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Comment Response Record for the Independent External Peer Review of the Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana Draft Environmental Impact Statement

Panel Final BackCheck Responses to USACE PDT Final Evaluator Responses

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for

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U.S. Army Corps of Engineers
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LIST OF ACRONYMS

AFS	American Fisheries Society
ASCE	American Society of Civil Engineers
ATR	Agency Technical Review
BRT	Biological Review Team
CE	Cost Effectiveness
COI	Conflict of Interest
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DrChecks	Design Review and Checking System
EA	Environmental Assessment
EC	Engineer Circular
EHU	Expected Habitat Unit
EIS	Environmental Impact Statement
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FPCI	Fish Passage Connectivity Index
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HEP	Habitat Evaluation Procedures
ICA	Incremental Cost Analysis
IEPR	Independent External Peer Review
IWR	Institute of Water Resources
LYP	Lower Yellowstone Project
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
O&M	operation and maintenance
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PCX	Planning Center of Expertise
PDT	Project Delivery Team
PWS	Performance Work Statement
Reclamation	U.S. Bureau of Reclamation
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

Final Panel Comment 1

There is substantial risk that the preferred alternative bypass channel will not provide upstream passage of pallid sturgeon in significant numbers to facilitate a measurable, population-level response in natural recruitment.

Basis for Comment

The bypass channel has been designed to meet criteria for water velocities and depths provided by the Biological Review Team (BRT) (Section 2.3.5.1 Bypass Channel Features), but it is unknown if these features meet the needs of adult pallid sturgeon attempting to migrate upstream. There is no evidence that the behavior of adult fish can be manipulated to attract them to the bypass channel, that they would be motivated to swim upstream through the bypass channel, or that they would navigate upstream through the proposed bypass channel in sufficient numbers to enable meaningful levels of spawning and recruitment in the Yellowstone River. In the DEIS, Section 2.5.2 Sturgeon Use of Bypass Channel, concerns are raised as to "…whether bypass channels, in general, have been demonstrated to actually be used by sturgeon for passage." Further, it is stated in Section 2.5.2.1 The Potential for Successful Passage in a Bypass Channel by Pallid Sturgeon, that "…to date, no successful upstream fish passage facility of any type has been built for shovelnose or pallid sturgeon."

The following issues regarding the potential for adult pallid sturgeon to move upstream through the bypass channel during their spring migration remain unaddressed:

a. It is unknown if pallid sturgeon can be attracted to the entrance to the bypass channel. Given the configuration of the Yellowstone River below the Intake Diversion Dam, research indicates that pallid sturgeon will swim upstream primarily on the north side of the channel on the inside of a river bend, which is habitat shown to be preferred by the species during upstream migrations. Typically, 13% of the river flow will be diverted through the bypass channel. It is unknown if this is a sufficiently large flow to attract adult pallid sturgeon. Further, it is unknown if adult fish will actively search for upstream pathways outside of main channel habitat that they have been identified to prefer. Additionally, attraction of adult fish to the entrance to the bypass channel is likely to be confounded by turbulent flows downstream from the Intake Diversion Dam.

b. Adult pallid sturgeon that may find their way to the entrance of the bypass channel would encounter a grade-control structure. The proposed grade-control structure "would be composed of buried riprap covered with gravel/cobble" (Section 2.3.5.2, page 2-49). Insufficient information is provided to make judgments regarding the ability of adult pallid sturgeon to pass over the structure. Further, it is unknown if adult fish will be motivated to swim upstream over this structure. Adult pallid sturgeon are bottom-oriented and select migration paths with sand substrates on the inside of bends near the borders of deep channels during migration. The proposed grade control structure at the entrance to the bypass channel differs substantially from habitat selected by adults during migration in the Yellowstone River.

c. Within the bypass channel, two vertical grade-control structures (riprap sills) are proposed "for maintaining channel slope and allowing for early identification of channel movement" (Section 2.3.5.2, page 2-49). At the upstream end of the bypass channel, another grade-control structure is also proposed. These structures would be “over-excavated and backfilled with natural river rock to give the appearance of a seamless channel invert while providing stability during extreme events” (Section 2.3.5.2, page 2-49). Insufficient information is provided to make judgments regarding the ability of adult fish to swim upstream over the structures. Further, it is unknown if adult pallid sturgeon will be motivated to swim upstream over these structures.

d. Water velocity and depth features proposed for the bypass channel may be sufficient to allow adult pallid sturgeon to move through the bypass channel, but it is not known if they are adequate to motivate movements through the bypass channel. Swimming ability determined in the laboratory is unlikely to be a predictor of behavior or habitat preference.

The DEIS states that upstream migration of adult pallid sturgeon through the bypass channel “may be a rare event” (Section 2.1, page 2-22). There is no evidence provided that sufficient numbers of adult pallid sturgeon would migrate upstream annually through the bypass channel to form spawning aggregations at suitable spawning sites, spawn, and contribute to natural recruitment in the Yellowstone River. Appendix E states an objective for upstream passage as “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)” (page 2). Evidence to support this as an achievable objective is lacking.

Significance – High

Because the potential for upstream migration of adult pallid sturgeon relative to each alternative is not fully addressed, it is unknown whether the preferred alternative will facilitate passage of adult fish.

Recommendation for Resolution

1. Conduct an alternative analysis exclusively for pallid sturgeon that assesses the potential for upstream passage for each stated alternative. Include relevant literature on upstream migration behavior and habitat selection by adult pallid sturgeon, utilization of bypass structures by various sturgeon species in other systems, and actual swimming capabilities of adult pallid sturgeon (not just extrapolations of adult swimming capabilities based on studies of juvenile fish). The analysis should consider the following:

    a. Probabilities that adult pallid sturgeon will be attracted to the entrance of the bypass channel or modified side channel, will enter the bypass channel or modified side channel over possible impediments, will migrate upstream through the bypass channel or modified side channel over possible impediments, and will exit the bypass channel or modified side channel to continue upstream migration.

    b. The size of the population of adult pallid sturgeon that migrate annually up the Yellowstone River to Intake Diversion Dam, the proportion of the migrants that are likely to migrate upstream through the bypass channel or modified side channel, and the subsequent population-level response resulting from natural recruitment by the proportion that successfully migrate.

PDT Final Evaluator Response (FPC 1)			
X	Concur		Non-Concur

The PDT added additional information to the EIS to clarify in more detail why the bypass channel design maximizes the likelihood of passing pallid sturgeon, based on the best available science. Also, information was added to provide more detail on why the agencies believe the bypass channel is the best course of action.

The agencies recognize the uncertainties regarding whether adult pallid sturgeon, under any alternative, would migrate and spawn in sufficient numbers far enough upstream to allow for sufficient drift distance for free embryos and larvae to develop and settle into suitable habitats before reaching the headwaters of Lake Sakakawea. The NEPA Implementing Regulations (40 CFR 1502.22) address this issue and Department of the Interior Regulations (43 CFR 46.125) provide additional detail stating, "In circumstances where the provisions of 40 CFR 1502.22 apply, bureaus must consider all costs to obtain information. These costs include monetary costs as well as other non-monetized costs when appropriate, such as social costs, delays, opportunity costs, and non-fulfillment or non-timely fulfillment of statutory mandates." While the monetary costs to obtain this information are likely considerable, the non-monetary costs are also significant in this case, especially the delays in implementing passage for the remaining wild pallid sturgeon population and the resulting non-timely fulfillment of statutory mandates (i.e., complying with ESA).The best available science strongly indicates that the Yellowstone River provides the best opportunity for natural spawning and recruitment of pallid sturgeon (as opposed to manipulations at Fort Peck Dam); although spawning and recruitment are outside the control and scope of this site-specific fish passage project. A key component of this project will be the Monitoring and Adaptive Management Plan (Appendix E) to specifically monitor the number of fish that do migrate upstream and to take adaptive management actions if the success criteria are not met. Additional information has been added to Appendix E (also see responses to Comment #3). However, measurable, population-level response in natural recruitment is uncertain for any of the alternatives and must be monitored over time to inform further management actions. Specific elements of clarification are provided below.

A. Regarding whether pallid sturgeon can be attracted to the entrance of the bypass channel, additional information has been added to Section 4.9.6.3 (formerly Section 4.10.6.3) about the design of the channel and behavior of pallid sturgeon. Tracking of radio telemetered wild adult pallid sturgeon has shown that pallid sturgeon will migrate up the Yellowstone River to Intake Diversion Dam (Delonay et al. 2014, 2015; Rugg 2014, 2015, 2016). Tracking has shown that some telemetered fish swim along the north side of the river in the two or so miles downstream of the weir (Figure 40 in Delonay et al. 2014), which generally coincides with the main channel location and includes both an outside bend and an inside bend. However, these fish do not statically reside only on the north side of the river but instead appear to "explore" around the weir and move both downstream and back upstream, indicating they may be searching for a passageway. Several of the telemetered fish have been recorded over multiple days or weeks in the vicinity of Intake Diversion Dam.

   Positioning the bypass entrance just downstream from the weir is acceptable, and desirable, when providing passage for migrant fish species (Clay 1995). This configuration has worked at dams in numerous countries. During their spawning migration, pallid sturgeon likely have a strong drive to migrate upstream to spawn.

In 2014 and 2015, adult pallid sturgeon were documented passing upstream of Intake Diversion Dam via the existing side channel around Joe's Island (Rugg 2014, 2015, 2016). In 2014, six wild adult pallid sturgeon migrated upstream (one female and five males) through the existing side channel; it is unclear whether any of these fish initially migrated to Intake Diversion Dam and then subsequently found the existing side channel, or if they were attracted to the existing side channel and used it without ever migrating to the weir. In 2015, one male wild adult pallid sturgeon migrated to Intake Diversion Dam and moved around in the 10 mile reach below the weir for over a month before using the existing side channel to bypass the weir.

The existing side channel is located on the south side of the river, nearly 2 miles downstream of the weir, and conveys only 2-6% of the river flow (the calibrated HEC-RAS model used in the design shows that the existing side channel conveys approximately 570 cfs at river flows of 30,000 cfs [2% of flow], 2,200 cfs at river flows of 54,200 cfs [4%] and 4,000 cfs at river flows of 63,000 cfs [6%]). Adult pallid sturgeon used the existing side channel at flows ranging from approximately 40,000 cfs in 2015 and 47,300 to 68,100 cfs in 2014, when the side channel was conveying 5-6% of the flow. The location of the existing side channel is likely to be difficult for fish to find as there is a large island that splits the river flow downstream of the channel entrance and several shifting bars present very near to the channel entrance. In addition, one juvenile hatchery-produced pallid sturgeon was documented passing upstream and then downstream through the existing side channel in 2015 (Rugg 2016).

