. Note fish screens in raised position at new headworks.

At present, pallid sturgeon reside in the Missouri River downstream from the confluence of the Missouri and Yellowstone rivers during 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. Today, these natural flows only regularly occur within the Yellowstone River system. 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 above the Yellowstone confluence. However, there are rare exceptions to this general pattern. For example, during the spring of 2011, a disproportionate number of adult pallid sturgeons migrated up the Missouri River and remained upstream of Wolf Point, Montana during the spawning period (Fuller and Haddix 2012). This change in migration behavior coincided with exceptionally higher than normal releases at Fort Peck Dam, as well as historically high discharge from the Milk River.

While naturally-produced wild larval pallid sturgeon have been documented within the Missouri and Yellowstone rivers, wild young-of-year and juvenile pallid sturgeon observations remain absent. However, artificially propagated pallid sturgeon stocked as juveniles do survive; strongly suggesting something is amiss in the species' early life history requirements.

2000 Biological Opinion (as amended in 2003)

Between 2000 and 2003, the Service completed the 2003 BiOp on the Corps operation of the Missouri River main stem reservoir system, operation and maintenance of the Missouri River bank stabilization and navigation project and operation of the Kansas River reservoir system. The Service determined that in the Upper Missouri River, continued operation of Fort Peck Dam as proposed would continue to significantly impair the reproduction of pallid sturgeon in this reach. The altered hydrograph and altered temperature regime reduces the ability of pallid sturgeon to spawn. It was believed that survival of larval and juvenile pallid sturgeon in this reach was impaired by the artificially produced cold water temperatures that restrict the amount of riverine habitat available. In addition, these same factors affect the production of forage fish which are important to the overall survival of pallid sturgeon. The Service concluded that the Corps proposed action would continue to jeopardize the pallid sturgeon in the wild and provided the Corps with a RPA.

Importantly, throughout the 2003 BiOp, the Service recognized that certain life history aspects of the pallid sturgeon were not well understood. Additionally, since prescribed management alternatives in the RPA could not be deterministically linked to sturgeon population demographic responses, the implementation of actions should be undertaken within an adaptive management framework. Adaptive management is a process that allows regular modification of actions in response to new information and changing environmental conditions. An adaptive management framework is a particularly effective way to address multiple species, ecosystem variability, and biological unknowns about the lifecycles, behaviors, and habitat requirements of the listed species under consultation.

The RPA described the framework for an adaptive management approach to the Corps' river operations and maintenance along the Kansas and Missouri rivers to avoid jeopardy to listed species and facilitate their eventual recovery. This approach included a regular regime of discussion, information exchange, evaluation and reevaluation, and monitoring between the Corps and the Service. The general management actions identified in the opinion as part of the current project descriptions and as the RPA, were to be conducted, modified, and continually improved upon through adaptive management.

The RPA included the following Fort Peck Dam elements in summary:

Adaptive Management
The Corps shall adopt adaptive management as one tool to preclude jeopardy to pallid sturgeon. The Corps, in cooperation with the Service, shall identify and describe the specifics of implementing and modifying management actions needed at any given time.

Flow Enhancement
The Corps shall no later than the 2004 annual operation, which will begin in March, 2004:
a) ensure that the Master Manual and the corresponding NEPA document sufficiently analyze and incorporate the capability to implement long-term flow enhancements in this reach upon completion of the Fort Peck tests (mini and full).
b) upon completion and evaluation of the Fort Peck tests (mini and full), assuming all technical issues have been addressed, implement flow enhancements to provide spawning cues and water temperature management at the first opportunity system storage and lake level allow.
c) the Corps shall, when implementing the system unbalancing, do so in a manner that starts with Fort Peck Lake at the highest elevation in the first year while achieving stable conditions in the second year.
d) to the extent that there are system-wide water savings from implementing the summer habitat flows below Gavins Point Dam, those savings shall be stored, to the maximum extent feasible, in Fort Peck Lake.

Development of Fort Peck Dam Temperature Control Device Feasibility
The Corps shall within 3 years prepare a study that will evaluate the feasibility of constructing a temperature control device on the upstream face of the Fort Peck Dam. The study, once completed, will be subject to an outside engineering peer review for technical and economic feasibility. The peer review will be jointly established and overseen by the Corps and the Service. If the peer review determines that the project is feasible and can be built and is a cost effective management action to provide water temperature management through the summer while continuing to provide hydropower, the Corps shall implement the necessary steps to proceed with construction of the facility.

