AMENDED BIOLOGICAL ASSESSMENT

INTERIM AND FUTURE OPERATION AND MAINTENANCE OF THE LOWER YELLOWSTONE IRRIGATION PROJECT AND CONSTRUCTION OF FISH PASSAGE WITH CONSERVATION MEASURES

March 2015

LOCATION:
Section 36, Township 18, Range 56 W
Dawson County, Montana

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Great Plains Region
Montana Area Office

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Proposed Action

The purpose of this biological assessment (BA) is to consider, analyze, and document the anticipated effects the three proposed federal actions – (1) interim operation and maintenance (O&M) of the Lower Yellowstone Irrigation Project (LYIP) in eastern Montana and western North Dakota until fish passage construction is complete, (2) construction of fish passage facilities, and (3) future O&M of the LYIP - may have on federally-listed threatened or endangered species, proposed species, and candidate species. Interim and future O&M of the LYIP includes existing measures to minimize fish entrainment at the newly-constructed headworks. Reclamation has prepared this BA in accordance with section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended and current regulations on Interagency Cooperation (50 CFR 402).

Interim O&M of the LYIP will include:

- Daily and seasonal adjustments to headwork gates by the LYIP in response to flow conditions and crop requirements. Diversions generally occur from April 15 to October 15. Weather and/or flow conditions could increase the irrigation season up to two weeks earlier or later.
- Diversions up to 1,374 cubic feet per second (cfs) from the Yellowstone River through the newly-constructed headworks into the main canal during the irrigation season.
- Periodic screen maintenance on the newly-constructed headworks. When a screen requires repair, replacement, or maintenance, the gate associated with that screen would be closed and a back-up screen and gate operated to divert a similar volume of water.
- Diverting unscreened water into the main canal at the beginning of the irrigation season (approximately one day) to sluice sediment and debris that accumulates in front of the headworks.
- Raising screens when water is not being diverted to avoid potential damage from ice and debris.
- Placement of rock on the existing diversion structure, up to elevation 1991.0 ft, to provide sufficient head to allow diversion of up to 1,374 cfs into the LYIP main canal until construction of the new diversion weir is complete. Rock will be placed on top of the existing dam with the existing trolley system.
- Conveyance of diverted water through LYIP canals, laterals, and drains.
- Operation of the five supplemental pumps (four on the Yellowstone and one on the Missouri) to supplement main canal diversions.
- O&M activities performed by the LYIP such as canal maintenance, inspections, upgrades, canal access road maintenance, and weed control.

Construction of fish bypass facilities includes:

- Constructing a new diversion weir that incorporates the existing weir.
- Excavation of a bypass channel with installation of riprap vertical control structures and riprap armoring on outside bends.
- Filling a portion of the upstream end of the existing side channel with excavated material from the bypass channel.
- Stockpiling and shaping excavated materials.
- Placing and shaping fill near the downstream entrance of the bypass channel to enhance attraction flows and reduce eddy formations.

Future O&M of the LYIP will include:

- Daily and seasonal adjustments to headwork gates by the LYIP in response to flow conditions and crop requirements. Diversions generally occur from April 15 to October 15. Weather and/or flow conditions could increase the irrigation season up to two weeks earlier or later.
- Diversions up to 1,374 cfs from the Yellowstone River through the headworks into the main canal during the irrigation season.
- Periodic screen maintenance on the headworks. When a screen requires repair, replacement, or maintenance, the gate associated with that screen would be closed and a back-up screen and gate operated to divert a similar volume of water.
- Diverting unscreened water into the main canal at the beginning of the irrigation season (approximately one day) to sluice sediment and debris that accumulates in front of the headworks.
- Raising screens when water is not being diverted to avoid potential damage from ice and debris.
- Conveyance of diverted water through LYIP canals, laterals, and drains.
- Operation of five supplemental pumps (four on the Yellowstone and one on the Missouri) to supplement main canal diversions.
- Maintenance of rock upstream and downstream of the new diversion weir.
- Maintenance of the fish passage bypass channel, including maintaining the bypass channel to Fish and Wildlife Service (Service) physical criteria, periodic replacement of riprap along the banks and bottom of the bypass channel, removal of sediment or debris from within the bypass channel, and maintenance of access roads to the bypass channel.
- Maintenance of fill near the downstream entrance of the bypass channel to enhance attraction flows and reduce eddy formations
- Other O&M activities performed by the LYIP such as canal maintenance, inspections, upgrades, canal access road maintenance, and weed control.

Existing Headworks

A new headworks with state-of-the-art integrated rotating drum fish screens was constructed by the Corps of Engineers (Corps) in 2011 in accordance with the Service's (2010) written concurrence that construction of the headworks and fish screens was not likely to adversely affect listed species. The first year of water delivery using the new headworks was 2012. The new headworks controls the diversion of water into a new main canal extension and include twelve removable rotating drum screens to minimize fish entrainment (Figure 1).

Figure 1 - New Headworks with Fish Screen at Intake (screens submerged)

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

Each drum screen is 6.5 feet in diameter and 25 feet in length. The headworks structure supporting the screens is 310 feet long (Figure 2). The screens have a maximum mesh size of 1.75 millimeters (mm) with a profile bar of 2.38 mm woven wire. Maximum approach velocity in front of the screen is designed at 0.4 feet per second providing even velocity distribution across the rotating screens. The cylindrical screens were constructed to be approximately one meter above the river bed to minimize entrainment of drifting larval pallid sturgeon. Water flows by gravity through the screens and slide gates where it then enters the main canal.

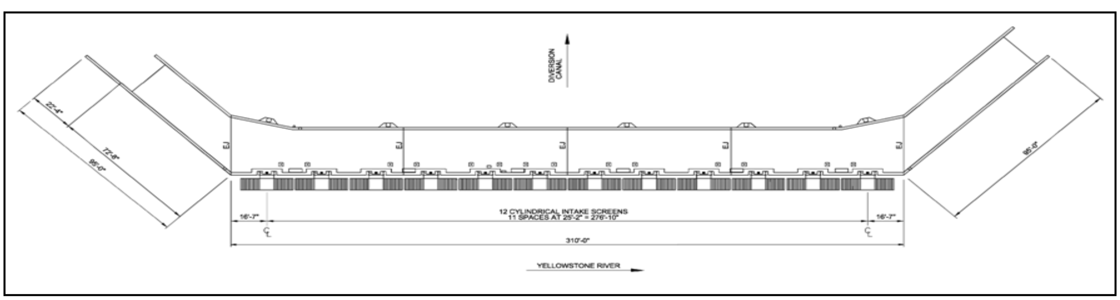

Figure 2 - New Headworks with 12 Rotating Removable Drum Screens

Removable rotating drums allow each screen to be adjusted on a track and be raised above the river when not in use (Figure 3). This feature minimizes damage from ice during winter and from other debris. Fixed brushes mounted on the inside and outside of the screens clean the screens when in use and remove aquatic organisms potentially impinged on the screens (Figures 3 and 4).

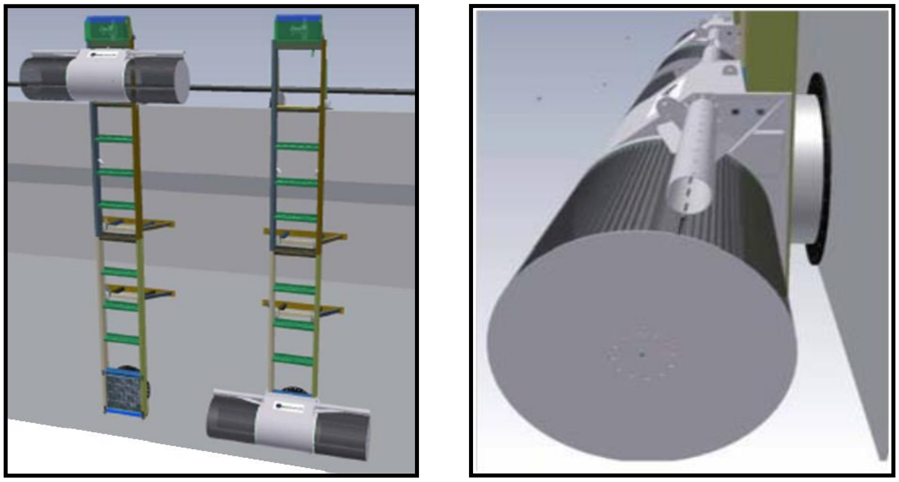

Figure 3 - Removable Drum Screens on Adjustment Track

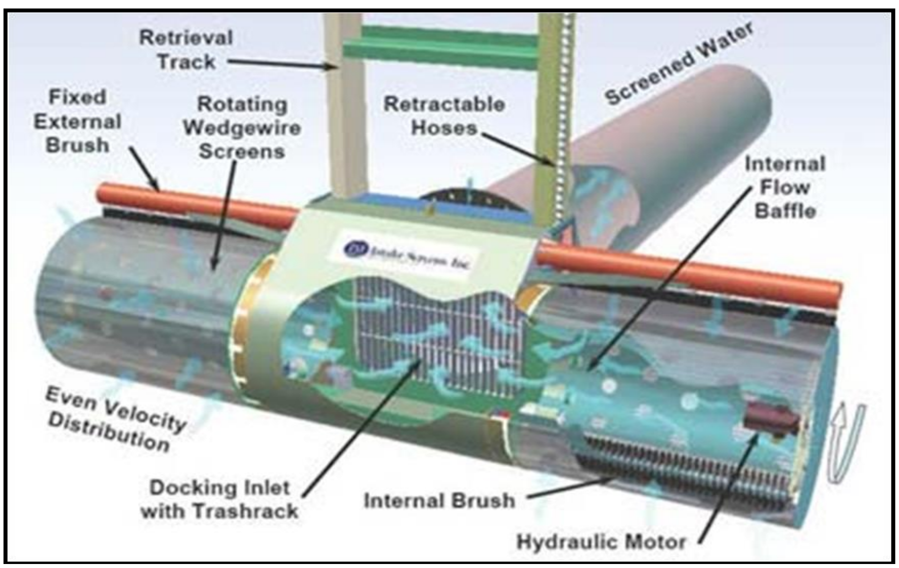

Figure 4 - Schematic of Removable Drum Screen

Interim and Future O&M of the screened headworks includes:

- The track-mounted fish screens would be lowered into place prior to the initiation of the irrigation season. The range of dates may vary due to ice off variability, weather, and crop requirements, but the screens would always be lowered before the gates are opened to divert water, except as noted below.
- Daily and seasonal adjustments to headwork gates by the LYIP in response to flow conditions, weather, and crop requirements generally from April 15 to October 15. Weather and flow conditions could increase the irrigation season up to two weeks earlier or later. Gate position is fully automated and can be accessed from the bridge deck on the headworks.
- Diversions up to 1,374 cfs from the Yellowstone River, when necessary, into the main canal during the irrigation season.
- Removal of sediment in front of headworks by diverting unscreened water through the headworks gates (approximately one day). If larger quantities of sediment are present, dredging may be necessary.
- Periodic screen maintenance. Fish screens may be periodically raised during the irrigation season for maintenance. When a screen requires repair, replacement, or maintenance, the gate associated with that screen would be closed and an auxiliary screen and gate employed. In the event two or more screens need to be raised simultaneously, unscreened water will enter the canal. Screens may need to be raised in the event of inadequate water delivery such as during extreme drought or screen blockage. All repairs, replacement, and/or maintenance will be made as expeditiously as possible to minimize unscreened water diversion. Screens are accessed by the bridge deck.
- A coffer box that can be lowered on the fish screen tracks may be deployed to allow a gate to be isolated from the river to allow maintenance, replacement, and/or repair of gates without the need to dewater the entire structure. This coffer box would be used as needed when gates become damaged or non-operational. The gate would be closed, if functional, prior to removal of the fish screen and placement of the coffer box. If the gate is not functional, the coffer box would be on-site prior to screen removal and installed as soon as possible to minimize entrainment.
- Fish screens will be raised on tracks when water is not being diverted to avoid potential damage from ice and debris.
- Routine inspection of the headworks structure and gates conducted by the LYIP. Inspections will occur annually after spring runoff and following ice events to ensure the integrity of the structure.
- Monitoring and recording screen operations to identify effectiveness of screening protocol.

Construction and Future O&M of the Proposed Diversion Weir

The proposed diversion weir would span the Yellowstone River and consist of a cantilevered structural wall created by a deep foundation of either driven piles or drilled shafts with a concrete cap (Figure 5). Because of the river water level, if drilled shafts are used, the shafts would be cased (pipe piles cleaned out and filled with reinforced concrete). The piles or shafts would be spaced such that there would be gaps between them below the cap but with backfill completely around them, and for purposes of retaining wall design, a bridge between them. The top of the structure would be at approximately 1991.0 ft with a reinforced concrete cap to protect it and allow for a smooth crest surface for ice to pass over.

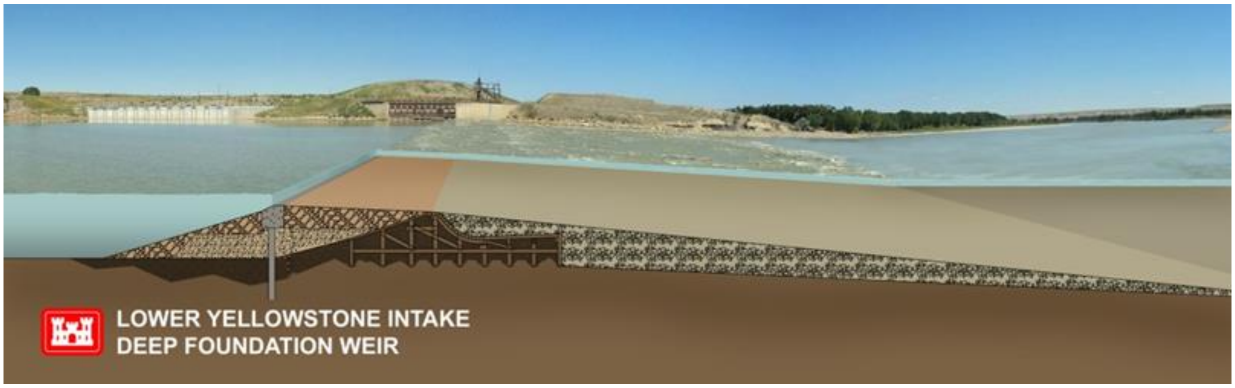

Figure 5 - Proposed New Weir

Construction of the new weir would begin on the north side of the river with approximately 1/3 of the weir being constructed at a time. The immediate construction area would be dewatered using sheet pile coffer dams. Once the weir section is complete, the coffer dam sheet piles would be removed. A notch in the weir crest and a downstream low flow channel is proposed. The notch is intended to facilitate downstream movement of adult, juvenile, and larval pallid sturgeon and the upstream movement of other native fish. The notch would be approximately 125' at its top width and about 85' at its bottom width. The bottom of the notch would be set at approximately 1989.0 ft. Large stone and other fill would be placed between the downstream side of the crest and the existing weir. Fill would also be placed upstream of the new weir structure and sloped to include rock protection.

Initially, the new weir was being designed as a stand-alone structure that was 25 feet in width (upstream to downstream). Based on this initial concept, stakeholders began to voice concerns over the size of the new weir and the potential impacts on fish passage. In an effort to alleviate these concerns, the new weir was reduced to six feet in width. With the reduction in width, the weir needs to be supported by fill that will be placed between the existing structure and the new structure. Maintenance of the rock field between the existing and new weirs would be necessary over the long-term to ensure the stability of the new structure. However, the riprap placed between weirs would not be subjected to the same level of displacement experienced with the existing weir since it would not sustain direct impact from ice and high flows. An access road would be constructed along the north side of the river to allow access for heavy equipment during construction. Following completion, the road and other points of access to the weir will be left in place for long-term O&M use.

Existing access roads to Joe's Island would be improved as needed to allow access to the weir. Access by motor vehicle across the proposed bypass channel would be limited at most flows. For major O&M actions, temporary access would need to be built, work would have to be done when the chute is iced-over, or equipment would need to be brought in by boat or barge. It has not been determined how access to, and on, the weir structure will be achieved for O&M activities. If vehicular access across the weir structure cannot be safely achieved, the existing trolley system may be repaired, a new trolley system constructed, or access provided by a barge.

During construction of the diversion weir and bypass channel, the LYIP would need to maintain the existing diversion weir. During construction, flows in the river could drop to levels that may require additional rock be placed on top of the existing dam to maintain diversions into the main canal. Rock would be placed on top of the existing weir as has occurred historically up to elevation 1991.0 ft. Once construction of the proposed diversion weir is completed, there will be no need to place rock on the existing structure to maintain diversions into the main canal or bypass channel.

Interim O&M of the existing diversion structure includes:

- Periodic placement of rock on top of the existing dam would occur until construction of the proposed diversion weir is complete, in order to maintain adequate water diversions in the interim.

Future O&M of the proposed diversion weir would include:

- Periodic replacement of rock between the proposed diversion weir and existing diversion structure to maintain stability.
- Maintaining roads and other access points to the diversion weir on north bank.
- Routine inspections of new weir by the LYIP.
- Replacement and patching of concrete on the new weir.
- Removal of trees and other large debris from the crest and/or notch, if possible.

Construction and Future O&M of Proposed Bypass Channel

The proposed bypass channel is intended to improve passage for pallid sturgeon around Intake Diversion Dam by means of an excavated bypass channel. This alternative was originally conceived during a Value Planning Study process conducted by Reclamation and others (Reclamation 2005) and was initially referred to as the long, low-gradient channel alternative. Reclamation originally envisioned utilizing the existing side channel as a fish bypass. However, use of the existing side channel through its entirety was originally considered infeasible for passage due to potential fish attraction issues associated with its downstream entrance being almost a mile downstream of the dam. Pallid sturgeon passage achieved through the existing side channel in 2014 may reflect the relative insignificance of flow attraction and bypass channel length, although given the lack of knowledge about pallid sturgeon behavior the location of and attraction to the bypass channel by pallid sturgeon remains an important design consideration. In light of this, the Service's Biological Review Team (BRT) and Reclamation recognized the need for an alternative that located the entrance closer to the diversion structure.

One of the primary features of the proposed action is the excavation of an engineered bypass channel from near the existing side channel upstream entrance to a location immediately downstream of the existing diversion dam and associated rubble field (Figure 6). By locating the downstream entrance to the bypass channel immediately downstream of the proposed weir, fish are more likely to locate the entrance. The proposed concrete weir, described in the previous section, would provide adequate water surface elevations for both diversions into the bypass channel for fish passage and the main canal for delivery of irrigation water.

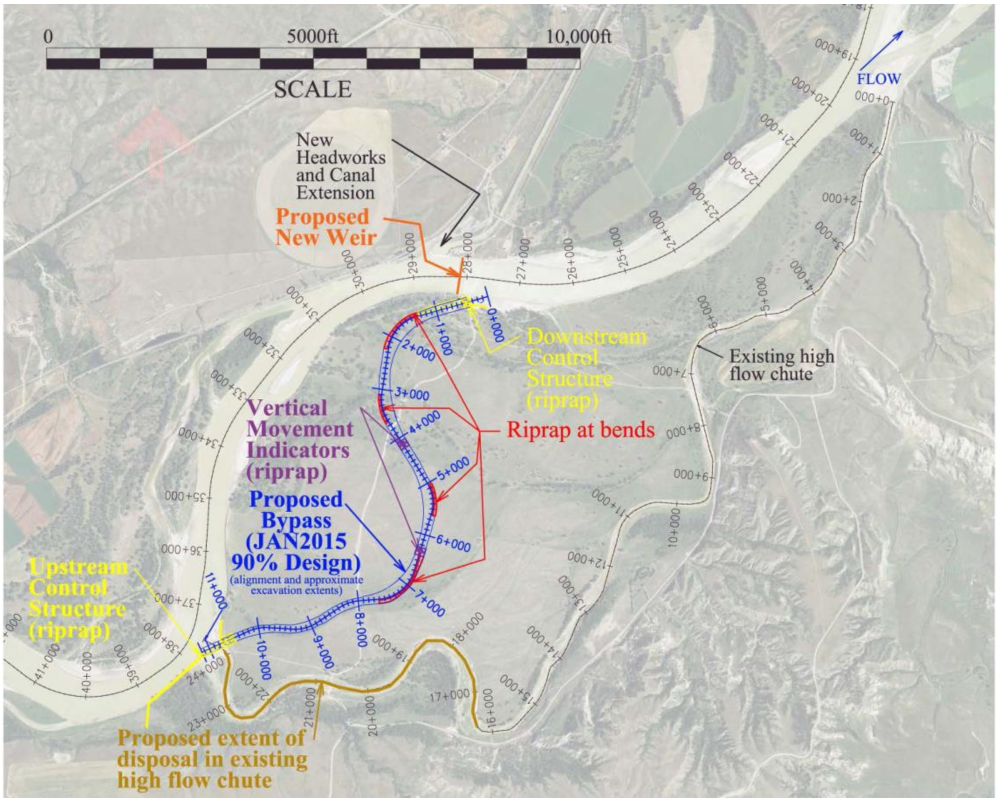

Figure 6 - Proposed Bypass Channel and Associated Features

During construction of the bypass channel two large coffer dams would be constructed on the upstream and downstream entrances. This would allow for the excavation of the bypass channel to be completed in the dry. Once the construction of the bypass channel is complete both coffer dams would be completely removed. Some riprap armoring may need to be conducted in the wet once the coffer dams have been removed.