Radio tracking of telemetered wild adult pallid sturgeon has also revealed that during their upstream migrations, they can and will use side channels (documented in the Lower Missouri River in constructed side channels in Delonay et al. 2014, 2016a, 2016b; documented in natural side channels in the Upper Missouri River in Braaten et al. 2015 and in natural side channels in the Lower Yellowstone River in Delonay et al. 2014). For example, in Delonay et al. (2014), 11 different pallid sturgeon were documented in 12 side channels in the Lower Yellowstone River, of which three individuals in three different side channels were unambiguously observed to have entered from the downstream end. Some of the channels used were too shallow for the research boat to enter, thus even channels with low flow volumes and depths are sometimes used. Current literature on bypass designs for sturgeon all highlight that the best approaches include those that mimic natural side channels. This would include building a channel with similar geometry, facilitate passage under a range of discharge conditions, and incorporate a broad range of hydraulic criteria that emulate the range, depths and velocities that have been successfully negotiated by targeted migratory fish. (Braaten et al. 2015, Aadland 2010, Jager et al. 2016)

For the design of the bypass channel, extensive input from pallid sturgeon experts, including the Biological Review Team (BRT) convened by the U.S. Fish and Wildlife Service, State of Montana, the U.S. Army Corps of Engineers and the Bureau of Reclamation, has been used to develop flow volume, depth, and velocity criteria and to inform the location and orientation of the channel and to avoid and minimize risks and concerns such as turbulence, eddies, and the ability of the fish to find the downstream entrance to the channel. The current scientific understanding indicates that providing good attraction flows is very important; thus, the BRT's criterion was developed for 13-15% of the river flow, which is nearly 3 times the flow volume of the existing side channel. In order to maximize the potential for upstream migrating pallid sturgeon to find the bypass channel, its entrance has been located immediately downstream of the rock rubble field below the weir. Thus, it is in proximity to where fish have been tracked to be present (see Figure 40 in Delonay et al. 2014) and is below the rock rubble field that has turbulent flow that pallid sturgeon have been shown to avoid. The existing side channel entrance is nearly two miles downstream of Intake Diversion Dam which is well out of the immediate weir zone where fish may be exploring to find a passageway, but nonetheless, some fish have found it. Further, both 2-dimensional and 3-dimensional modeling (i.e. a physical model) were conducted to inform the design of the downstream channel entrance. Placement of fill and grading along both the right and left bank of the channel as it enters the Yellowstone River were recommended based on this modeling to avoid the scour hole immediately downstream of the rock rubble field and to reduce the eddy that exists along the right bank of the river near the proposed channel entrance. Also, the elevation of the bypass channel has been raised slightly at the downstream end to increase attraction flows and keep sediment mobilized out into the main channel of the Yellowstone River.

B. The proposed grade control structures will be buried beneath 9 inches of natural cobble/gravel similar to the larger material present in the river. They are included in the bypass channel design to keep the bypass channel from eroding and incising its bed. . The bypass channel flows and velocities will be within the ranges that occur in natural side channels that pallid sturgeon have been shown to use in the Lower Yellowstone River and those side channels have gravel/cobble substrates. However, the modeling conducted for the design indicated at some flows there could be sufficient shear stresses on the bed to cause some erosion. The grade control structures are insurance to protect the channel from any rapid erosion/incision that could occur during a flood or from severe ice scour, but are otherwise generally expected to remain buried. Thus, pallid sturgeon would not have to swim “over” these structures as the channel bed will be continuous with a slope of 0.0696% at the downstream structure and even flatter slopes for the other three structures. This slope is within the range of slopes of side channels pallid sturgeon have been shown to use on the Yellowstone River.

Regarding whether pallid sturgeon will migrate over gravel and cobble – the Lower Yellowstone River has a natural substrate of predominantly gravel and cobble upstream of River mile (RM) 31 (Bramblett & White 2001), similar to what is proposed within the bypass channel which is at approximately RM 70. This substrate would be expected to form naturally over time if not incorporated in the initial design of the bypass channel.

C. As stated above in the response to item B, the other proposed grade control structures in the bypass channel would also be buried under 9 inches of cobble and gravel similar to the material present in the Yellowstone River. Pallid sturgeon would not need to swim “over” them as the bed will be continuous at each of these locations at slopes of approximately 0.07%. This slope is within the range of slopes of natural side channels pallid sturgeon have been shown to use on the Yellowstone River.

D. The water velocity and depth criteria developed by the BRT were based on the best available science that includes laboratory studies of juvenile and adult pallid sturgeon and shovelnose sturgeon (Adams et al. 1999, 2003; White & Mefford 2002; Hoover et al. 2011; Kynard et al. 2002) and more importantly, by tracking of wild adult pallid sturgeon migrating upstream in the Yellowstone River (Braaten et al. 2015). Braaten et al (2015) demonstrates that wild adult pallid sturgeon do migrate successfully upstream in velocities ranging from 0.77 to 1.95 m/s (2.5 to 6.4

feet/sec) and use depths of 2.2 to 3.4 meters (7.2 to 11.2 feet). Additional detail on depths and velocities actually used by wild adult pallid sturgeon is provided in Delonay et al 2014 and 2015.

Adams, S. R., J. J. Hoover, and K. J. Killgore. 1999. Swimming performance of juvenile pallid sturgeon, *Scaphirhynchus albus*. Copeia 802-807.

Adams, S.R., G.L. Adams, and G.R. Parson. 2003. Critical swimming speed and behavior of juvenile shovelnose sturgeon and pallid sturgeon. Transactions of the American Fisheries Society 132: 392-397.

Braaten, P.J., C.M. Elliott, J.C. Rhoten, D.B. Fuller, & D.J. McElroy. 2015. Migrations and swimming capabilities of endangered pallid sturgeon (*Scaphirhynchus albus*) to guide passage designs in the fragmented Yellowstone River. Restoration Ecology 23(2): 186-195.

Bramblett, R.G. and R.G. White. 2001. Habitat use and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota. Trans. Am. Fish Soc. 130: 1006-1025.

Clay, C. H. 1995. Design of fishways and other fish facilities. Lewis Publ., CRC Press, Boca Raton, FL.pp. 248.

Delonay, A.J., R.b. Jacobson, M.L. Annis, P.J. Braaten, K.A. chojnacki, C.M. Elliott, D.B. Fuller, J.D. Haas, T.M. Haddix, B.J. JcElroy, G.E. Mestl, D.M. Papoulias, J.C. rhoten, and M.L. Wildhaber. 2014. Ecological requirements for pallid sturgeon reproduction and recruitment in the Missouri River: Annual report 2011. U.S.G.S. Open File Report 2014-1106.

Delonay, A.J., R.B. Jacobson, K.A. Chojnacki, P.J. Braaten, K.J. Buhl, B.L. Eder, C.M. Elliott, S.O. Erwin, D.B. Fuller, T.M. Haddix, H.L.A. Ladd, G.E. Mestl, D.M. Papoulias, J.C. Rhoten, C.J. Wesolek, & M.L. Wildhaber. 2015. Ecological Requirements for Pallid Sturgeon Reproduction and Recruitment in the Missouri River – Annual Report 2013. U.S.G.S. Open File Report 2015-1197.

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.

Hoover, J.J., J. Collins, K.A. Boysen, A.W. Katzenmeyer, and K.J. Killgore. 2011. Critical swimming speeds of adult shovelnose sturgeon in rectilinear and boundary-layer flow. Journal of Applied Ichthyhology 27: 226-230.

Kynard, B., D. Pugh, E. Henyey, and T. Parker. 2002. Preliminary comparison of pallid and shovelnose sturgeon for swimming ability and use of fish passage structure. Final Rep. USACOE, Omaha Dist., Omaha, NE. pp. 30.

Kynard, B., M. Horgan, D. Pugh, E. Henyey, and T. Parker. 2008. Using juvenile sturgeons as a substitute for adults: a new way to develop fish passage for large fish. AFS Symp. 61: 1-21.

Kynard, B.; Kieffer, M.; Burlingame, M.; Vinogradov, P.; Kynard, B. E. 2012. Demography, movements, spawning habitat, and spawning success of Connecticut River shortnose sturgeon migrating to Holyoke Dam. WSCS Spec. Publ. No. **4**. pp. 51−72.

McElroy, B., A. Delonay, and R. Jacobson. 2012. Optimum swimming pathways of fish spawning migrations in rivers. Ecology 93(1): 29-34.

Rugg, M. T. 2014. Lower Yellowstone River pallid sturgeon progress report. Montana Fish Wildlife and Parks, Glendive, MT.

Rugg, M. T. 2015. Lower Yellowstone River pallid sturgeon progress report. Montana Fish Wildlife and Parks, Glendive, MT.

Rugg, M.T. 2016. Native Fish Species Movements at Intake Dam on the Yellowstone River. Presentation at: Missouri River Natural Resource Conference, Great Falls, MT, March 22-24, 2016.

White, R.G. and B. Mefford. 2002. Assessment of behavior and swimming ability of Yellowstone River sturgeon for design of fish passage devices. Bureau of Reclamation 0029903.

Recommendation 1:		Adopt	X	Not Adopt

The PDT does not think that additional analysis to attempt to develop a statistical probability of adult pallid sturgeon passage upstream through the bypass channel or other alternatives is feasible at this time. There is a lack of comprehensive data on pallid sturgeon passage behavior, and as such, we must rely on available literature that describe observed pallid sturgeon migration behavior through river features that are similar to a bypass or improved sidechannel (Delonay et al. 2014, 2016a, 2016b; Braaten et al. 2015, Rugg 2014, 2015, 2016), rely on studies for similar sturgeon species' use of passage structures (Jaeger 2016) and expert opinion such as that of the BRT. In order to complete a quantitative analysis on the probabilities that adult pallid sturgeon will be attracted to, enter, migrate through and exit the bypass channel or modified side channel would require much time and effort to appropriately design and scope a study, and complete the significant data collection and evaluation that would be required. In addition to the problem of insufficient time to complete a study, there is the issue of having enough data points (i.e. observation of a rare fish) to have enough statistical power to develop probabilities for these specific behavioral responses, as well as the issue of lacking the specific fish passage structures in which to complete such a study.

Additional modeling was considered by the PDT to potentially provide an analytical evaluation of the probability of fish passage success for each alternative. We considered assessing the pattern of complex hydraulic variables and how these variables influence pallid sturgeon swim-path selection to reduce the uncertainty and further understand the risks associated with the Bypass Project. Specifically, we discussed utilizing an Eulerian-Lagrangian-agent Method (ELAM; e.g., Numerical Fish Surrogate (NFS)) coupled with a multi-dimensional hydraulics model (e.g., 2-D ADH; model resolution should be matched to the channel geomorphology and how pallid sturgeon use the habitat) (Goodwin et al. 2006) to forecast and evaluate adult pallid sturgeon behavior relative to the Intake Dam structure (e.g., migratory pathways based on pallid telemetry information) and the design elements (e.g., bypass entrance locations and orientations, physical conditions at the bypass entrances and within the bypass channel) of the proposed Intake fish bypass. The NFS could be used to forecast how pallid sturgeon may respond to the bypass structure before it is built to determine how the design can be optimized or it could be used after it is built to better understand potential problem areas and prescribe modifications. This methodology has been used successfully by Dr. Dave Smith (USACE's Engineer, Research, and Development Center; ERDC) to evaluate shovelnose sturgeon behavior below Lock and Dam 22 on the Mississippi River (simulations with and without a fish ladder; Smith et al. 2012) and could be used to evaluate and maximize the Intake bypass design.

