Lower Yellowstone Intake Diversion Dam Fish Passage Project, Montana

DRAFT - Appendix E

Monitoring and Adaptive Management

Contents

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1.0 Introduction

The proposed Intake Diversion Dam fish passage improvement alternatives (project alternatives) described in the Draft Lower Yellowstone Intake Diversion Dam Fish Passage Project Environmental Impact Statement (EIS) have been developed as a wide range of possible pathways for fish passage based on the best available scientific information for pallid sturgeon. Nonetheless, 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.

The purpose of this monitoring and adaptive management appendix is to present anticipated required monitoring studies that would support the validation of assumptions and address uncertainties through monitoring of physical and biological responses to management actions, assess progress towards project objectives, and identify potential adjustments to achieve and maintain project performance. Once a final alternative has been selected, a final Monitoring and Adaptive Management Plan (AMP) will be prepared for the proposed project. Monitoring and adaptive management elements described herein may be modified in the future as necessary in response to new data and information from on-going studies or from other requirements that may be contained in the Biological Opinion for the project.

Adaptive management is 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. This appendix also describes the process for analysis and decision-making that can be used to implement the AMP developed for the recommended Project.

In this appendix, it is presumed that no action is not a viable alternative as it would not improve fish passage and thus monitoring and adaptive management actions are not proposed for the No Action Alternative.

Project Goal and Objectives

Goal: The goal of the fish passage improvement project is to improve pallid sturgeon fish passage at the Intake Diversion Dam. This would make approximately 165 miles of additional habitat available for pallid sturgeon migration and spawning in the Yellowstone River, upstream of Intake Diversion Dam. Under current conditions, the majority of the spawning activity takes place within the lowest 10 to 20 miles of the Yellowstone River (Delonay et al 2016; Bramblett 1996), which does not allow for adequate drift distance for free embryos and larval pallid sturgeon to mature and settle out before they reach the headwaters of Lake Sakakawea, where

larvae are believed to succumb to hypoxia (Bramblett et al 2016; Guy et al. 2015). By improving passage at Intake Diversion Dam, the majority of adult pallid sturgeon that migrate up to the weir would be able to migrate and spawn further upstream, increasing the available drift distance and improving survival and ultimately contributing to increased recruitment of pallid sturgeon within the Great Plains Management Unit (Upper Missouri River and Yellowstone River area as defined by the U.S. Fish and Wildlife Service [Service] in the Pallid Sturgeon Recovery Plan [2014]).

The following specific objectives are based on the physical and biological criteria developed by the Service's Biological Review Team (BRT) for a bypass channel. Physical criteria developed earlier for a rock ramp are displayed in parentheses as they have some slight differences (BRT 2009). Physical criteria do not apply to weir removal alternatives as removing the weir would return the river channel to essentially natural conditions. The biological criteria apply to all alternatives.

Objective 1: Create and maintain appropriate physical criteria parameters that allow pallid sturgeon passage. The physical criteria are:

- **Depth**
  1) Minimum depths in fish passageway measured at the lower discharge range of 7,000 cfs to 14,999 cfs at any sampled cross-section must be greater than or equal to 4.0 feet across 30 contiguous feet of the measured channel cross section profile.
  2) Minimum depths in the fish passageway measured at the discharge range of 15,000 cfs to 63,000 cfs at any sampled cross-section must be greater than or equal to 6.0 feet across 30 contiguous feet of the measured channel cross sectional profile.
- **Velocities**
  1) Mean cross-sectional velocities must be equal or greater than 2.0 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 7,000 cfs to 14,999 cfs (equal or less than 4.0 feet/second for rock ramp).
  2) Mean cross-sectional velocities must be equal or greater than 2.4 feet/second, but less than or equal to 6.0 feet/second over the discharge range of 15,000 cfs to 63,000 cfs (equal or less than 4.0 feet/second for rock ramp).

Objective 2: Upstream and downstream passage of pallid sturgeon

- Upstream Passage
  1) Greater than or equal to 85% of motivated adult pallid sturgeon (fish that move up to the weir) annually pass upstream of the weir location during the spawning migration period (April 1 to June 15) within a reasonable amount of time without substantial delay (≥0.19 miles/hour).
- Downstream Passage
  1) Mortality of adult pallid sturgeon that migrate downstream of the weir location cannot exceed 1% annually during first 10 years. Document any injury or evidence of adverse stress.

2) Assess impingement and entrainment of free-embryo, larval, and young-of-year sturgeon at headworks/screens, irrigation canal and downstream of the weir location.

Objective 3: Upstream and Downstream Passage of Native Fish

- Determine if native fish can effectively migrate upstream and downstream of the weir location.

2.0 Rock Ramp

This alternative is intended to provide fish passage past Intake Diversion Dam by constructing a low gradient rock ramp on the downstream side of the weir to reduce the drop at the weir and also to reduce velocities and turbulence and thus encourage fish passage. The existing side channel would remain as a possible migration corridor when flows exceed 20,000 cfs in the river. The key features of the Rock Ramp Alternative include:

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure spans 300 feet and is equipped with 12 rotating drum screens designed to reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Rock Ramp. The rock ramp would extend for 1,200 feet downstream of the dam, burying the existing boulder field, with variable slopes from 0.2 to 0.7%. The ramp would be constructed with large rock (1 to 4 feet in diameter) with cobbles filling in the voids. A low flow channel would be constructed into the shape of the ramp to concentrate flows during low flow periods and also to mimic a deeper main channel area for main channel oriented fish such as pallid sturgeon.
3. Replacement Concrete Weir. To maintain irrigation diversion capabilities with the screened headworks, a concrete weir would be constructed to an elevation of 1991.0 feet. The concrete weir would preclude the necessity of adding large rock to the crest of the existing diversion structure to maintain diversion capabilities (Figure 2-1).

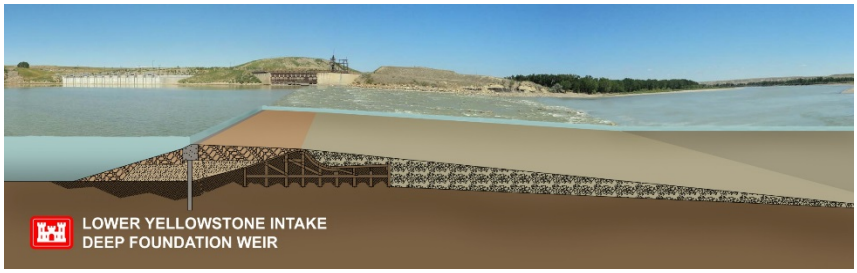


Figure 2-1 Cross-section of New and Existing Weir

NOTE: Figure 2-1 shows only the proposed replacement weir. Tan colored field shows existing rock/rubble field, but not new rock ramp configuration.

4. Weir Notch. A low-flow notch would be constructed in the new weir with a bottom elevation of 1988 feet, with an 85 foot bottom width and approximately 125 foot top width. This notch would connect to the low flow channel in the ramp.

2.1 Uncertainties

There are uncertainties relative to the physical and biological performance of the rock ramp that could affect the ability to meet the project goals of improving fish passage, particularly for pallid sturgeon. Modeling conducted by the Corps indicates that the rock ramp would not meet the Service's BRT physical criteria for pallid sturgeon passage under all flow conditions (i.e. velocities exceed criteria at the toe of the ramp at flows above 30,000 cfs and the depths are lower than criteria at flows less than 7,000 cfs) and there are also concerns about whether the rock would remain in place without frequent maintenance due to ice and flood damage. The use of rock will also introduce roughness that will likely create turbulent flows, which pallid sturgeon appear to avoid or have difficulty passing through (White and Medford 2002; Kynard et al. 2002, 2008). Further, sturgeon can be injured by large rock or bedrock as they swim close to the substrate (Kynard et al. 2012).

1. Rock Ramp Design and Performance
    a. What are the velocities and depths at multiple locations along the rock ramp and through the weir low-flow notch, the low-flow channel and other locations?
    b. What is the turbulence distribution along the rock ramp?
    c. How much do the rocks move around and what frequency of maintenance is required?
2. Fish Passage
    a. Does the rock ramp provide upstream passage for adult and juvenile pallid sturgeon?
        i. What percentage pass?
        ii. Are there any delays to passage?
        iii. What size and what sex pass the dam and what do not?
    b. Does the rock ramp provide downstream passage for adults, juveniles, and larval pallid sturgeon?
    c. Are other native fish (size and sex) able to pass upstream and downstream of the dam and at what passage percentage?

d. Do pallid sturgeon (size and sex) and other fish (size and sex) pass upstream through the existing high-flow side channel and at what percentage and frequency compared to the rock ramp?

3. Fish Entrainment

    a. How many fish and eggs smaller than 40 mm are entrained into the headworks?