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

The bypass channel has been designed to divert 13% to 15% of total Yellowstone River flow (Table 1). While the channel would typically divert 13% of the total flow during spring and summer discharges, diversion percentages could vary from 10% at extreme low flows to 15% at higher flows. To facilitate diversion of water into the proposed bypass channel, a channel plug in the existing side channel is proposed. Material excavated from the bypass channel would be used to create the channel plug. Fill would be placed in approximately the first 1.5 miles of the existing side channel. This fill material would be compacted, sloped and reseeded for stability. This plug would not allow any water to be diverted into and flow through the existing high flow channel under most flow conditions (Table 1).

Table 1- Expected Flow Splits in Proposed Bypass Channel and Existing High Flow Channel

Total Yellowstone River Flow	Historic High Flow Channel Flow Spilt Under Existing Conditions		Proposed Bypass Channel Flow Spilt		Historic High Flow Channel Flow Split with Constructed Bypass Channel	
(cfs)	(cfs)	(%)	(cfs)	(%)	(cfs)	(%)
7,000	0	0	930	13.3	0	0
15,000	0	0	1990	13.3	0	0
30,000	780	2.6	4000	13.3	0	0
2-yr 45,300	2120	4.7	6200	13.7	0	0
10-yr 70,100	5090	7.3	10180	14.5	0	0
50-yr 89,400	7120	8.0	13370	15.0	0	0
100-yr 97,200	8060	8.3	14720	15.1	0	0

The bypass channel would be constructed consistent with criteria provided by the Service (Service 2014; Table 2). The proposed channel would require excavation of approximately 1,100,000 cubic yards of material from Joe's Island as shown in Figure 6. The proposed bypass channel alignment extends approximately 11,150 feet with a slope of approximately 0.0007 ft/ft. The slope of the Yellowstone River in this area is approximately 0.0004 ft/ft to 0.0007 ft/ft. The channel cross-section would have a bottom width of 40 feet, a top width of 150-250 feet, and side slopes varying from 1V:8H to 1V:4H. Appropriate sections of the bypass channel would be shaped to mimic natural channel sections.

Table 2 - Bypass Channel Design Criteria

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

Vertical grade control structures (riprap sills) are included at the downstream and upstream ends of the bypass channel as well as at two intermediate locations to prevent excessive vertical degradation that would impact passage success. The upstream sill would be 60-foot wide by 30-foot long by 6-foot thick to prevent ice damage to the entrance of the channel.

The two intermediate locations are proposed for maintaining channel slope and allowing for early identification of channel movement. Similar to the upstream control structure, these would be over-excavated and backfilled with natural river rock to give the appearance of a seamless channel invert while providing stability during extreme events. A riprap sill is also proposed for the downstream end of the channel to maintain channel elevations.

The vertical grade control structures are expected to provide a hardened bottom that would allow the LYIP to cross the bypass channel during low flow situations. The LYIP would need to coffer dam off a portion or the entire channel to reduce flows and velocities that would allow for a safe crossing. This would be one potential option to access Joe’s Island where O&M activities on the bypass channel and new weir are expected to take place.

Additionally, bank riprap is proposed at four outside bends identified as having potential for failure. It is possible that additional protection could be required in the future if assumptions about channel stability are proven incorrect, and channel migration or degradation begins to impact passage effectiveness. Approximately 65,000 tons of riprap would be required within the bypass channel.

Current sediment modeling efforts indicate a degradational trend in the bypass channel (Reclamation 2014). Modeling also shows that an increase in size of the bypass bed material minimizes the expected degradation; therefore, construction of an armor layer is proposed. The armor layer would consist of large gravel to cobbles, similar in size to the naturally-occurring course channel material found on Yellowstone River point and mid-channel bars and similar to what would be expected to occur naturally over time.

Under current conditions, a large eddy forms on the south side of the Yellowstone River near the proposed downstream entrance of the bypass channel. To prevent this eddy from forming and causing shear flows that may be detrimental to passage, a large area of fill on the right descending bank of the river is proposed (Figure 7). The shape and contour of this fill was determined by physical and computer modeling efforts. The proposed fill was shown to eliminate the current eddy that forms on the south bank as well as increase attraction flows towards the main channel of the river.

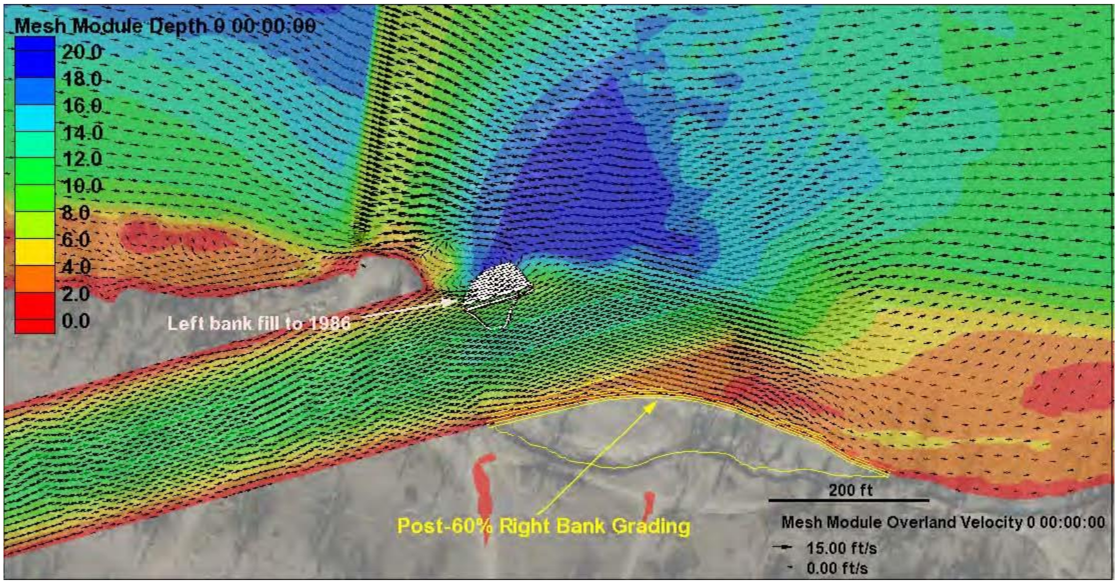

Figure 7 - Computer Modeling of Downstream Fill at 63,000 cfs in the Yellowstone River

Future O&M activities on the proposed bypass channel would include:

- Periodic replacement of riprap along the banks of the bypass channel.
- Maintaining access roads to bypass channel.
- Removal of sediment or debris from within the bypass channel.
- Construction of a temporary coffer dam at the head of the bypass channel to conduct O&M activities.
- Construction of a temporary heavy equipment crossing over the bypass channel or driving through the bypass channel with heavy equipment to conduct O&M activities.
- Maintaining the bypass channel to the Service's constructed physical criteria.
- Removal of rock or debris from the entrance/approach of the bypass channel.
- Maintaining the channel plug in existing side channel.
- Maintenance of the downstream fill area to help with attraction flows and reduce eddy formation.
- Maintenance of planted vegetation along the bypass channel to ensure the stability of the channel.

Interim and Future O&M of the LYIP

The LYIP would continue to divert water from the Yellowstone River to provide a dependable supply of irrigation water for 54,000 acres of land along the west bank of the river. The LYIP would O&M proposed and existing features (described in this section) under contract with Reclamation. Reclamation and the LYIP will need to amend the existing O&M transfer contract to address O&M of the new headworks, proposed bypass channel, and weir consistent with the authorizing legislation (Reclamation Act of June 17, 1902, as amended; Water Conservation and Utilization Act of August 11, 1939, as amended) and Reclamation policy. Funding responsibility for O&M, monitoring, and any necessary adaptive management measures would depend on a number of factors including applicable laws, regulations, and policies; opportunities for cooperative funding; the nature of the activity; and likely other factors specific to a given O&M, monitoring, or adaptive management measure.

Depending on weather and crop requirements, diversion of water into the main canal for irrigation would range from 600 to 1,374 cfs. This range of diversion is generally independent of flow volume in the river. With little or no demand, approximately 600 cfs would be diverted to maintain the saturated prism conditions in the main canal. Diversions over 1,100 cfs and approaching 1,374 cfs could occur approximately 50% of the irrigation season and may continue as late as the first week of September (Nypen, personal communication 2005; Brower 2014b).

As mentioned in previous sections, the existing diversion structure would need to be maintained until the construction of the new weir is complete. Rock would be placed up to elevation 1991.0 ft on the existing structure by using the existing trolley system. Once the new weir is in place, rocking activities on the existing dam would no longer be needed.

The average total volume of water diverted annually would not change with approximately 20% being consumptively used. A significant portion of the remaining water returns to the Yellowstone River via drains and spillways within the LYIP (Brower 2014a).

Interim and future O&M activities for the LYIP other than that necessary to O&M the headworks, screens, weir, and bypass channel would generally include:

- Replacing, maintaining, inspecting, or upgrading canals and laterals.
- Use and maintenance of supplemental pumps.
- Repairing and replacing roads throughout the LYIP.
- Headgate/screen repair, replacement, and maintenance.
- Weed control throughout the LYIP on roads, canals, and laterals.

These O&M activities are further described below.

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

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

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

There are approximately 25 drains and spillways associated with the LYIP that return water to both the Yellowstone and Missouri rivers (Brower 2014a; (Maps 1 and 2; Appendix B)). Flow rate and duration in the canals and laterals in the LYIP is a function of crop requirements and weather. Approximately 20% of diverted water is consumptively used in the LYIP. A significant portion of the remaining water that is diverted, but not consumptively used, returns to the Yellowstone and Missouri rivers through these drains and spillways.

It is anticipated that water conservations measures would continue to be implemented on the LYIP. Continued water conservation measures include:

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

It is uncertain at this time whether current and continued water conservation measures will affect demand and diversion volume.

Pumps
Other than pumps located on canals, there are five supplemental pumps within the LYIP (Brower 2014; Map 3, Appendix B). These pumps are located downstream of Sidney and pump water from both the Missouri and Yellowstone rivers to supplement canal deliveries. Use of these pumps is sporadic and only during high demand periods that typically occur during May, July, and August. Some pumps are not used every year. Three pumps are powered by diesel. The other two use electricity.

In a typical high demand period, the pumps are operated accordingly:

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

During normal years, these pumps are used as little as practical (Brower 2014).

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

Weed Control

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

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

LYIP Background and Consultation History

Project Authorization

Reclamation constructed the LYIP under the Reclamation Act/Newlands Act of 1902 (Public Law 161) (Act). The Act set aside money from the sale of lands to be used in the "examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of water for the reclamation of arid and semiarid lands." The Act authorized development of irrigation projects to establish farms in the western United States. As is the case for most authorized Reclamation projects, the long-term O&M of project facilities is the responsibility of the water users. Reclamation retains ownership of the LYIP facilities, and O&M is carried out by the Board of Control of the LYIP under contract with Reclamation.

The LYIP consists of four districts:

- Lower Yellowstone District #1
- Lower Yellowstone District #2
- Intake Project
- Savage Unit

Water rights for water delivered to these districts are jointly held by the districts and Reclamation. Lower Yellowstone Districts 1 & 2, Intake Irrigation District, and Savage Irrigation District all have water service and repayment contracts with Reclamation. All have met their full financial obligation for repayment of the diversion structure and supply works for the project. With the exception of Savage Irrigation District, the water service contracts have no expiration dates. The Savage water service contract is currently in the preliminary stages of renewal.

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

The LYIP was developed to provide a dependable supply of irrigation water for 54,000 acres of land along the west bank of the Yellowstone River. Approximately two-thirds of the irrigated lands are in Montana with the remaining lands located in North Dakota.

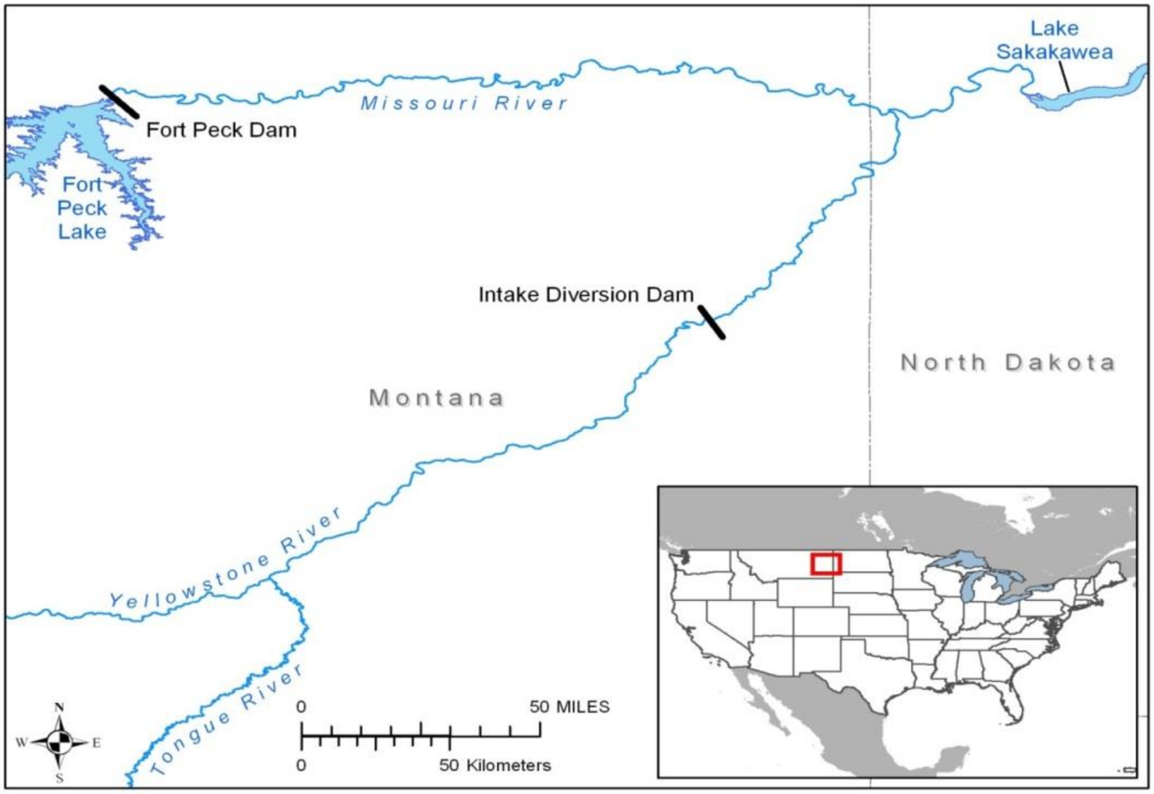

Figure 8 - Project Location

The LYIP diverts water from the Yellowstone River into the main canal at the diversion dam near Intake, Montana fifteen miles northeast of Glendive. Water flows by gravity through 71 miles of the main canal, 225 miles of laterals, and 118 miles of drains that flow toward the confluence of the Missouri and Yellowstone rivers.

There are three pumping plants on canals in the LYIP: one at Thomas Point on the main canal, one at Crane on the main canal, and one on Drain 27. The Thomas Point pumping plant is on the main canal about nineteen miles below the headworks. The plant has two units directly connected to hydraulic turbines and one motor-driven unit. The Crane Pumping Plant has two motor-driven units, each of which pumps five cfs of water from the main canal. The pumping plant on Drain 27 has one motor-driven unit which pumps fifteen cfs from the drain. There are five unscreened supplemental pumps in the LYIP that pump water directly from the Missouri and Yellowstone rivers to supplement diverted waters.

Lower Yellowstone Irrigation Districts 1 and 2

Approximately 2,300 acres of bench lands are irrigated by water pumped from the main canal at the Thomas Point Pumping Plant. Other lands within Districts 1 and 2 are irrigated from the main canal by use of laterals. Lower Yellowstone Irrigation District #1 is located in Montana, and Lower Yellowstone Irrigation District #2 is located in North Dakota (Map 1, Appendix A). Total acreage of available land for irrigation is 54,000 acres.

Intake Irrigation District

The Intake Irrigation District was constructed in 1945 and irrigates approximately 823 acres of land by using water pumped from the main canal. The pumping plant is located on the main canal approximately 1.5 miles downstream from Intake, Montana (Map 2, Appendix A). One pump lifts three cfs of water and discharges it into a mile-long lateral. Another pump lifts fifteen cfs to a three-mile long canal.

Savage Irrigation District

The Savage Irrigation District was constructed in 1949 and is composed of 2,300 acres of land. Approximately 2,200 acres are irrigated using water pumped to a feeder canal off the main canal at a location approximately 3.5 miles south of Savage, Montana (Map 3, Appendix A). Water is pumped into a 7.8-mile long canal having a capacity of 44 cfs. This irrigation district also has approximately five miles of laterals and one mile of drains.

Consultation History

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

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

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

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

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

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

By 2008, alternatives to resolve the fish passage and entrainment issues were identified, and Reclamation and the Corps initiated the National Environmental Policy Act (NEPA) compliance process in September. During the preparation of the environmental assessment (EA) in 2009, Reclamation continued informal consultation with the Service and the agencies jointly determined that the EA would serve as an ESA section 7 biological assessment (BA) for construction of Intake modifications.

During a May 12, 2009 meeting, Reclamation, the Corps, and the Service reached an agreement that informal section 7 consultation would be appropriate for construction of the proposed Intake modifications as long as concurrent formal section 7 consultation continues on O&M of the LYIP. Reclamation and the Corps submitted the EA and *Biological Assessment for Construction Activities Associated with the Intake Diversion Dam Modification, Lower Yellowstone Project* to the Service on March 18, 2010. On April 8, 2010, Reclamation and the Corps received written concurrence from the Service that the proposed action was not likely to adversely affect listed species. Additional details related to consultation history can be found in the 2010 BA.

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

In April 2010 after signing the FONSI, Reclamation and the Corps made the decision to proceed with the modifications, and a construction contract for the new headworks and fish screens was awarded in July 2010. The Corps at the same time started to proceed with the final design of the rock ramp so a construction contract could be awarded in 2011. The conceptual design level cost estimate for the rock ramp was approximately $18 million. In late 2010 and early 2011, the estimated costs for the rock ramp design significantly increased. The primary reasons for the increased cost estimate included:

1. The amount of rock needed for the rock ramp significantly increased. The length of the rock ramp would need to be significantly longer with more gradual slope than originally considered in the conceptual designs and cost estimates.

2. Additional rock would also be required for the rock ramp to provide more point-to-point contact in the structure to maintain its stability given the wide range of flow and environmental conditions in the Yellowstone River.

3. The construction of the rock ramp would likely need to be conducted "in the dry" to ensure that careful placement of the rock is accomplished so that the ramp would be sufficiently stable to withstand the wide range of flow conditions. River diversions and dewatering would be needed that would increase costs.

4. The source of rock for the ramp had not been well-defined previously. Local rock sources would likely not have acceptable qualities for the ramp. Cost estimates to import rock from suitable sources would involve long haul distances and significantly increased costs.

As a result of this new information, it appeared that the estimated cost of the rock ramp could approach $90 million. The Corps and Reclamation, in coordination with the Service, considered the implications of this new information in early 2011. Under authority of the WRDA of 2007 and consistent with the joint agency decision in April 2010, the Corps had committed up to $40 million in Missouri River Recovery and Mitigation Program funding to the entire fish passage project. The potentially significant increase in the cost of the rock ramp, combined with the design and constructability issues described above, led Reclamation and the Corps to reconsider the rock ramp alternative for fish passage.

In April 2011, Reclamation and the Corps determined further evaluation of other alternatives for improving fish passage was necessary to address the new/additional information and issues that had arisen since 2010. In addition to new cost information, new information regarding pallid sturgeon behavior also became available. Originally, because of uncertainties in pallid sturgeon movement, one of the requirements of the BRT's passage criteria was full river-width passage. Based on new information documenting pallid sturgeon use of side channels (McElroy et. al. 2012; Service 2012), the BRT relaxed this criterion in 2011. Reclamation and the Corps believed there was merit in revisiting a bypass alternative that had been previously considered but eliminated from detailed study because it did not provide full channel passage. Through collaborative efforts, further information, and preliminary design reviews, Reclamation, the Corps, and stakeholders supported further analysis of a bypass alternative. Changes to the project were substantial enough to trigger preparation of supplemental EA prior to a decision how to proceed with fish passage.

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

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

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

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

During 2013 and 2014, Reclamation and the Corps brought interested stakeholders together to re-evaluate alternatives and select a passage alternative with which to move forward. After several meetings with the State of Montana (Fish, Wildlife & Parks and Department of Natural Resources and Conservation), LYIP, the Service, the Corps and Reclamation, it was determined that the rock ramp and a bypass channel were the two alternatives that provided the best opportunity to improve passage at Intake and meet the purpose and need for the proposed action.

In 2014, Reclamation and the Corps determined that a bypass channel was the preferred alternative, and design on a bypass channel should proceed. Currently, Reclamation and the Corps are finalizing a supplement to the 2010 EA to analyze and disclose effects associated with the preferred alternative. The supplemental EA is scheduled to be complete in March 2015. A decision whether to sign a FONSI or prepare an environmental impact statement is scheduled shortly thereafter.