However, we feel that close adherence to the BRTs recommendations on the design criteria for the side channel is our best bet to maximizing passage potential at this point. These experts have the most up-to-date knowledge of pallid science and relevant passage efforts related to other sturgeons. In addition to the BRT input, we also have new additional information that provides good insights that suggest sturgeon would use a bypass channel and/or modified side channel, such as literature that observed pallid sturgeon migration behavior through natural and constructed river features that are similar to a bypass or improved side channel alternative (Delonay et al. 2014, 2016a, 2016b; Braaten et al. 2015, Rugg 2014, 2015, 2016) as well as the (Jaeger 2016) report that supports the idea of natural designs for sturgeon passage are most successful. Once the project is completed, additional data collection could increase the usefulness and confidence in this modeling approach such that it could be very valuable in understanding potential fixes if impediments to passage become evident.

Similarly, developing a population-scale model to predict the specific recruitment is also not currently feasible at this time. Furthermore, based on the science and studies outlined above, it is reasonable to conclude pallid sturgeon will use the bypass channel.

At this point, a rigorous analysis of this type cannot be completed due to the lack of critical pieces of information such as transitional survival probabilities from egg to age-1 and what proportion of the adult population will be motivated to migrate above Intake and spawn and how far upstream they will choose to spawn. These unknowns exist for all passage options including dam removal. It would be unwise to spend time in developing an EIS to take the many years that it would take to develop this information.

Success of the Intake Diversion Dam Fish Passage Project will be determined by its ability to successfully pass fish. There are no assurances that any type of bypass system or even complete weir removal will lead to a self-sustaining population of pallid sturgeon. However, it is widely acknowledged by the scientific community and the Service (USFWS 2014) that a lack of drift distance sufficient for development of free embryos prior to settling into reservoir habitats is limiting natural recruitment of pallid sturgeon in the upper basin population. If this is true, providing access to habitats above Intake Dam will give drifting free embryos additional time and distance for development and may ultimately provide natural recruitment. It is not certain how many pallid sturgeon will be motivated to pass upstream regardless of the passage alternative, how far upstream they may choose to spawn, and what level of recruitment may result. As a result, the Missouri River Management Plan that is currently being developed does not assume success for any of these options but instead sets up a comprehensive strategy to learn from providing passage at Intake as well as continuing studies to decrease relevant uncertainties on both the Missouri and Yellowstone River so that subsequent actions on either system will be informed on the evolving science.

Goodwin R.A., J.M. Nestler, J.J. Anderson, L.J. Weber, and D.P. Loucks. 2006. Forecasting 3-D fish movement behavior using a Eulerian-Lagrangian-agent method (ELAM). Ecological Modelling 192:197–223.

Smith, D.L., J.M. Nestler, and R.A. Goodwin. 2012. Testing the “river machine” conceptual model for large rivers with data from the Mississippi River. 9th International Symposium on Ecohydraulics, Vienna, Austria.

U.S. Fish and Wildlife Service (Service). 2014. Revised Recovery Plan for the Pallid Sturgeon (*Scaphirynchus albus*). U.S. Fish and Wildlife Service, Billings, MT.

Panel Final BackCheck Response (FPC 1)

X	Concur		Non-Concur

It is acknowledged that while the preferred alternative bypass channel may improve the potential for fish passage at the Intake Diversion Dam there is a substantial risk it may not provide upstream passage of pallid sturgeon in numbers consistent with the BRT criteria outlined in Section 4.9.3. A bypass channel to facilitate upstream passage of pallid sturgeon around a dam has not been tried previously. There is a lack of data on pallid sturgeon passage behavior and it is uncertain how many pallid sturgeon may be motivated to pass upstream through a bypass channel.

Final Panel Comment 2

The FPCI and the CE analysis based on the index do not adequately represent the significance of pallid sturgeon passage as an objective of the proposed action and the uncertainty associated with pallid sturgeon passage.

Basis for Comment

The stated purpose of the proposed action is to improve upstream 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 (ES, p. xxvi). In addition, given the endangered status of pallid sturgeon (DEIS, pp. 1-7 to 1-8), it is stated "…the primary purpose of a fish passage project at Intake Dam is to improve pallid sturgeon passage…" (Appendix D, p. 1).

To compare alternatives, the FPCI was used to estimate EHUs under each alternative. The FPCI was developed to evaluate ecosystem outputs of alternative fish passage improvements for navigation dams on the Upper Mississippi River System, but the pallid sturgeon was not included in the model development (USACE, 2011). As an ecosystem restoration metric, the FPCI provides a consistent framework to evaluate the effects of restoration on an array of fish species. For this application to the LYP, the FPCI has three major shortcomings. First, it does not adequately represent the significance of pallid sturgeon passage as an objective of the proposed action. Second, the FPCI does not reflect the uncertainty associated with pallid sturgeon migration through the bypass channel or modified side channel alternatives. Third, this uncertainty is not reflected in the parameter values used to characterize pallid sturgeon migration behavior in the FPCI.

Based on the information in Appendix D, the spreadsheet "Fish Passage Connectivity Index_w_pallid_14species_v4.xlsx" (hereinafter FPCI_v4), and USACE (2011), the FPCI is a simple arithmetic index [(Ei x Ui x Di)/25] for each species, where E is the chance of encountering a passage entrance (1 – 5), U is the potential to use the passage (0 – 5), and D is the duration over which passage is available. The number 25 is used to normalize the index value for each species. The resulting connectivity value, Єi, is then multiplied by the potentially available habitat for each species to determine the EHUs for that species relative to a passage alternative. This calculation is repeated to EHUs for each species that might use the passage, and the results are then averaged across all species used in the analysis.

For this application to the LYP, 14 species were used in the analysis, so the EHUs for pallid sturgeon have little impact on the overall results and identification of a preferred alternative. For example, Appendix D (Table 2-4) presents the ICA with 7,116 net EHUs under the bypass channel alternative and 11,011 net EHUs under the multiple pump alternative. With annual costs of $5,170,000 under the bypass channel alternative and $10,594,000 under the multiple pump alternative, the incremental cost per EHU is $727 under the bypass channel alternative and $962 under the multiple pump alternative. If pallid sturgeon were dropped completely from the analysis and only the remaining 13 species were used, the new net EHUs would be 7,123 under the bypass channel alternative and 10,929 under the multiple pump alternative. The resulting incremental costs per EHU would be $726 and $1,032, respectively. The bypass channel alternative is indicated to be the 'best buy' under both applications of the FPCI, and the inclusion of pallid sturgeon habitat availability has no impact on the identification of a preferred alternative.

Appendix D states that in using the FPCI, “The inclusion of pallid sturgeon does not change the ranking of alternatives, but provides a better differentiation between similar alternatives” (page 3). This statement is questionable if the uncertainty surrounding pallid sturgeon migratory behavior is factored into the analysis. For example, Table 1-7 in Appendix D presents the rating for E for pallid sturgeon in the FPCI as a 4 under the bypass channel alternative and a 2 under the side channel alternative, both on a scale of 1 – 5 where 5 is the “no dam” rating. What makes it questionable is the lack of documented studies to support the assumption that a bypass channel would provide nearly the same connectivity as a free-flowing river for pallid sturgeon. If uncertainty about the potential success of the bypass channel is considered and the rating is lowered to a 2 (the same as the side channel), the net EHUs under the bypass channel alternative in Table 2-4 would change from 7,116 to 6,935 using the 14-species FPCI. The incremental cost per EHU would increase from $727 to $746. Given that the cost per EHU for the side channel alternative is $791 in Table 2-4, the bypass channel alternative would be indicated to be the ‘best buy’ even though both alternatives have exactly the same connectivity rating for pallid sturgeon. Note also that the bypass channel with the same connectivity as the side channel is the preferred alternative despite the lower annual cost for the side channel ($5,137,000 vs $5,170,000).

The importance of pallid sturgeon passage and uncertainty about the success of the bypass channel alternative for passage of pallid sturgeon can be evaluated directly by calculating the FPCI for pallid sturgeon only. Under the baseline assumptions in the DEIS, Appendix D and FPCI_v4, the bypass channel FPCI for pallid sturgeon is 0.60 ((3 x 5 x 1)/25), resulting in 7,582 EHUs (0.6 x 12,637). The no action alternative is 551 EHUs, so the net EHUs would be 7,031. At an annual cost of $5,170,000, the incremental cost is $727 per EHU. If the bypass channel is less successful and the FPCI for pallid sturgeon is only 0.30 ((1.5 x 5 x 1)/25), the net EHUs would be 3,240 (3,791 – 551). The risk-adjusted incremental cost would be $1,596 per EHU, or more than double the baseline assumption.

The risk-adjusted incremental cost under the bypass channel alternative can now be compared with the multiple pump alternative using only the pallid sturgeon FPCI. Under the baseline assumptions in the DEIS, Appendix D and FPCI_v4, the multiple pump FPCI for pallid sturgeon is 1.0 ((5 x 5 x 1)/25), resulting in 12,637 EHUs (1.0 x 12,637). The no action alternative is 551 EHUs, so the net EHUs would be 12,086 (12,637 – 551). At an annual cost of $10,594,000 in Table 2-4, the incremental cost is $877 per pallid sturgeon EHU. This cost is lower than the $962 per EHU for the multiple pump alternative in Table 2-4 because the net change in EHUs is smaller (11,011) for the 14 species used in the baseline FPCI.

Comparing the bypass channel alternative with the multiple pump alternative, the risk-adjusted incremental cost of $1,596 per pallid sturgeon EHU for the bypass channel alternative is significantly greater than the baseline incremental cost of $877 per pallid sturgeon EHU for the multiple pump alternative. Accounting for the uncertainty associated with pallid sturgeon passage through the bypass channel would indicate the multiple pump alternative as the ‘best buy.’

Significance – High

Because the FPCI and CE analysis are the primary decision tools used to select the preferred alternative, further information about critical parameters used to evaluate alternatives can lead to better risk-informed decisions.

Recommendation for Resolution

1. Provide more information about the effects of uncertainty on the parameters used in the FPCI and explain how this uncertainty influences the EHUs under each alternative.
2. Provide a CE analysis using only a pallid sturgeon FPCI to determine EHUs under each alternative and directly integrate uncertainty about parameters in the FPCI into the analysis.
3. Compare the CE results using the baseline 14-species FPCI and the pallid sturgeon FPCI to illustrate the differences in expected outcomes.
4. Document any new or revised information generated from recommendations 1-3 in the FEIS.

PDT Final Evaluator Response (FPC 2)			
X	Concur		Non-Concur

In response to this comment and other similar comments received on the DEIS, the PDT has added additional text and a sensitivity analysis to Appendix D to explain in more detail how each number in the FPCI was selected, based on the best available science and professional judgment of the project team. The sensitivity analysis was completed to evaluate if the outcome would be affected if only the pallid sturgeon scores were used. Secondly, a change in the value assigned to fishway location (Fl) for the bypass channel was evaluated to see if that would affect the results. The results indicate the outcome is not affected by either change.