2.2 Monitoring

The following monitoring plan is proposed to evaluate if the rock ramp is maintained as designed and constructed, meets the physical and biological criteria, and that biological assumptions were correct.

Objective 1: Maintain rock ramp passageway within physical criteria parameters.

After construction of the new weir and rock ramp, the U.S. Army Corps of Engineers (Corps) will be responsible for the first year of physical criteria monitoring to document physical performance as compared to the design for depths and velocities. Once the one year warranty period is complete, Reclamation through the LYP will be responsible for maintaining the rock ramp for the life of the project.

An acoustic Doppler current profiler (ADCP) will be deployed at 5 cross-sections across the rock ramp to analyze depths and velocities. These locations include:

1. Downstream toe of the rock ramp
2. Cross-sections at 300, 600, and 900 feet up from the toe of the rock ramp
3. Low-flow notch through the weir
4. After sturgeon and native species are tracked swimming up the ramp, use fine scale fish tracking and the ADCP to trace the fish's migration route during the same river discharge and determine the hydraulics used by fish. Also, map the substrate size along the fish's route.

Years 1 – 3 (Baseline)

An ADCP unit will be deployed by boat or line across the rock ramp during the spring moderate and high runoff conditions and summer low flow baseline. This will document depth and velocity conditions during three different flow conditions.

Years 3 – 6 (Intermediate)

The ADCP unit will be deployed in the same locations as described above. Monitoring will take place in the spring before peak runoff and then again during summer baseline flows to provide data on pre-migration and post-migration conditions.

Years 6 + (Long-term Monitoring)

Once a baseline and an understanding of how the rock ramp performs under different flow conditions have been established, the monitoring program will be scaled back. The primary concern will be if a severe or unique event occurs (major flooding or ice jam) the ADCP unit will be deployed to document if the physical and hydraulic characteristics have changed.

Objective 2: Upstream and Downstream Passage of Pallid Sturgeon

Reclamation will be responsible for ensuring passage monitoring occurs once the rock ramp and new weir are complete. Below is a description of monitoring that will take place.

Upstream Adult Monitoring

Currently, the U. S. Geological Survey (USGS), U.S. Fish and Wildlife Service (Service) and Montana Fish, Wildlife & Parks (MFWP) capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year (i.e. spawning).

Reclamation will locate six telemetry stations at strategic locations to track the movement of these tagged fish relative to the new weir and rock ramp. These stations will be located at:

1. One mile downstream of the toe of the rock ramp
2. At the toe of the rock ramp
3. One mile upstream of the project
4. At the downstream end of the existing side channel
5. At the upstream end of the existing side channel
6. At the midpoint of the existing side channel

Because the Lower Yellowstone Irrigation Project (LYP) does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only tagged pallid sturgeon that come within one mile of the project will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry station located one mile downstream of the toe of the rock ramp will be used to establish the number of pallid sturgeon migrating upstream in any given year. The telemetry

station at the ramp will determine if pallid sturgeon try to use the rock ramp. The stations located in the existing side channel will document if and how many pallid sturgeon use the side channel. The station located one mile upstream from the project will confirm how many tagged fish successfully migrated upstream from either the rock ramp or the side channel.

Downstream Adult Monitoring

Downstream monitoring will begin with the station located one mile upstream of the dam. This will provide a base number of tagged pallid sturgeon attempting to move downstream over the rock ramp. If pallid sturgeon attempt to move back downstream over the weir they will be monitored using that station located at the downstream end of the rock ramp. The stations within the high-flow side channel will detect pallid sturgeon using the side channel to migrate downstream. The station located one mile downstream of the project will detect the total number of pallid sturgeon successfully migrating back downstream.

Downstream Free Embryo and Larval Monitoring

As mentioned above, MFWP monitors movements of adult pallid sturgeon in the Yellowstone River and this effort is expected to continue. Once adult pallid sturgeon migrate past the project, MFWP will be monitoring for spawning activities that may occur upstream. If MFWP confirms spawning has taken place upstream, and Reclamation has sufficient lead time, Reclamation will monitor for free embryos and larval pallid sturgeon downstream of the rock ramp to ensure these organisms are successfully passing downstream.

Entrainment monitoring at the headworks and main canal will continue following the existing monitoring plan. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluated larval drift and in the main canal to evaluate entrainment through the new headworks.

Objective 3: Upstream and Downstream Passage of Native Species

Upstream and Downstream Monitoring

Currently, Reclamation and MFWP capture and tags native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate six telemetry stations at strategic locations to track the movement of tagged native fish.

Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the Project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing dam.

The telemetry stations located one mile upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area. The telemetry stations within the side channel will be used to determine whether and how

many of these native species are using the side channel. If native species are migrating over the rock ramp and weir they will be monitored using the station located on the downstream end of the rock ramp. The station at the downstream end of the ramp will not reveal if fish successfully pass upstream, just that they are at the site and attempting to pass upstream. The station one mile upstream of the project will confirm how many tagged fish successfully migrated upstream from either the rock ramp or the side channel.

2.3 Possible Adaptive Management Measures

Data collected from physical monitoring would be evaluated and compared to the data collected from biological monitoring. If objectives are not met, Reclamation will consider the following measures, or variations or combinations of these measures, or new measures suggested by the Corps, USGS, Service, or MFWP, based on the monitoring results:

1. Rock Ramp
    a) Modifications to the downstream toe or low-flow channel configuration to address physical or hydraulic issues.
    b) Modification of rock sizing to minimize turbulence or address ice or flood damages.
    c) Adding additional length to the rock ramp to reduce slope.
    d) Creation of pools or other lower velocity resting areas along the rock ramp.
    e) Modification of the ramp based on determining fish movement route relative to physical characteristics of their route.
2. Weir Notch
    a) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon toward the weir notch.
    b) Narrowing or widening the notch to address depth/velocity issues.
3. Headworks
    a) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon away from the headworks structure.

Implementation of the above measures would be based on results of physical and biological monitoring including: depth, velocity, and width; and observation of pallid sturgeon migration upstream and downstream of the Project. Implementation would also depend on funding availability and a detailed analysis and design (including hydraulic and/or physical modeling) to ensure the feasibility of each, particularly if there are potential effects on water delivery or fish passage.

3.0 Bypass Channel

The Bypass Channel Alternative is intended to improve fish passage by creating a 2.1 mile long, low-gradient channel around the weir. The primary features of this alternative are described below. The effectiveness of these features to provide passage will be monitored, and if needed, modifications will be made in an effort to achieve Project objectives.

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure spans 300 feet and is equipped with 12 rotating drum screens that reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Bypass Channel. The bypass channel would be excavated from the inlet of the existing side channel to just downstream of the existing weir. The proposed bypass channel alignment is approximately 11,150 feet long at a slope of 0.07 percent. The channel cross section has a 40-foot bottom width with side slopes varying from 1V:8H to 1V:4H. The bypass channel would divert on average 13-15% of the total flow of the Yellowstone River (Figure 2).