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

Action Area

The action area for the pallid sturgeon for this consultation is defined as the reach of the lower Yellowstone River and its tributaries from the Cartersville diversion dam at river mile 237 downstream to its confluence with the Missouri River, the Missouri River downstream to Lake Sakakawea in North Dakota, and lands serviced by the Districts. District lands are located in Dawson, Wibaux, and Richland counties, Montana and McKenzie and Williams counties, North Dakota (Figure 9; Maps in Appendix A).

The action area for the interior least tern, whooping crane, red knot, and northern long-eared bat, greater sage-grouse, and Sprague's pipit is the extent of the LYIP including a one-mile radius surrounding the new headworks and proposed bypass channel.

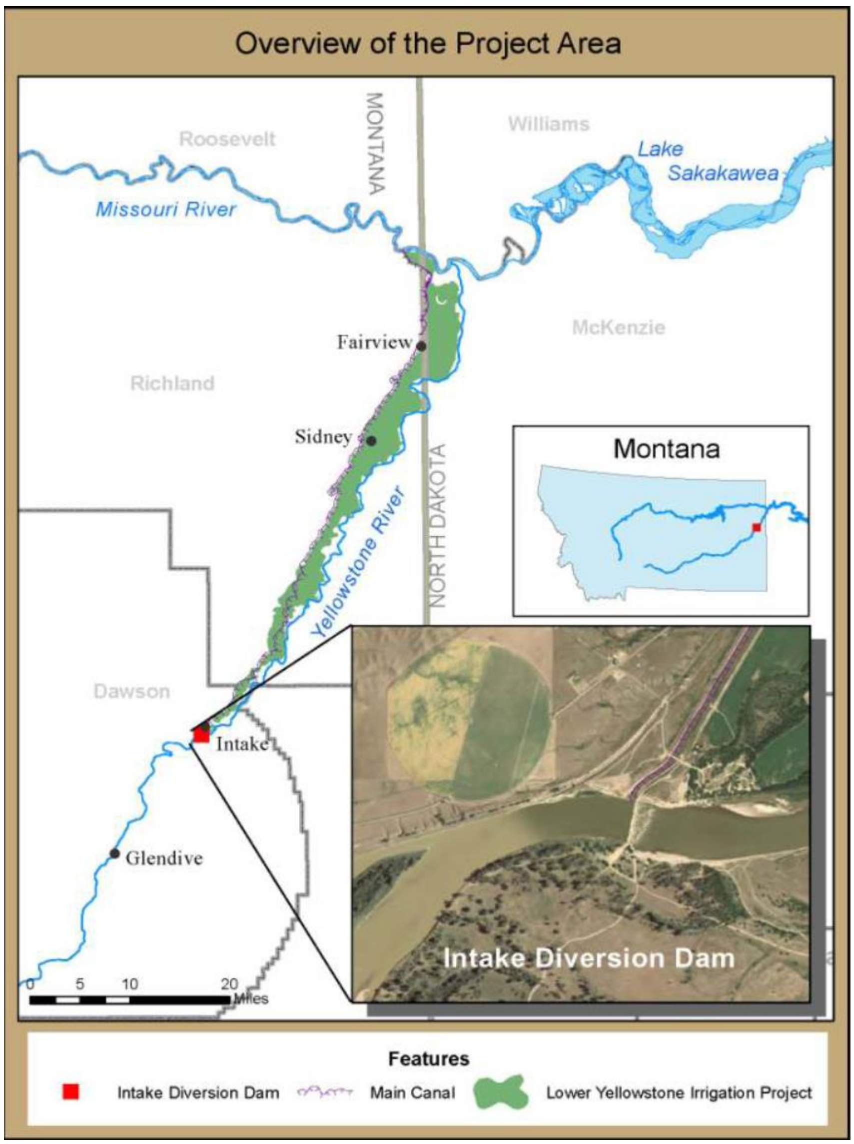

Figure 9 - Project Overview

Federally-Listed Threatened or Endangered Species

The following federally-listed and candidate species are considered in this BA. There is no designated or proposed critical habitat in the action area.

Pallid sturgeon (*Scaphirhynchus albus*)……………....Endangered
Interior least tern (*Sterna antillarum athalassos*)….......Endangered
Whooping crane (*Grus americana*)………..…………Endangered
Red knot (*Calidris canutus*)…………..………………Threatened
Northern long-eared bat (*Myotis septentrionalis*)….......Proposed
Greater sage-grouse (*Centrocercus urophasianus*)…...Candidate
Sprague's pipit (*Anthus spragueii*).……….…………..Candidate

Environmental Baseline

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

Yellowstone River Basin

Existing conditions at the project site are described in Chapter Three of the 2010 Intake EA and the 2015 Supplemental EA. The Yellowstone River is essentially free-flowing. The river is not impounded by storage reservoirs, and the mainstem of the river is not regulated. However, there are six additional diversion dams upstream of Intake on the Yellowstone River (Figure 10).

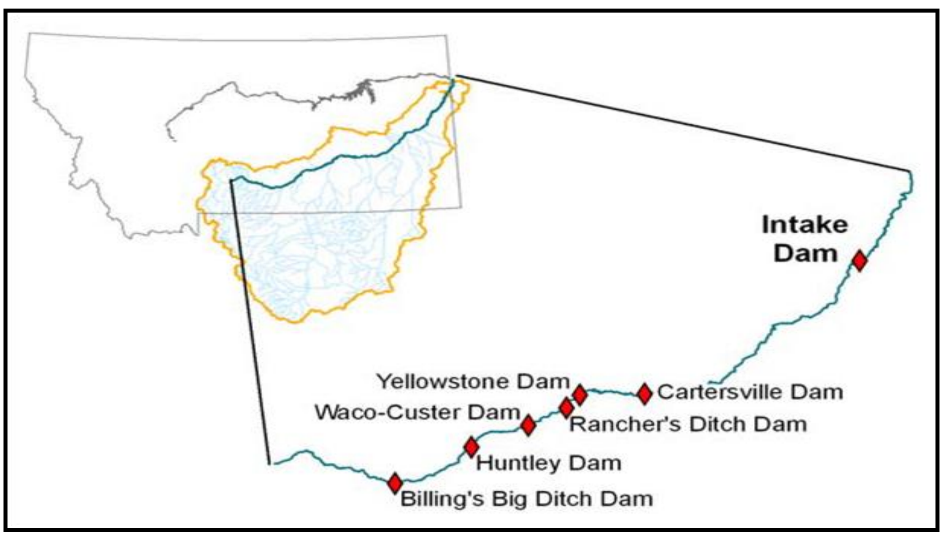

Figure 10 - Diversion Dams along the Yellowstone River

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

The Bighorn and Tongue Rivers are major tributaries to the Yellowstone River. Reclamation currently operates Yellowtail Dam and Afterbay Dam on the Bighorn River while the Montana Department of Natural Resources and Conservation operates the Tongue River Dam on the Tongue River. Yellowtail Dam was constructed for hydropower, flood control, and storage of water for irrigation. The Tongue River Dam was constructed primarily for irrigation purposes.

Bank stabilization projects have proliferated over the years and require permitting by the Corps under section 404 of the Clean Water Act (CWA). Authorization is also required under section 10 of the Rivers and Harbors Act of 1899 (RHA) because the Yellowstone River is classified as a navigable water for much of its length. Therefore, any future bank stabilization projects requiring a permit under section 404 of the CWA or section 10 of the RHA would be subject to section 7 consultation between the permitting agency and the Service. The Intake area has a total of five man-made structures that stabilize the river channel. These structures are the existing headworks, the new headworks, the existing diversion dam, a boat ramp, and a field of displaced boulders extending about 300 feet downstream of the diversion dam. These boulders were originally placed as a means to raise the water surface elevation for diversion into the LYIP main canal.

Conservation groups have been working with landowners to conserve and restore riparian areas along the Yellowstone River and other watercourses. The Natural Resource Conservation Service continues to work with landowners adjacent to the Yellowstone River, including LYIP, on a wide variety of conservation efforts including water and natural resource conservation. Recently, the Corps has, through section 404 and 10 permits, been requiring screening to minimize fish entrainment in some irrigation intakes on the Yellowstone River. However, many older irrigation projects have unscreened intakes.

<u>Yellowstone and Missouri Rivers</u>

Although construction of LYIP's screened headworks and proposed bypass channel are on the Yellowstone River, the pallid sturgeon population under consideration is part of a larger population in the upper Missouri River basin. More specifically, fish passage at Intake would affect pallid sturgeon in the Great Plains Management Unit (Service 2013), which includes the Missouri River above and below Fort Peck Dam downstream to Fort Randall Dam and the Yellowstone River upstream to the confluence of the Bighorn River (Figure 11). The same connection to the Missouri River is true for nesting interior least terns and migrating whooping cranes. Therefore, a reference to both of these rivers when considering the environmental baseline is appropriate.

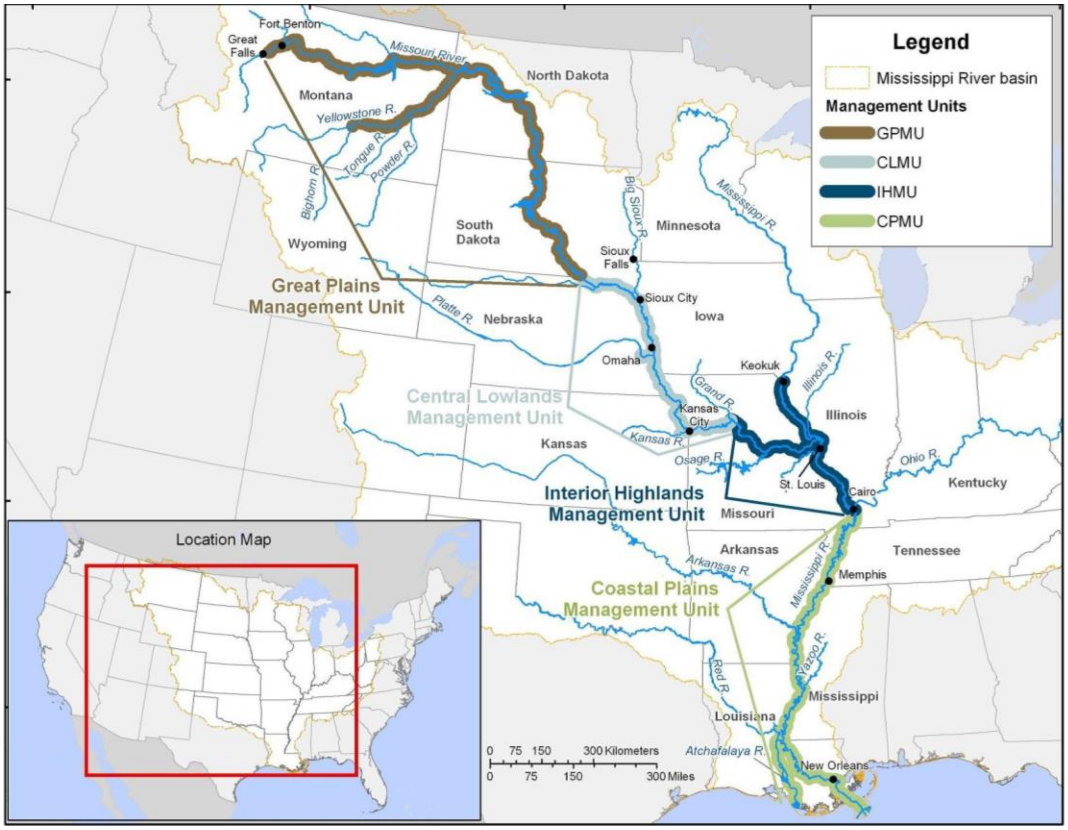

Figure 11 - Pallid Sturgeon Management Units (Service 2013).

Other past and present activities in the Missouri River basin, which includes the Yellowstone River, have been well documented in previous BAs (Corps 1998 and 2003; Reclamation and Service 2006; 2010; 2012; 2014), subsequent biological opinions (Service 2000a; Service 2003 and amendments; Service 2006a;), concurrence letters (Service 2010; 2012; 2014), and the newly revised Pallid Sturgeon Recovery Plan (Service 2013) and will not be reiterated here. Appendix D identifies reports documenting environmental baseline actions/impacts for other resources important to the species being considered.

Habitat restoration programs are ongoing on both the Yellowstone and Missouri rivers. The Corps has been working with the Service and other federal agencies, states, and tribes on restoration efforts on the Missouri River while others have been working on restoration efforts on the Yellowstone River through the Yellowstone River Conservation District Council. This council was formed to address conservation issues on the entire river. Ongoing actions on both rivers that would benefit the pallid sturgeon, interior least tern, and whooping crane include habitat restoration, fish hatchery supplementation, fish passage, fish entrainment protection, riparian restoration, bank stabilization studies, flow modeling, and water conservation.

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

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

Before the current screens were in place Hiebert et al. (2000) estimated that about 500,000 fish of 36 species are annually entrained into the main canal at Intake Diversion, of which as many as 8% were sturgeon. These screens installed in 2011 are designed to meet salmonid criteria established by the Service and the National Marine Fisheries Service. The current fish screens are expected to all but eliminate entrainment of fish larger than 40 mm.

In December 2014, a 12-inch crude oil pipeline ruptured in the Yellowstone River approximately 30 miles upstream of the LYIP. It is estimated that approximately 50,000 gallons of crude oil was released into the Yellowstone River. At this time, the river is ice-covered, reclamation activities have been limited, and any potential effect on pallid sturgeon is unknown.

Species Habitat Requirements, Distribution, and Current Status

Pallid Sturgeon (*Scaphirhynchus albus*) – Endangered

Background and Distribution

The pallid sturgeon was listed as endangered by the Service on September 6, 1990. Since the listing, the status of the species has improved and is currently stable (Service 2013). New information related to habitat extent and condition, abundance, and potential recruitment in most portions of its range has improved our understanding of the species (Service 2013).

The historical distribution of the pallid sturgeon includes the Missouri and Yellowstone rivers in Montana downstream to the Missouri-Mississippi confluence and the Mississippi River possibly from near Keokuk, Iowa downstream to New Orleans, Louisiana (Coker 1929; Bailey and Cross 1954; Brown 1955; Carlson and Pflieger 1981; Kallemeyn 1983; Keenlyne 1989 and 1995).

Pallid sturgeon also were documented in the lower reaches of some of the larger tributaries to the Missouri, Mississippi, and Yellowstone rivers including the Tongue, Powder, Milk, Marias Niobrara, Platte, Kansas, Big Sioux, St. Francis, Grand and Big Sunflower rivers (Bailey and Cross 1954; Brown 1955; Keenlyne 1989; Ross 2001; Snook et al. 2002; Braaten and Fuller 2005; Peters and Parham 2008; Rugg 2014). The total length of the pallid sturgeon range historically was about 3,515 river miles (Rmi).

Because the pallid sturgeon was not recognized as a species until 1905, little detailed information is available concerning early abundance. Forbes and Richardson (1905) suggested that the lack of prior recognition of the species might have been attributable to scarcity, noting that pallid sturgeon accounted for about one in five hundred individuals of the *Scaphirhynchus* sturgeon collected from the central Mississippi River. The species was reported to be more abundant in the lower Missouri River where some fishermen reported one in five sturgeon as pallid sturgeon (Forbes and Richardson 1905). However, it is probable that commercial fishermen failed to accurately distinguish the species in their sturgeon catches. As late as the mid-1900s, it was common for pallid sturgeon to be included in commercial catch records as either shovelnose or lake sturgeon (Keenlyne 1995). Correspondence and notes of researchers suggest that pallid sturgeon were often encountered in portions of the Missouri River as late as the 1960s (Keenlyne 1989). While there are fewer than 40 historical (pre-listing) records of pallid sturgeon from the Mississippi River (Kallemeyn 1983; Keenlyne 1989), this may be attributed to a lack of historical systematic fish collections from that portion of the range.

Since listing in 1990, wild pallid sturgeon have been documented in the Missouri River between Fort Benton and the headwaters of Fort Peck Reservoir, Montana; downstream from Fort Peck Dam to the headwaters of Lake Sakakawea, North Dakota; downstream from Garrison Dam, North Dakota to the headwaters of Lake Oahe, South Dakota; from Oahe Dam downstream to within Lake Sharpe, South Dakota; between Fort Randall and Gavins Point Dams, South Dakota and Nebraska; downstream from Gavins Point Dam to St. Louis, Missouri; in the lower Yellowstone River, Montana and North Dakota; the Powder River in Montana; the lower Big Sioux River, South Dakota; the lower Platte River, Nebraska; the lower Niobrara River, Nebraska; and the lower Kansas River, Kansas. Pallid sturgeon observations and records have increased with sampling effort in the middle and lower Mississippi River. Additionally in 1991 the species was identified in the Atchafalaya River, Louisiana (Reed and Ewing 1993) and in 2011 pallid sturgeon were documented entering the lower reaches of the Arkansas River (Kuntz in litt., 2012).

Approximately 50 wild adult pallid sturgeon are estimated to exist in the Missouri River upstream of Fort Peck Reservoir (Service 2013). An estimated 125 wild pallid sturgeon remain in the Missouri downstream of Fort Peck Dam to the headwaters of Lake Sakakawea as well as the lower Yellowstone River (Jaeger et al., 2009). Current abundance estimates are lacking for the Missouri River between Gavins Point Dam and St. Louis, MO. Garvey et al. (2009) generated an estimate of 1600 to 4900 pallid sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). No estimates are available for the remainder of the Mississippi River. Since 1994, supplementation with hatchery-reared pallid sturgeon has occurred throughout the Missouri River and sporadically in the Mississippi River. Supplementation data are summarized in the stocking plan (Service 2008).

Increases in the number of observations of the species is the direct result of enhanced monitoring efforts, improvements in sampling technique, greater emphasis on research in the impounded portion of its range, and artificial supplementation throughout the Missouri River Basin (Service 2013).

Population estimates for wild pallid sturgeon within some inter-reservoir reaches of the Missouri River indicate the extant wild populations are declining or extirpated. To prevent further extirpations, a conservation propagation program has been established. Hatchery and stocking programs appear to be successful in maintaining the species' presence in the Missouri/ Yellowstone River. However, if supplementation efforts were to cease, the species would once again face local extirpation within several reaches (Service 2013).

Life History and Biology

Pallid sturgeon have a flattened shovel-shaped snout, a long, slender, and completely armored caudal peduncle, and lack a spiracle (Forbes and Richardson 1905). Like all other sturgeon species the pallid has a toothless mouth that is protrusible and ventrally position under the head. The skeletal structure is primarily composed of cartilage than bone.

Pallid sturgeon are very similar in appearance to the more common shovelnose sturgeon. Both species inhabit overlapping portions of the Missouri and Yellowstone Rivers (Service 2013). In general pallids grow to larger sizes than shovelnose and they have longer outer barbels and shorter inner barbels than the shovelnose.

Pallid sturgeon can be long-lived species with females reaching sexual maturity later than males (Keenlyne and Jenkins 1993). Based on wild fish, estimated age at first reproduction is 15 to 20 years for females and approximately five years for males (Keenlyne and Jenkins 1993); however like most fish species, water temperature can influence growth and maturity. Thus, age at first reproduction can vary based on local conditions.

According to the Service (2013), the wild pallid sturgeon population in the Great Plains Management Unit (GPMU) continues to decline. The Service (2007) reported that data compiled from the National Pallid Sturgeon Database showed 245 unique individual pallid sturgeon (essentially all adults) were collected during sixteen years of sampling (1990-2006). The population is being supplemented with hatchery-reared fish to prevent local extirpation (Service 2013). The Service (2007) reports that pallid sturgeon from all stocking events have produced recaptures and are contributing to the current population structure. From 1998-2007, over 11,000 pallid sturgeon have been stocked in the Yellowstone River above the diversion dam (Krentz et al. 2005). Recapture has been as high as 6% and included five year classes (Jaeger et al. 2006).

Females do not spawn every year (Kallemeyn 1983). Observations of wild pallid sturgeon collected as part of the conservation stocking program in the northern part of its range indicated that females spawn every two to three years (Rob Holm, Garrison Dam Hatchery, unpublished data). Fecundity is related to body size. The much larger fish of the upper Missouri River and Lower Yellowstone can produce as many as 150,000 to 170,000 eggs (Keenlyne et al 1992; Rob Holm, Garrison Dam Hatchery, unpublished data). Spawning appears to occur between March and July during spring runoff for the fish in northern latitudes.

Incubation rates are governed by and depend upon water temperature within the river. In a hatchery environment, fertilized eggs hatch in approximately 5-7 days (Keenlyne 1995). Typically in a natural river environment, newly hatched larvae are predominantly pelagic drifting in the currents for 11 to 13 days and dispersing over one hundred miles downstream from spawning and hatching locations (Kynard et al. 2002; 2007; Braaten et al. 2008; 2010; 2012).

The free embryo life stage starts at egg-hatch (7-9mm in size), whereby the organism enters the water to initiate downstream drift and dispersal with river currents (Braaten, personal communication 2015). These free embryos have a large yolk sac and exhibits active swimming behaviors while drifting. These active behaviors include brief upward swimming motion primarily in the lower portions of the water column followed by a short free-fall back down to the lower portions of the water column (Braaten, personal communication 2015). This free embryo life state persists until the yolk is absorbed which could be several days depending on water temperature and development rate. The free embryos transition to larva when they begin to settle out of the main river currents and start to feed on benthic macroinvertebrates (Braaten, personal communication 2015). The larval life stage, starting about 18-19 mm and persisting through >80 mm, is mainly associated with living close to the bottom of the river, but could still exhibit downstream drift and dispersal (Braaten, personal communication 2015).