Recognizing the value of restoring the Yellowstone River as a natural migratory route for pallid sturgeon, and in making the upper Yellowstone River available as spawning and nursery habitat, the Service also provided the following conservation recommendation to the Corps under Section 7(a)(1) of the ESA:

The Intake Diversion Dam, operated by the Bureau of Reclamation, located on the Yellowstone River approximately 70 miles upstream of the confluence with the Missouri River has been identified as an impediment to migration of pallid sturgeon during the spawning season. As pallid sturgeon is forced to spawn in the lower reaches of the Yellowstone River, it is likely that larval sturgeon then drifts into the lake environment of Lake Sakakawea and perish. Suitable spawning substrates and significant tributary inflows are present upstream of the barrier. Reconstruction of the Intake Diversion Dam to allow pallid sturgeon spawning migrations in the spring would be a significant benefit to this species. Such an action would make available approximately 170 river miles of highly suitable habitat for this species and should have a significant impact on reproduction and recruitment in this reach. We encourage the Department of the Army to work with the Department of the Interior to implement existing plans for reconstruction of this facility at the earliest possible date.

Other Recovery Activities in the Upper Missouri River:

In addition to the Biological Opinion and its associated activities, a number of other significant efforts have been undertaken that have provided information, influencing our understanding and Corps adaptive management decisions. Several of these include:

Memorandum of Understanding

A multi-agency MOU addressed fish passage, entrainment protection, and monitoring of the Lower Yellowstone Intake Diversion Dam. Signed in July 2008 by the BOR, Corps, Service, state of Montana, and The Nature Conservancy, this multi-agency MOU was undertaken to collaboratively identify conservation measures to reduce adverse effects of Intake Diversion Dam Operations on pallid sturgeon. It identified scope of involvement for each of the parties and worked to identify a process for funding identified actions. It was the efforts of this partnership that lead to Section 3109 of the 2007 Water Resources Development Act, Public Law 110–114, Nov. 8, 2007 (uncodified), which gave the Corps authority to use funds appropriated to carry out the Missouri River recovery and mitigation program to assist the Bureau of Reclamation in the design and construction of the Lower Yellowstone project of the Bureau, Intake, Montana, for the purpose of ecosystem restoration.

Upper Basin Pallid Sturgeon Workgroup – White Paper.

This analysis reviewed the habitat availability and larval drift issues for pallid sturgeon and other native fishes in the Yellowstone River. It was completed in May 2009. This document provided a synthesis of pallid sturgeon science in the Upper Missouri River regarding pallid sturgeon life history particularly larval drift and recruitment on the Yellowstone River. In conclusion, the Upper Basin Pallid Sturgeon Workgroup was strongly supportive of renovating Intake Diversion Dam as a means of providing passage for pallid sturgeon and other native fishes. In addition, the Workgroup strongly supported constructing a fish screening system that will prevent or minimize entrainment of pallid sturgeon and other native fishes. Available scientific data at that time suggested that fish passage and entrainment protection at Intake Diversion Dam may restore habitat conditions that allow natural pallid sturgeon recruitment to occur. Accordingly, the Upper Basin Pallid Sturgeon Workgroup believed that this project provided one of the best opportunities to achieve natural pallid sturgeon recruitment in the upper Missouri River basin.

Independent Pallid Sturgeon Science Review Report

This report on the Lower Yellowstone Intake Project was completed in November 2009. At the request of the Bureau of Reclamation (Reclamation) an independent Science Review Panel (Panel) was convened to provide a critical evaluation of the science surrounding the Lower Yellowstone Diversion Dam Project (Reclamation 2009).

This review specifically considered whether decision documents being developed were using the best available science and whether the science supported a conclusion that the Intake Project is a viable alternative for recovery of pallid sturgeon in the Great Plains Management Unit.

It was the consensus view of the Panel that the best science available was used in the development of the decision documents and supporting documentation. This review concluded that the information effectively supports hypotheses that:

1. The project will provide passage and enhance upstream migration for adult pallid sturgeon.
2. Suitable spawning habitat exists upstream of the project.
3. Conditions at the potential upstream spawning sites are suitable for the development and survival of pallid sturgeon eggs.
4. There is sufficient downstream drift distance for larval development for at least a portion of the larvae in some years for some level of natural recruitment to occur.
5. Proposed fish screens will effectively decrease entrainment of adult, juvenile, larval, and embryonic pallid sturgeon and other fish species.
6. Conditions in the Yellowstone and connected sections of the Missouri River are suitable conditions to support completion of the pallid sturgeon life cycle.

Technical Addendum to the Yellowstone River Intake Diversion Scientific Review

This technical addendum was submitted on January 29, 2010. This report included additional scientific data and analysis as an addendum to the Independent Pallid Sturgeon Science Review Report - Lower Yellowstone Intake Project. It provided additional detailed decision support information by modeling larval drift effects of temperature and channel velocity in the Upper Missouri River.