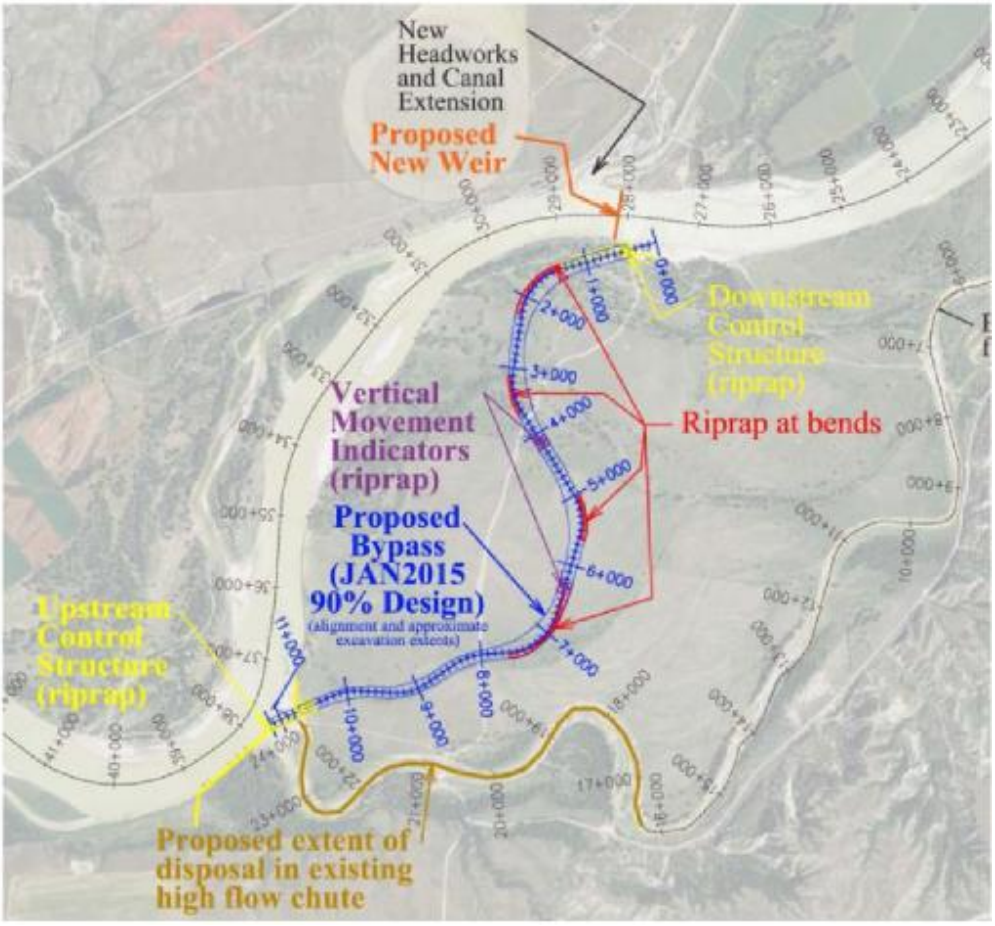


Figure 3-1 Bypass Channel Alignment

3. Upstream Control Structure. A riprap control structure designed to control discharge and stabilize the water entrance (fish exit) to the bypass channel would be situated on the upstream end of the channel.
4. Existing Side Channel Plug. Fill will be placed in the existing side channel to keep all split flows within the proposed bypass channel.
5. Vertical Control Structures. Two vertical control structures (riprap sills) are proposed within the bypass channel for maintaining channel slope and allowing for early identification of channel movement.
6. Downstream Vertical Control Structure. A riprap sill is proposed at the downstream end of the bypass channel to maintain channel elevations.

7. Armor Layer. The bed of the bypass channel would be armored with sorted sands, gravels and cobbles to reduce the risk of bed degradation. The proposed armor layer would be similar to naturally-formed bed material in the Yellowstone River.
8. Replacement Concrete Weir. To maintain irrigation and bypass channel diversion capabilities a replacement concrete weir would be constructed as described for the rock ramp alternative. The new weir would preclude the necessity of adding large rock to the crest of the existing diversion structure to maintain diversion capabilities (Figure 2-1).
9. Weir Notch. A low-flow notch would be constructed in the new weir with a bottom elevation of 1988 feet, with an 85 foot bottom width and approximately 125 foot top width.
10. Downstream Fill. Fill is proposed near the downstream entrance of the bypass channel to reduce eddy formation and to increase attraction flows (Figure 3-2).

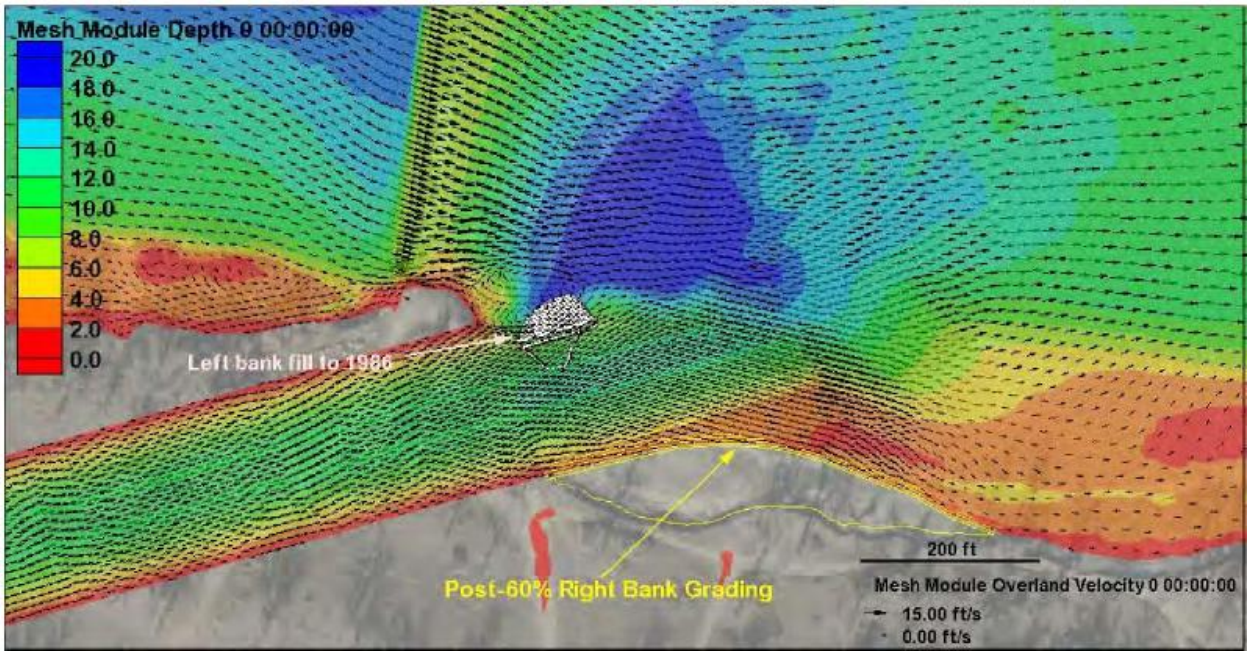


Figure 3-2 Computer Modeling Showing Extent of Downstream Fill Area

3.1 Uncertainties

There are uncertainties relative to the physical and biological performance of the bypass channel that could affect the ability to meet the project goals of improving fish passage, particularly for pallid sturgeon. Existing modeling indicates that the bypass channel would meet BRT criteria under all flow conditions, but it remains to be seen if the channel maintains these characteristics over the long term and if these physical criteria result in biological performance.

1. Bypass Channel Design and Performance
    a. What are the velocities, depths and flows at multiple locations along the bypass channel, particularly at the entrance and exit and grade control sills?
2. Fish Passage
    a. Does the bypass channel and weir provide upstream passage for adult and juvenile pallid sturgeon?
        i. What percentage enter the channel, successfully pass through the channel, and successfully exit back into the river?
        ii. What is the route of passage through the channel and what velocities are experienced by the fish?
        iii. Are there any delays to passage? Where and for how long?
        iv. What is the diel pattern of fish passage?
    b. Does the bypass channel and weir provide downstream passage for adults, juveniles, and larval pallid sturgeon?
    c. Does the bypass channel and weir provide upstream and downstream passage of other native species?
3. Fish Entrainment
    a. How many fish and eggs smaller than 40 mm are entrained into the headworks?

3.2 Monitoring

The following monitoring plan is proposed to evaluate if the bypass channel is maintained as designed and constructed, meets the physical criteria, and that biological assumptions were correct.

Objective 1: Maintain bypass channel within physical criteria parameters.

After construction of the new weir and bypass channel, the Corps would be responsible for the first year of physical criteria monitoring (depths, velocities, and flows) to document physical performance as compared to the design. Once the one year warranty period is complete, Reclamation through the LYP will be responsible for maintaining the new weir and bypass channel for the life of the project.

An acoustic doppler current profiler (ADCP) will be deployed at 5 cross-sections across the bypass channel to analyze depths and velocities. These locations include:

1. Downstream entrance to the bypass channel.
2. Cross-sections at 1,000, 5,000 and 10,000 feet up from the downstream entrance or representative cross-sections at rock sills and at intermediate sections.
3. Upstream outlet to the river.

b)

c) Years 1 – 3 (Baseline)

An ADCP unit will be deployed by line across the bypass channel during the spring moderate and high runoff conditions and summer low flow baseline. This will document depth and velocity conditions during three different flow conditions. If pallid sturgeon are tracked in the bypass channel during a particular river flow regime, ADCP sampling will be done during a time period of most fish use of the channel.

d) Years 3 – 6 (Intermediate)

e) The ADCP unit will be deployed in the same locations as described above. Monitoring will take place in the spring before peak runoff and then again during summer baseline flows to provide data on pre-migration and post-migration conditions.

f) Years 6 + (Long-term Monitoring)

Once a baseline and an understanding of how the bypass channel performs under different hydraulic scenarios have been established, the monitoring program will be scaled back. The primary concern will be to determine if a severe or unique event occurs (major flooding or ice jam) and changes the physical and hydraulic characteristics, in which case the ADCP will be deployed.

Objective 2: Upstream and Downstream Passage of Pallid Sturgeon

Reclamation will be responsible for ensuring passage monitoring occurs once the bypass channel and weir are complete. Below is a description of monitoring that will take place.

Upstream Adult Monitoring

Currently, the USGS, Service and MFWP capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year.