Spawning substrate has not been specifically identified in the upper Missouri River basin including the Yellowstone River. Spawning has occurred in the Yellowstone River, but there is no evidence that the resulting young survive to adulthood and reproduce (Bergman et al. 2008; (reported as M. Jaeger and D. Fuller personal communication in 2009 Draft Recovery Plan for the Pallid Sturgeon)). In addition, although larvae were collected in GPMU from the Missouri River in 2002, their post-hatch drift may carry them into the lentic waters of Lake Sakakawea which does not provide the necessary habitat for rearing (cited in Jordan et. al 2006 as S. Krentz, Service, personal communication 2003).

Historically, pallid sturgeon have been documented at least 112 miles upstream of Intake or about 267 miles above the present headwaters of Lake Sakakawea. Pallid sturgeon were observed at this location during times of the year when spawning is known to occur (Brown 1955; Brown 1971). Watson and Stewart (1991) captured a pallid sturgeon near Fallon, Montana in 1991 in conjunction with studies associated with the Tongue River Project. There are other reports from the 1920s and 1930s that document pallid sturgeon above Intake in the vicinity of the Tongue River (Service 2000b). Historic data also cites fifteen occurrences of pallid sturgeon at Intake Dam between 1977 and 1994 with all of these confirmed captures in May or June (Service 2000b).

A gravid adult female and four adult males used the neighboring four and a half mile long side channel to migrate upstream of Intake Diversion Dam in June 2014 (Rugg 2014). Three of these fish – the gravid female and two males - were later located in the Powder River. The gravid female moved approximately 20 miles up the Powder River while the two males moved to between river mile five and eight. The other two males moved upstream of the Intake Diversion Dam where one stayed in the general vicinity and the other moved upstream to near Glendive. The gravid female was captured shortly after her return to the Yellowstone River, and the absence of eggs confirmed that spawning had occurred either in or near the Powder River. After spawning, all three fish returned to the Yellowstone River.

This is the first time pallid sturgeon have been documented moving over or around the diversion dam, and the first time spawning has been documented above Intake. Along with the five fish that successfully used the existing side channel, one juvenile fish entered the side channel but returned downstream before it swam completely through it. Several other adult and juvenile fish were documented moving to, but not past, the diversion dam via the main channel of the Yellowstone River.

Growth and survival of drifting larvae depend on being transported to suitable rearing habitats with abundant nutritional food and relatively benign environmental conditions (Wildhaber et al. 2007). The Service (2000a and 2003) stressed the importance of shallow water habitats for larval rearing. Montana Fish, Wildlife & Parks has estimated that there are about 5,000 acres of shallow water rearing habitat between Intake and Cartersville diversions near baseflow conditions when this habitat type is important for rearing larvae (M. Jaeger, personal communication 2010). Jaeger et al. (2004) further indicated that spawning and rearing habitats upstream of Intake Diversion are suitable for pallid sturgeon restoration efforts.

Like most sturgeon species, pallid sturgeon move upstream to spawn, and spawning is believed to occur at or near the summit of this movement (A. DeLonay, personal communication 2010). Yellowstone River telemetry data indicate that some pallid sturgeon move into the Yellowstone River in the spring, some move upstream to Intake Dam but not above, and that the majority of study fish remained in the lower Yellowstone River (Bramblett and White 2001). None of these fish were of known reproductive condition. Subsequent work studying fish in known spawning condition documented at least one gravid female pallid sturgeon moving up to Intake Dam and then moving back downstream (M. Jaeger, unpublished data).

Despite recent evidence of spawning in the lower Yellowstone and Powder rivers, there are no detectable levels of recruitment occurring (reported as M. Jaeger and D. Fuller personal communication in 2009 Draft Recovery Plan for the Pallid Sturgeon). The Service (2013) has suggested that Intake Diversion Dam is a barrier to upstream passage that may prevent pallid sturgeon from accessing upstream reaches. The best available science suggests that the Intake Diversion Dam is a partial barrier to some species (Helfrich et al. 1999; Jaeger et al. 2004; Backes and Gardner 1994; Stewart 1986; 1988; 1990; 1991). It is likely a total barrier to other species, including pallid sturgeon, due to impassable turbulence and velocities associated with the rocks at the dam and downstream (Jaeger et al. 2008; Fuller et al. 2007; Helfrich et al. 1999; White and Mefford 2002; Bramblett and White 2001; Service 2000a; 2003; 2007).

Braaten et al. (2008) suggests larval drift distance available below Intake Dam is insufficient in length and settling habitat. If these young fish reach the lake environment, their survival rate is believed to be very low because of unsuitable habitat (Kynard et al. 2007). Biologists also suspect that pallid sturgeon larvae are intolerant of sediments in the river-reservoir transition zone (Wildhaber et al. 2007). The cause of larval deaths in the reservoir is unknown but could be the lack of food, predation, or related to sedimentation in reservoirs (Bergman et. al. 2008). Recent research by Guy et al., (2015) indicates that oxygen levels in the headwaters of reservoirs such as Fort Peck and Lake Sakakawea may be too low for larval pallid sturgeon to survive. They attribute the low oxygen levels to the decomposition of organic matter that settles out in the headwaters or reservoirs. This further illustrates the need for increased drift distances above lake/reservoir habitats.

Diet

Data on food habits of age-0 pallid sturgeon is very limited. In the hatchery environment, exogenously-feeding fry will readily consume brine shrimp suggesting zooplankton and/or small invertebrates are likely the food base for this age class (Service 2013). The data that are available for age-0 pallids in the wild indicate that mayflies and midge larvae are important (Sechler et al. 2012).

Juvenile and adult pallid sturgeon diets have been documented to compose of fish and aquatic insect larvae with a trend toward piscivory as they increase in size (Carlson and Pflieger 1981; Hoover et al. 2007; Gerrity et al. 2006; Grohs et al. 2009; Wanner 2006; French 2010).

Habitat Requirements

Pallid sturgeon are bottom-oriented, large river obligate fish. Pallid sturgeon have likely evolved in the diverse habitats of the Missouri and Mississippi rivers. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters for these large river ecosystems have historically met habitat and life history needs of the pallid sturgeon.

Many scientist caution the use of data that has been collected in recent years because in most cases the natural environment has been altered substantially. In the upper portions of the species range, such as around Intake, sub-adult hatchery-reared pallid sturgeon more often select main channel habitats (Gerrity 2005). Conversely, adult pallids have been shown to select areas with frequent islands and sinuous channels while rarely occupying areas without islands or with straight channels (Bramblett and White 2001; Snook et al. 2002; Peters and Parham 2008).

Pallids have been documented over a variety of available substrates, but are more often associated with sandy and fine bottom materials (Bramblett and White 2001; Elliott et al. 2004; Gerrity 2005; Snook et al. 2002; Swigle 2003; Peters and Parham 2008; Spindler 2008). Substrate associations appear to be seasonal with winter/spring locations occurring over a mixture of sand, gravel, and rock substrates (Koch et al. 2006a). Summer and fall substrates appear to be sandy areas (Koch et al. 2006a).

Across their range, pallid sturgeon have been documented in waters varying in depths and velocities. Depths at collection sites range from 0.58 meters to > 20 meters (Bramblett and White 2001; Carlson and Pflieger 1981; Constant et al. 1997; Erickson 1992; Gerrity 2005; Jordan et al. 2006; Peters and Parham 2008; Wanner et al. 2007). Despite the wide range of depths, the species is typically found in areas where relative depths exceed 75% (Constant et al. 1997; Gerrity 2005; Jordan et al. 2006; Wanner et al. 2007) of mean channel depth.

Bottom water velocities associated with collection locations were generally <1.5 m/s with reported average of 0.58 m/s to 0.88 m/s (Carlson and Pflieger 1981; Elliotte et al. 2004; Erickson 1992; Jordan et al. 2006; Swigle 2003; Snook et al 2002).

Recovery Plan

Suitable habitat for pallid sturgeon is typically found within the flowing reaches of the upper Missouri and lower Yellowstone rivers. Originally, the Service established six recovery priority management areas to focus recovery efforts at locations believed to have the highest recovery potential, but since that time the understanding and science behind the species has increased.

Instead of six priority areas, the Service has delineated pallid sturgeon range into "Management Units" (Service 2013).

The area around Intake has been included into the GPMU defined as the area from Great Falls, Montana to Fort Randall Dam in South Dakota (Figure 11) (Service 2013). This unit includes important tributaries like the Yellowstone River as well as the Marias, Milk, and Powder rivers. The upper boundary is at the Great Falls of the Missouri River as this is a natural barrier above which pallid sturgeon could not migrate historically (Service 2013). The lower boundary was defined as Fort Randall Dam to ensure consistent management on inter-reservoir reaches of the Missouri River.

The primary strategy for recovery of pallid sturgeon is to: 1) conserve the range of genetic and morphological diversity of the species across its historical range; 2) fully quantify population demographics and status within each management unit; 3) improve population size and viability within each management unit; 4) reduce threats having the greatest impact on the species within each management unit; and, 5) use artificial propagation to prevent local extirpation within management units where recruitment failure is occurring (Service 2013). Pallid sturgeon recovery will require an increased understanding of the status of the species throughout its range; developing information on life history, ecology, mortality, and habitat requirements; improving our understanding of some poorly understood threat factors potentially impacting the species; and using that information to implement management actions in areas where recovery can be achieved.

The Service, along with many state game and fish departments, have coordinated efforts to help recover pallid sturgeon. Other federal agencies, like the Corps and Reclamation, have also been involved with priority recovery activities. A monitoring and assessment program for pallid sturgeon on the Missouri River has been established among the recovery agencies. Avoidance of extirpation over the next 50 years in the upper Missouri River Basin may depend largely on the success of the pallid sturgeon artificial propagation program. These efforts are a part of the Pallid Sturgeon Recovery Plan (2013) and are assuming increasing importance because of the general absence of natural reproduction or recruitment in the upper Missouri River during the past 30 years (Jordan 2006). Both state and federal hatcheries are involved in these efforts. The Pallid Sturgeon Recovery Team and Service completed a Pallid Sturgeon Five-year Review in 2007 (Service 2007).

The Service (2013) completed a revised Pallid Sturgeon Recovery Plan. The recovery plan recommends reclassification of pallid sturgeon status when identified threats are sufficiently reduced such that a self-sustaining and genetically-diverse population is achieved within each management unit. Delisting will be considered when identified threats are alleviated and a self-sustaining genetically diverse population is achieved within each management unit for three generations (36-60 years). In this context, the population data must reflect year class strength, survival to age, and mortality rates sufficient to maintain long-term population stability sustained through natural reproduction.

At the request of Reclamation, a Science Review Panel (Panel) was convened in October 2009 to provide a third-party evaluation of the science involved in the Intake Diversion Dam

Modification Project. The Panel concluded that the best available science supports the hypothesis that installation of new fish screens will effectively decrease entrainment of adult, juvenile, larval, and embryonic pallid sturgeon and other fish species (PBS&J 2009). Reclamation's screen design was found to be effective at avoiding entrainment of pallid sturgeon and other fish species over 1.5 inches (40 mm) total length. A subsequent lab study indicated that entrainment may be problematic for larval pallid sturgeon between one and 1.5 inches total length that spend an extensive amount of time in the immediate area of the diversion screens (reported as Mefford and Sutphin 2008 in PBS&J 2009). The Panel noted that a lack of behavioral and habitat use data for pallid sturgeon between one and 1.5 inches total length is lacking, and therefore, any quantitative conclusions about entrainment risk are precluded (PBS&J 2009). The Panel agreed that decreasing entrainment of other fishes would likely provide increased food resources and thus improve growth, survival, and maturation of pallid sturgeon (PBS&J 2009). The Panel also identified flow regimes under which they believed pallid sturgeon would have sufficient distance to develop in the Yellowstone and Missouri rivers before entering Lake Sakakawea (PBS&J 2009)

Interior least tern (*Sterna antillarum athalassos*) – Endangered

<u>Background and Distribution</u>
The Service listed the interior population of the least tern as endangered on May 28, 1985. The interior least tern nests on the Mississippi, Missouri, Arkansas, Red, Rio Grande, Kansas, Platte, Loup, Niobrara, Canadian, Cheyenne, Ohio, and Yellowstone rivers. Range-wide estimates from 1999 were about 7,400 birds (Service 2000a). More recent estimates by the Service (2005) report a considerable increase of up to about 12,000 birds. It is important to note that this does not represent a complete census, because segments of some rivers are surveyed in one year but not in another. The Service (2005) reports the total estimate is likely a minimum estimate.

Range-wide numbers have increased in the 1999-2003 period. The interior least tern recovery plan established a goal of 7,000 terns range-wide maintained for ten consecutive years. The current estimate of over 12,000 terns greatly exceeds this goal; however, recovery plan goals for least terns in all drainage basins have not been reached, and most areas have not been monitored for ten years. The recovery plan has not been revised since it was written in 1990, and recovery goals may need to be updated.

In 2005, the first complete range-wide survey for interior least terns was conducted since the species was originally listed as endangered almost 20 years ago (Lott 2006). A total of 17,591 interior least terns were counted in association with 489 different colonies. Just over 62% of these birds were on the lower Mississippi River (10,960 birds on 770+ river miles). The Arkansas River, Red River, Missouri River, and Platte river systems accounted for 33.3% of the remaining least terns. Birds were counted in smaller numbers in the Ohio River system, the Trinity River system, the Rio Grande/Pecos River system, the Wabash River system, and the Kansas River system (Lott 2006). The survey counted 1,217 birds in the Missouri River above Sioux City, Iowa. On the Missouri River, 904 adults were counted while tributaries accounted for the remainder, including 289 on the Niobrara and smaller numbers on the Cheyenne (4) and Yellowstone (16) rivers (Lott 2006).

Interior least terns nest on sparsely vegetated sandbars on the Missouri and Yellowstone rivers in Montana and North Dakota. On the Yellowstone River, nesting is on bare sands and gravels on the upstream portions of vegetated channel bars below Miles City (Bacon and Rotella 1998). Most breeding sites on the Yellowstone River are in a section where channel meandering increases with more channel bars and islands (Service 2003). Interior least terns feed mostly on small fish. Their breeding season lasts from May through August with peak nesting occurring from mid-June to mid-July.

Although least terns in Montana represent a small proportion of interior least terns throughout their range, Montana's Yellowstone and Missouri rivers offer suitable habitat for breeding birds during years when more southern reaches have abnormal weather and river conditions (Atkinson and Dood 2006). The recovery plan goal for this species is 50 birds for the state of Montana.

More recent informal least tern surveys (A. Dood, personal communication 2010; L. Brown, personal communication 2011; 2014a) for the Yellowstone River are as follows:

- 2006 – ten adults (surveys conducted June 12-13 when the river was high with little suitable habitat)
- 2007 – eleven adults (surveys conducted June 26-28)
- 2008 – five adults (surveys conducted July 16-18 when the river was very high and no habitat was available)
- 2009 – 17 adults (surveys conducted in July)
- 2010 – no adults (surveys conducted on June 20th when the river was high with little suitable habitat)
- 2011 – No surveys conducted due to very high water
- 2012 – four adults were observed in July between Miles City and the confluence near RM 438 (no nests were located)
- 2013 – one adult with three fledged young were observed in July between the Fallon bridge and Glendive (no nests were located)
- 2014 – eight adults were observed in July between the Fallon bridge and Glendive (no nests were observed but three adult piping plovers with four chicks were observed)

The highest number of terns reported along the Yellowstone River since the birds were federally-listed occurred during the 1994-1996 breeding seasons when the river reach between Miles City and Seven Sisters Recreation Area supported an average of 27 birds (Atkinson and Dood 2006).

Using a 10-year trend average, as set forth in the Interior Least Tern Recovery Plan (1990), Montana has averaged 72.9 birds (ranging from 40-181) (Atkinson and Dood 2006). However, Montana has elected to use a five-year running average for trend analysis and management planning. The population over the past five-year period (2001-2005) averaged 51.6 birds ranging from 49-58. The state has met and/or exceeded its specific recovery goal of 50 adult birds in the past 20 years when counting birds both on the Yellowstone and Missouri rivers (Atkinson and Dood 2006).

Recovery Plan

The recovery plan for the interior least tern recommends removal of this species from the endangered species list if essential habitat throughout its range is properly protected and managed and the species distribution and population goals are reached and maintained for ten years (Service 1990). Recovery goals for the entire population are habitat protection, management, and attaining a population of 7,000 birds distributed across specific areas, including the Missouri River system. Recovery goals for the Missouri River system are habitat protection and reaching population levels of 2,100 adults in specific distributions assigned by state.

The range-wide survey would suggest that overall the interior population of the least tern has surpassed the 7,000 bird recovery goal but, in fact, the distribution of least tern populations does not yet meet the criteria/goals as envisioned by the Service when the recovery plan was written. Populations have apparently increased over time in some areas, e.g., the Mississippi River system, while others have declined, e.g., the Platte River. While questions remain on the status of interior least terns, an Interior Least Tern Working Group was formed to address these concerns and to work toward developing a range-wide strategy for monitoring population status and trends. A monitoring program coordinator position was created by American Bird Conservancy, with the support of the Corps, to coordinate range-wide monitoring efforts.

Recent and ongoing recovery efforts on the Missouri River by the Corps should assist in the continued recovery of this species. The recent signing of the Platte River Recovery Implementation Program by the Secretary of the Interior and the governors of Colorado, Nebraska, and Wyoming should also boost recovery actions for the interior least tern on the Platte River system.

Whooping crane (*Grus americana*) – Endangered

Background and Distribution

The Service listed the whooping crane as endangered on June 2, 1970. The species lives exclusively in North America. Historically, these birds bred primarily in wetlands of the northern tall- and mixed-grass prairies and aspen parklands of the northern Great Plains. Their principal nesting area is in Wood Buffalo National Park, Canada. They winter on and near the Aransas National Wildlife Refuge along the Texas coast. That population is referred to as the Aransas-Wood Buffalo population, and it migrates through the action area twice each year. During migration, the birds use a variety of feeding and roosting habitats, including croplands, marshes, shallow reservoirs and sheet-water areas, and submerged sandbars in rivers along the migration route. Approximately 343 individuals live in the wild at three locations, and 135 whooping cranes are in captivity at nine sites. Only the Aransas-Wood Buffalo National Park population is self-sustaining with approximately 220 in the flock (Canadian Wildlife Service and Service 2007).

The whooping crane may pass through Montana and North Dakota during both spring (April-mid-June) and fall migration (late August to mid- October). These migration flights are between its breeding territory in northern Canada and wintering grounds on the Gulf of Mexico. Frequently, whooping cranes migrate with sandhill cranes. Whooping cranes inhabit shallow wetlands but may also be found in upland areas, especially during migration. The whooping crane prefers freshwater marshes, wet prairies, shallow portions of rivers and reservoirs, grain and stubble fields, shallow lakes, and wastewater lagoons for feeding and loafing during migration.

Whooping crane sightings have been recorded in adjacent Richland County, Montana. The sightings were in areas outside of the action area (M. Tacha, personal communication 2010). The peak of spring migration in Montana is April 26 while the peak of fall migration is October 22 (Austin and Richert 2001). Austin and Richert (2001) also reported that spring observations are more common than fall and that riverine habitats have accounted for only 36% of the sightings in Montana. No whooping crane sightings have been recorded on the Yellowstone River, but have been recorded on the Missouri and Poplar rivers (M. Tacha, personal communication 2010).

Recovery Plan

Whooping crane recovery efforts have made great strides over the years with new populations being established in Florida and Wisconsin. The Aransas-Wood Buffalo population that migrates through the proposed action area is also doing favorably. There was a successful breeding season at Wood Buffalo National Park in 2006, which resulted in record numbers on the wintering grounds at Aransas National Wildlife Refuge. The newly revised recovery plan (Canadian Wildlife Service and Service 2007) includes scientific information about the species and provides objectives and actions needed to down-list the species. Recovery actions designed to achieve these objectives include protection and enhancement of the breeding, migration, and wintering habitat for the Aransas-Wood Buffalo National Park population to allow the wild flock to grow and reach ecological and genetic stability; reintroduction and establishment of geographically separate self-sustaining wild flocks to ensure resilience to catastrophic events; and maintenance of a captive breeding flock to protect against extinction that is genetically managed to retain a minimum of 90% of the whooping crane's genetic material for 100 years.

Red knot (*Calidris canutus)* – Threatened

The red knot was listed as threatened by the Service on January 12, 2015.

Background and Distribution

Adult red knots are nine to ten inches long with an 18 to 21 inch wingspan. Their body shape is typical for the genus with a small head and eyes, a short neck, and a slightly tapering bill that is no longer than its head (Harrington 2001). It has short dark legs and a medium thin dark bill. Their winter plumage becomes uniformly pale grey and is similar between the sexes. Their breeding plumage is mottled grey on top with a cinnamon face, throat, and breast and light-colored rear belly. The breeding plumage of females is similar to that of the male except it is slightly lighter, and the eye-line is less distinct (Harrington 2001).

Red knot weights vary with subspecies, but ranges between 45 and 90 ounces and are known to double their weight prior to migration. Like many migratory birds they can reduce the size of their digestive organs prior to migration (Harrington 2001).