Also, for clarification, in the fourth paragraph of the comment, the EHU cost for the Multiple Pumping Alternative has been calculated by the commentor to be $1,032. However, using the commentor's formula the figure should actually be $969.

As stated in the response to Comment #1, pallid sturgeon have been documented using numerous side channels in their upstream migrations in both the Yellowstone and Missouri rivers. The bypass channel has been designed to have similar flows, depths, velocities, and substrate to natural channels. Also, as stated above, the location of the downstream end of the bypass channel immediately downstream of the existing rock rubble field below the weir, is the best location for a bypass channel as it is in immediate proximity to where the fish stop when confronted with the turbulence and high velocities at the weir and rock rubble field. Field tracking data show fish move around in this area, likely looking for a passageway to continue their upstream migrations. Thus, the fishway location (Fl) was assigned a score of 4 – it does not merit a score of 5 because the bypass channel is not the main channel where sturgeon would primarily be migrating, but the location is better than typical side channels because it occurs where the fish seek to continue upstream migration via an alternate passageway.

In the originally approved model (Corps 2011), side channels were assigned a Fl score of 3 for strong benthic swimmers such as sturgeon, but the judgment of the PDT indicated that a 4 was merited. The sensitivity analysis was conducted using an Fl score of 3 to see if that substantially changed the results – it revises the pallid sturgeon index from 0.6 to 0.5, but does not change the CE/ICA results. The Modified Side Channel Alternative, on the other hand, has a downstream entrance located nearly 2 miles downstream of the weir and behind sand/gravel bars on the opposite bank from the main channel. In the two years that fish were documented to use this channel, the number of adult pallid sturgeon using it is estimated to range from 14 – 50% of the fish that migrated up to Intake Diversion Dam (Rugg 2014, 2015;

6 of 12 in 2014 and 1 of 7 in 2015). Improving the attraction flows would likely increase the number of fish that find this existing side channel, but it is unclear if even half of the pallid sturgeon would find it given its distance from the weir. Thus, the PDT estimated that the fishway location (Fl) was only a 2. This results in a pallid sturgeon index of 0.4. The Fl score is only half of the resulting Ei score (Potential to Encounter). Ei results from averaging Fs (Fishway Size) and Fl (Fishway Location).

The PDT does not agree that either the bypass channel or the modified side channel are so unlikely for fish to find that the Ei score should be 1.5. This would require a Fishway Location (Fl) score of 1, indicating that it is unlikely that any of the fish would encounter the fishway. Fish clearly do find the existing side channel, and pallid sturgeon have even used it in small numbers. Furthermore, the information provided in response to Comment #1 clearly indicates pallid sturgeon make use of side channels.

Recommendation 1:	X	Adopt		Not Adopt

The PDT has added additional discussion on the selection of the Fishway Location scores to Appendix D.

Recommendation 2:	X	Adopt		Not Adopt

A sensitivity analysis addressing both recommendations 2 and 3 was completed and added in Section 2.5 of Appendix D.

In order to evaluate the sensitivity of the CE/ICA results to changes in the FPCI model outputs, two sensitivity scenarios were modeled. In the first scenario, revised fishway location, the scores were reduced for the bypass channel, which reduces that alternative's habitat outputs. In the second scenario, pallid sturgeon only, only the variable for pallid sturgeon was included, which changes the total habitat outputs for all alternatives. These two scenarios reasonably evaluate the possibility of reduced effectiveness for the bypass channel and a focus on pallid sturgeon-specific benefits. Note that the Modified Side Channel alternative in both scenarios always has been given a lower score than the Bypass Channel Alternative as the location of the entrance for upstream migrating fish is approximately 2 miles downstream of Intake Diversion Dam and distant from the main channel so fish are less likely to find it as compared to the bypass channel.

Tables in the appendix summarize the FPCI revisions for each scenario. Based on these revised habitat output values, and using the same costs, the CE/ICA model was re-run twice.

Even when components of the FPCI scoring are revised, the order of alternatives in terms of average cost per unit output does not change.

- Scenario 1 – Revised Fishway Location Scenario: the reduced output of the Bypass Channel alternative makes its average cost per unit output more expensive, though it remains less expensive per unit than the Modified Side Channel, resulting in no changes to the identified cost effective and best buy plans.
- Scenario 2 – Pallid Sturgeon Only: by only considering Pallid Sturgeon in the FPCI, the relative cost effectiveness of the alternatives does not change. The Bypass Channel remains the first best buy plan. However, the total output possible for the Rock Ramp, Modified Side Channel, and Bypass Channel alternatives are all reduced. In this scenario, the Bypass Channel would provide for about 48% of possible habitat output, rather than 65% as in the main analysis which considered 14 species.

In both scenarios, the order of alternatives in terms of average cost per unit output did not change. Based on this analysis, it was determined that there is reasonable confidence that, as currently designed, the Bypass Channel Alternative is less costly per unit than the Multiple Pump Alternative, and that the two best buy action alternatives are the Bypass Channel and the Multiple Pump Alternative. Additional

information has been added to Appendix D to clarify that scores are based on best professional judgement.			
Recommendation 3:	**X**	**Adopt**	**Not Adopt**
See response to Recommendation 2, both were combined in one response.			
Recommendation 4:	**X**	**Adopt**	**Not Adopt**

Results of the sensitivity analysis have been described in the revised Appendix D FPCI and CE/ICA.

In addition, information has been added to the EIS in Section 2.3.5 describing how the design of the bypass channel was informed by the best available science and why the agencies believe the channel will pass pallid sturgeon. Current literature on bypass designs for sturgeon all highlight that the best approaches include those that mimic natural side channels. This would include building a channel with similar geometry, facilitate passage under a range of discharge conditions, and incorporate a broad range of hydraulic criteria that emulate the range and depths and velocities that have been successfully negotiated by targeted migratory fish. (Braaten et al. 2015, Aadland 2010, Jager et al. 2016). Pallid sturgeon have been shown to use natural side channels in the upper Missouri River (Braaten et al. 2015), the Yellowstone River, and constructed side-channels in the lower Missouri River (DeLonay et al. 2014, 2015, 2016) during spawning migration. In the upper Missouri River, pallid sturgeon migrating upriver passed through a variety of short (0.4-km long; 0.25 mi) and long (3.9-km long; 2.42 mi) side channels (Braaten et al. 2015). The constructed side channels in the lower Missouri River, even though not constructed with adult sturgeon migration in mind, have demonstrated that sturgeon will use constructed channels and at times will choose to use them even when the main channel is unobstructed. The physical and resulting hydraulic features of the proposed bypass channel at Intake were modeled according to the features within known migratory pathways (main channel and side channel) used by pallid sturgeon in the upper Missouri River and Yellowstone River. The final geometry of the proposed bypass channel falls within the range of all parameters, including length, width, sinuosity, bend radius, and meander wavelength. In addition, this bypass channel has been engineered with expert input to increase the odds of use by sturgeon by optimal location and orientation of the downstream entrance, a flow split which is higher than side channels which have been used by pallid sturgeon, and water velocities and depths suitable for passage at a wide range of flows. Because pallid sturgeon have been observed to use side channels (both constructed and natural) on the Missouri River and Yellowstone River, even when the main channel is unobstructed, and because the designs mimic physical parameters of natural side channels actually used by pallid sturgeon on the Yellowstone, we believe that construction of the bypass channel will result in a high likelihood of use and passage under a variety of flows. Lastly, the design of the bypass is constructed with the entrance near the base of the obstruction, rather than located some distance downstream. The best entrance locations are at the base of the obstructions because a fish's natural tendency is to seek an alternate upstream passage at the obstruction. Entrances located significant distances downstream of the barrier may cause fish to swim past and become trapped below the dam by their natural instinct to swim upstream (Aadland et al. 2010).

Fish passage attempts which have failed for sturgeon or are not suitable for sturgeon typically involve ladders, fishways with baffles, sharp turns, passage through large reservoirs, and dams with turbines (Jager et al. 2016). Fishways and nature-like fishways, however, have been successful in passing sturgeon species. Nature-like fishways (the Intake bypass falls into this category) have reconnected lake sturgeon populations in Minnesota through 36 migration barriers (Jager et al. 2016)

Panel Final BackCheck Response (FPC 2)

X	**Concur**		**Non-Concur**

Acknowledging the risk of project failure is an integral part of an adaptive management strategy. The sensitivity analysis for the CE/ICA results for selecting a preferred alternative in the revised Appendix D is consistent with the comment/response teleconference discussion with USACE.

Literature Cited

Aadland, L.P. 2010. Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage. Minnesota Department of Natural Resources.

Braaten, P.J., C.M. Elliott, J.C. Rhoten, D.B. Fuller, & D.J. McElroy. 2015. Migrations and swimming capabilities of endangered pallid sturgeon (*Scaphirhynchus albus*) to guide passage designs in the fragmented Yellowstone River. Restoration Ecology 23(2): 186-195.

Bramblett, R.G. and R.G. White. 2001. Habitat use and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota. Trans. Am. Fish Soc. 130: 1006-1025.

Delonay, A.J., R.b. Jacobson, M.L. Annis, P.J. Braaten, K.A. Chojnacki, C.M. Elliott, D.B. Fuller, J.D. Haas, T.M. Haddix, B.J. JcElroy, G.E. Mestl, D.M. Papoulias, J.C. rhoten, and M.L. Wildhaber. 2014. Ecological requirements for pallid sturgeon reproduction and recruitment in the Missouri River: Annual report 2011. U.S.G.S. Open File Report 2014-1106.

Delonay, A.J., R.B. Jacobson, K.A. Chojnacki, P.J. Braaten, K.J. Buhl, B.L. Eder, C.M. Elliott, S.O. Erwin, D.B. Fuller, T.M. Haddix, H.L.A. Ladd, G.E. Mestl, D.M. Papoulias, J.C. Rhoten, C.J. Wesolek, & M.L. Wildhaber. 2015. Ecological Requirements for Pallid Sturgeon Reproduction and Recruitment in the Missouri River – Annual Report 2013. U.S.G.S. Open File Report 2015-1197.

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.

Jager, H.L., M.J. Parsley, J.L. Cech, Jr., R.L. McLaughlin, P.S. Forsythe, R.F. Elliott, and B.M. Prachell. 2016. Reconnecting fragmented sturgeon populations in North American rivers. Fisheries 41(3): 141-148.

USACE (2011). Fish Passage Connectivity Index. A Planning Model Developed to Upper Mississippi River System Fish Passage Improvement Ecosystem Restoration Projects. January.

Final Panel Comment 3

The Monitoring and Adaptive Management Plan does not provide specific, quantified fish passage objectives and targets for pallid sturgeon or other native fish species, which are necessary to identify the need for adaptive management actions and the potential future costs of such actions.

Basis for Comment

The stated objective of the Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana is "to improve passage of pallid sturgeon and other native fish at the Lower Yellowstone Project Intake Diversion Dam while continuing a viable and effective operation of the Project" (DEIS Executive Summary).