Reclamation will locate five telemetry stations at strategic locations to track the movement of these tagged fish. These stations will be located at:

1. One mile downstream of the project
2. At the downstream entrance to the bypass channel

3. One mile upstream of the project
4. At the upstream outlet of the bypass channel
5. At the downstream entrance to the side channel (which will become backwater)

Because the LYP does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only tagged pallid sturgeon that come within one mile of the project will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry station located one mile downstream of the project will be used to establish the number of pallid sturgeon migrating upstream in any given year. The telemetry station(s) at the bypass channel will determine if pallid sturgeon try and succeed in using the bypass channel. The station located at the existing side channel will document if pallid sturgeon try to use the side channel after it no longer has flows. The station located one mile upstream from the project will confirm how many tagged fish successfully migrated upstream.

Because telemetry station data only indicates when a fish was present near the station, mobile tracking would be used to supplement the stations once fish are detected at the downstream station to provide supplemental information on the route that fish use in the Project area to better understand what particular depths, velocities and other physical factors influence passage.

Downstream Adult Monitoring

Downstream monitoring will begin with the station located one mile upstream of the project. This will provide a base number of tagged pallid sturgeon attempting to move downstream over the weir. If pallid sturgeon attempt to move back downstream over the weir they will be monitored using that station located one mile downstream of the project. The stations within the bypass channel will detect pallid sturgeon using the bypass channel to migrate downstream. The station located one mile downstream of the Project will detect the total number of pallid sturgeon successfully migrating downstream for either pathway.

Downstream Free Embryo and Larval Monitoring

As mentioned above, MFWP currently monitors movements of adult pallid sturgeon in the Yellowstone River and this effort is expected to continue. Once adult pallid sturgeon migrate past the Project, MFWP will be monitoring for spawning activities that may occur upstream. If MFWP confirms spawning has taken place upstream, and Reclamation has sufficient lead time, Reclamation will monitor for free embryos and larval pallid sturgeon downstream of the new weir to ensure these organisms are successfully passing downstream.

Entrainment monitoring at the headworks and main canal will continue following the existing monitoring plan. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluated larval drift and in the main canal to evaluate entrainment through the new headworks.

Objective 3: Upstream and Downstream Passage of Native Species

Upstream and Downstream Monitoring

Currently, Reclamation and MFWP capture and tag native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate five telemetry stations at strategic locations to track the movement of tagged native fish.

Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the Project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing dam.

The telemetry stations located one mile upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area. The telemetry stations within the bypass channel will be used to determine whether these native species are using the bypass channel. If native species are migrating over the weir they will be monitored using the stations located one mile upstream and downstream of the project.

3.3 Possible Adaptive Management Measures

Data collected from physical monitoring would be evaluated and compared to the data collected from biological monitoring. If objectives are not met, Reclamation will consider the following measures, or variations or combinations of these measures, or new measures suggested by the Corps, USGS, Service, or MFWP, based on the monitoring results:

1. Bypass Channel
    a) Modifications to upstream and/or downstream control structure, vertical control structure or channel or bank substrate to address physical or hydraulic issues.
    b) Modifications to rock sizing within the channel, either to enhance stability or to reduce passage barriers.
2. Bypass Channel Entrance
    a) Modifications to bank fill to improve attraction flows, alleviate sheer flows, and/or minimize eddy formation near the channel entrance.
    b) Construction of a wing wall or other structure that guides upstream migrating fish towards to the bypass channel entrance.
3. Existing High-Flow Side Channel
    a) Removal of fill material in the existing side channel to provide an alternate passage option.

4. Existing Rock/Boulder Field
    a) Removal of existing rock in the river near the entrance of the bypass channel to reduce turbulence and achieve better fish passage.
    b) Removal of all or most of the existing rock in the river to improve upstream and downstream passage conditions for other native species.
5. Weir Notch
    a) Narrowing or widening the notch to address depth/velocity issues.
6. Headworks
    g) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon away from the headworks structure.

Implementation of the above measures would be based on results of physical and biological monitoring including: depth, velocity, and width; and observation of pallid sturgeon migration upstream and downstream of the project. Implementation would also depend on funding availability and a detailed analysis and design to ensure the feasibility of each, particularly if there are potential impacts to water delivery and/or fish passage.

4.0 Modified Side Channel

The Modified Side Channel Alternative is intended to improve fish passage by meeting the Service's BRT criteria for flows, depths, and velocities by modifying the existing side channel that has already been demonstrated to be used by upstream migrating pallid sturgeon to bypass around Intake Diversion Dam (Rugg 2014, 2015). The primary features of this alternative are described below and shown in Figure 4-1. The effectiveness of the deeper channel to provide passage will be monitored, and if needed, modifications will be made in an effort to achieve project objectives.

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure spans 300 feet and is equipped with 12 rotating drum screens that reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Existing Weir. The existing weir would remain as is for this alternative.
2. Existing Side Channel. The existing side channel would be excavated along the majority of its length to be deep enough to achieve the 13-15 percent flow volumes in the Service's BRT criteria. The proposed modified side channel would be slightly shorter than the existing side channel by cutting off three meander bends to ensure the desired volume of flow can be achieved across the range of flows in the river. The modified side channel would be approximately 20,350 feet long at a slope of 0.06 percent. The channel cross section has a 40-foot bottom width with side slopes varying from 1V:4H to 1V:8H.
11. Upstream Control Structure. A riprap control structure designed to control discharge and stabilize the entrance to the high-flow channel would be situated on the upstream end of the channel.
12. Vertical Control Structures. Two vertical control structures (buried riprap sills) are proposed within the high-flow channel for maintaining channel slope and allowing for early identification of channel movement.
13. Downstream Vertical Control Structure. A riprap sill is proposed at the downstream end of the high-flow channel to maintain channel elevations.
14. Armor Layer. The bed of the high-flow channel would be armored with sorted sands, gravels and cobbles to reduce the risk of bed degradation. The proposed armor layer would be similar to naturally-formed bed material in the Yellowstone River.