On their breeding grounds, red knots eat mostly spiders, arthropods, and larvae obtained by surface pecking. On their wintering and migratory grounds, they eat a variety of hard-shelled prey such as bivalves, gastropods, and small crabs that are ingested whole and crushed by a muscular stomach (Harrington 2001).

Red knots are territorial and seasonally monogamous. It is unknown if pairs remain together from season to season. They breed in moist tundra across the Arctic from June to August. Red knots nest on the ground near water and usually inland. The nest is a shallow scrape lined with leaves, lichens and moss. Both sexes incubate the eggs, but the female leaves parental care to the male once the eggs have hatched (Marchant et al. 1986). The chicks and parents move away from the nest within a day of hatching and begin foraging with their parents. The female leaves before the young fledge while the males remain. After the young have fledged, the male begins his migration south, and the young make their first migration on their own (Harrington 2001).

The red knot has an extensive range estimated at almost one-half million square miles with a population of over one million birds. Most red knots (*C.c. rufa*) migrate along the Atlantic coast to breed in the Canadian Arctic, but other subspecies (*C.c. roselaari*) winter in northern South America, Florida and Texas, breed in northern Alaska and Russia, and occasionally migrate through the western United States. The red knot (*C.c. rufa)* is considered an "accidental migrant" in Montana that may occur during migration (L. Brown, personal communication, 2014b). The Montana Natural Heritage Program has no records that indicate the red knot has been observed in the action area (Miller 2014).

Northern long-eared bat (*Myotis septentrionalis*) – Proposed

Note: much of this information is taken from the Northern Long-Eared Bat Interim Conference and Planning Guidance (Service 2014a)

The Service proposed to list the northern long-eared bat (NLEB) as endangered on October 2, 2013. The NLEB is a medium-sized bat about three to 3.7 inches long but with a wingspan of nine to ten inches. Its fur color can be medium to dark brown on the back and tawny to pale-brown on the underside. The NLEB is distinguished by its long ears, particularly when compared to other bats in its genus, *Myotis*, which are bats noted for their small ears.

The NLEB is found in the United States from Maine to North Carolina, westward to eastern Oklahoma and north through the Dakotas, extending southward to parts of southern states from Georgia to Louisiana, and reaching into extreme eastern Montana and Wyoming. Historically, the species has been found in greater abundance in the Northeast and portions of the Midwest and Southeast, and has been more rarely encountered along the western edge of the range.

During summer NLEBs roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags that are typically greater than or equal to three inches at breast height. Males and non- reproductive females may also roost in cooler places like caves and mines. The NLEB seems opportunistic in selecting roosts and uses tree species based on presence of cavities or crevices or presence of peeling bark. The NLEB has also been occasionally found roosting in structures like barns and sheds when suitable tree roosts are unavailable. The NLEB emerges at dusk to forage in upland and lowland woodlots and tree-lined corridors where they feed on insects, which they catch while in flight using echolocation. This species also feeds by gleaning insects from vegetation and water surfaces.

Suitable summer habitat for NLEB consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit characteristics of suitable roost trees and are within 1000 feet of other forested/wooded habitat. The NLEB has also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat. The NLEB typically occupies their summer habitat from mid-May through mid-August each year, and the species may arrive or leave some time before or after this period.

Maternity habitat for the NLEB is defined as suitable summer habitat used by juveniles and reproductive (pregnant, lactating, or post-lactating) females. The NLEB home range, consisting of maternity, foraging, roosting, and commuting habitat, typically occurs within three miles of a documented capture record or a positive identification of NLEB from properly deployed acoustic devices, or within 1.5 miles of a known suitable roost tree.

Suitable NLEB roosts are trees that may be alive, dying, dead, or a snag with a diameter at breast height of three inches or greater and that exhibits any of the following characteristics: exfoliating bark, crevices, cavity, or cracks. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree within a woodlot or wooded fencerow.

Suitable spring staging/fall swarming habitat for the NLEB consists of the variety of forested/ wooded habitats where they roost, forage, and travel typically within five miles of a hibernaculum. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. The NLEB typically occupies their spring staging/fall swarming habitat from early April to mid-May and mid- August to mid-November, respectively

As with many other bat species, the NLEB migrates between their winter hibernacula and summer habitat. The spring migration period likely runs from mid-March to mid-May with fall migration likely between mid-August and mid-October. Overall, the NLEB is not considered to be a long- distance migrant although known migratory distances vary greatly between five and 168 miles.

Suitable winter habitat (hibernacula) for the NLEB includes underground caves and cave-like structures. These hibernacula typically have large passages with significant cracks and crevices for roosting; relatively constant, cool temperatures (0-9 degrees Celsius) and with high humidity and minimal air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks often with only the nose and ears visible. The NLEB will typically hibernate between mid-fall through mid-spring each year.

The action area is located at the extreme western edge of its known range; however, the Montana Natural Heritage Program has no record of observations in the action area (Miller 2014). Within the action area are large linear forests of cottonwood (*Populus* spp.) and other deciduous trees that may provide suitable roosting habitat for the bat. These riparian forests are the only forests within the action area and may provide corridors for migration or expansion of their habitat.

Greater sage-grouse (*Centrocercus urophasianus*) – Candidate

The Service determined the greater sage-grouse was warranted for listing on March 5, 2010, but was precluded from listing by higher priority actions and is a candidate species. As their name implies, sage-grouse are dependent year-round on sagebrush/steepe-grassland for survival. Historically, sage-grouse occupied portions of 16 states and three Canadian provinces. Currently, the species is limited to 11 western states and two provinces, including Washington, Oregon, Idaho, Montana, North Dakota, South Dakota, Wyoming, Colorado, Utah, Nevada, and California. A 2004 status review estimated range-wide populations between 100,000 to 500,000 individuals (Service 2005).

In Montana, greater sage-grouse inhabit roughly 27 million acres spanning 39 counties in the eastern half and southwestern corner of the state (Montana Sage Grouse Work Group 2005). Grazing and agricultural development led to a 50% decrease in populations by the 1930s (Montana Sage Grouse Work Group 2005). Evidence suggests that habitat fragmentation and destruction across much of the species' range has contributed to significant population declines over the past century. Other important factors in the species' decline include fire and invasive plant species. Statewide, sage-grouse populations increased from the mid-1960s through 1973 and fluctuated slightly until peaking in 1984. Sage grouse populations again declined from 1991 through 1996 before increasing through 2001 to a level above 30 males per lek (Montana Sage Grouse Work Group 2005). Population estimates from 2003 indicated approximately 27.7 males per lek (Montana Sage Grouse Work Group 2005). If current trends persist, many local populations may disappear in the next several decades, with the remaining fragmented population vulnerable to extinction (Service 2011).

Of the 27 million acres currently inhabited by sage grouse, Montana Fish, Wildlife & Parks refined these acres into 13 separate "core" sites, totaling 8.9 million acres. These core areas provide habitat for 75% of all known breeding sage-grouse in Montana, and provide a target area for conservation efforts. According to the Management Plan and Conservation Strategies for Sage Grouse in Montana (Montana Sage Grouse Work Group 2005), the following bulleted list provides a summary of seasonal habitats that are important to the survival of greater sage-grouse:

- Breeding Habitat—Strutting grounds or "leks," where breeding actually occurs, are key activity areas and most often consist of clearings surrounded by sagebrush cover. Findings from research in central Montana reported a sagebrush canopy cover at feeding and loafing sites in the vicinity of leks of 20-50% with an average of 32%.

- Nesting Habitat— Sage-grouse invariably prefer sagebrush for nesting cover, and quality of nesting cover directly influences nest success. Successful nesting requires concealment provided by a combination of shrub and residual grass cover. Sage-grouse most frequently select nesting cover with a sagebrush canopy of 15-31%. Research findings in central Montana suggest that about two-thirds of nests occur within two miles of a lek.

- Brood-Rearing Habitat—Areas providing an abundance and diversity of succulent forbs, an important summer food source for young sage-grouse, provide key brood-rearing habitat. Research in central Montana indicated that sage grouse broods prefer relatively open stands of sagebrush during summer, generally with a canopy ranging from 1-25%. As palatability of forbs declines, sage-grouse move to moist areas that still support succulent vegetation, including alfalfa fields, roadside ditches, and other moist sites. During summers of high precipitation, sage-grouse in Montana may remain widely distributed throughout the entire summer due to the wide distribution of succulent forbs. Sage-grouse in southwest Montana and eastern Idaho often move to intermountain valleys during late summer where forbs remain succulent through summer and early fall. Reported sagebrush canopy on these sites varied from 8.5-14%.

- Winter Habitat— Sage-grouse generally select relatively tall and large expanses of dense sagebrush during winter. Wintering areas in central Montana included sagebrush stands on relatively flat sites with a 20% canopy and an average height of ten inches. The importance of shrub height increases with snow depth. Thus, snow depth can limit the availability of wintering sites to sage-grouse.

Sprague's pipit (*Anthus spragueii*) – Candidate

The Service determined that the Sprague's pipit was warranted for listing on September 14, 2010, but was it precluded from listing by higher priority actions and is a candidate species. The Sprague's pipit is endemic to the mixed-grass prairies of the northern Great Plains, including breeding habitat in Minnesota, Montana, North Dakota and South Dakota as well as south-central Canada. Wintering occurs in Arizona, Texas, Oklahoma, Arkansas, Mississippi, Louisiana, and New Mexico. Long-term surveys have indicated a range-wide population decline of 3.9% annually (Jones 2010). Global population estimates have projected as many as 870,000 breeding birds, although this calculation is unverified with existing data and is likely a maximum estimate (Jones 2010).

The breeding range extends through the north-central and eastern counties of Montana. Breeding in the southeastern and south-central counties was last reported in 1991 (Jones 2010). Breeding population estimates range from as many as 400,000 in Alberta, Canada to as few as 3,000 in South Dakota (Jones 2010). Generally, pipits prefer to breed in well-drained native grasslands with high plant species richness and diversity (Jones 2010).

The principal causes for the declines in Sprague's pipit range and populations are habitat conversion (to seeded pasture, hayfield, and cropland) as well as overgrazing by livestock. In addition to the habitat losses from changes in land use, energy development, introduced plant species, nest predation and parasitism, drought, and fragmentation of grasslands are all threats that currently impact Sprague's pipit populations throughout their present range (Jones 2010). Anecdotal accounts from early naturalists suggest that Sprague's pipits were one of the most common grassland songbirds in the northern Great Plains. Since its discovery, the Sprague's pipit has suffered greatly throughout its breeding range from conversion of short- and mid-grass prairie to agriculture (Jones 2010).

Sprague's pipits are likely influenced by the size of grassland patches and the amount of grassland in the landscape. Pipits had a 50% probability of occurring on patches greater than approximately 400 acres; pipits were absent from grassland patches less than 72 acres. The shape of the habitat is also important; sites with a smaller edge-to-area ratio had higher pipit abundance and were an important predictor of their occurrence. No consistent effect of patch size was found on nest success. Sprague's pipits rarely occur in cultivated lands and are uncommon on non-native planted pasturelands. They have not been documented to nest in cropland, in land in the Conservation Reserve Program, or in dense nesting cover planted for waterfowl habitat (Jones 2010).

The conversion, degradation, fragmentation, and loss of native prairie are the primary threats to Sprague's pipit populations. The once abundant grasslands of the Great Plains have been drastically reduced, altered, and fragmented by intensive agriculture, roads, tree plantings, encroachment by woody vegetation, invasion of exotic plants, and other human activities, including the removal of native grazers and a change in the natural fire regime. In the United States, about 60% of native mixed-grass prairies in Montana, North Dakota, and South Dakota have been converted to cropland. Grassland conversion has greatly reduced the quality and availability of suitable habitat for Sprague's pipits (Jones 2010).

Fragmentation of native prairie has likely contributed to the decline of Sprague's pipit populations through a reduction in average patch size, increased isolation of habitat patches, and increase in the ratio of edge-to-interior in habitat and potentially, an increase in parasitism. In fragmented landscapes, habitat interior species such as Sprague's pipits may experience lower reproductive success when nesting near habitat edges, where they are more susceptible to nest predators and brood parasites (e.g., brown headed cowbird). Sprague's pipits, like many other grassland endemics, tend to prefer areas with less than 20% shrubs, and are negatively associated with trees on a local territory scale. Sprague's pipit abundance has also been inversely correlated with distance to cropland and to water (Jones 2010).

Sprague's pipits may avoid roads and trails during the breeding season and the increased road densities associated with energy development may have negative effects on Sprague's pipit habitat. The type of road (e.g., secondary or tertiary, the presence of deep ditches on the sides, heavily graveled) and the level of traffic are the potential issues in determining the degree of effect roads and trails have on Sprague's pipit populations. In Saskatchewan, Sprague's pipits were significantly more abundant along trails (wheel ruts visually indistinct from surroundings) than along roadsides (fenced surfaced roads with adjacent ditches), which may be attributed to the reduction of suitable habitat associated with the road right-of-way. Sprague's pipit's avoidance of roads may also be due to the roadside habitat which tended to have non-native vegetation, dominated by smooth brome (Jones 2010).

Methods

Information concerning federally-listed and candidate species was collected by reviewing existing literature and through contact with knowledgeable individuals from the Service; Corps; U.S. Geological Survey (USGS); Montana Fish, Wildlife and Parks; and Reclamation. Listed species addressed in this BA were identified by the Service in a memorandum dated July 24, 2003 as possibly being present in the action area. The list of species was confirmed by the Service by telephone on June 21, 2004 (Jobman, personal communication 2004), by telephone on October 2, 2006 (Harms, personal communication. 2006), and by electronic mail on August 6, 2014 (Bergland 2014).

Biological Review Team Criteria

The Service, in conjunction with the LYIP BRT, worked with the Corps to define performance objectives and subsequent design criteria for the bypass channel. The bypass channel was designed to meet these criteria while also addressing stability and sedimentation issues.

The following, unless modified based on new data, apply to conditions as measured at the USGS stream gage at Sidney, regardless of date, over the discharge ranges specified. In order to maximize the probability of success, two sets of design criteria are recommended - one set applies to discharges less than 15,000 cfs and another set that applies to discharges equal to or greater than 15,000 cfs (Table 3).

Table 3 - Bypass Channel Design Criteria

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

Bypass Channel Flow Split

The flow split, or proportion of Yellowstone River discharge the bypass channel is designed to convey will influence many aspects of the channel design and overall scale. Given the variability of the unregulated flows in the Yellowstone River, we recognize that the flow split will vary with river discharge. As such, the general flow split percentage target for the bypass channel design should be 15% with final design attaining at least 12% over the discharge range of 7,000 to 14,999 cfs and from 13% to more than 15% over the discharge range of 15,000 to 63,000 cfs.

Bypass Channel Cross-sectional Velocities

Mean bypass channel cross-sectional velocities at all sampled cross-sections must be equal to or greater than two feet per second (ft/s), but less than or equal to six ft/s over the discharge range of 7,000 to 14,999 cfs. Mean bypass channel cross-sectional velocities (measured as mean column velocities) at all sampled cross-sections must be equal to or greater than 2.4 ft/s, but less than or equal to six ft/s over the discharge range of 15,000 to 63,000 cfs. The proportion of the channel exceeding maximum velocities should be minimized to the extent possible. Channel characteristics that maintain variability of flow within or on the margins of the bypass channel, without introducing significant turbulence, are highly valued.

Bypass Channel Cross-sectional Depths

Minimum cross-sectional depths measured at the lower discharge range of 7,000 to 14,999 cfs at any sampled cross-section must be greater than or equal to four feet across 30 contiguous feet of the measured channel cross-sectional profile. Minimum cross-sectional depth over the discharge range of 15,000 to 63,000 cfs at any sampled cross-section must be greater than or equal to six feet across 30 contiguous feet of the measured channel cross-sectional profile. Adult pallid sturgeon typically use depths greater than one meter throughout their range. Although adults have occasionally been observed in shallower water, depths greater than one meter will reduce the likelihood that adult pallid sturgeon may fail to pass through the bypass channel.

Bypass Channel Fish Entrance and Exit

The downstream entrance to the bypass channel (i.e., HEC-RAS station 136) is critical to the performance of the structure. Significant efforts remain to adequately characterize suitable conditions at the downstream and upstream openings. To provide sufficient attractant flows, the downstream fish entrance should have a mean cross-sectional velocity of greater than or equal to two ft/s (measured as mean column velocity) through the lower discharge range of 7,000 to 14,999 cfs and mean cross-sectional velocity greater than or equal to 2.4 ft/s (measured as mean column velocity) through the range of discharge of 15,000 to 63 000 cfs. Mean cross-sectional velocities (measured as mean column velocity) at both the upstream and downstream bypass channel openings should be less than or equal to six ft/s for river discharges ranging from 7,000-63,000 cfs. The proportion of the channel exceeding maximum velocities should be minimized to the extent possible. Characteristics that maintain variability of flow within or on the margins of the bypass channel openings, without introducing significant turbulence, are highly valued.

Hydraulic and Hydrologic Modeling

Since completion of the 30% design for the bypass channel and weir, additional numerical and physical modeling has been completed by Reclamation and the Corps. Due to the compressed design schedule, a multifaceted approach to modeling including various models used to reduce uncertainties, especially in sediment transport. Both one-dimensional and two-dimensional numerical modeling has been completed by both the Corps and Reclamation. The Corps modeling has consisted of one-dimensional HEC-RAS modeling of both hydraulics and sediment transport as well as initial ADH two-dimensional hydraulic modeling. Reclamation has performed two-dimensional modeling of hydraulics and sediment transport with SRH-2D. Additionally, Reclamation built a 1:16 Froude-scale physical model combining the downstream end of the bypass channel and one-half of the main channel of the Yellowstone River (Figure 12). The physical model was only capable of modeling hydraulics.

Figure 12 - Intake Physical Model

HEC-RAS Modeling

Initial indications that the downstream end of the 30% design bypass channel was too low were noticed when comparing the computed depths and velocities against the BRT design criteria. Velocities of less than two ft/s were computed in the downstream end of the bypass due mainly to backwater effects from the main channel (Figure 13). In addition to not providing adequate attractive flow velocities, the low velocities indicated potential for sediment deposition. The first attempt to increase velocities included raising the downstream invert of the bypass channel. Raises of one foot, two feet, and three feet were modeled and evaluated while maintaining the 30% design channel slope (bypass channel length is shortened). Raises of two and three feet showed areas of high velocity, especially at low flows, where the bypass flows into the main channel. Therefore, a one foot raise of the downstream invert of the bypass was selected.

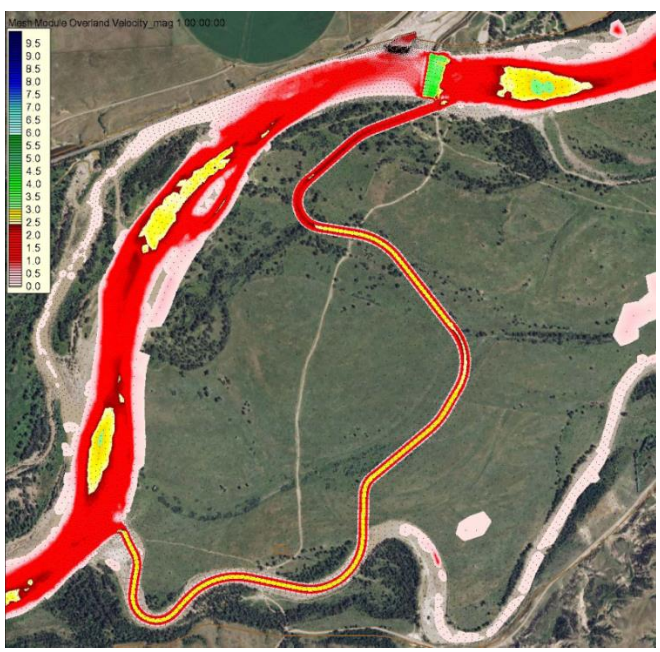

Figure 13 - 2 - D Modeling of the 30% Design

Hydraulics

Using a one foot raise, the rating curve for the downstream end of the 30% design cross section matches the rating curve for the main channel at low discharges but still showed backwater effects at higher discharges. Therefore, various bypass cross section shapes were evaluated to better match the main channel rating curve. An iterative process was required because when the cross section shape is varied, the flow split changes, which in turn changes the rating curve comparison. Additional water surface and discharge data were collected in June 2014 to further refine the hydraulic modeling calibration of the Manning's roughness value, especially in the flow range above 15,000 cfs. The computed flow splits for 30% and 60% design are illustrated below (Table 4):

Table 4 - Expected Flow Splits - 60% Design, May 2014 Interim Progress Report

Total Yellowstone River Flow	Historic High Flow Channel Flow Spilt Under Existing Conditions		Proposed Bypass Channel Flow Spilt		Historic High Flow Channel Flow Split with Constructed Bypass Channel	
(cfs)	(cfs)	(%)	(cfs)	(%)	(cfs)	(%)
7,000	0	0	930	13.3	0	0
15,000	0	0	1990	13.3	0	0
30,000	780	2.6	4000	13.3	0	0
2-yr 45,300	2120	4.7	6200	13.7	0	0
10-yr 70,100	5090	7.3	10180	14.5	0	0
50-yr 89,400	7120	8.0	13370	15.0	0	0
100-yr 97,200	8060	8.3	14720	15.1	0	0

* 7000 cfs is used to represent the 50% exceedance by duration discharge for the months of April and August; 15,000 cfs is used to represent May and July, and 30,000 cfs is used to represent June.