Pallid Sturgeon:

Little information is provided in peer-reviewed literature regarding the parameters necessary to facilitate upstream passage for adult pallid sturgeon. As a result, many of the design features are based on the best professional judgment of a qualified multi-disciplined team of experts. This approach results in a level of risk and uncertainty that must be addressed using a robust and quantitative monitoring and adaptive management approach. The draft Monitoring and Adaptive Management Plan states, "… as there are very few examples of fish passage projects designed for sturgeon species and none specific to pallid sturgeon, uncertainty exists regarding the assumptions made about the physical and biological response to the alternatives and their relative effectiveness to improve fish passage past Intake Diversion Dam." (Appendix E, section 1.0, p. 1).

The definition and purpose of monitoring and adaptive management as stated are, "… a decision-making process that provides for implementing management actions in the face of uncertainty. Included in this appendix are objectives, metrics, and targets for proposed management actions and potential adjustments that may be warranted based on the results of the proposed monitoring" (Appendix E, section 1.0, p. 1).

The Monitoring and Adaptive Management Plan provides two objectives pertinent to pallid sturgeon. Objective 1 identifies physical criteria for water depths and velocities in fish passageways that are measurable; this objective is readily quantifiable and is adequately addressed in the plan. Objective 2 addresses upstream and downstream passage of pallid sturgeon. The first element of Objective 2, addressing upstream passage, states "Greater than or equal to 85% 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 ($\geq$ 0.19 miles/hour)." This element does not provide a timeframe for achieving the objective or by what time in the future the proponents expect the objective to be reached. Further, "motivation" of adult pallid sturgeon cannot be measured. This element of Objective 2 would be more precise if that term were omitted and the objective were stated as, "Greater than or equal to 85% of adult pallid sturgeon that move up to the weir annually pass upstream…"

The second element of Objective 2, addressing downstream passage of adult pallid sturgeon following the spawning period, begins with this statement: "Mortality of adult pallid sturgeon that migrate downstream of the weir location cannot exceed 1% annually during the first 10 years." (Appendix E, section 1.0, p. 2). Additional components of this element to assess injury and stress are mentioned, but no statement is provided as to how injury or stress may be measured or quantified. Further, no timeframe for achieving these elements of the objective is provided. A second component addressing downstream passage focuses on impingement and entrainment of larval and young-of-year fish. Again, quantifiable measures of impingement and entrainment and a timeframe for assessment are not provided.

It is recognized that the Monitoring and Adaptive Management Plan is preliminary and will be expanded, but more precise objectives, as well as more detail regarding the monitoring methods that will be used to assess progress toward objectives, are needed. The objectives for monitoring pallid sturgeon provide very limited "quantifiable targets for proposed management actions and potential adjustments that may be warranted" as stated on page 1 of the plan. Quantifiable targets are necessary to ensure that the fish passage produces projected species-specific and ecosystem benefits. If specific quantifiable targets are not documented in the Adaptive Management Plan, it will be difficult to determine if the project falls short or succeeds in achieving the stated objectives.

Native Fish Species:
The Monitoring and Adaptive Management Plan does not present quantitative objectives or targets for native fish species successfully passing upstream and downstream through the Intake Diversion Dam area. Objective 3 is relevant to native fish species, stating "Determine if native fish can effectively migrate upstream and downstream of the weir location." No quantifiable metrics or timeframe for assessment are provided. The Panel understands that an elevated level of significance is placed on successful passage by pallid sturgeon. However, the alternatives analysis was conducted predominantly on the basis of the potential for fish passage of the 14 native species considered to "…represent the migratory species typically found in the Yellowstone River at Intake Diversion Dam and the species provide good representation of the various guilds of fish based on their various migration behaviors" (Appendix D, section 1.3.1.2, p. 3). For the same reasons mentioned above regarding pallid sturgeon, quantitative objectives and targets are necessary for other native fishes in the adaptive management plan.

Costs:
Further information on quantitative objectives and targets would also help to identify potential future costs for the adaptive management plan that are based on specific actions rather than the fixed percentage of total project cost estimates used in the alternative selection process.

The Panel recognizes that the current Monitoring and Adaptive Management Plan acknowledges that a more detailed plan may be developed in the future.

Significance – High

Refinement of objectives and more quantitative details to the Monitoring and Adaptive Management Plan are essential to ensure the success of the proposed project.

Recommendation for Resolution

1. Include quantifiable pallid sturgeon and native fish species passage targets with timeframes that are compatible with the objectives to reach specific adaptive management milestones at reasonably accurate estimated costs.

2. Provide more details on the methods used to (a) achieve the elements of the monitoring plan and

(b) assess progress toward the stated objectives for pallid sturgeon and other native fish species.

PDT Final Evaluator Response (FPC 3)

X	Concur		Non-Concur

As referenced in the comment and stated in the DEIS a more detailed monitoring and adaptive management plan has been developed and is included in the FEIS. The PDT has been coordinating concurrently with the Service to develop metrics and targets as part of Section 7 consultation. Once a project is approved, the plan will continue to be refined and updated with more detail in coordination with the Service and the State of Montana.

Recommendation 1:	X	Adopt		Not Adopt

The revised monitoring and adaptive management plan has clarified the project objectives, which includes the Biological Review Team physical and biological criteria to be met. It describes the monitoring to be conducted, which specifies specific elements to be monitored annually and proposed responsible entity. The plan describes the decision-making process that will be used to implement adaptive management measure and provides a suite of adaptive management measures to be used in response to monitoring findings.

Recommendation 2:	X	Adopt		Not Adopt

Draft adaptive management measures are identified for the objectives that have been identified in the plan. They include timing and action items (adaptive management measures) thought to be necessary to achieve the elements of the plan.

Panel Final BackCheck Response (FPC 3)

X	Concur		Non-Concur

Final Panel Comment 4

The need for a new bridge for maintenance and recreation access under the modified side channel alternative is not well justified.

Basis for Comment

Maintenance Access

The bypass channel and the modified side channel alternatives both require similar maintenance access to the south side of the river; however, only one includes a new bridge. This inconsistency has resulted in the modified side channel being more expensive than the bypass channel. The following instances throughout the document indicate where this inconsistency was noted.

The preferred alternative (bypass channel) includes a replacement weir, but does not include a bridge across the bypass channel. The justification provided in the DEIS is that only infrequent access to the south side of the weir will be necessary due to reduced need to maintain the new concrete weir (Section 2.3.5). A new bridge is not provided for maintenance access. When access is required, a temporary cofferdam would be constructed across the bypass channel.

The DEIS suggests that under the modified side channel alternative, reuse of the existing Intake Diversion Dam with periodic rock placement would require a new bridge for maintenance access (Section 2.3.6). The bypass channel alternative includes a new weir, but not a new bridge due to the bypass channel's reduced maintenance needs.

The goal of the bypass channel and the side channel alternatives is to provide fish passage opportunities for the pallid sturgeon. Upstream migration is known to occur in the spring and early summer, when flow in the river reaches seasonal highs. The DEIS states that maintenance work on the existing weir does not occur until late July or August, when flow in the river has decreased. Since the timing of maintenance work does not conflict with the timing of sturgeon migration, a temporary cofferdam should suffice to allow for maintenance access under either alternative scenario.

Currently, maintenance access is primarily from the north bank. 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. It is unclear why, under the modified side channel alternative, a bridge for access from the south is necessary for this operation. A bridge may have unresolved design issues and potential impacts that have not been fully addressed. The DEIS states that the bridge may need to be elevated up to 10 feet above the floodplain level to accommodate flowing ice in the bypass channel. Bridge approach embankments, which would be necessary for a higher bridge elevation, may cause barriers to floodwater flow. This could result in erosion damage to the embankments, bypass channel, and surrounding land.

Recreation Access

Recreation access was cited as a benefit of bridge construction, but no documentation was provided that indicated that recreation access was required during the late spring and early summer season when flow in the river is high. Since recreation is not part of the new project's purpose and need, it should not be used as justification for a proposed new bridge.

Significance – Medium

Inclusion of a bridge impacts the cost of the modified side channel alternative and potentially affects the selection of the preferred alternative.

Recommendation for Resolution

1. Consider eliminating the proposed bridge from the modified side channel alternative.
2. If the proposed bridge is retained, address potential flood damage impacts of bridge abutment construction on embankments, the bypass channel, and the surrounding land.

PDT Final Evaluator Response (FPC 4)

	Concur	X	Non-Concur

Maintenance Access - A point of clarification is required before responding to this comment. In the first sentence of the 5th paragraph under maintenance access this comment states that "*Currently, maintenance access is primarily from the north bank*." Currently access for weir maintenance is on Joe's Island, which is the south bank of the Yellowstone River. Clarification has been added to the FEIS to ensure this is clear. This maintenance includes the import of rock for use on the weir, which includes hauling rock across the existing side channel. Rock is stockpiled with a loader, dumped into a skid, and then hauled by an existing overhead trolley cableway over the river for placement on the weir. Since the existing weir is not being replaced under the Modified Side Channel Alternative, there will be a similar frequency of rock hauling as in the No Action alternative or baseline condition. This would require crossing the modified side channel frequently, certainly more frequently than under the Bypass Channel Alternative under which the weir is being replaced.

Since the existing side channel is proposed for modifications under the Modified Side Channel Alternative to provide fish passage and would be between 2-5 feet lower (deeper) than the current side channel and have more frequent flows for a longer duration, the PDT determined that a bridge for maintenance access would be preferable to making frequent modifications to the side channel to allow haul vehicles to cross it, which would thereby reduce impacts to the side channel. Given the design slopes of the modified side channel (necessary to achieve the physical criteria), it would be difficult for dump trucks to cross the slopes on the modified channel without making modifications to it when necessary to cross. There is the risk that frequent interruption and modifications to the side channel would make it difficult to maintain the fish passage criteria to which that design was developed. Please see Figure 2-6 of the DEIS which depicts the conceptual bridge location and existing dirt roads, and the quarry from where maintenance rock is acquired.

Recreation Access- Recreation access is not a project purpose, and benefits of recreation were not used to justify the bridge. Any recreation access from the bridge would be incidental.

Recommendation 1:		Adopt	X	Not Adopt

For the reasons described above the agencies believe the bridge is necessary to provide access across the modified side channel thereby reducing the need for frequent, routine crossing or modifications of the channel proposed for fish passage. Under the Bypass Channel Alternative, there will not be as frequent access required for rocking because the weir is being replaced with a concrete weir and the existing side channel will have more gradual slopes and be less deep than under the Modified Side Channel Alternative.

Therefore, we believe it is important to include the proposed bridge with the Modified Side Channel and will maintain it as part of the proposed alternative.

Recommendation 2:	**X**	**Adopt**		**Not Adopt**

The bridge design and cost estimate are sufficient for alternative comparison in the NEPA document. As stated in Section 2.3.6 and Appendix A the bridge abutments are set outside the main channel banks to minimize encroachment. The new low chord of the bridge is also set two (2) feet above the 100-year water surface in accordance with the State of Montana and the National Flood Insurance Program criteria. The design appendix states that as a worst case scenario the bridge may need to be elevated up to 10 feet and this has been accounted for in uncertainties and cost estimates (see cost and schedule risk analysis in Appendix C). The design appendix states that should the alternative be selected for further analysis these items would be addressed.