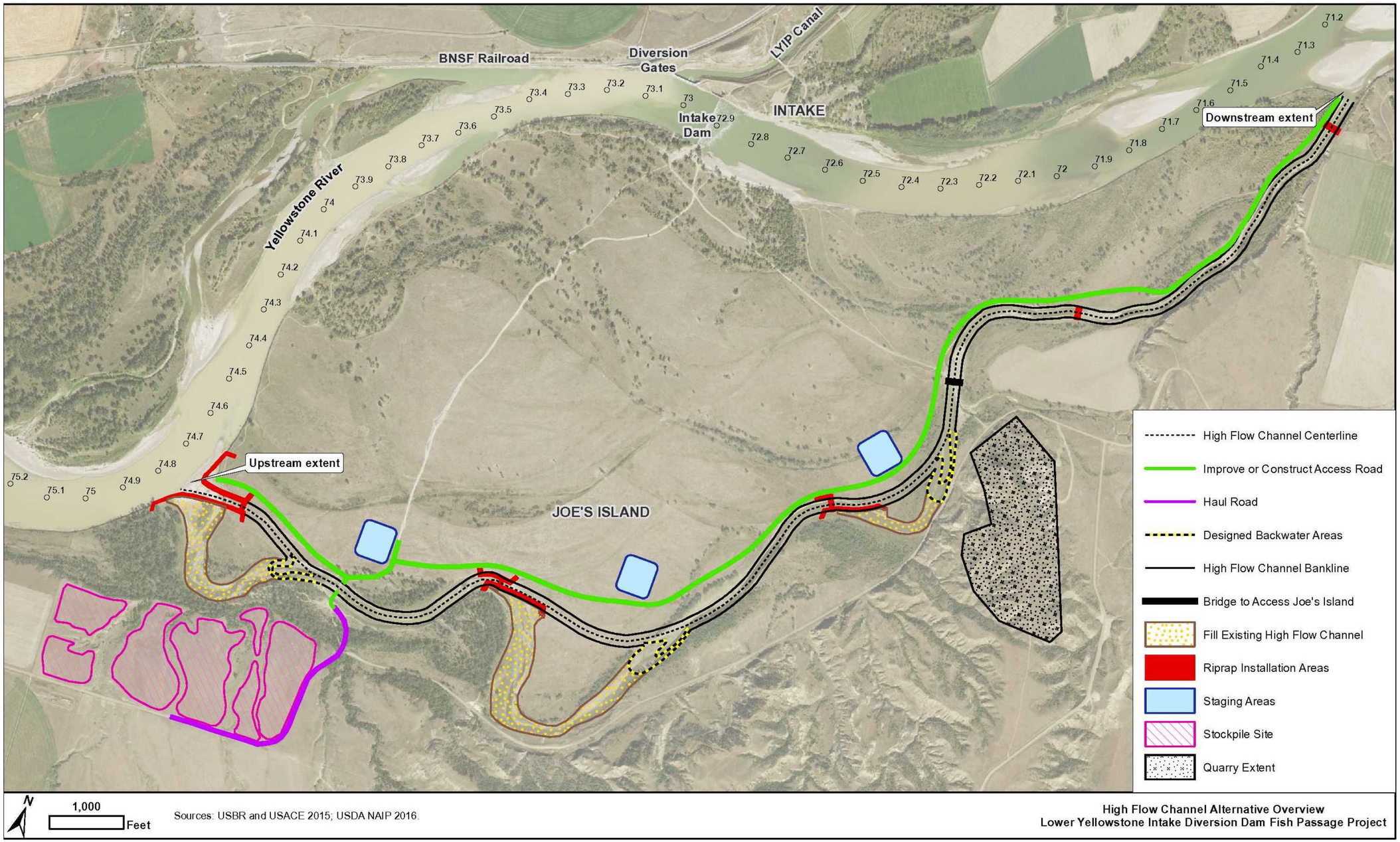


Figure 4-1 Modified Side Channel Alternative

4.1 Uncertainties

There are uncertainties relative to the physical and biological performance of the modified side channel that could affect the ability to meet the project goals of improving fish passage, particularly for pallid sturgeon. Modeling conducted by Tetra Tech (Appendix A of the EIS) indicates that the modified side channel would meet the Service's BRT criteria under all flow conditions, except the 1D model indicates that average velocity at the upstream connection to the river might be slightly higher than the BRT criteria of 6 feet/second, at 6.7 feet/second. However, these velocities are consistent with those calculated for the Yellowstone River channel at this location and may not represent the high-flow channel due to the velocity averaging within the 1D model. If this design moves forward, a 2D model would be recommended to provide detailed design parameters. It also remains to be seen if the channel would maintain these characteristics over the long term and if the physical criteria result in the desired biological performance.

1. High-Flow Channel Design and Performance
    a. What are the velocities, depths and flows at multiple locations along the modified side channel?
2. Fish Passage
    a. Does the modified side channel provide upstream passage for adult and juvenile pallid sturgeon?
        i. What percentage enter the side channel, pass upstream in the channel, and successfully exit back into the river on the upstream side?
        ii. Are there any delays to passage? Where and how long?
    b. Does the modified side channel and existing weir provide downstream passage for adults, juveniles, and larval pallid sturgeon?
    c. Does the modified side channel and existing weir provide upstream and downstream passage for other native fish species?
3. Fish Entrainment
    a. How many fish and eggs smaller than 40 mm are entrained into the headworks?

4.2 Monitoring

The following monitoring plan is proposed to evaluate if the modified side channel is maintained as designed and constructed, meets the physical criteria, and that biological assumptions were correct.

Objective 1: Maintain modified side channel within physical criteria parameters.

After construction of the modified side channel, the Corps will be responsible for the first year of physical criteria monitoring to document physical performance as compared to the design. Once the one year warranty period is complete, Reclamation through the LYP will be responsible for maintaining the high-flow channel for the life of the project.

An ADCP will be deployed at 5 cross-sections across the high-flow channel to analyze depths and velocities. These locations include:

1. Downstream entrance to the modified side channel
2. Cross-sections at 5,000, 12,000, and 20,000 feet up from the downstream entrance
3. Upstream exit from the modified side channel

In addition, the size and shape of the sandbars at the upstream and downstream ends of the side channel will be tracked via aerial photography to document changes and compared to river flows.

Years 1 – 3 (Baseline)

An ADCP unit will be deployed by boat or line across the modified side channel during the spring moderate and high runoff conditions and summer low flow baseline. This will document depth and velocity conditions during three different hydraulic scenarios. Area, shape and orientation of the sandbars will be compared each year to the previous aerial photography.

Because telemetry station data only indicates when a fish was present near the station, mobile tracking would be used to supplement the stations once fish are detected at the downstream station to provide supplemental information on the route that fish use in the project area to better understand what particular depths, velocities and other physical factors influence passage.

Years 3 – 6 (Intermediate)

The ADCP unit will be deployed in the same locations as described above. Monitoring will take place in the spring before peak runoff and then again during summer baseline flows to provide data on pre-migration and post-migration conditions. Area, shape and orientation of the sandbars will be compared each year to the previous aerial photography.

Years 6 + (Long-term Monitoring)

Once a baseline and an understanding of how the side channel performs under different hydraulic scenarios have been established, the monitoring program will be scaled back. The primary concern will be to determine if a severe or unique event occurs (major flooding or ice jam) and changes the physical and hydraulic characteristics, in which case the ADCP will be deployed.

Objective 2: Upstream and Downstream Passage of Pallid Sturgeon

Reclamation will be responsible for ensuring passage monitoring occurs once the high-flow channel is complete. Below is a description of monitoring that will take place.

Upstream Adult Monitoring

Currently, the USGS, Service and MFWP capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year.

Reclamation will locate five telemetry stations at strategic locations to track the movement of these tagged fish. These stations will be located at:

1. At or immediately downstream of the existing weir
2. At the downstream entrance to the side channel
3. Across the river near the downstream entrance to the side channel
4. At the upstream end of the side channel
5. One mile upstream of the project

Because the LYP does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only tagged pallid sturgeon that come at least to the side channel downstream entrance will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry stations located near the downstream entrance to the side channel will be used to establish the number of pallid sturgeon migrating upstream in any given year. The telemetry station(s) at the side channel will determine if pallid sturgeon try to use and succeed in using the side channel. The station located at the weir will document if fish continue to migrate to the weir and will document which fish may or may not subsequently find the side channel. The station located one mile upstream from the project will confirm how many tagged fish successfully migrated upstream.

Downstream Adult Monitoring

Downstream monitoring will begin with the station located one mile upstream of the project. This will provide a base number of tagged pallid sturgeon attempting to move downstream. If pallid sturgeon attempt to move back downstream over the weir they will be monitored using that station located at the weir. The stations within the side channel will detect pallid sturgeon using the side channel to migrate downstream. The stations located near the downstream end of the side channel will detect the total number of pallid sturgeon successfully migrating back downstream.

Downstream Free Embryo and Larval Monitoring

As mentioned above, Reclamation and MFWP monitor movements of adult pallid sturgeon in the Yellowstone River and this effort is expected to continue. Once adult pallid sturgeon migrate past the Project, MFWP will be monitoring for spawning activities that may occur upstream. If MFWP confirms spawning has taken place upstream, and Reclamation has sufficient lead time, Reclamation will monitor for free embryos and larval pallid sturgeon downstream of the weir and side channel to ensure these organisms are successfully passing downstream.

Entrainment monitoring at the headworks and main canal will continue following the existing monitoring plan. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluated larval drift and in the main canal to evaluate entrainment through the screened headworks.

Objective 3: Upstream and Downstream Passage of Native Species

Upstream and Downstream Monitoring

Currently, Reclamation and MFWP capture and tag native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate five telemetry stations at strategic locations to track the movement of tagged native fish.

Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the Project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing weir.

The telemetry stations located upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area. The telemetry stations within the modified side channel will be used to determine whether these native species are using the side channel. If native species are migrating over the weir they will be monitored using the station located on the weir.

4.3 Possible Adaptive Management Measures

Data collected from physical monitoring would be evaluated and compared to the data collected from biological monitoring. If objectives are not met, Reclamation will consider the following measures, or variations or combinations of these measures, or new measures suggested by the Corps, USGS, Service, or MFWP, based on the monitoring results:

1. Modified Side Channel
    a) Modifications to upstream and/or downstream control structure, vertical control structure or channel or bank substrate to address physical or hydraulic issues.

b) Modifications to rock sizing within the channel, either to enhance stability or to reduce passage barriers.

2. Downstream Side Channel Entrance

    a) Modifications to sandbar to improve attraction flows, alleviate sheer flows, and/or minimize eddy formation near the channel entrance.

    b) Construction of a wing wall or other structure that guides upstream migrating fish towards the side channel entrance.

3. Existing Rock/Boulder Field

    a) Remove rock from the existing rock field to reduce turbulence and improve upstream and downstream passage.

4. Headworks

    a) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon away from the headworks structure.

Implementation of the above measures would be based on results of physical and biological monitoring including: depth, velocity, and width; and observation of pallid sturgeon migration upstream and downstream of the project. Implementation would also depend on funding availability and a detailed analysis and design to ensure the feasibility of each, particularly if there are potential impacts to water delivery or fish passage.

5.0 Multiple Pump Alternative

The Multiple Pump Alternative is intended to improve fish passage by removing the existing weir and rock/boulder field and returning the river to a natural channel. The depths and velocities in the natural channel are not required to meet the Service's BRT criteria, because it is presumed that this is a natural condition and the channel is passable for most species during most flows. The primary features of this alternative are described below.