State of the Science and 2003 BiOp Implementation:

Subsequent to the completion of the 2003 BiOp, a substantial research and monitoring effort has been undertaken to advance our understanding of the pallid sturgeon and the effects of anthropogenic environmental alterations on its life history needs. These alterations including altered flow regimes, impoundment, and fragmentation, continue to be identified as threats to pallid sturgeon (55 FR 36641-36647, USFWS 1993, 2000, 2003, and 2014) and currently form the basis for the prevailing hypothesis explaining recruitment failure in the Missouri and Yellowstone rivers downstream from Fort Peck and Intake dams due to inadequate larval drift distance.

Upon hatching, larval pallid sturgeon are thought to swim up from the substrate where they are dispersed downstream for 10-17 days resulting in the pallid sturgeon free embryos and larvae being transported 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).

Because the natural upstream migrations of spawning adult pallid sturgeon are blocked by Fort Peck Dam and severely limited by Intake Dam, the maximum total available main channel drift distance for hatching larval pallid sturgeon is currently limited by Fort Peck and Intake dams on the upstream end and the headwaters of Lake Sakakawea (a Missouri River Reservoir impounded by Garrison Dam) at the downstream end (Figure 2). Lake Sakakawea is currently considered to be an impediment to larval pallid sturgeon survival by truncating riverine habitat necessary for wild pallid sturgeon larvae to complete their drifting transition from free embryos to larvae (Guy et al. 2015).

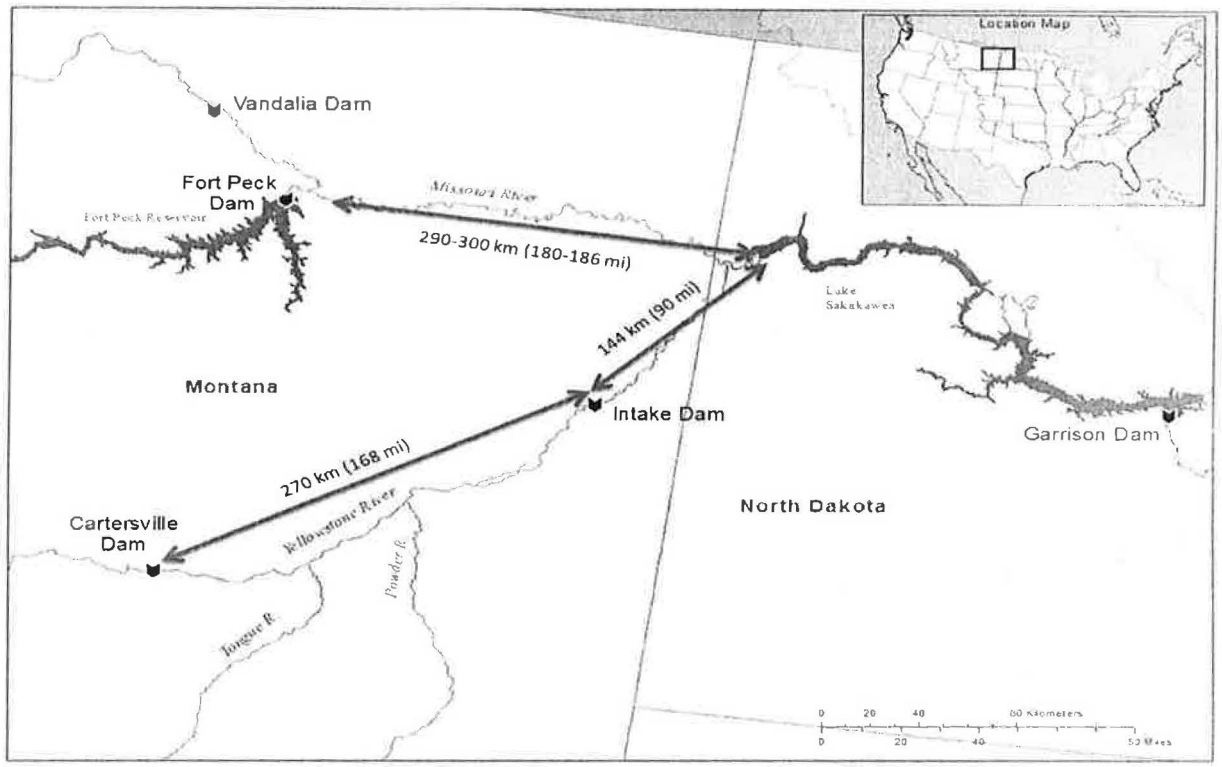

Figure 2. Approximate main-channel larval pallid sturgeon drift distances between prominent Missouri and Yellowstone river structures.