Sediment Transport

Numerous sediment transport runs were completed with HEC-RAS, version 4.2.0 Beta. Sensitivity runs on multiple sediment loading values, incoming gradation, bed gradation, transport functions, sorting methods, discharges and channel slopes were completed.

In addition to running historic flows from the Sidney gage data, constant flows representing the approximate channel-forming discharge were evaluated. The two-year discharge (45,300 cfs to 54,200 cfs for the main channel depending on study used) results in approximately 6,500 cfs in the bypass channel and was selected as the channel-forming discharge used to estimate channel stability. Once a relatively stable channel configuration was selected, model analysis was performed with the post-Yellowtail Dam period of record flows (1967-2014). The maximum flow through the bypass during this analysis was limited to the approximate bankfull discharge, 9,000 cfs (equivalent to 60,000 cfs total Yellowstone flow) due to model instabilities when larger discharges were used. Similar instabilities occur in the main channel when modeling large flows, indicating that model limitations (rather than actual geometry or sediment loading) are the cause. Future evaluation will further investigate modeling of extreme Yellowstone River flows, mainly with 2-D modeling where overland flows can be modeled with sediment (currently HEC-RAS cannot model more than one reach with sediment).

Base Data

Base data used in the sediment transport analysis include the following:

- Median incoming load from the Sidney USGS gage data (USGS Gage #06329500) was used to develop a suspended sediment loading curve for the bypass channel based on the estimated flow split. This was converted to a concentration which was then used to determine the load in the bypass channel.

- Gradation of incoming suspended load based on estimated median of Sidney gage data.

- Estimated bedload of approximately 5% of suspended load (varies from 0.5-7% depending on flow) with gradation based on 2008 bar samples (grab samples taken with shovel) taken by the Corps and analyzed by USGS. Maximum incoming material size was limited to medium gravel (8-16mm).

- Transport function used for base is Laursen-Copeland, a total load function that was generalized by Copeland for gravel transport so the equation could be used for graded beds.

- Bed gradation was based on 2008 Wolman counts representing the processed armor layer that was proposed in the 30% design. The 60% design still includes the processed armor layer. The Wolman count gradation is coarser than the bar samples or test pits, but is expected to be representative of the processed armor layer after construction.

Sensitivities

Numerous sensitivity runs have been completed for the proposed bypass channel. Sensitivity runs on multiple sediment loading values, incoming gradation, bed gradation, transport functions, sorting methods, discharges and channel slopes were completed. In general, the model shows high sensitivity to the incoming gradation, transport function, and incoming load; moderate sensitivity to the bed gradation, discharge, and sorting method; and low to moderate sensitivity to the channel slope.

The model shows particularly high sensitivity to the largest size of the incoming material, especially for certain transport functions. In addition to Laursen (Copeland), Yang, Toffaleti, and Ackers-White were used. When using medium gravel (8-16mm) as the largest incoming material, Yang, Toffaleti, and Ackers-White showed unrealistic aggradation (on the order of 100+ft). However, when the maximum size of incoming material was limited to very coarse sand, results with the alternative transport functions were much more realistic. This trend was similar with the main channel of the Yellowstone River, indicating that limitations of the various transport functions are the cause rather than actual physical predictions of extreme aggradation.

ADH Modeling

Modeling completed to date includes a downstream focus model of existing conditions and the 30% design as well as an overall model of existing conditions and the 30% design. Both models initially showed general agreement with HEC-RAS and physical modeling.

SRH-2D Modeling

A team from Reclamation's Technical Service Center in Denver has been modeling the 30% design bypass channel using SRH-2D.

Reclamation Physical Model

A 1:16 Froude-scale physical model was constructed and evaluated by Reclamation at their hydraulic laboratory in the Technical Service Center in Denver. Initial results confirmed that the higher bypass channel invert at the downstream end provided superior performance. The physical model evaluated both the 30% design invert (1981ft NAVD88) and a two-foot raise (1983ft NAVD88). The 1983 invert showed improved velocity performance (less backwater and higher velocities at confluence); however, during low flow simulations (7000 cfs total river flow) velocities were potentially too high at the confluence. The high velocities at low flows agree with the HEC-RAS model with a two-foot raise.

Uncertainties

The proposed modifications/conservation measures described above were designed using the best available scientific information on pallid sturgeon. Nonetheless, uncertainty exists regarding assumptions about the biological response to the bypass channel and the relative effectiveness for improving fish passage. In response to these uncertainties, Reclamation has developed an Adaptive Management Plan (AMP) framework (Appendix E) that will be finalized with success criteria after formal consultation is complete. The AMP will provide success criteria for the project as well as monitoring objectives and goals for the project.

Direct and Indirect Effects of Interim and Future Operation and Maintenance of the Lower Yellowstone Irrigation Project and Construction of the Bypass Channel and Weir with Conservation Measures

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

The Service has identified three potential conclusions regarding analyses for impacts on listed species or designated critical habitat:

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

Pallid Sturgeon

<u>Direct and Indirect Effects: Construction of Proposed Bypass Channel and Weir</u>

The construction of the bypass channel would involve the placement of two coffer dams, one each on the upstream and downstream entrances to the bypass channel. This would allow for the excavation of the channel in the dry. The coffer dams would be built outside of pallid sturgeon migration (migration document from May – July) so impacts from coffer dam construction would be limited to a short term increase in turbidity in the immediate area. The upstream coffer dam would plug the existing side channel that currently routes around Joe's Island. Fill that is excavated from the bypass channel would then be placed in the side channel permanently blocking all flows from entering and flowing through the channel. The existing side channel needs to be permanently blocked to better manage flows through the bypass channel and to minimize sediment issues in the bypass channel and at the headworks once construction is complete.

Although filling the side channel with fill would eliminate direct flow from the river, the side channel would still hold water and provide habitat for prey species and other native aquatic and terrestrial organisms through the backwater effect of the river. Modeling indicates that almost the entire side channel up to the channel plug would be subject to backwater effects during spring runoff and other high flow events. The length of side channel to be filled is currently proposed to be about one and a half miles; however, the filled area would be minimized to the extent practicable.

Montana Fish, Wildlife and Parks monitored pallid sturgeon use in the existing side channel for the first time in 2014. Five pallid sturgeon used the side channel to move upstream beyond Intake. Four of these fish eventually moved upstream to the Powder River where spawning was documented (FWP 2014). Placing fill in the existing channel would no longer allow the side channel to be used as a viable passage alternative for pallid sturgeon. Although this passage avenue would be blocked, Reclamation believes that construction of the proposed bypass channel would offset this effect. Currently, the existing side channel conveys water when river discharge is above 30,000 cfs - approximately a two-year event. The proposed bypass channel would convey water at all river discharges. This would allow for increased passage potential, not only for pallid sturgeon, but for other native species as well. The proposed bypass channel is also expected to convey more water (13–15% of total river discharge compared to 5–6%) than the current side channel, as well as provide greater depths and velocities to encourage passage.

Currently, a large eddy forms on the south side of the Yellowstone River where the proposed downstream entrance of the bypass channel would be located. To help alleviate concerns of eddy formations or complex shear flows that could impact passage, a large area of fill is proposed just downstream of the bypass channel to help direct flows back towards the main river channel. Physical and computer modeling indicated that this area of fill eliminated the formation of eddies and provided a smoother transition with the Yellowstone River. Construction of the fill area would be conducted outside of pallid sturgeon migration (migration documented from May – July) so affects would be limited to a short term increase in turbidity in the immediate area.

The new proposed weir would be constructed approximately forty feet upstream from the existing diversion structure and be set at elevation 1991.0 ft. The new weir would incorporate a low flow notch that would allow for both downstream passage of adult, juvenile and larval pallid sturgeon as well as upstream passage for stronger swimming native species. Sheet pile coffer dams would be constructed around the area of the new weir and cover approximately 1/3 of the river at a time. Once the coffer dam is in place the large main sheet piles for the new weir would be driven into the river bed. After the sheet piles are in place, forms would be constructed for the concrete. When the first 1/3 of the weir is complete the coffer dams would be removed and the next 1/3 of the river would be diverted around the construction site. As construction progresses across the river, the area between the new weir and existing weir would be filled with riprap to stabilize the structure. This construction would either take place from an overhead trolley or barge and would occur outside of pallid sturgeon migration (migration documented from May – July). It is expected that the new weir would be completed before the completion of the bypass channel. Construction of the new weir is anticipated to create intermittent, short term increases in turbidity in the immediate area.

The construction of a new concrete weir that incorporates the existing wood and rock structure in place would represent a continued barrier to migrating pallid sturgeon, which has existed for the life of the project. Even with the bypass channel in place, some pallid sturgeon may still attempt to move upriver in the main channel and find the route impassible. It may also be difficult for some pallid sturgeon to locate the entrance of the proposed bypass channel. During 2014 when five pallid sturgeon migrated upstream using the existing side channel, it was conveying less than 5% of total Yellowstone River discharge. That volume is much less than the 13-15% proposed for the bypass channel. Reclamation believes that placing the downstream entrance to the proposed bypass channel next to the passage impediment provides the best opportunity for successful location of the bypass and ultimate passage. For those pallid sturgeon that fail to use the proposed bypass channel, the new concrete weir, existing weir, and boulder field would continue to be an upstream barrier to these fish.

Direct and Indirect Effects: Interim and Future O&M

The proposed modifications are intended to improve fish passage at Intake. Developing a bypass channel for pallid sturgeon, while maintaining surface diversions for irrigation, is complicated. Reclamation and the Corps have devoted years and substantial resources to design a bypass channel to improve passage that satisfies physical criteria provided by the Service. Following the Corps' one-year warranty period, Reclamation will be responsible for maintaining the bypass channel.

By providing passage at Intake, it would make approximately 165 miles of habitat and drift distance available to spawning pallid sturgeon. With the exception of 2014, most of the spawning activity has taken place in the lower ten miles of the Yellowstone River (Bramblett 1996). This location does not provide adequate drift distance for larval pallid sturgeon to mature before they drift into the headwaters of Lake Sakakawea where they are believed to succumb to hypoxia in the Lake Sakakawea headwaters (Guy et al. 2015).

Until the construction of the proposed weir and bypass channel is complete, the existing weir would need to be maintained at elevation 1991.0 ft so the LYIP can divert their full water right. The existing weir and any rock added to maintain the 1991.0 ft elevation would continue to be an upstream impediment to pallid sturgeon over the short-term. It is anticipated that this short-term rocking would not aggravate passage issues but instead maintain the existing condition and perpetuate the adverse effects that have existed over the past 100 years. However, Reclamation believes that with the construction of the bypass channel, these long term passage concerns will be alleviated.

In order to maintain the proposed weir and bypass channel it is likely that the LYIP would need to place a temporary coffer dam within the bypass channel to reduce or completely eliminate flows for access. Flows would also need to be reduced or eliminated in the bypass channel for the removal of sediment, removal of large debris, reshaping of the bypass channel to physical criteria, implementation of adaptive management measures, or the replacement of riprap. The use of a coffer dam would only be during the low summer/fall flows which occur outside of the pallid sturgeon migration period eliminating potential effects to pallid sturgeon passage.

Pallid sturgeon have been shown to avoid areas of eddy formation and shear flows (White and Mefford 2002). Under current conditions a large eddy forms on the south side of the Yellowstone River where the proposed downstream entrance of the bypass channel would be located. With the help of stakeholders, Reclamation and the Corps identified an area that would be filled and graded on the south river bank to eliminate formation of the eddy. This fill area was modeled using the Reclamation physical model and the Corps' computer models to determine the extent of fill needed. The modeling shows that the proposed fill eliminates the formation of the eddy and increases attraction flows toward the main channel of the Yellowstone River. This area will need to be maintained by the LYIP to ensure attraction flows near the entrance of the bypass channel are maintained. If shear flows begin to form affecting passage success, the manipulation of this fill or the placement of more fill may be a potential AM action.

In order for the bypass channel to function properly and the LYIP to receive their full water right, the proposed weir must be maintained. As mentioned previously the LYIP would need access across the bypass channel to conduct O&M activities on the new weir. The rock field between the new diversion and old diversion structures would need to be maintained to ensure the proposed weir remains stable. Currently Reclamation is unsure how the rock field would be maintained but options include 1) construction of a new cable/trolley rocking structure, 2) placement of rock via barge, or 3) placing rock by a vehicle in the river. These activities would occur during low flows outside of the pallid sturgeon migration season.

Screens at the headworks where designed to minimize entrainment of pallid sturgeon larger than 40 mm into the main canal. Pallid sturgeon less than 40 mm, such as free embryos and larvae, may still be entrained in the canal. If spawning, incubation and hatching are all successful in the Yellowstone River around the Powder River area, similar to what occurred in 2014 (~rivermile 150, ~ 80 miles upstream from Intake), the free embryos would be approximately 9-12 mm in size when drifting through the Intake area (Braaten, personal communication 2015). Work done by Mefford and Sutphin (2008) showed that pallid sturgeon free embryos sized 13-18 mm passed directly through a 1.75 mm wedgewire screen, which is the current design used on the new headworks.

Based on drift studies, most pallid sturgeon free embryos drift in the lower 0.5 m of the water column, but a few will be caught in the upper portions of the water column, depending on turbulence and secondary currents (Braaten, personal communication 2015). As designed, the headworks screens are approximately 1 meter above the river bottom and have an approach velocity of 0.4 meters per second, which reduces the chance of these organisms from being entrained.

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.

Free embryo and larval pallid sturgeon drift occurs during mid-June through mid-July each year, which is typically the peak run off months for the Yellowstone River. During June the average discharge is 38,200 cfs and in July is 22,000 cfs (Table 5, USGS Data). Because the LYIP is diverting between 6% and 3% of the average discharge during this time, large numbers of pallid sturgeon less than 40 mm are not expected to be entrained.

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

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

* Indicate expected months for free embryo and larvae downstream drifting

Reclamation has been monitoring headwork screen effectiveness, but has no data to provide at this time because of the lack of passage above the current structure. Data collected in 2014 has yet to be fully quantified. Therefore, Reclamation is unable to project the level of entrainment of pallid sturgeon associated with the screened headworks.

If the LYIP is not able to divert their entire water right due to debris in or near the headworks, plugged screens, gate maintenance, or failure, they may lift screens one at a time until they are able divert their full water right down to river flows of 3,000 cfs measured at the Sidney gage. Under such circumstances, adult and juvenile pallid sturgeon are subject to entrainment into the main canal. Reclamation is unable to project the magnitude of potential incidental take of pallid sturgeon associated with this activity. Before screens are lifted, the Service and Montana Fish, Wildlife and Parks would be notified.

Diversions into the main canal reduce flows in the Yellowstone River to varying degrees depending on season, crop requirements, and watershed snowpack. Maximum diversion is 1,374 cfs, and during late summer and early fall, this volume of water could represent as much as 20% of the total flow in the river on an average year (Table 5). Much of the diverted water is necessary for the LYIP's irrigation system to operate properly. It is estimated that as much as 80% of diverted flows return to the river through drains and spillways. At this time, Reclamation is not aware of data or information that would indicate that this level of diversion adversely affects pallid sturgeon.

It may be possible that free embryo, larval, juvenile or adult pallid sturgeon could be adversely affected as they migrate downstream over the proposed weir and through the rubble field and associated turbulence. Although the effects to pallid sturgeon moving downstream over the proposed weir and rubble field are unknown; the sloped approach on the upstream face of the proposed weir and incorporation of a notch should minimize impediments or impacts to these fish moving downstream. It is anticipated that the free embryos, larvae, adults, and juveniles could use the bypass channel to migrate back downstream reducing the risk of injury over the new weir and rubble field.

The LYIP uses five pumps to supplement surface diversions at Intake. These pumps collect return flows from the LYIP out of the Yellowstone and Missouri rivers. Currently, these pumps have two–inch wide trash racks and operate during May, July, and August. The current trash racks largely eliminate the chances of adult and juvenile pallid sturgeon from becoming entrained. There would still be potential for free embryo and larval sturgeon in both the Missouri and Yellowstone rivers to be entrained in these pumps, but the likelihood is small as these pumps are only operated intermittently, divert a small portion of the Yellowstone and Missouri rivers (Table 6, 7), and do not occur on outside bends where these organisms are expected to be concentrated.

Table 6 - Average Yellowstone River Discharge vs. Supplemental Pumps
USGS Data, Sidney Montana: http://waterdata.usgs.gov

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

Table 7 - Average Missouri River Discharge vs. Supplemental Pump W
USGS Data, Culbertson Montana: http://waterdata.usgs.gov

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

Herbicide and pesticide use to maintain canals and ditches should have no effect on pallid sturgeon or its prey base provided such activities are carried out in accordance with label directions. Other current O&M activities in the LYIP, such as canal, ditch, and road maintenance and fence repair will continue and should have no effect on pallid sturgeon.

There are unknowns associated with pallid sturgeon use of the bypass channel. To address these uncertainties, Reclamation proposes using an Adaptive Management Plan (AMP). The purpose of the AMP is to validate assumptions and address project uncertainties through monitoring of physical and biological responses to the proposed action, assess progress towards project objectives, and identify potential adjustments to achieve and maintain project performance. This plan will include monitoring for physical and biological criteria that have been established by the Service through the BRT. The AMP is expected to be modified and supplemented in the future as new information develops and knowledge is acquired. If an adaptive management measure is identified in the future that is not addressed by this current consultation, Reclamation will be responsible for reconsultation with the Service.

Summary of Effects

The proposed modifications are intended to benefit pallid sturgeon and other native fish. Interim and future O&M of the project is likely to adversely affect pallid sturgeon through potential entrainment of larval fish less than 40 mm into the main canal and supplemental pumps; interim and future impediment of upstream migration for pallid sturgeon that do not locate or use the bypass channel; and from potential harm as free embryos, larvae, juvenile, and adult pallid sturgeon migrate downstream over the proposed weir and boulder field.

Whooping Crane

Direct Effect and Indirect Effects

Reclamation did not identify any impacts associated with the construction of the proposed modifications, or interim and future O&M of the LYIP on migrating whooping cranes. Based on a review of past sightings for this species, it would be unlikely that migrating whooping cranes would be in, or near, the action area. Furthermore, monitoring for local whopping crane sightings, as identified in chapter four and in appendix I of the Intake EA, would avoid potential adverse effects. Reclamation is unaware of any interrelated or interdependent actions that would adversely affect the whooping crane in the action area.

Summary of Effects

The proposed action will have no effect on the whooping crane.

Interior Least Tern

Direct and Indirect Effects

Reclamation did not identify any impacts associated with the construction of the proposed modifications or interim and future O&M of the LYIP on foraging or nesting interior least terns. Based on a review of past sightings of this species, the potential for least terns to be in the action area is possible. However, restricting all surface-disturbing activities through continued O&M to within 0.25 mile, or within line of site, of any active interior least tern nest from May 15 to August 15 would avoid potential adverse effects. In the event of an emergency, a nest with eggs may need to be moved or be subject to destruction if human life or infrastructure is in danger. Reclamation will report such actions to the Service. Reclamation is not aware of any interrelated or interdependent actions that would adversely affect the interior least tern in the action area.

Summary of Effects

The proposed action may affect, but is not likely to adversely affect, the interior least tern.

Red knot

Direct and Indirect Effects
Reclamation has not identified any activities described in the proposed action that has potential to adversely affect the red knot.

Summary of Effects
The proposed action will not affect the red knot.

Northern long-eared bat

Direct and Indirect Effects
Live and dead deciduous trees, mainly cottonwoods, would be removed during construction of the proposed bypass channel. Some trees likely contain features known to attract roosting NLEBs. To minimize potential adverse effects on the NLEB, removal of potential roost trees in the construction zone will be kept to the minimum practicable.

Interim and future O&M of the LYIP may adversely affect NLEBs if insecticide use by individuals significantly reduces the insect prey base in the area or roost trees and buildings are removed.

Summary of Effects
The proposed action is not likely to jeopardize the continued existence of the NLEB.

Greater Sage-grouse

Direct and Indirect Effects
There are no known sage-grouse leks on the LYIP, and we are unaware whether sage-grouse use occurs on Joe's Island. Disturbed areas on Joe's Island that are to be reclaimed will be seeded with native grasses and planted with sagebrush to improve habitat values for sage-grouse.

Blocking the existing side channel should not affect sage-grouse as it will still provide cover habitat and water through much of the growing season. Free water would be available in the proposed bypass channel until it freezes.

The LYIP does not anticipate clearing and/or plowing of grassland or sagebrush habitats on the LYIP as part of interim and future O&M. Some pesticide and/or herbicide use could affect sage-grouse directly if they are in direct contact with the agent(s) or indirectly through loss of habitat and insect prey.

Summary of Effects
The proposed action may affect, but is not likely to adversely affect, greater sage-grouse.

Sprague’s Pipit

Direct and Indirect Effects

Construction of the proposed bypass channel and attendant access roads on Joe’s Island may eliminate habitat suitable for the pipit. Because the pipit is a migratory bird protected by the Migratory Bird Treaty Act, disturbance of grassland habitats will be scheduled to occur outside of their nesting and brood-rearing window. Disturbed areas on Joe’s Island that are to be reclaimed will be seeded with native grasses and planted with sagebrush to improve habitat values for Sprague’s pipit.