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure spans 300 feet and is equipped with 12 rotating drum screens that reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Existing Weir and Rock/Rubble Field. The existing weir and the rock/rubble field will be removed from the river channel. The accumulated wedge of coarse sediment upstream from the existing weir will be allowed to naturally transport downstream over time.
2. Pump Stations. Five pump stations would be installed over a distance of about 20 miles from the existing dam and downstream that would withdraw surface water from the Yellowstone River to supplement gravity flow into the main irrigation canal (see Figure 5-1). Each of the pump stations would be equipped with V-screens that would reduce entrainment of fish larger than 40 mm into the pumps. Additionally, a fish return pump would be installed to return fish to the river that are swept or swim past the screens.

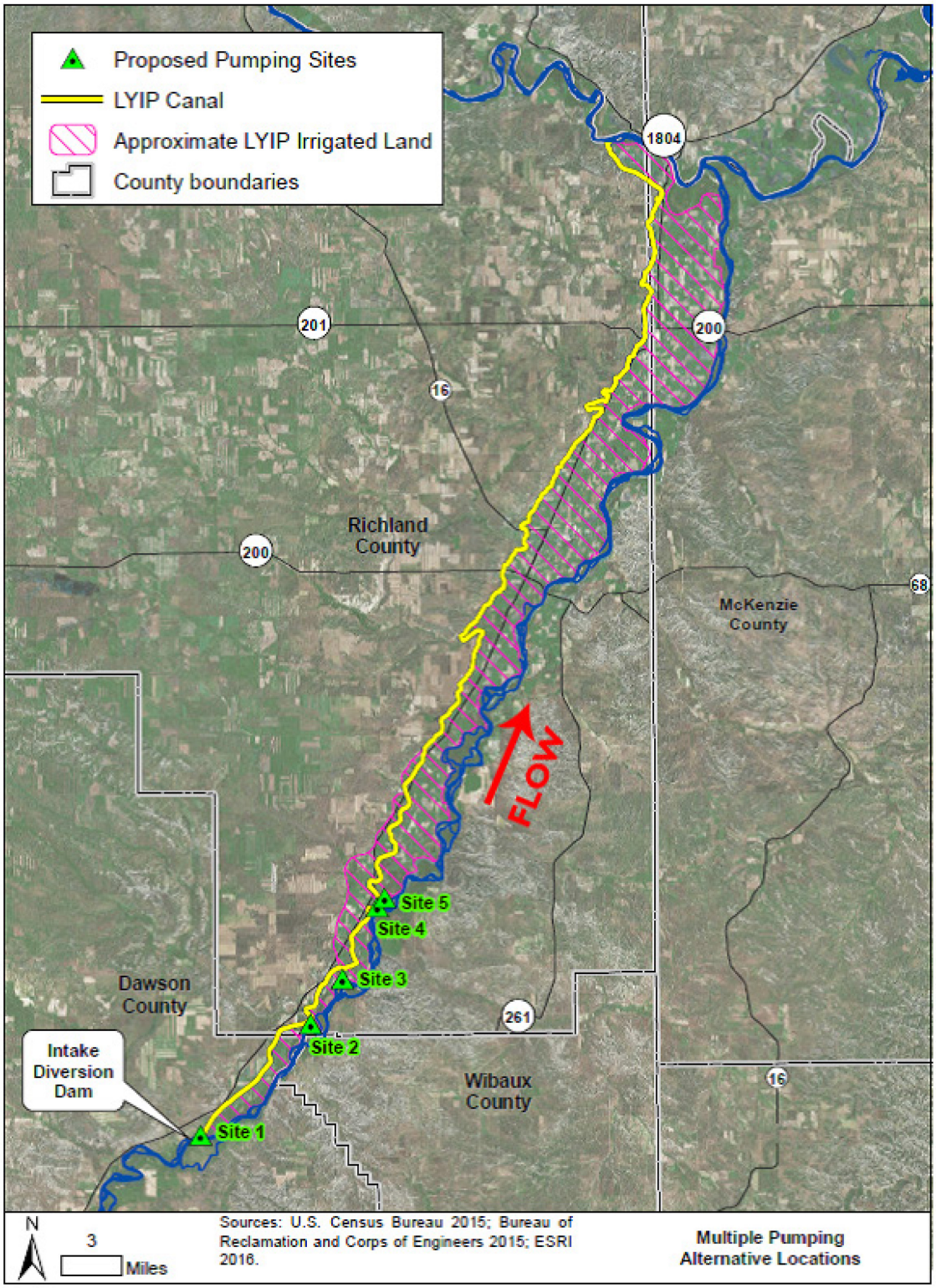


Figure 5-1 Multiple Pump Station Locations

5.1 Uncertainties

There are uncertainties relative to the physical and biological performance of the pumping alternative that could affect whether the project meets the goal and objectives and also influence mortality of free embryo and larval fish. The primary question will be related to fish entrainment as fish passage is presumed to be fully functional with a natural river channel.

2. Fish Entrainment
    a. How many fish and eggs smaller than 40 mm are entrained into the headworks and pumps?
    b. Are fish returned unharmed to the river via the fish return pump? What signs of injury?

5.2 Monitoring

The following monitoring plan is proposed to evaluate if the Multiple Pump Alternative is maintained as designed and constructed and that biological assumptions were correct.

Objective 1: Upstream and Downstream Passage of Pallid Sturgeon

While there is no uncertainty as to the potential for fish passage once the weir is removed, Reclamation will nonetheless continue to monitor pallid sturgeon passage. Below is a description of monitoring that will take place.

Upstream Adult Monitoring

Currently, the USGS, Service and MFWP capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year.

Reclamation will locate three telemetry stations at strategic locations to track the movement of these tagged fish. These stations will be located at:

1. One mile downstream of the headworks
2. At the former weir location
3. One mile upstream of the project

Because the LYP does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only tagged pallid sturgeon that come at least to one mile downstream of the headworks will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry station located one mile downstream will be used to establish the number of pallid sturgeon migrating upstream in any given year. The station located at the former weir location will document if fish continue to migrate upstream. The station located one mile upstream from the project will confirm how many tagged fish successfully migrate upstream.

h) Downstream Adult Monitoring

Downstream monitoring will begin with the station located one mile upstream of the project. This will provide a base number of tagged pallid sturgeon attempting to move downstream. The station located one mile downstream of the headworks will detect the total number of pallid sturgeon successfully migrating back downstream.

i) Downstream Free Embryo and Larval Monitoring

As mentioned above, MFWP currently monitors movements of adult pallid sturgeon in the Yellowstone River and this effort is expected to continue. Once adult pallid sturgeon migrate past the project, MFWP will be monitoring for spawning activities that may occur upstream. If MFWP confirms spawning has taken place upstream, and Reclamation has sufficient lead time, Reclamation will monitor for free embryos and larval pallid sturgeon downstream of the former weir location to ensure these organisms are successfully passing downstream.

Entrainment monitoring at the headworks and main canal will continue following the existing monitoring plan. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluated larval drift and in the main canal to evaluate entrainment through the screened headworks.

Entrainment monitoring will also be conducted at the new pump stations. Larval nets will be deployed immediately downstream of each of the pump stations in the main canal to evaluate entrainment through the pump station screens. Sampling from the fish return pump will also occur to document which species are in the pump and if any injury or stress is evident. Monitoring of impingement of larger fish on the trash racks within the feeder canals to the pump stations will also occur during the same sampling events.

j) **Objective 3:** Upstream and Downstream Passage of Native Species

k) Upstream and Downstream Monitoring

Currently, Reclamation and MFWP capture and tag native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate three telemetry stations at strategic locations to track the movement of tagged native fish.

Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing dam.

The telemetry stations located upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area.

5.3 Possible Adaptive Management Measures

Data collected from biological monitoring would be evaluated. If objectives are not met, Reclamation will consider the following measures, or variations or combinations of these measures, or new measures suggested by the Corps, USGS, Service, or MFWP, based on the monitoring results:

2. Headworks
    a) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon away from the headworks structure.
3. Pump Stations/Screens
    a) Installation of smaller gauge screens on the pumps.
    b) Installation of smaller gage trash racks in the feeder canals.
    c) Changes in the area of the screens to reduce velocities.
    d) Installation of ELJs or wing walls to deflect larval fish away from the pump feeder canal entrance.
    e) Modifications to fish return pumps/pipes.

Implementation of the above measures would be based on results of biological monitoring including: observation of pallid sturgeon migration upstream and downstream of the Project and entrainment results. Implementation would also depend on funding availability and detailed analysis and design to ensure the feasibility of each, particularly if there are potential impacts to water delivery or fish passage.

6.0 Multiple Pumps with Conservation Measures

The Multiple Pumps with Conservation Measures Alternative is intended to improve fish passage by removing the existing weir and rock/boulder field and returning the river to a natural channel. The depths and velocities are not required to meet the Service's BRT criteria, because it is presumed that this is a natural condition and the channel is passable for most species during most flows. The key features of this alternative are described below.