If the modified side channel alternative is selected for implementation, additional design and analysis would be conducted during the design phase.

Panel Final BackCheck Response (FPC 4)

X	**Concur**		**Non-Concur**

The additional detail provided by the PDT clarifies the maintenance access requirements of the existing weir, as well the modified side channel depth and slopes. This information provides sufficient justification to include the bridge in the Modified Side Channel Alternative.

Final Panel Comment 5

Maintaining the existing Intake Diversion Dam, as opposed to installing a new weir, is not fully considered under the bypass channel alternative.

Basis for Comment

The revised project Purpose and Need statement includes the continued operation of the LYP and the normal functioning of the main irrigation canal. The DEIS states that the existing diversion weir provides sufficient water surface elevation to provide for the normal operation of the main canal and its new intake structure.

The DEIS justifies the installation of a new weir as a measure to reduce the potential for rock displaced from the Intake Diversion Dam obstructing the bypass channel's lower entrance over time. The entrance to the side channel is located further downstream of the Intake Diversion Dam. The DEIS indicates that the side channel's lower entrance location negates the need for a new weir.

A new weir across the Yellowstone River is proposed under the bypass channel alternative as a way to reduce the potential for displaced rock to obstruct the bypass channel's lower entrance and to reduce future maintenance costs; however, a new weir is not required for continued water delivery to the main canal, and its costs are not adequately justified. Over many years, the existing Intake Diversion Dam has required maintenance due to periodic rock displacement. However, it is not clear that the potential for periodic displaced rock obstructing the lower bypass channel entrance justifies a new weir. The potential for obstruction can be mitigated through monitoring and adaptive management. Removal of sediment/displaced rock from the channel's lower entrance is addressed in the Monitoring and Adaptive Management Plan.

A new diversion weir may be beneficial to the continued operation of the LYP, but a cost/benefit analysis of a new weir versus continued maintenance of the existing weir is not provided. The proposed new weir is a costly element of the overall project. Since it may not be necessary in order to meet the project objectives, it warrants careful consideration as a stand-alone project element.

Significance – Medium

Construction of a new weir impacts the cost of the alternatives and potentially affects the selection of the preferred alternative.

Recommendation for Resolution

1. Conduct a cost/benefit analysis of maintaining the existing Intake Diversion Dam versus construction of a new weir under the bypass channel alternative.

2. Consider a design modification that would reduce the potential for bypass channel obstruction due to rock displacement.

PDT Final Evaluator Response (FPC 5)			
	Concur	X	Non-Concur

The purpose and need has not changed and does not include a statement requiring normal functioning of the main irrigation canal. Per requirements of NEPA, the alternatives evaluated in the EIS were formulated to disclose the potential impacts that could occur from a range of reasonable alternatives. A final decision could include a variation of the alternatives within the range of impacts disclosed. – Alternatives were considered both with and without the concrete weir.

Not constructing a new weir under the Bypass Channel Alternative would result in the need to rebuild the trolley system, which is a significant cost since it would have to span the Yellowstone River and the bypass channel, and result in higher annual O&M costs than the bypass channel since annual rock placement would need to occur.

Expanded discussion pertaining to the value for a concrete weir with the Bypass Channel Alternative has been added to Section 2.3.5.4 of the FEIS. There are other factors that weigh into the decision on whether to include a new weir in the alternative besides costs. In summary the advantages of the concrete weir under the Bypass Channel Alternative are:

1.) The new weir would not require the annual placement of rock on the weir crest like the existing structure. If the existing weir structure was maintained there would be continued risk of rock migrating downstream in front of the bypass channel, which would likely have a negative effect on passage success. The location of the downstream outlet of the bypass channel immediately downstream of the weir and boulder field is an optimal location for fish passage, moving the channel further downstream adds to the risk of fish not finding it.

2.) The new weir provides better reliability for continued diversions of 1,374 cfs into the Main Canal down to 3,000 cfs in the Yellowstone River and for delivery of water into the bypass channel.

3.) The new weir would provide a smoother transition through the area for downstream migrating adult pallid sturgeon and downstream drifting free embryos and larvae.

Recommendation 1:		Adopt	X	Not Adopt

Based on the description above the PDT believes this is unnecessary. The analysis has already addressed the range of alternatives sufficient for the NEPA process. There have been analysis of alternatives with and without a new weir.

Recommendation 2:		Adopt	X	Not Adopt

There is uncertainty whether rock migration will create an issue for pallid sturgeon location of the bypass channel. As a result, the adaptive management plan identifies monitoring to determine if rock migration has an adverse effect on pallid bypass channel location, and measures to address this issue.

Panel Final BackCheck Response (FPC 5)			
X	Concur		Non-Concur

The revised Section 2.3.5 does a good job in addressing the issues brought up in this Final Panel Comment. Adding expanded discussion pertaining to the value of the proposed new concrete weir will clarify this issue in the EIS. The Panel acknowledges that a new weir has multiple benefits, including reduced O&M costs, reduced risk of displaced rock impacting the bypass channel, more reliable water diversion and a smoother water surface transition, which may be beneficial to pallid sturgeon larvae that drift over the Intake Diversion Dam.

Final Panel Comment 6

The existing side channel should remain open to accommodate flood flow and fish passage during high-flow events.

Basis for Comment

The bypass channel alternative utilizes the existing side channel entrance as the upstream starting point for the new bypass channel and uses fill to plug the existing side channel. This effectively closes the existing side channel to any future use by fish for upstream passage. The Panel believes that leaving the side channel open for flood flow and upstream fish passage during high-flow events would:

- Allow some flood flows to cross Joe's Island without crossing the bypass channel.
- Allow upstream fish passage during moderate- to high-flow events (this is the one proven route for upstream migration of pallid sturgeon under current conditions).
- Promote overall ecosystem health by maintaining as much aquatic and biotic connectivity as possible.

It does not appear that the functionality of the bypass channel alternative depends on closure of the existing side channel. It does appear that the inlet to the new bypass channel could be altered or relocated slightly to accommodate flood flow into the existing side channel, without compromising the bypass channel design.

Significance – Medium

With so little known about the migration behavior of the pallid sturgeon, the retention of any potential option for upstream passage would support the primary objective of the proposed Federal action.

Recommendation for Resolution

1. Consider relocating the inlet to the new bypass channel downstream by 500 feet, and constructing a high-flow inlet weir that allows flow into the existing side channel when discharge in the river exceeds 30,000 cubic feet per second.

PDT Final Evaluator Response (FPC 6)

	Concur	X	Non-Concur

The ability of the bypass channel alternative to meet Biological Review Team physical criteria is dependent on closure of the existing side channel. The inlet of the proposed bypass channel was selected based on the historical location and relative stability of the existing high flow channel. Higher uncertainty regarding the stability of the upstream end of the proposed bypass channel (bypass exit by fish orientation) would arise if the location was moved downstream. Allowing flow into the existing side channel above 30,000 cfs would reduce the amount of flow in the proposed bypass channel in the 30,000 to 63,000 cfs range. Pallid Sturgeon migrations are likely to occur when the Yellowstone River flows are in this range. The agencies felt utilizing the full extent of flow available for the bypass would better serve project objectives as opposed to splitting flows between two different alignments, which would reduce the potential effectiveness of each. Splitting the flows of the Yellowstone River three ways adds substantial uncertainty to the geomorphic stability of the system. If a high flow weir were incorporated to convey flows to the existing high flow channel, it could be a passage barrier, limiting the benefit of conveying flows through the existing side channel.

Even if the existing high flow channel were allowed to carry flow in higher events (above 63,000 cfs), the likelihood and duration of flows above 63,000 cfs are relatively small. The 20% annual chance exceedance (ACE) discharge - commonly referred to as the 5-year flood - is approximately 74,400 cfs while the 10% ACE discharge (10-year flood) is 87,600 cfs. With a high flow channel designed to begin flowing at approximately 63,000 cfs, approximately 90,000 cfs would be required in the main channel to divert a sufficient amount of water into the high flow channel for pallid sturgeon passage (based on BRT criteria of 1 meter depth). Therefore, on average, once every 10 years there would be less than a single day that would likely provide sufficient flow in the proposed third channel for passage. Another consideration (besides flow frequency) is flow duration. During the months of April-June, a flow of 66,600 cfs is equaled or exceeded 1% of the time. The USGS streamflow statistics are not computed beyond the 1% exceedance by duration.

The stability near the upstream end of a three channel system would be even more complex than the existing conditions or the proposed bypass channel. As shown in the attached, the upstream end of the existing high flow channel has moved 200-300ft eastward in the past 66 years. Much consideration went into the stabilization for the proposed bypass channel; adding a third branch in the vicinity of the confluence would add another level of complexity.

The existing state of the science in hydraulic engineering allows for relatively high confidence in computing flow splits. Even so, the split into two separate side channel is complex and adds uncertainty. Given that, the computation of the split of sediment is much more difficult, even for one side channel. Adding another side channel increases the uncertainty exponentially. The main concern is that even if the computed flow splits are relatively accurate, one of the side channels may pull water with a lower sediment concentration, leaving the other side channel with a much higher sediment concentration, resulting in the potential for major deposition and/or erosion.

The Bureau of Reclamation's Technical Service Center (TSC) reviewed a proposed second side channel suggested by the State of Montana Fish, Wildlife, and Parks. The TSC had a number of comments and concerns which were made available to the panel.

The configuration of the existing high flow channel would require significant alteration to function as a fish passage route in a two side channel system. Previous bypass channel designs considered building a channel "plug" near the upstream end of the existing side channel to prevent flow splits from occurring at low flows. The plug would essentially be an earthen levee/dam. Using this to prevent diversion flows until the main channel is at 63,000 cfs would result in a large obstruction near the upstream end of the bypass. Fish that had migrated the 4+ miles up the side channel would be unable to continue upstream. Another method would be to add a rock ramp at significant cost and with significant uncertainty on passability. Yet another method would be to raise the invert of the existing side channel for a long distance, gradually sloping it back to existing grades. However, this major change would fundamentally alter the existing side channel's functionality. **See file, FPC 6 Response V2.pdf.**

Recommendation 1:		**Adopt**	**X**	**Not Adopt**

The existing side channel will be closed off to maximize passage potential and geomorphic stability of the proposed bypass.

Panel Final BackCheck Response (FPC 6)

X	**Concur**		**Non-Concur**

Supplemental information provided with the Final Evaluator Response (V2.pdf) substantiates the reasoning why the existing side channel should not be maintained for fish passage. Attachments to the Final Evaluator Response include comments from Bureau of Reclamation from their review of the hydraulic conditions occurring if both side channels were utilized. BuRec's conclusions support the PDT's decision not to maintain the existing side channel. With this supplemental information, the Panel better understands the prior analysis and decision making process, and can now support the PDT's non-concur to this Final Panel Comment.

Final Panel Comment 7

The current design of the bypass channel does not include erosion control measures to counter flood damage when flood flows overtop Joe's Island.