The LYIP does not anticipate clearing and/or plowing of grassland habitats on the LYIP as part of the interim and future O&M of the district. Some pesticide and/or herbicide use could affect Sprague’s pipit directly if they are in direct contact with the agent(s) or indirectly through loss of habitat and insect prey. It is unlikely Sprague’s pipit are using habitats in vicinity of the ditches and canals that are to be maintained through the use of herbicides and pesticides.

Summary of Effects

The proposed action may affect, but is not likely to adversely affect, the Sprague’s pipit.

Cumulative Effects and Interrelated and Interdependent Effects Associated with Interim and Future Operation and Maintenance of the LYIP and Construction of the Proposed Bypass Channel and Weir with Conservation Measures

Cumulative Effects

The implementation of conservation measures for fish passage and entrainment protection may benefit paddlefish populations in the lower Yellowstone and Missouri rivers by providing increased access to habitat. By providing additional habitat for paddlefish, individuals are likely to be more widespread in the Yellowstone River, and snagging opportunities at Intake may decrease. This may disperse anglers and affect paddlefish egg collecting activities by local organizations. Dispersed paddlefish snagging may make it more difficult for Montana Fish, Wildlife and Parks to monitor anglers and overall catch. Increased paddlefish populations with a more widely-dispersed range may lead to increased fishing/snagging pressure and may result in increased incidental snagging of pallid sturgeon.

Energy development in Montana and North Dakota require massive amounts of water. Much of this water becomes contaminated and cannot legally be returned to surface water systems. Withdrawal from aquifers and surface streams contribute to reduced flows in the Missouri River that may adversely affect pallid sturgeon.

Energy development in Montana and North Dakota has also disturbed and/or destroyed large areas of grassland and shrub nesting habitat for migratory and resident birds. Much of the known Sprague's pipit's habitat overlies major energy development areas in both states. Increased agricultural commodity prices and bioengineered crop varieties have contributed to a significant expansion of crop land, especially in North Dakota, at the expense of grasslands. Poorly-managed livestock grazing also adversely affects some ground-nesting bird habitat such as greater sage-grouse.

Reclamation is not aware of other non-federal actions that may affect listed species in the action area.

Interrelated and Interdependent Actions

Bank stabilization projects have proliferated over the years and require permitting by the Corps under section 404 of the Clean Water Act (CWA). Authorization is also required under section 10 of the Rivers and Harbors Act of 1899 (RHA) because the Yellowstone River is classified as a navigable water for much of its length. Therefore, any future bank stabilization associated with the LYIP would require a permit under section 404 of the CWA or section 10 of the RHA would be subject to section 7 consultation between the permitting agency and the Service.

Effects Determinations

Reclamation has determined that the proposed action is likely to adversely affect the pallid sturgeon.

Reclamation has determined that the proposed action will have no effect on the whooping crane.

Reclamation has determined that the proposed action may affect, but is not likely to adversely affect, the interior least tern.

Reclamation has determined that the proposed action will have no effect on the red knot.

Reclamation has determined that the proposed action is not likely to jeopardize the continued existence of the long-eared bat.

Reclamation has determined that the proposed action may affect, but is not likely to adversely affect, greater sage-grouse.

Reclamation has determined that the proposed action may affect, but is not likely to adversely affect, the Sprague's pipit.

Conservation Measures

The LYIP has been operating the new headworks with state-of-the-art rotating fish screen drums to minimize entrainment of juvenile and adult pallid sturgeon and other native fish for three irrigation seasons. The LYIP will continue to O&M the new structure as identified in past consultation efforts, as well as this consultation.

Reclamation will maintain the proposed bypass channel to the Service-established physical and hydrologic criteria after the Corps' one year warranty period.

Construction activities will not be allowed in the Yellowstone River during May 1 – July 1 to eliminate potential impacts to migrating pallid sturgeon.

All surface-disturbing and construction activities related to construction, and interim and future O&M of the LYIP would be restricted within 0.25 mile, or within line of site, of any active interior least tern nest from May 15 to August 15 to minimize potential adverse effects.

Land-clearing activities and removal of vegetation associated with construction, interim and future O&M will occur outside of the nesting and brood-rearing window, e.g., May through July, for greater sage-grouse, Sprague's pipit, and other migratory birds.

To minimize long-term effects to greater sage-grouse, Sprague's pipit, and other migratory birds, land disturbance associated with construction, and interim and future O&M, other than that necessary for permanent access roads, will be seeded with native grasses and forbs and planted with sagebrush where appropriate. Cottonwood trees and other native trees that are removed during construction and continued O&M of the bypass channel will be replaced 2:1 at appropriate sites on Joe's Island. To minimize potential adverse effects to the northern long-eared bat, clearing mature and dead cottonwoods on the LYIP will be minimized to the extent practicable.

Reclamation is committed to implementing an adaptive management plan to improve the potential success of the project (Appendix E).

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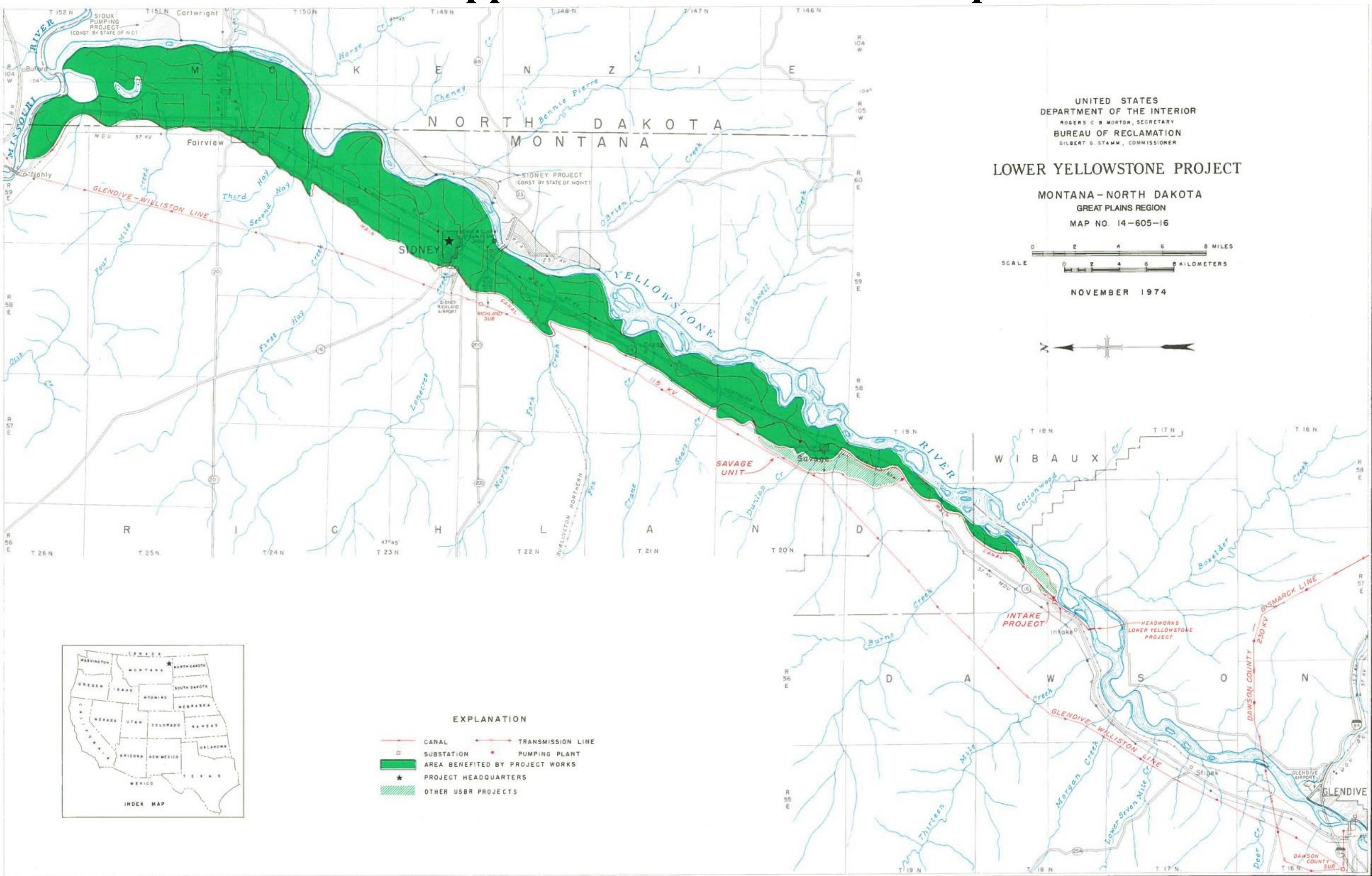
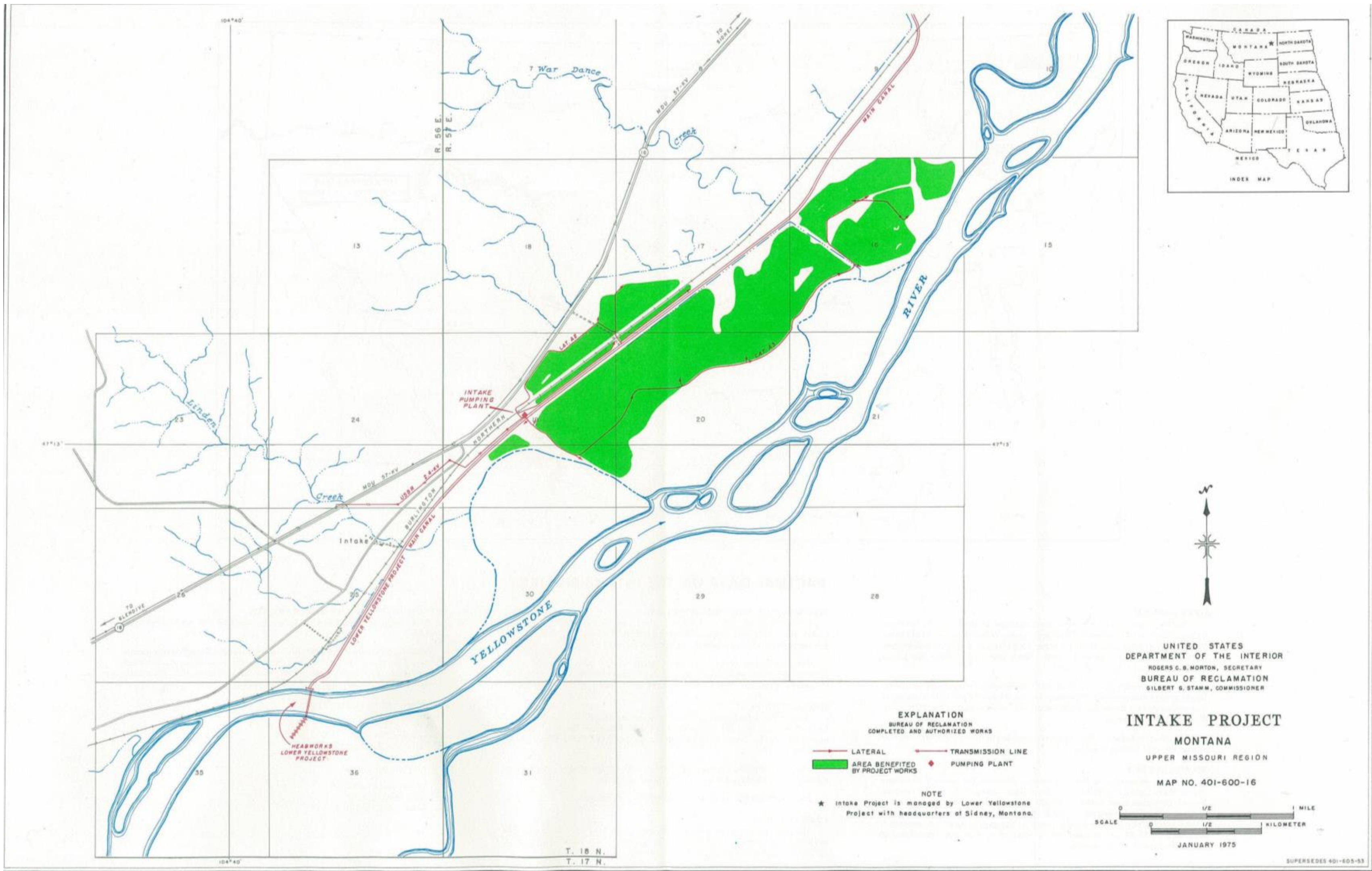
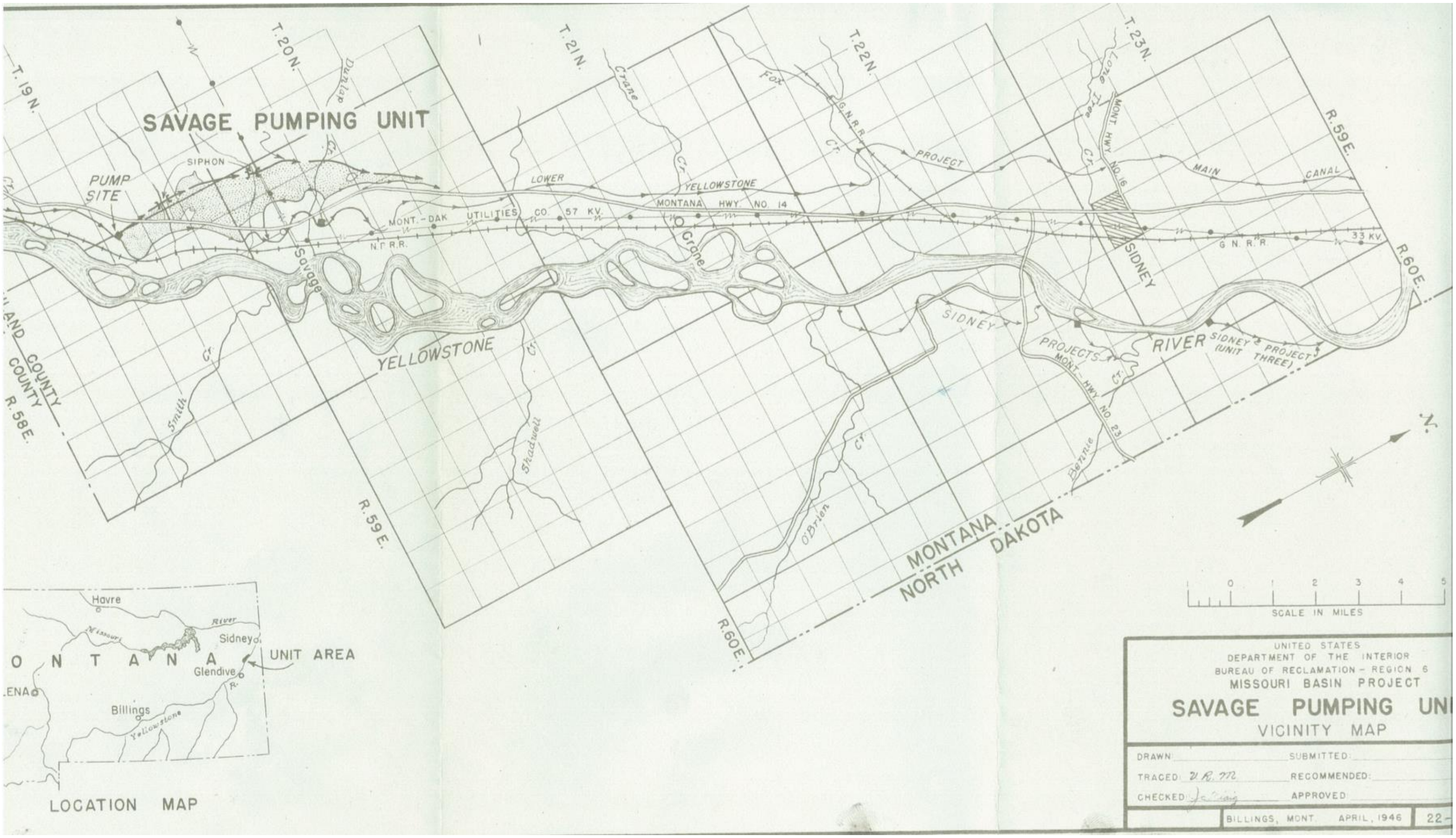
Appendix A – LYIP District Maps