1. Headworks. A screened headworks was completed in 2012 and has been in operation since 2012. The structure spans 300 feet and is equipped with 12 rotating drum screens that reduce entrainment of fish larger than 40 mm into the main irrigation canal.
2. Existing Weir and Rock/Rubble Field. The existing weir and rock/rubble field will be removed from the river to return it to a natural channel. The accumulated coarse sediment upstream of the weir will be allowed to naturally transport downstream over time.

2. Ranney Wells. Seven alluvial groundwater pump stations (i.e. Ranney Wells) would be installed along the river from the site of the existing weir down to below Sidney. These pump stations would not pump surface water, but would pump shallow groundwater in the alluvial aquifer associated with the river to supplement gravity flows into the main irrigation canal.

3. Water Conservation. The LYP irrigation canal system would be upgraded through a variety of measures to reduce water consumption and leakage, including lining the canals, converting open canals to pipes, and converting on-farm irrigation systems to pivot sprinklers and other more efficient mechanisms. These measures are proposed to reduce the need to divert more than 608 cfs of water into the LYP.

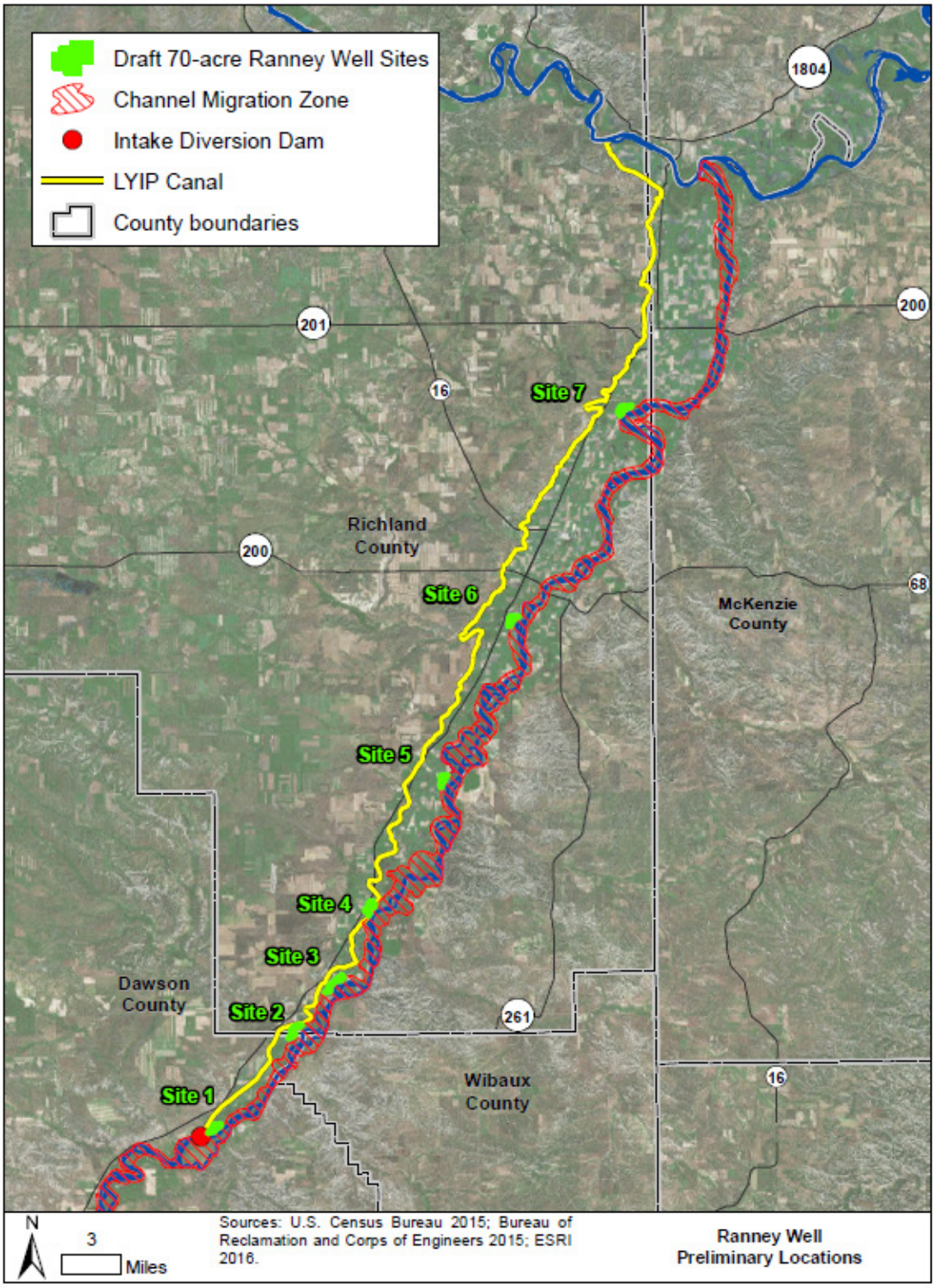


Figure 6-1 – Preliminary Ranney Well Locations

6.1 Uncertainties

There are uncertainties relative to the biological performance of the Multiple Pumps with Conservation Measures aAternative that could affect whether the project meets the goal and objectives and whether there is mortality of free embryos and larval fish. The primary uncertainty is related to entrainment of larvae at the screened headworks.

2. Fish Entrainment

    a. How many fish and eggs smaller than 40 mm are entrained into the main irrigation canal?

6.2 Monitoring

The following monitoring plan is proposed to evaluate if the pumping with water conservation alternative is maintained as designed and constructed, meets the physical criteria, and that biological assumptions were correct.

Objective 1: Upstream and Downstream Passage of Pallid Sturgeon

While it is presumed that fish will have unhindered fish passage upstream and downstream once the existing weir and rock/rubble field are removed, nonetheless, Reclamation will monitor fish passage once the dam is removed. Below is a description of monitoring that will take place.

l) Upstream Adult Monitoring

Currently, the USGS, Service and MFWP capture and tag both adult and juvenile pallid sturgeon in the spring. This effort is expected to continue to ensure a portion of the population is tagged and can be tracked every year. During this effort, fish are also checked for sexual maturity which is critical for determining what their movements mean in a given year.

Reclamation will locate three telemetry stations at strategic locations to track the movement of these tagged fish. These stations will be located at:

1. One mile downstream of the headworks
2. At the former weir location
3. One mile upstream of the project

Because the LYP does not influence whether pallid sturgeon are motivated to migrate up the Yellowstone River or the Missouri River in a given year, only tagged pallid sturgeon that come at least to one mile downstream of the headworks will be monitored for passage success. It is assumed that if pallid sturgeon are within the vicinity of the project, they are seeking to migrate further upstream.

The telemetry station located one mile downstream will be used to establish the number of pallid sturgeon migrating upstream in any given year. The station located at the former weir location will document if fish continue to migrate upstream. The station located one mile upstream from the project will confirm how many tagged fish successfully migrated upstream past the former weir location.

Downstream Adult Monitoring

Downstream monitoring will begin with the station located one mile upstream of the project. This will provide a base number of tagged pallid sturgeon attempting to move downstream. The station located one mile downstream will detect the total number of pallid sturgeon successfully migrating back downstream.

Downstream Free Embryo and Larval Monitoring

As mentioned above, MFWP currently monitors movements of adult pallid sturgeon in the Yellowstone River and this effort is expected to continue. Once adult pallid sturgeon migrate past the Project, MFWP will be monitoring for spawning activities that may occur upstream. If MFWP confirms spawning has taken place upstream, and Reclamation has sufficient lead time, Reclamation will monitor for free embryos and larval pallid sturgeon downstream of the former dam location to ensure these organisms are successfully passing downstream.

Entrainment monitoring at the headworks and main canal will continue following the existing monitoring plan. Larval nets will be deployed at the river side of the headworks (as feasible) to evaluate larval drift and in the main canal to evaluate entrainment through the screened headworks.

Objective 2: Upstream and Downstream Passage of Native Species

Upstream and Downstream Monitoring

Currently, Reclamation and MFWP capture and tag native species and species of special concern in the spring of each year. These fish will be monitored using the same telemetry system that will be deployed for the pallid sturgeon monitoring. As identified above, Reclamation will locate three telemetry stations at strategic locations to track the movement of tagged native fish.

Reclamation and MFWP will be monitoring paddlefish, shovelnose sturgeon, blue sucker, and sauger within the immediate area of the project. These species were selected because, like pallid sturgeon, they are known to make long migrational movements during the spring of the year for spawning and have also shown difficulty in passing the existing dam.