Available data indicate that hatchery released 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 (Braaten et al. 2008; 2010, 2012b). These observations support the hypothesis by Kynard et al. (2007) which implicates total drift distance as a limitation on natural recruitment. Thus, within a given river reach, the distance required to complete the early life history requirements is dependent on total reach length, river discharge, velocity, habitat complexity, and temperature; all of which influence the Missouri and Yellowstone rivers differently .

The Missouri River between Fort Peck Dam, Montana, and the headwaters of Lake Sakakawea, North Dakota is regulated by releases from Fort Peck Dam, ultimately affecting water temperature, spawning cues, side-channel inundation, and habitat forming processes. Overall, this reach is approximately 340 km (211 mi) in length. Considering only the effects of the hypolimnetic discharge (cold water releases from the bottom of the reservoir) from Fort Peck Dam, it is reasonable to conclude that the first 40-50 km (24-31 mi) downstream of the dam is unsuitable for pallid sturgeon spawning due, in part, to cold water temperatures (Braaten et la. 2012). Thus, realistically, there is a maximum of only 290-300 km (180-186 mi) of riverine habitat available for the larval drift transition to occur (Figure 2). The available drift distance within this reach is at the very lower end of what is believed necessary and so far no evidence of recruitment within this reach has been documented since the species was listed.

Several hypotheses guide conventional thinking about the likelihood of successful recruitment of pallid sturgeon to age one on the Upper Missouri River. Recent studies (Guy et al. 2015) have demonstrated that the transitional zone between the riverine (lotic) and reservoir (lentic) conditions in the upper reaches of Fort Peck are anoxic (no oxygen) due to high concentrations of organic particulate material subject to microbial respiration. There is strong evidence that similar conditions exist in the transitional zone of Lake Sakakawea, and that free embryos that settle in that zone would not survive. A second hypothesis is that settlement of drifting free embryos generally occurs about 8 to 14 days post hatch depending on temperature (Braaten et al. 2012), though the actual amount of time spent drifting could be less than that if the fish reside in the interstices of the substrate for some period following hatch. It is believed that free embryos generally drift in the lower portion of the water column, near the channel thalweg, at a rate slightly less than the mean channel velocity (Braaten et al. 2010, 2012).

In 2013, the Corps, in collaboration with the Missouri River Recovery Implementation Committee, and following the recommendation of its Independent Science Advisory Panel; initiated a detailed effects analysis to evaluate the efficacy of its management actions on the listed species. The resulting Effects Analysis (Fischenich et al. 2015) applied the above assumptions to the reach between Fort Peck and Lake Sakakawea, and used advection/dispersion modeling to assess drift in the reach. In one set of analyses, they replicated flows and pool levels in a ten-year period from 2003 to 2012 to determine what percentage of free embryos remained within lotic reaches, i.e. upstream of the reservoir transition zone, for various drift durations. Spawning was assumed to occur at the Milk River confluence, about 9 miles downstream of the dam. The model predicted that 70 percent of the embryos remained in riverine segments on average after 6 days over the 10-year period. That figure dropped to 45 percent after seven days, 16 percent after eight days, and four and one percent at nine and ten days of drift, respectively. In the absence of larval being retained in the interstices of the substrate, these analyses again suggest that long-term retention of sturgeon larvae in riverine segment below Fort Peck Dam is likely less than five percent. Considered on an annual basis (rather than an average), retention after eight days of drift was in excess of 20 percent for half the years (but zero or nearly zero in the remaining half). Table 1 provides a summary of the results of these analyses.

Table 1. Summary of free embryo retention in the upper Missouri River using advection/dispersion modeling for actual conditions in the period from 2003 through 2012.

The assumed spawning location is at the Milk River confluence with the Missouri River. Retention is the percentage of free embryos remaining upstream of the reservoir transition zone in each year for the specified drift period.

Year	% Retained @ T=5	% Retained @ T=6	% Retained @ T=7	% Retained @ T=8	% Retained @ T=9	% Retained @ T=10
2003	97	82	24	2	1	0
2004	99	100	79	29	7	3
2005	99	100	90	43	10	2
2006	99	98	71	23	6	3
2007	99	99	82	33	8	4
2008	100	99	76	26	4	0
2009	99	84	26	2	0	0
2010	80	20	3	0	0	0
2011	0	0	0	0	0	0
2012	84	17	0	0	0	0
Total	**86**	**70**	**45**	**16**	**4**	**1**