Basis for Comment

The bypass channel will be covered with flood flow in the 100-year event (and probably in smaller flood events) because floodwater will be flowing down-valley, which is perpendicular to the direction of flow in the bypass channel. The Panel believes that damage to the bypass channel is likely and ideally would be mitigated as much as possible through design rather than dealt with as a maintenance issue. In the 2013 IEPR, the Panel identified a similar comment based on the original design. However, this concern is now compounded because the proposed new diversion weir would raise the base water surface in the river by an additional 0.5 feet or more, increasing the frequency of water overtopping Joe's Island.

Flood flow crossing the bypass channel will have two potential effects: (1) erosion of the channel side slopes and deposition of sediment in the channel itself, and (2) changes to the hydraulics of the bypass channel during an overtopping flow event. The response to the 2013 IEPR Panel comment concluded that sedimentation issues would be limited to "isolated deposits," but did not provide a detailed analysis of the locations where this would occur, the volumes of sediment deposition expected, or the frequency of sedimentation events. The 2016 DEIS acknowledges this potential problem by stating that some of the soil excavated from the bypass channel could be sidecast on the left bank of the new channel, and that action may reduce the risk of sediment deposition in the bypass channel from flood flows. The Panel believes that the damage to the bypass channel from erosion and sedimentation could be much more than isolated sediment deposits.

The hydraulic analysis demonstrates that the bypass channel meets the BRT criteria for fish passage, but only when flow is limited to the bypass channel itself. Hydraulic conditions in the bypass channel will change when floodwater is overtopping this channel and flowing perpendicular to the channel alignment. There does not appear to be any 2D or 3D modeling that confirms that fish passage hydraulics will be maintained during an overtopping flood event.

Without a quantitative analysis demonstrating that flood damage to the bypass channel will be minimal, and that hydraulic conditions for fish passage can be maintained over a wide range of spring flood events in the river, the efficacy of the design cannot be confirmed. The Panel believes that the threat of flood damage and the disruption of hydraulic conditions that may facilitate fish passage can be minimized by design.

In addition, a low levee between the river and the bypass channel would be more effective at reducing sediment deposits in the bypass channel than a pile of sidecast soil. A low levee would reduce the frequency of flood flows crossing the bypass channel, and the frequency of potentially damaging flows could be limited to extreme events only. As a side benefit, a significant portion of soil from bypass channel excavation could be disposed of in this levee with only a short haul distance. Fuse plugs in the levee could be used to control where levee failures are most likely to occur, and that allows for control of where the bypass channel might need extra erosion protection.

Significance – Medium

The success of the preferred alternative depends on the bypass channel being designed to withstand erosional and depositional forces and being a viable waterway for fish passage under a wide range of flow conditions.

Recommendation for Resolution

1. Consider revising the design to allow the existing side channel to carry a portion of the total flood flow over Joe's Island, or document in the DEIS with quantitative hydraulic modeling why the current design can withstand an overtopping event without suffering damage.
2. Instead of side-casting soil excavation to protect the bypass channel from overtopping flow damage, consider compacting that soil into a low levee between the river and the bypass channel.

PDT Final Evaluator Response (FPC 7)

	Concur	X	Non-Concur

Also refer to Comment 6 as it pertains to Recommendation 1.

The PDT acknowledges a bypass channel left bank levee would serve to reduce damage risk when river stages inundate the surrounding floodplain. Floodplain concerns, which include a likely rise in surface water elevation from construction of a levee, prevented us from developing it fully. This issue is the primary reason a levee is not included in the final design. An additional concern with constructing a levee on the bypass channel left bank pertains to the potential for sediment to accumulate on the upstream side of the levee. Over time, the deposition could result in a larger floodplain constriction resulting in even higher water surfaces.

An evaluation would need to be conducted to determine the increase in water surface against the headworks structure during extreme events, especially ice-affected stages.

Hydraulic characteristics as they relate to fish passage considered up to 63,000 cfs total Yellowstone flow.

In order to place a significant amount of water in the overbank areas at the project site, an event in excess of 100 year recurrence would need to be experienced. 2D Hydraulic modeling of the 30% design indicates that portions of the bypass channel are likely to go ineffective in terms of velocity somewhere between the 1% and 0.2% annual chance of exceedance event. In other words, at extreme flows the bypass will be at risk for deposition/erosion. Somewhere between the 100 year and 500 year flood overbank flows orient in an entirely downstream direction and there is a discontinuity of flow/velocity through the bypass. When this occurs there is risk of deposition

Current O&M estimates account for routine O&M. These do not account for the removal of sediments from the bypass channel, as all analysis to date has indicated a slightly degradational trend to be experienced. While true that there is potential for deposition in the proposed bypass during a valley-wide flood event, it would not be accounted for in the lifecycle costs assumed in routine O&M estimates.

Damage to the channel is likely during an overbank flooding event, however grade control and bank stabilization design elements are expected to serve to maintain the function of the channel once a flood passes.

Recommendation 1:		**Adopt**	**X**	**Not Adopt**

Please see response to comment 6. The existing side channel will be closed off to maximize passage potential and geomorphic stability of the proposed bypass.

Recommendation 2:		**Adopt**	**X**	**Not Adopt**

Floodplain impacts, such as a rise in surface water elevation which could induce flooding would prohibit the inclusion of the left bank bypass levee.

Panel Final BackCheck Response (FPC 7)

X	**Concur**		**Non-Concur**

Based on the PDT Evaluator's Response, the Panel understands that the frequency of flood flows crossing the bypass channel in a perpendicular direction is relatively low. If designed to accommodate a variety of overtopping conditions, "grade control and bank stabilization design elements" should be effective at minimizing flood damage to the new bypass channel. The Panel acknowledges that a full levee on the left bank of the bypass channel may create secondary flooding problems for the project. The Panel noted this is the most substantial documentation so far describing bank stabilization control design elements and should be carried over into the design.

Final Panel Comment 8

The Monitoring and Adaptive Management Plan does not mention the establishment of formal agreements with Federal and state agencies to conduct vital monitoring elements.

Basis for Comment

The Monitoring and Adaptive Management Plan includes monitoring efforts to be conducted by multiple agencies. It is not clear whether appropriate formal agreements have been established but are omitted from the document or whether these types of agreements are currently being pursued. For example, upstream adult fish monitoring would be conducted by the U.S. Geological Survey, USFWS, and Montana Fish, Wildlife & Parks (Appendix E, p. 6), while the Bureau of Reclamation would be involved in future downstream monitoring of larval pallid sturgeon (Appendix E, p. 7).

Regarding agency participation in upstream monitoring, Appendix E states, "This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year" (p. 6). Since monitoring and adaptive management are critical to the success of the proposed project, it is necessary to establish Federal and state commitments to conduct monitoring. If critical monitoring elements are not conducted, then it will be difficult to determine if the project achieves the projected ecosystem benefits.

In addition, these types of commitments and/or agreements should contain important details such as:

1. Who is responsible for collecting, integrating, and evaluating monitoring data?
2. Who will be responsible for initiating the adaptive management process if data indicate that project goals are not being achieved?
3. What is the timeline for responding to monitoring results leading to implementation of adaptive management measures?

Such details regarding individual agency responsibilities are necessary components of an effective monitoring and adaptive management program.

Significance – Medium/Low

Including information regarding interagency agreements in the monitoring and adaptive management plan would improve the quality and completeness of the report. Establishing such agreements (if not already in place) would improve the quality of the Monitoring and Adaptive Management Plan.

Recommendation for Resolution

1. If agreements regarding monitoring elements already exist or are currently being pursued, document those agreements in the Monitoring and Adaptive Management Plan.
2. If agreements regarding monitoring elements do not exist and are not being pursued, document the approach that is being taken, and/or provide reasons why they will not be pursued.

PDT Final Evaluator Response (FPC 8)

X	**Concur**		**Non-Concur**

As mentioned in the DEIS the Monitoring and Adaptive Management Plan was draft and would include more detail for the FEIS. There is an existing MOA between the Corps and Reclamation that lays out the commitments and responsibilities of each agency in the role of adaptive management and monitoring. There are current working relationships with the State of Montana and USGS for other related pallid sturgeon monitoring actions and it is anticipated that those relationships would continue as the details of the plan are developed. Once a project is approved, monitoring details and adaptive management measures will be further developed in detail.

A revised Monitoring and Adaptive Management Plan has been prepared and will be appended to the FEIS. This revised document provides addition information on the roles and responsibilities of agencies engaged in the project, timing, and funding.

Recommendation 1:	**X**	**Adopt**		**Not Adopt**

Reclamation and the Corps signed an MOA (April 7, 2015) outlining agency roles and responsibilities as they pertain to the adaptive management plan. The plan being included with the FEIS includes a section titled Agency Roles, Responsibilities, and Funding. There will also be more details on reporting and data management once an alternative has been selected for implementation.

Recommendation 2:	**X**	**Adopt**		**Not Adopt**

See PDT response to Recommendation 1.

Panel Final BackCheck Response (FPC 8)

X	**Concur**		**Non-Concur**

Final Panel Comment 9

Impacts of downstream passage on mortality of drifting fish larvae associated with proposed structures and water intakes under each alternative, including the preferred alternative, are not addressed in the DEIS.

Basis for Comment

The Montana Chapter of the American Fisheries Society (5.MTAFS_Intake_Draft.pdf), and Defenders of Wildlife and Natural Resources Defense Council (6. Defenders and NRDC.pdf, Section C, pages 18-19) state in their public comment submissions that both larval fish drift post spawning and larval fish mortality are important factors in the survival of pallid sturgeon.

Many riverine fishes, including pallid sturgeon, migrate upstream in the spring to spawn, with subsequent drift of fertilized eggs and/or larvae downstream. Flowing water is needed for larval fish to remain suspended in the water column as they grow to the point where they can swim and maintain themselves in the water column. In the case of pallid sturgeon, fisheries scientists who have studied the species in the Yellowstone River have concluded that there is currently not a sufficient length of river distance between the Intake Diversion Dam and Lake Sakakawea for drifting larvae to remain suspended and survive. With the ability of adult pallid sturgeon to migrate upstream beyond the Intake Diversion Dam, it is likely that there will be a sufficient length of river for their larvae to drift in current, survive, and contribute to natural recruitment.

Larval fishes are very fragile and have little or no swimming ability. Consequently, mortality can occur through battering when these fishes drift downstream over dams or pass through turbulent cascades. Further, mortality can occur when larval fishes are removed from a river by entrainment associated with water diversion structures or pumps.

Currently, all of the alternatives considered will, to some degree, contribute to the mortality of larval fishes in the Yellowstone River as the fishes drift downstream over the Intake Diversion Dam or are removed from the river by water diversion structures or pumps. The relative contributions to mortality of larval fishes, especially pallid sturgeon, under each alternative are not provided in the DEIS.

Significance – Medium/High

By not including information on the extent of fish larvae mortality, particularly for the pallid sturgeon, estimates of the benefits to fish populations under the preferred project alternative and other alternatives associated with enhanced upstream fish passage may not be accurate.