The telemetry stations located upstream and downstream of the project will be used to establish the base number of native fish migrating upstream or downstream through the project area.

6.3 Possible Adaptive Management Measures

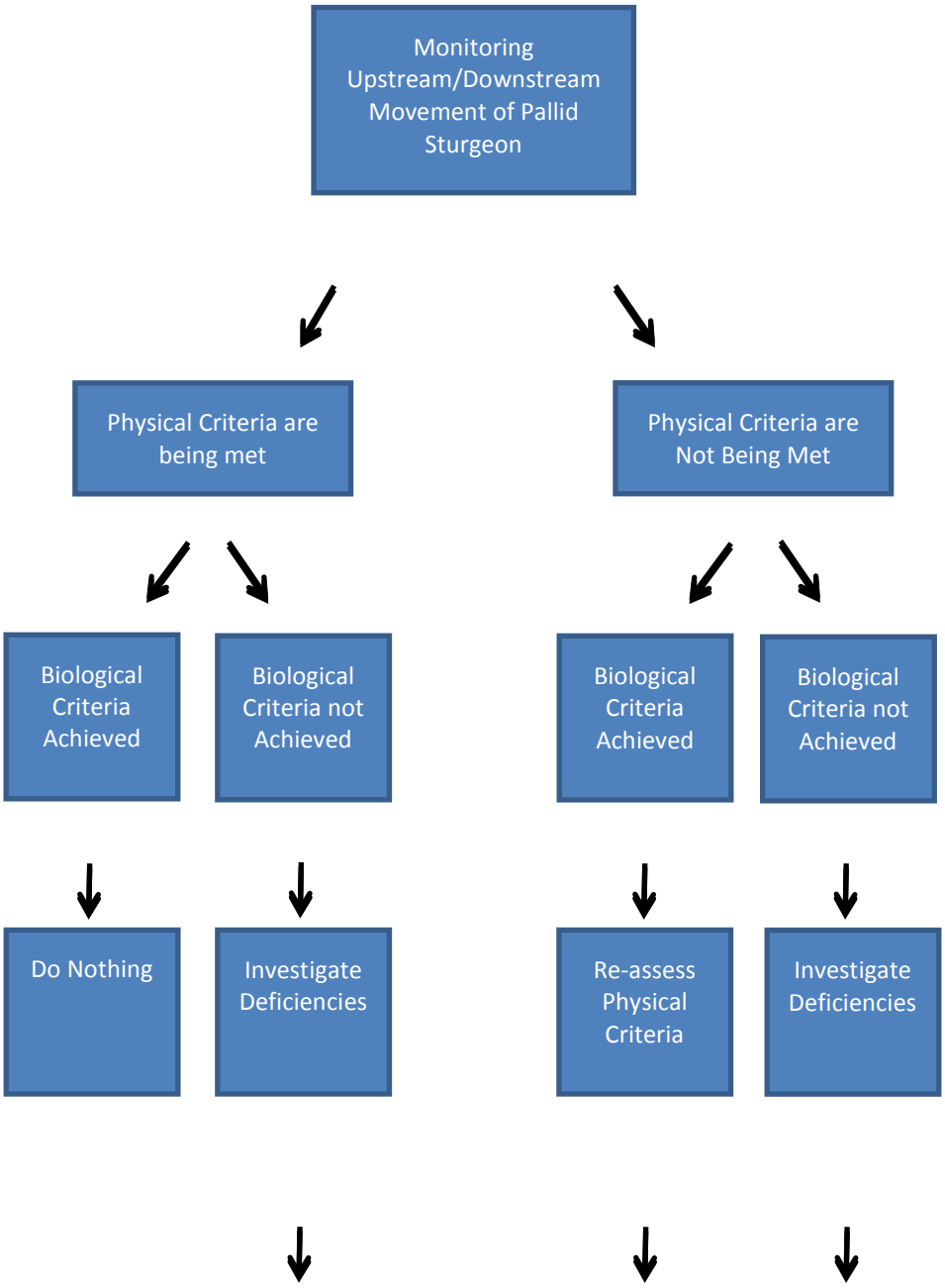
Data collected from biological monitoring would be evaluated. If objectives are not met, Reclamation will consider the following measures, or variations or combinations of these measures, or new measures suggested by the Corps, USGS, Service, or MFWP, based on the monitoring results:

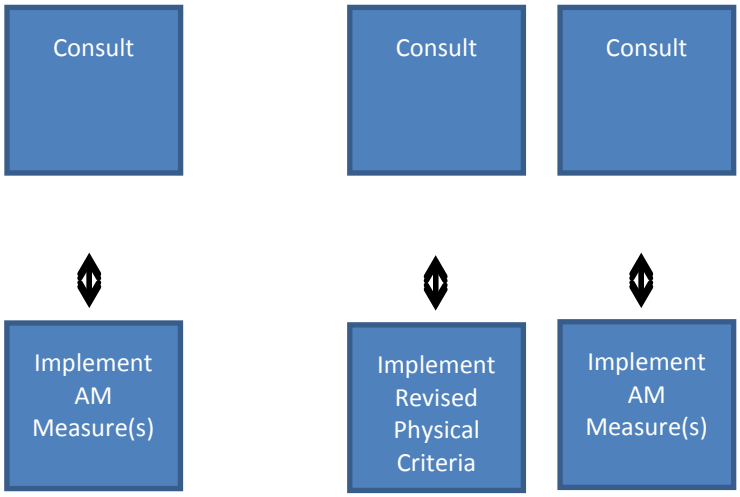
2. Headworks
    a) Construction of a wing wall or training structure that guides adults, juveniles, free embryos, and larval pallid sturgeon away from the headworks structure.

Implementation of the above measures would be based on results of biological monitoring including: observation of pallid sturgeon migration upstream and downstream of the project and larval entrainment results. Implementation would also depend on funding availability and a detailed analysis and design to ensure the feasibility, particularly if there are potential impacts to water delivery or fish passage.

7.0 Adaptive Management Process

The monitoring and evaluation of project objectives will be coordinated by Reclamation with the assistance of the Service. Reclamation will review data from monitoring of the physical parameters and compare that to pallid sturgeon passage results. It will be Reclamation's responsibility, in coordination with the Service, to determine whether or not the project is meeting the objectives established in this document and provide recommendations to remedy potential problems.





Monitoring of the physical criteria and the biological responses to these criteria would begin the first full year after construction is complete for whichever alternative is implemented. Physical and biological monitoring is expected to take place from April 1 – July 15. This covers the expected time frame for pallid sturgeon upstream migration, spawning, and downstream migration through the project. Once the field season is complete Reclamation will work with MFWP to compile monitoring results and begin assessing the effectiveness of the project to meet stated objectives.

During the yearly assessment Reclamation will determine if the physical criteria have been met. Once this has been established Reclamation will compare this to the biological criteria monitoring results for that year.

1. All Objectives Met

   m) If the physical criteria and the biological criteria are achieved, then Reclamation will not implement any adaptive management measures. Reclamation will submit these results to the Service for concurrence and the monitoring program will continue as planned for the next year.

2. If One or All Objectives Are Not Met

   n) If one or more of the stated objectives or criteria are not being met Reclamation will conduct further analysis. Questions that may need to be addressed include:

   - Were runoff conditions in the basin a factor? (Extreme high flow or drought conditions)
   - Were any fish able to pass upstream? If not, why?
   - Did fish migrate partially through the project? Where did they turn around?
   - Are there hydraulic conditions these fish encountered that discouraged passage?

- Were fish able to migrate back downstream through the project? If not, why?

o) Once a problem has been identified Reclamation will look at possible measures to address the identified issue(s). Once an adaptive management measure has been identified it would likely be subject to one or all of the following:

- Feasibility Study
- Physical Modeling
- Computer Modeling
- NEPA Analysis
- ESA Consultation

p) If it is determined that the adaptive management measure identified is the appropriate solution, then Reclamation will implement the measure within one field season if possible. Once the measure has been implemented Reclamation will resume monitoring activities or, if necessary, revise monitoring activities in consultation with the Service.

8.0 Reporting

Reclamation will provide annual reports documenting monitoring results and previous management actions. Recommendations for changes to monitoring or management actions will be proposed as necessary and this document may be updated and reissued.

For each monitoring element, the report will document the methods and results. Results will be evaluated with respect to the goals and objectives of the adaptive management program, and may indicate that changes in monitoring priorities and management activities are warranted.

9.0 Data Management

All monitoring data will be stored electronically on a secured server maintained by Reclamation and will comply with Reclamation's proposed data stewardship guidelines. All data collected by contractors will be provided to Reclamation in an agreed upon electronic format. Additionally, contractors will provide hard copies of any field notes or data sheets. Upon completion of the Monitoring and Adaptive Management Program, all data, results of analyses, and reports will be archived.

10.0 References

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