The Effects Analysis also directly considered the effectiveness of two management measures – decreased flows to reduce advection and lowered pool levels in Lake Sakakawea to extend the riverine segment. A third management measure – temperature control – can be implied using drift duration as a surrogate for temperature. Simulations of drift were made using advection/dispersion models with an assumed spawning location at the Milk River confluence, as described above. Flows were varied from 3000 to 18,100 cfs (the historic minimum to the 5 percent exceedance level), and pool elevations were varied from 1805 ft. msl to 1856 ft. msl, approximately the range of observed values in the past 50 years, including the historic minimum, recent minimum, and maximum levels as well as the median and 10 and 90 percent exceedance values. In all, 48 combinations of flow and pool level were modeled and the percentage of free embryos retained in lotic reaches documented at two-day intervals from four to ten days (Table 2). These analyses demonstrate that all three management actions affect retention. They also confirm the earlier analyses using historic flows. Retention is very low and approaching zero after about eight days of drift. The analyses also reinforce the importance of interstitial hiding as a critical unknown. If no interstitial hiding occurs, recruitment failure is likely except when both flows from Fort Peck and pool levels on Lake Sakakawea approach historic minimums.

Table 2: Embryo retention as a function of discharge and pool level (ten days of drift).

Percent Larvae Upstream of Reservoir Pool at T = 10 Days							
		Lake Sakakawea Pool Level					
Flow		HMin	Min	10	50	90	Max
Exceed	Ft. Peck	1805.0	1812.6	1821.6	1843.2	1850.4	1856.0
Min	3000	21%	19%	6%	3%	1%	1%
5	5500	4%	5%	1%	1%	0%	0%
10	6100	0%	3%	1%	0%	0%	0%
25	7150	1%	1%	1%	0%	0%	0%
50	8600	0%	0%	0%	0%	0%	0%
75	11000	0%	0%	0%	0%	0%	0%
90	14400	0%	0%	0%	0%	0%	0%
95	16100	0%	0%	0%	0%	0%	0%

Temperatures of the Missouri River as it flows into Fort Peck Reservoir are warmer than the outflow temperatures of Fort Peck Dam generally during March through August. The water in deep reservoirs thermally stratifies resulting in a colder and denser water layer at depth. When this cold water is released, it substantially cools the riverine environments downstream. As an example, average and maximum water temperatures immediately downstream of Fort Peck Dam can be reduced by as much as 6° C (10.8° F) and 10.4° C (18°F), respectively (Fuller and Braaten 2012). While the magnitude of these effects decrease with increased distance from the dam, these cooling effects still influence 290 km (180 mi) of the Missouri River downstream. Even at this distance, the average and maximum temperatures are still 1° C (1.8° F) cooler than Missouri River reaches above Fort Peck Reservoir (Fuller and Braaten 2012).

The water intakes for Fort Peck Dam are on the bottom of the reservoir making it challenging to develop and implement design options to discharge warm surface waters downstream. In 2009, the Corps provided their Fort Peck Dam Temperature Control Device Reconnaissance Study. Ten alternatives to improve downstream water temperatures were evaluated for further consideration (COE 2009). Through subsequent investigations (COE 2012), the use of a flexible curtain to act as a submerged weir became the focus. This option utilizes a flexible curtain that is suspended a set distance from the water surface using a float system with the curtain bottom being anchored to the lake bottom with ballast and anchors. This option works by passing the warmer water from the upper portion of the water column over the weir crest into the intake area, rather than drawing cold water from the bottom of the reservoir (COE 20012a). Due to an estimated short life cycle (i.e. 10-20 years), uncertainties with meeting downstream temperature targets, emerging science on larval drift distances, high construction and O&M costs, and significant dam operation safety concerns, this option was determined infeasible by the Corps.

The Yellowstone River is the largest tributary to the Missouri River. While the Yellowstone River contains several low head diversion weirs that individually and cumulatively effect some fish migrations (Helfrich et al. 1999), these low weirs have insignificant effects on temperature and discharge when compared to the main-stem Missouri River Dams and reservoirs resulting in the Yellowstone River retaining a near-natural hydrograph and temperature profile as well as natural habitat forming processes.