Recommendation for Resolution

1. Provide information on the extent of drifting larval fish mortality associated with structures and pumps under the preferred alternative and other alternatives.
2. Document whether the preferred alternative will result in higher or lower levels of larval fish mortality than the other alternatives.

PDT Final Evaluator Response (FPC 9)			
X	Concur		Non-Concur

The PDT added information to Section 4.9 (formerly Section 4.10) of the EIS to evaluate the potential effects on pallid sturgeon larvae from each of the alternatives. 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). Considering that free embryos and larvae are neutrally buoyant and are present in the lower part of the water column where velocities are lower, and their constant swim-up and drift behavior, it is less likely they would be adversely affected when drifting through the Project Area.

Specific to water diversions, it has been estimated that prior to the installation of screens at the Intake headworks that in some years as much as 8% of the fish entrained into the irrigation canal were shovelnose sturgeon. Since screens were installed in 2012, only one sturgeon larvae has been found entrained into the canal (Reclamation unpublished sampling data 2013-2015). It appears that the screens, although designed to prevent entrainment of all fish larger than 40 mm, have to date, reduced entrainment for most larval fish above 10 mm (Horn & Trimpe 2012). If pallid sturgeon successfully spawned upstream of Intake Diversion Dam, their larvae would likely be in the 9-12 mm size (P. Braaten, pers. comm. 2015), thus minimizing the potential for entrainment at the headworks. 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 (P. 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. This 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.

Additionally, 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. 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.

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).

The proposed new weir to be constructed approximately 40 feet upstream of the existing weir would have a smooth concrete top and a 125 foot-wide low-flow notch located approximately 100 feet out from the left bank, near to the channel thalweg. Rock and cobble will be placed sloping up to the new weir from the upstream side and then sloping down from the weir on the downstream side. This will smooth out flows and reduce turbulence. Further, as there will no longer be rock placed on the crest of the weir, there will not be turbulent and plunging flows associated with the rock. Downstream of the weir, the rock rubble field will still be present.

The drifting free embryo are fragile, but their continuous day and night swim-up and drift swimming behavior is sufficient to move them far downstream and out of side eddies (Kynard et al. 2002, 2007). Although it seems that mass mortality would occur when these fragile fish drift downstream over dams or pass through turbulent cascades, a study observing mortality of free embryos of white sturgeon drifting at fast velocity (1 m/s) over a bottom of rip-rap found only a slight mortality and no significant difference compared to a smooth bottom control. High survival appears to be related to the swim-up and drift behavior of the embryos, which keeps them in the water column (Kynard et al. 2014). While the results are not conclusive for effects on pallid sturgeon, they suggest drifting pallid larvae survive well from passing over dams and rapids and can swim up in the water column to avoid eddies and other turbulence.

Kynard, B., E. Henyey, M. Horgan. 2002. Ontogenetic behavior, migration, and social behavior of pallid sturgeon, Scaphirhynchus albus, and shovelnose sturgeon, S. platorhynchus, with notes on the adaptive significance of body color. Env. Biol. Fish. 63:389-403.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2007. Use of laboratory studies to develop a dispersal model for Missouri River pallid sturgeon early life intervals. J. Appl. Ichthyol. 23:365-374.

Kynard, B., B.E. Kynard, M. Horgan, and A. Giraldo. 2014. Artificial stream studies on Kootenai River white sturgeon: 2013-2014. Final Rep. to Kootenai Tribe of Idaho, Bonners Ferry, ID. pp.36.

Recommendation 1:	**X**	**Adopt**		**Not Adopt**

Although there is not sufficient information on larval fish mortality from rock and similar structures to estimate this for any of the alternatives, additional information has been added to Sec. 4.9 on potential effects.

Recommendation 2:	**X**	**Adopt**		**Not Adopt**

Although there is not sufficient information on larval fish mortality from rock and similar structures to estimate this for any of the alternatives, additional information has been added to Sec. 4.9 on potential effects.

Panel Final BackCheck Response (FPC 9)

X	**Concur**		**Non-Concur**

The Panel believes that inclusion of the additional information is appropriate.

Final Panel Comment 10

The design criteria used to identify the non-dam alternatives do not explain how the multiple pump alternatives were developed.

Basis for Comment

The design criteria used to identify the non-dam alternatives are very general, and it is unclear how the multiple pump alternatives were developed. This uncertainty about the design criteria is reflected in the following DEIS statement:

> The two pumping alternatives have been structured in a way that discrete elements from either alternative could be combined or added to one another to achieve a more optimal alternative if new information indicates such combinations would improve alternative performance, reduce impacts, and/or reduce costs (DEIS p. 2-64).

Several public comments raised issues regarding the design of the non-dam alternatives, including the reliability of the pumping/power supply alternatives (4. USCOE Comment Letter, 12. LYREC Bypass Letter); the number of pumps necessary to meet irrigation demand (6. and 7. Defenders of Wildlife and the Natural Resource Defense Council, 10. American Rivers); the cost-effectiveness of irrigation conservation measures (6. and 7. Defenders of Wildlife and the Natural Resource Defense Council, 10. American Rivers); and the potential financial impacts of changes in Lower Yellowstone Project operation and maintenance costs on member farms (4. USCOE Comment Letter, 6. and 7. Defenders of Wildlife and the Natural Resource Defense Council).

These design issues influence the costs of the non-dam alternatives and the overall selection of the preferred alternative.

Significance – Medium/Low

Providing additional information on how the configurations of the non-dam alternatives were selected would contribute to a greater understanding of the alternatives assessment process.

Recommendation for Resolution

1. Document the design criteria used for the non-dam alternatives and clarify whether these criteria could be achieved with alternative pumping/power supply configurations.
2. Provide information on the reliability and the initial and recurring costs of different pumping power supply configurations, including the impacts of variable water supplies and conservation measures on crop yields/revenues.

PDT Final Evaluator Response (FPC 10)

	Concur	**X**	**Non-Concur**

O&M estimates that are located in the draft EIS are based on actual O&M expenses associated with the Buffalo Rapids Irrigation District, Sidney Irrigation District and similar Reclamation projects. These estimates account for uncertainties associated with the design and replacement costs that would occur within the 50 year timeline established within the document.

Section 2.3 describes the alternatives evaluated in the EIS. The alternatives evaluated in the EIS were formulated to evaluate a range of reasonable alternatives and disclose the potential impacts that could occur. A final decision could include a variation of project elements within the range of alternatives evaluated. The costs developed for each alternative are based on the reality of the types of pumps and existing limited electricity available to the site. If the Multiple Pumps Alternative were to be selected to move forward for more detailed design, some elements could be optimized for efficiency and cost savings. However, it is typically rare for a project's costs to be significantly reduced when moving from a feasibility level to the final design level as numerous factors are included as detailed line items that are currently considered in the contingency value.

The Multiple Pumping Station alternative is described in Section 2.3.7 and in Appendix A-2. This alternative is designed with a total diversion capacity of 1,374 cfs with pumping stations constructed along the river to deliver water to the main canal. We acknowledge that there are comments pertaining to the reliability of the pumping and power supply for the pumps. This was recognized during alternative development and as described in the alternative descriptions and details provided in Appendix A-2, and A-3 discussions occurred with the local utility and power upgrades were incorporated into the cost and design. In addition based on experience with power outages backup generators were included in the designs.

The power supply for this alternative in the DEIS was assumed to be from the local utility and costs developed with that assumption, with the option to acquire Pick-Sloan power. Per comments received, the FEIS includes the costs of Pick-Sloan power instead. The costs of supplying wind power to the project was analyzed and disclosed as part of the Multiple Pumps with Conservation Measures alternative and is described in the EIS document.

As explained in Section 1.7 and 2.3.8 the Multiple Pumping with Conservation Measures Alternative was proposed by public comment in scoping. It proposes removing the weir and reducing the gravity diversion while compensating for that with conservation measures. Section 2.3.8.7 of the EIS explains the irrigation water requirements of the current crops and shows that it cannot be met with a proposed reduced diversion.

Note that some of the comments referenced appear to assume that the current water right and annual diversions can be reduced but the analysis in Section 2.3.8.7 shows that the full water right is necessary to support peak demands of the current crop mix. The Multiple Pumping Alternative was designed to provide 1,374 cfs capacity. Without the weir, diversion can be achieved through gravity diversion during 17% of the irrigation season based on 30,000 cfs in the Yellowstone River, but almost never occurs during August and September (See FEIS 2.3.7.6 and Section 3.1.1.2 of Appendix A).

Additional calculations of diversion data have been added to the FEIS, Appendix A. The calculations provided in public comments differ from the data. Average daily flow rate from 2000-2015 has been calculated as 1,135 cfs and comparing to the period from 1968 to 2015 the average flow rate during the irrigation season is 1,122 cfs. This is merely average historic diversions, which is not the factor by which the design was developed of providing the water right of 1,374 cfs. The design was developed for 1,374 cfs, which meets the peak crop demands.

Based on those lower diversion rates, comments suggest using three pumping sites instead of five and lowering the design flow rate for the system to 825 cfs, with the remainder of the required irrigation water being provided by gravity through the existing Intake when the river level is high enough to allow it. A review of the diversion-exceedance data previously presented in the DEIS shows that the proposed reduced-capacity system (3 pumps) would fail to provide the 1374 cfs of irrigation water on 30% to 40% of the days during a typical irrigation season.

Furthermore the LYID canal system is designed for gravity diversions and upstream control. Should a modified system such as pumping water from sites 3-5 be implemented, the irrigation system would require modifications (physical and operational). This could be in the form of reductions in canal capacity, additional check structures, or additional pumping stations. There would be cost and impacts involved with such changes that are not accounted for in the assumption that reducing the pumps from 5 to 3 would reduce costs.

Recommendation 1:		**Adopt**	**X**	**Not Adopt**

As stated in the EIS the design criteria for the Multiple Pumping Alternative is to provide the current water right (1,374 cfs) to the irrigation canal without the weir. The analysis describes the period and percentage of time that gravity diversion could occur, and incorporated that into the cost and benefit analysis. Two alternate power and pumping alternatives have been analyzed in the document and a third was dismissed (Ram Pumps, see 2.3.1) as not feasible. Two pumping and power scenarios are compared in the Environmental Impact Statement.

Recommendation 2:		**Adopt**	**X**	**Not Adopt**

Information pertaining to the costs and impacts of two different pumping and power supply configurations have been disclosed in the EIS. Section 2.3.8.7 describes the irrigation water requirements of the current crop mix irrigated in the LYID. The two alternatives analyzed provide a range of benefits and effects. Providing less than the 1,374 cfs water right does not meet the peak crop demands and therefore would not likely meet the purpose and need of continuing the viable and effective operation of the project. Changing the water supply quantities and crop mixes based on different scenarios is also beyond the scope. The EIS does address the costs associated with the different pumping alternatives (of which one includes conservation measures) and the different O&M costs of doing so are described in Socioeconomics section of Chapter 4.

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X	**Concur**		**Non-Concur**

The Panel believes the PDT is clarifying and addressing the issue in the public comments and adding it to the report in a succinct way.

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