Map 1 - Lower Yellowstone Districts 1 and 2

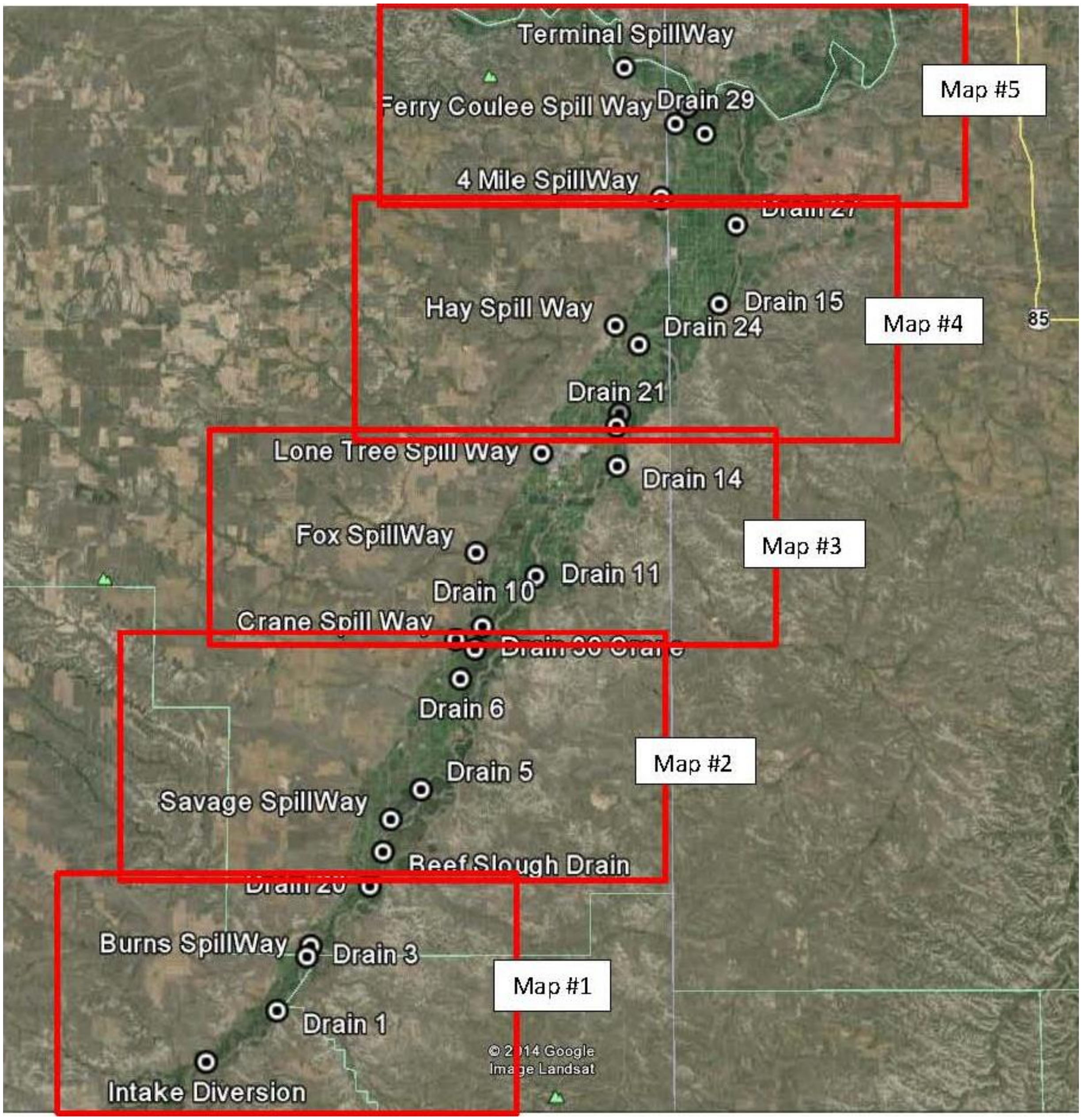


Map 2 - Intake Irrigation District

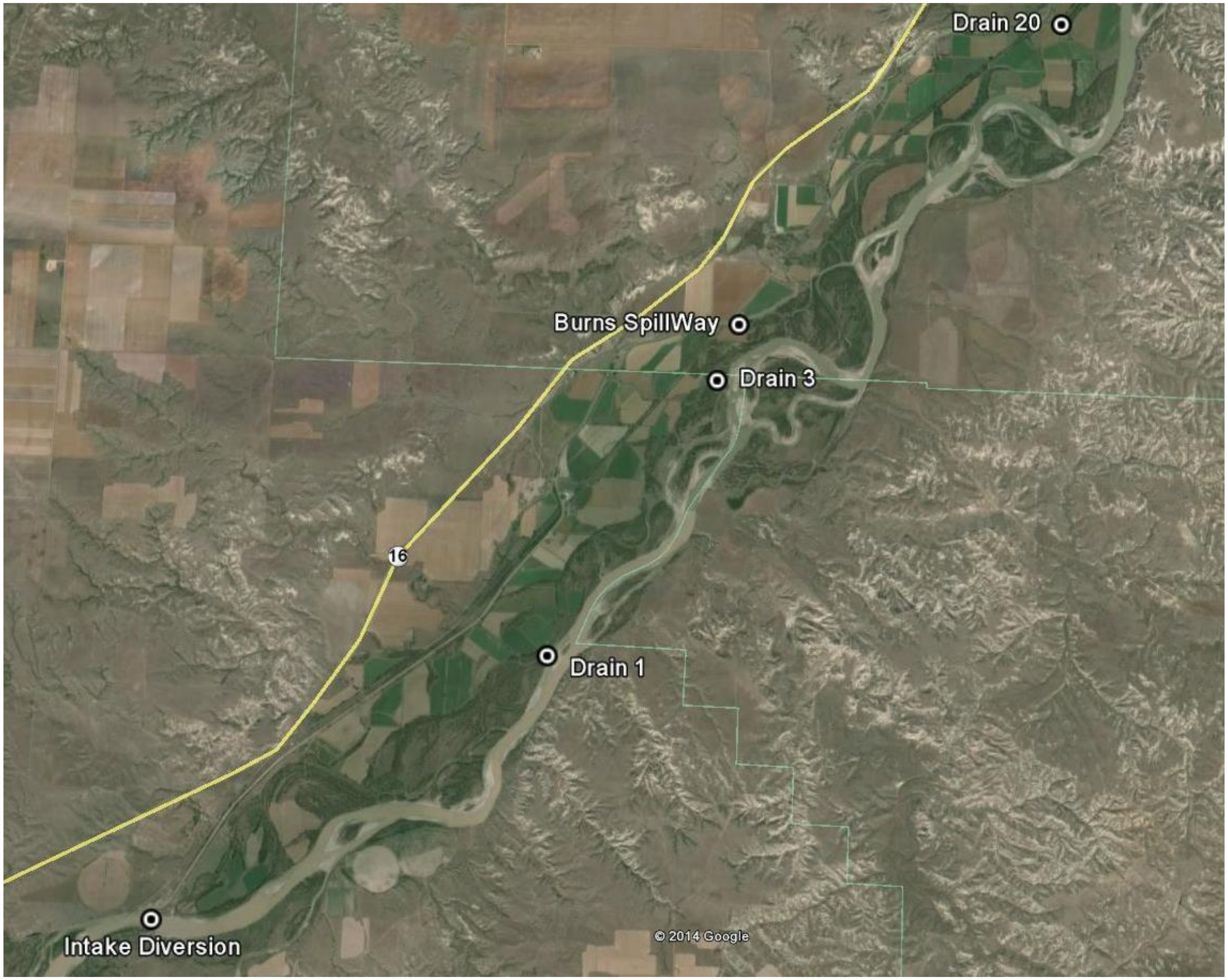


Map 3 - Savage Irrigation District

Appendix B – LYIP Drain Locations

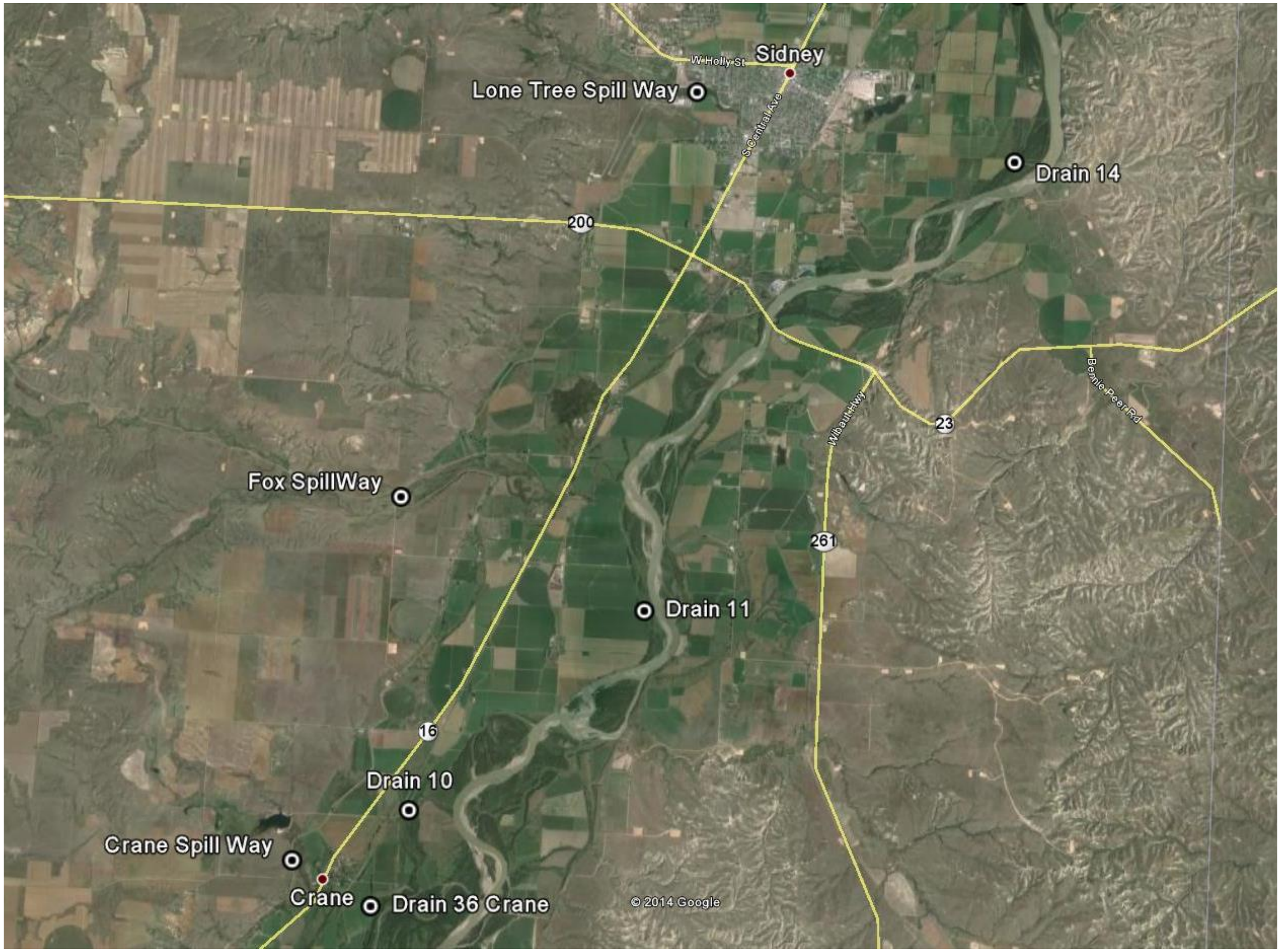


Overview of LYIP Drain Locations

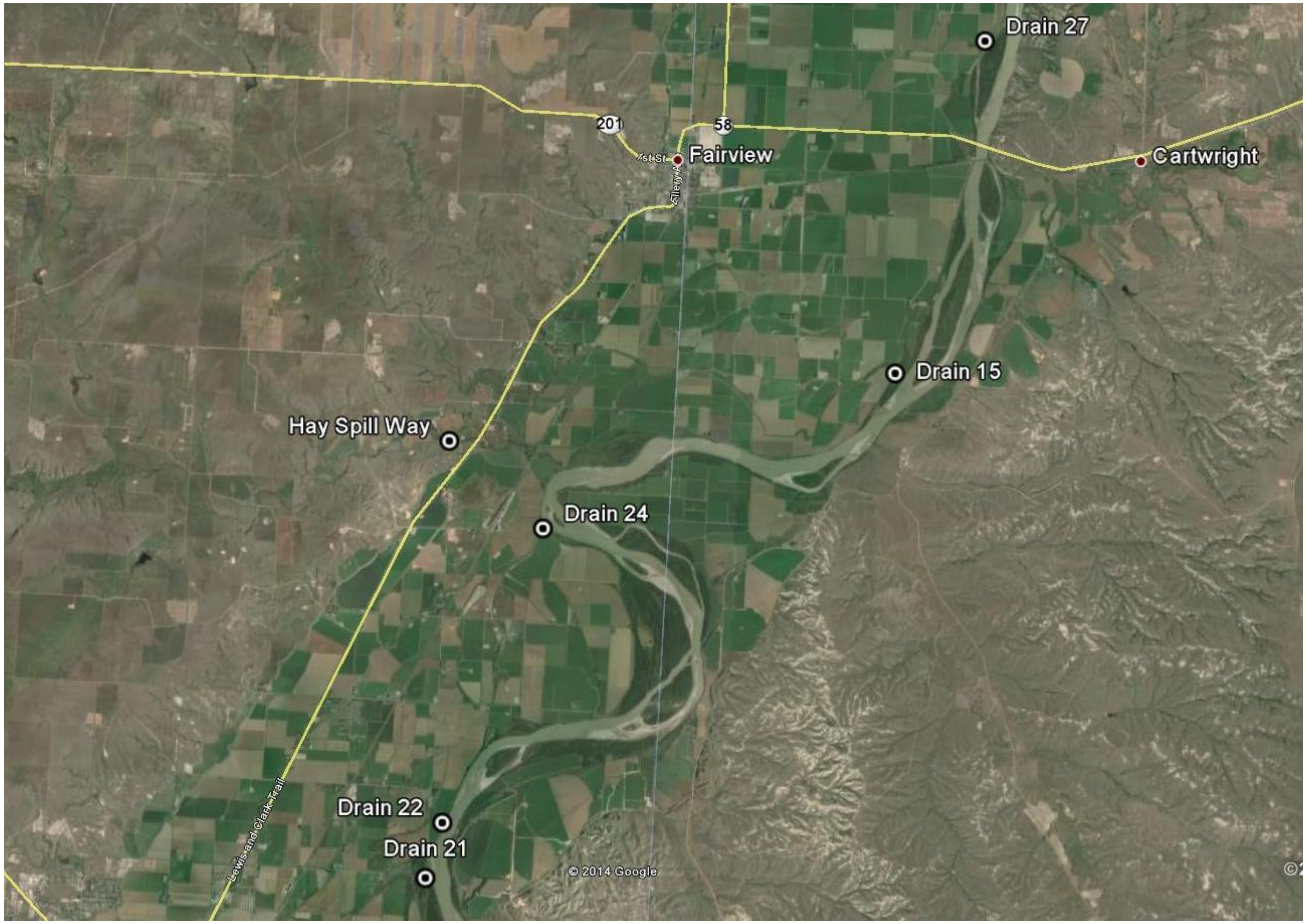


Map 1: LYIP Drain Locations

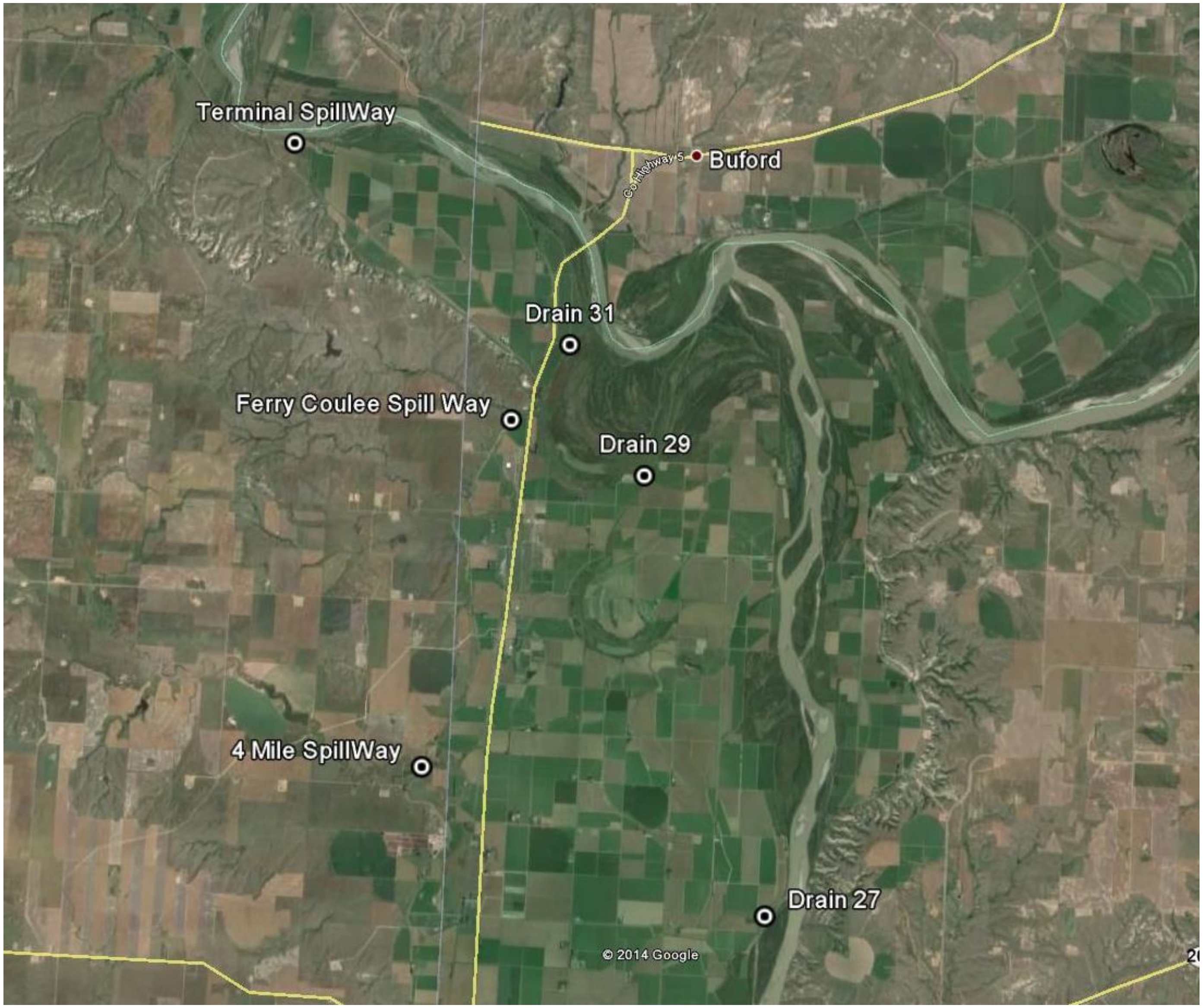
Map 2: LYIP Drain Locations



Map 3: LYIP Drain Locations

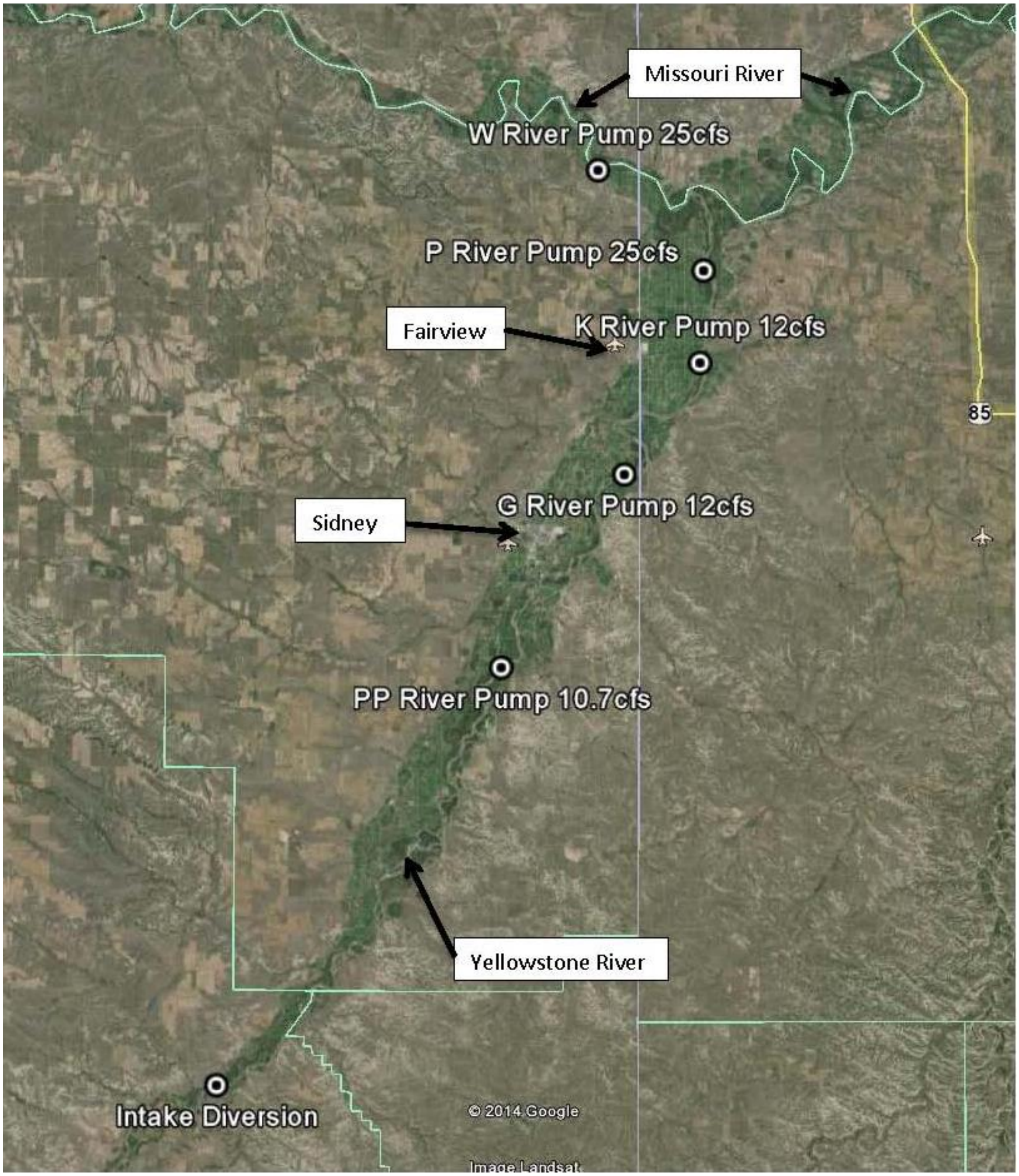


Map 4: LYIP Drain Locations



Map 5: LYIP Drain Locations

Appendix C – LYIP Supplemental Pump Locations



Map 1: LYIP Supplemental Pump Locations

Appendix D – Environmental Baseline Reports

- Atkinson and Dood – Montana Piping Plover Management Plan
- Austin and Richert 2001 – Review of Observational and site evaluation data or migrant whooping cranes in the U.S.
- Backes et al. 1994 - Lower Yellowstone River Sturgeon Study IV and Missouri River
  Pallid Sturgeon Creek Survey
- Bacon and Retella 1998 – Breeding Ecology of Interior Least Terns
- Board of Control 2009 - Conservation Plan Lower Yellowstone Irrigation Project
- Bratten et al. 2008 – Drift Dynamics of Larval Pallid Sturgeon
- Bratten et al. 2010 – Distribution of Pallid and Shovelnose Sturgeon in Natural Side Channels
- Bramblett and White 2001 – Habitat and Movements of Pallid and Shovelnose Sturgeon in the Yellowstone and Missouri Rivers
- Corps and Reclamation 1996 - Population Structure and Habitat Use of Benthic Fishes
  Along the Missouri and Lower Yellowstone Rivers
- Fuller et al. 2008 - Spawning and Associated Movement Patterns of Pallid Sturgeon in
  the Lower Yellowstone River
- FWP 1994 – Pallid Sturgeon and Shovelnosed Sturgeon in the Missouri River
- FWP 1996 – Lower Missouri River and Yellowstone River Pallid Sturgeon Study
- FWP 2006 – Montana Interior Least Tern Management Plan
- Gerrity 2005 – Habitat Use, Diet, and growth of Hatchery Reared Juvenile Pallid Sturgeon and Indigenous Shovelnose Sturgeon
- Helfrich et al. 1999 – Influence of Low-Head Diversion Dams on Fish Passage, Community composition, and Abundance in the Yellowstone River
- Hiebert et al. 2000 – Fish Entrainment at the Lower Yellowstone Diversion Dam
- Jaeger et al. 2005 – Assessment of the Yellowstone River for Pallid Sturgeon Restoration Efforts
- Jaeger et al. 2008 – Assessment of Pallid Sturgeon Restoration Efforts in the Lower
- Yellowstone River
- Jordan et al. 2006 – Post-Stocking Movements and habitat use of Hatcher-reared Pallid Sturgeon
- Kapuscinski 2003a – Status of Wild Pallid Sturgeon in Montana
- Klungle and Baxter 2005 – Lower Missouri and Yellowstone Rivers Pallid Sturgeon
- Study
- Koch and Curry 1977 Effect of Altered Streamflow on the Hydrology and Geomorphology of the Yellowstone River Basin

- Lott 2006 – Distribution and Abundance of the Interior Population of the Least Tern
- Marchant et al. 1986 – Shorebirds, Guide to the Waders of the World
- Reclamation and Corps 2009 – Public Scoping Summary Report
- Service 2000b – Memorandum to the Bureau of Reclamation from the Service,
- September 19, 2000
- Service 2009 – Amendment to Reasonable and Prudent Alternatives in the 2003
- Amended Biological Opinion to the Corps
- Watson and Stewart 1991 – Lower Yellowstone Pallid Sturgeon Study
- White and Mefford 2002 – Behavior and Swimming Ability of Yellowstone River
- Sturgeon
- Zelt et al. 1999 – Environmental Setting of the Yellowstone River Basin