Of the six diversion weirs on the river, the lowermost, Intake Dam, is approximately 115 km (71 mi) from the confluence with the Missouri River and effectively limits upstream movements of pallid sturgeon (Bramblett and White 2001). Though Intake Dam negatively affects upstream migrations of pallid sturgeon, passage over or around this structure has been occasionally documented. During 2014, five radio-tagged pallid sturgeons (one female and four males) migrated around Intake Dam at Yellowstone River discharges ranging between 46,900 – 63,800 cfs (recorded at the USGS gage station near Sidney, MT). All five were confirmed to have migrated through the periodically inundated natural side channel located to the south of Intake Dam and all five were documented to have swum upstream into the Powder River where they were believed to have spawned (Montana Fish, Wildlife, and Parks, unpublished data). Based on the 74 year period of flow records from the same gage station for the period May 15-June 15, comparable Yellowstone River discharges to those observed when the pallid sturgeon migrated through the natural side channel in 2014 occur for approximately 7 days in 5 out of 10 years. Prior to these 2014 observations, there are two additional confirmed observations of wild adult pallid sturgeon collected upstream of Intake dam as well as two hatchery stocked pallid sturgeon that were released below Intake Dam and recaptured above. Specifically, one wild adult was caught by an angler in 1950 in the mouth of the Tongue River, one wild adult was collected by biologists in 1991 sampling near Fallon, Montana, and the two hatchery released fish were collected by biologists sampling upstream of Intake dam, one in 2011 and one in 2013 (Brown 1955, Watson and Stewart 1991; Montana Fish Wildlife and Parks, unpublished data). It is unknown if these fish migrated over Intake Dam or around it in the natural existing channel. Thus the total available drift distance from Intake Dam on the Yellowstone River to the headwaters of Lake Sakakawea is approximately 144 km (90 mi) (Figure 2). The next diversion dam upstream from Intake Dam is Cartersville Dam which is located about 270 km (168 mi) upstream from Intake Dam or 415 km (258 mi) from the headwaters of Lake Sakakawea (Figure 2).

Adaptive Management Changes to the 2003 BiOp RPA:

Following completion of the 2003 BiOp and in deliberate consideration of rapidly advancing understanding of pallid sturgeon life history needs and management opportunities in the Upper Missouri River described above, the Service in coordination with the Corps, made letter amendments to the 2003 BiOp per the RPA adaptive management framework. Following is a chronological listing of those letter amendments.

August 13, 2008: Letter from the USFWS (Acting RD) to the Corps (Anderson) concurring to look at the RPA elements in light of the Corps new authority under Section 3109 of WRDA 2007 and determine how the RPA could be modified if the Corps commits to the Intake Dam project.

December 12, 2008: Letter to the USFWS from Assistant Secretary of the Army – Civil Works, conferring the Corps implementation guidance regarding Section 3109 of WRDA 2007. Corps seeks clarification from the USFWS on how assuming the Intake Dam project would affect the Corps mainstem Missouri River ESA obligations.

May 20, 2009: Letter to the USFWS (Guertin) from the Corps (Anderson) requesting flexibility on four specific elements of the RPA.

October 23, 2009: Letter from the USFWS (Guertin) to the Corps (Ponganis) amending the RPA elements related to the Flow Enhancement below Fort Peck Dam and Development of Fort Peck Dam Temperature Control Device Feasibility. It also provided success criteria that would be used for evaluating the effectiveness of the Yellowstone River Intake Diversion Dam project.

April 7, 2010: Letter from USFWS (Acting RD) to the Corps (Anderson) with clarifying edits to the October 23, 2009 letter.

April 23, 2012: Letter from the USFWS (Walsh) to the Corps (Ponganis) confirming the USFWS position that the Yellowstone River Intake Diversion Dam project is a top priority in the ability to recover the pallid sturgeon in the upper Missouri River Basin.

February 6, 2013: Letter from the USFWS (Walsh) to the Corps (Ponganis) amending the RPA elements related to Fort Peck to clarify the Corps role in the Yellowstone River Intake Diversion Dam project and clarifying the success criteria for the Corps to include the fish bypass design criteria.

December 18, 2013: Letter to the USFWS (Thabault) from the BOR (Campbell) confirming the BOR commitment to the operations and maintenance, monitoring and adaptive management of the Yellowstone River Intake Diversion Dam project post construction.

March 19, 2014: Letter from the USFWS (Walsh) to the Corps (Ponganis) conferring the bypass channel hydraulic and physical performance objectives.

Conclusion:

Efforts to design, develop, and implement workable modifications at Fort Peck Dam (e.g. U.S. Army Corps of Engineers (COE) 2009, 20012a) and passage at Intake Dam (e.g. Reclamation 2002, 2005, 2012; COE 2011, 2012b) have been ongoing for the past decade. During this time, the Service has been working cooperatively with Montana Department of Fish Wildlife and Parks, Corps, Reclamation, and other partners.

As stated previously, current understanding indicates larval drift distances are implicated as a leading factor in the lack of natural recruitment in the pallid sturgeon population inhabiting the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River. Options to increase drift distances include modifying infrastructure and operations at Fort Peck Dam to improve release timing and duration and increase water temperature. However, modifying Fort Peck Dam operations poses unacceptable dam safety risks and threatens compliance with congressionally authorized project purposes, including flood control and recreation (COE 2009). Even if these issues could be overcome, actively managing the hydrology below Fort Peck Dam to provide the appropriate volume and temperature at the correct time would be a significant challenge containing hydrological, physical, and biological uncertainty with a small probability of success. Additionally, for necessary larval drift distance to be achieved in this reach, the pool elevation of Lake Sakakawea would need to be lowered to historically low levels.

Providing passage at Intake Dam on the Yellowstone River will provide access to an additional 270 km (168 mi) of important historical habitats, increase main-channel total larval drift distances to approximately 415 km (258 mi), as well as allow pallid sturgeon access to large tributaries like the Powder and Tongue rivers (Figure 2). At present, the fish passage alternative being developed is a constructed bypass channel that would provide migrating fishes with a route around Intake Dam. The designed channel is approximately 3.4 km (2.1 mi) in length, has a slope of 0.0002 m/m (0.0007 ft. /ft.), and a 12 m (40 ft.) bottom width. The fish entrance to the bypass channel is near the downstream extent of the existing Intake Dam and is angled slightly downstream to both mimic natural side channels and maximize fish attraction. The exit from the bypass channel is located well upstream of the dam to minimize fish being swept back down below the dam and is angled similar to the fish entrance. The overall bypass channel has been designed to specifications which are intended to maximize the probability of successful pallid sturgeon passage upstream of Intake Dam over a wide variety of river discharges. Based on flow duration curves, the design discharge range approximates the 80% flow exceedance probability in May and 5% flow exceedance probability in June. In other words, during the key migration period for pallid sturgeon, May - June, the bypass channel should provide appropriate depths and velocities for approximately 25 days in 10 out of 10 years.

Additionally providing passage at Intake Dam improves access to the Yellowstone River's natural hydrograph and temperature profiles as well as natural riverine habitat necessary for triggering spawning movements and successful reproduction. The Yellowstone River provides 35-50% more area of slow current velocity habitat patches than the Missouri River during periods when the larval drift occurs. Passage at Intake Dam will also provide access to tributaries like the Tongue and Powder rivers. None of the irrigation diversion structures on the Yellowstone River significantly trap sediment and alter the resultant seasonally high turbidity levels, thereby reducing predation on pallid sturgeon larvae.

Summary Statement:

Pallid sturgeon survival in the Missouri River reach below Fort Peck Dam and in the Lower Yellowstone River are ecologically linked. The fish found in the Missouri River below Fort Peck Dam are often found in the Yellowstone River and in the reach of the Missouri, below the confluence with the Yellowstone. The two river reaches form one ecosystem and any river restoration efforts in the area should be viewed as benefiting both rivers and their fish populations. While water temperatures and flows identified in the original Fort Peck RPA element are important, other ecological variables affecting long-term survival of the pallid sturgeon in the Upper Missouri River, including the amount of contiguous free flowing river miles, are also critical to the recovery of the pallid sturgeon in this region and throughout its range.

It is the position of the Service, based on the aforementioned information, that providing for consistent and reliable upstream adult pallid sturgeon migration, and unimpeded downstream movement of juvenile pallid sturgeon on the Yellowstone River, is the best biological option for ensuring pallid sturgeon recovery in the upper Missouri River Basin.

I look forward to the completion of the Lower Yellowstone Intake Fish Passage and Fish Screen Project. If you need further information, please do not hesitate to contact me at (303) 236-7920 or Michael Thabault, the Assistant Regional Director for Ecological Services in the Mountain-Prairie Region, at (303) 236-4210.

Sincerely,

Noreen E. Walsh

Regional Director

Braaten P. J., D. B. Fuller, L. D. Holte, R. D. Lott, W. Viste, T. F. Brandt, and R. G. Legare. 2008. Drift dynamics of larval pallid sturgeon and shovelnose sturgeon in a natural side channel of the upper Missouri River, Montana. North American Journal of Fisheries Management 28:808-826.

Braaten P. J., D. B. Fuller, R. D. Lott, M. P. Ruggles, and R. J. Holm. 2010. Spatial distribution of drifting pallid sturgeon larval in the Missouri River inferred from two net designs and multiple sampling locations. North American Journal of Fisheries Management 30:1062-1074.

Braaten, P. J., D. B. Fuller, R. D. Lott, M. P. Ruggles, T. F. Brandt, R. G. Legare, and R. J. Holm. 2012a: An experimental test and models of drift and dispersal process of pallid sturgeon (Scaphirhynchus albus) free embryos in the Missouri River. Environmental Biology of Fishes 93:377-392.

Braaten, P.J., C.M. Elliott, J.C. Rhotten, D. B. Fuller, and B. M. McElroy. 2015. Migrations and swimming capabilities of endangered Pallid Sturgeon (*Scaphirhynchus albus*) to guide passage designs in the fragmented Yellowstone River. Restoration Ecology. 10pp.

Bramblett, R. G. and R. G. White. 2001. Habitat use and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers in Montana and North Dakota. Transactions of the American Fisheries Society 130:1006-1025.

Brown, C. J. D. 1955. A record-sized pallid sturgeon, *Scaphirhynchus album*, from Montana. Copeia 1:55-56.

COE. 2009. Fort Peck temperature control device reconnaissance study Fort Peck, Montana, Final Report prepared by Tetra Teck for U.S. Army Corps of Engineers, Omaha, Nebraska. pp 116.

COE. 2011. Intake Diversion Dam modification project summary of fish passage concepts. U.S. Army Corps of Engineers, Omaha, Nebraska. pp 28.

COE. 2012a. Fort Peck Lake Dam temperature study and preliminary design. Interim Report: Preliminary engineering of the submerged weir alternative. U.S. Army Corps of Engineers, Omaha, Nebraska. pp 136.

COE. 2012b. Intake Diversion Dam modification lower Yellowstone Project, Montana; Bypass channel 30% design documentation report (Draft). U.S. Army Corps of Engineers, Omaha, Nebraska. pp. 19.

Fuller, D. B. and P. J. Braaten. 2012. For Peck Flow Modification Biological Collection Plan compendium; a summary of 2001 - 2009 activities. Report prepared for the U.S. Geological Survey and the U.S. Army Corps of Engineers, Omaha District. Montana Fish Wildlife and Parks. Fort Peck, Montana. pp. 122.

Fuller, D. B. and T. M. Haddix. 2012. Examination of pallid sturgeon use, migrations, and spawning in the Milk River and Missouri River below Fort Peck Dam. Report prepared for the U.S. Geological Survey and the U.S. Army Corps of Engineers, Omaha District. Montana Fish Wildlife and Parks. Fort Peck, Montana. pp. 15.

Guy, C. S., 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, 40:1:6-14.

Helfrich, L.A., C. Liston, S. Heibert, M. Albers, and K. Frazer. 1999. Influence of low-head diversion dams on fish passage, community composition, and abundance in the Yellowstone River, Montana. Rivers 7:21-32.

Jaeger, M., A. Ankrum, T. Watson, G. Hadley, J. Rotella, G. Jordan, R. Wilson, S. Camp, T. Thatcher, and K. Boyd. 2009. Pallid sturgeon management and recovery in the Yellowstone River. Unpublished report. Montana Fish, Wildlife, and Parks. Glendive, Montana. pp. 31.

Kynard, B., E. Parker, D. Push, and T. Parker. 2007. Use of laboratory studies to develop a dispersal model for Missouri River pallid sturgeon early life history intervals. Journal of Applied Ichthyology 23:365-374.

Reclamation. 2002. Intake Diversion Dam fish protection and passage concept design, lower Yellowstone Project. Final Value Engineering Report. U. S. Bureau of Reclamation, Technical Services Center, Denver, Colorado. pp. 67.

Reclamation. 2005. Lower Yellowstone fish passage alternatives value planning study. Final Report. U. S. Bureau of Reclamation, Montana Area Office, Billings, MT. pp. 53.

Reclamation. 2009. Intake Diversion Dam Modification, Lower Yellowstone Project. Science Review Report. Prepared by PBS&J. U. S. Bureau of Reclamation, Billings, MT. pp. 33

Reclamation. 2012. Lower Yellowstone Intake Diversion Dam fish bypass channel entrance and exit pre-appraisal study (progress report) Technical Services Center, Denver, Colorado. pp. 28.

USFWS. 1993. Recovery Plan for the Pallid Sturgeon (Scaphirhynchus albus). U.S. Fish and Wildlife Service, Bismarck, North Dakota. pp. 55.

USFWS. 2000. Biological opinion on the operation of the Missouri River main stem reservoir system, operation and maintenance of the Missouri River bank stabilization and navigation project, and operation of the Kansas River reservoir system. U.S. Fish and Wildlife Service. Denver, Colorado. pp. 385

USFWS. 2003. U.S. Fish and Wildlife Service amendment to the biological opinion on the operation of the Missouri River main stem reservoir system, operation, and maintenance of the Missouri River bank stabilization and navigation project, and operation of the Kansas River reservoir system. U.S. Fish and Wildlife Service. Denver, Colorado. pp. 308.

USFWS. 2014. Revised Recovery Plan for the Pallid Sturgeon (*Scaphirhynchus albus*). U.S. Fish and Wildlife Service, Denver, Colorado. 115 pp.
Reclamation. 2005. Lower Yellowstone Fish Passage Alternatives Value Planning Study. Final Report. Bureau of Reclamation, Denver, Colorado. 67 pp.

Watson, J. H., and P. A. Stewart. 1991. Lower Yellowstone River Pallid Sturgeon Study. Montana Fish, Wildlife and Parks, Miles City, Montana. 29 pp.